XVI International Conference on Gravitation, Astrophysics and Cosmology

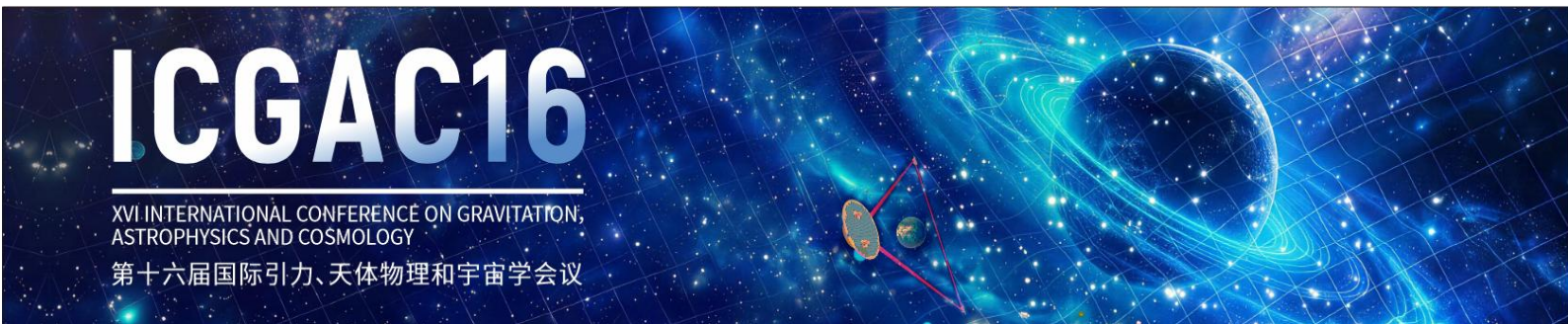
第十六届国际引力、天体物理和宇宙学会议

PROGRAM BOOK

会 议 手 册

SYSU Academic Vila, Shenzhen, China

Aug 10 - 14, 2026



1.Overview

ICGAC16 is the series of triennial conferences on Gravitation, Astrophysics and Cosmology which take place in the Asia-Pacific region, with the goals to promote cooperation among the member countries and within an international context, high level studies on hot topics and to encourage young physicists on these fields. This conference has been one of the key programs sponsored by APCTP over the past twenty years. It has been hosted by AP regions: Seoul, Korea (1993); Hsinchu, Taiwan, China (1995); Tokyo, Japan (1997); Beijing, China (1999); Moscow, Russia (2001); Seoul, Korea (2003); Jhongli, Taiwan, China (2005); Nara, Japan (2007); Wuhan, China (2009); Qui-Nhon, Vietnam (2011); Almaty, Kazakhstan (2013); Moscow, Russia (2015), Seoul, Korea (2017); Taiwan, China (2020) and Gyeongju, Korea (2023). After ICGAC15, Korea (2023), it will be held at Shenzhen, China in August 10-14, 2026, as a sequence of MG, GRG and ICGAC for every three years.

The topics of ICGAC16 include

1. Classical Gravity, GR Extensions
2. Classical and Quantum Cosmology
3. Dark Matter and Dark Energy
4. Black Holes, Wormholes
5. Strings, Branes, Higher Spin Fields and Quantum Gravity
6. Extra Dimensions and Variation of Constants
7. Experimental Studies of Gravity and Fundamental Physics
8. Gravitational Waves
9. Multi Messenger Astronomy
10. Numerical Relativity
11. Relativistic Astrophysics
12. White Dwarfs, Neutron Stars and Gamma Ray Bursts
13. Applied relativity

International Standing Committee(ISC)

Cho, Yongmin (SNU, Korea, Chair)
Abishev, Medeu (Al-Farabi Kazakh NU, KZ)
Bolejko, Krzysztof (U Tasmania, Australia)
Brill, Dieter (U Maryland, USA)
Cai, Rong-Gen (NBU, China)
Chen, Chiang-Mei (NCU, Taiwan, China)
Frolov, Valeri (U Alberta, Canada)
Gal'tsov, Dmitri (Moscow S U, Russia)
Giacomini, Alex (Universidad Austral de Chile, Chile)
Hsu, Jong-Ping (U Mass Dartmouth, USA)
Kenmoku, Masakatsu (Nara WU, Japan)
Kim, Sung-Won (Ewha WU, Korea)
Laemmerzahl, Claus (U Bremen, Germany)
Li, Li (ITP, China)
Luo, Jun (Sun Yat-sen U, China)
Mukohyama, Shinji (Kyoto U / U Tokyo, Japan)
Ni, Wei-Tou (NTHU, Taiwan, China)
Paik, Ho Jung (U Maryland, USA)
Reula, Oscar (Ciudad U, Argentina)
Ruffini, Remo (ICRA, Italy)
Triay, Roland (CNRS, France)
Wiltshire, David L (Canterbury U, NZ)
Yoon, Jong Hyuk (Konkuk U, Korea)

Local Organizing Committee (LOC)

Jun Luo, Sun Yat-sen University
Ronggen Cai, Ningbo University
Renxin Xu, Peking University
Xiangdong Li, Nanjing University
Bin Wang, Yangzhou University
Xinmin Zhang, Institute of High Energy Physics, CAS
Zebing Zhou, Huazhong University of Science and Technology
Jianwei Mei, Sun Yat-sen University

2. Useful Information

2.1 Registration:

Registration time: a) August 9, 14:00-21:00
b) August 10~14, 8:30-9:30

Registration venue: the lobby of SYSU Academic Vila

2.2 Conference Venue

SYSU Academic Vila, Sun Yat-sen University Shenzhen Campus, No.66 Gongchang Road, Guangming District, Shenzhen 518055, China

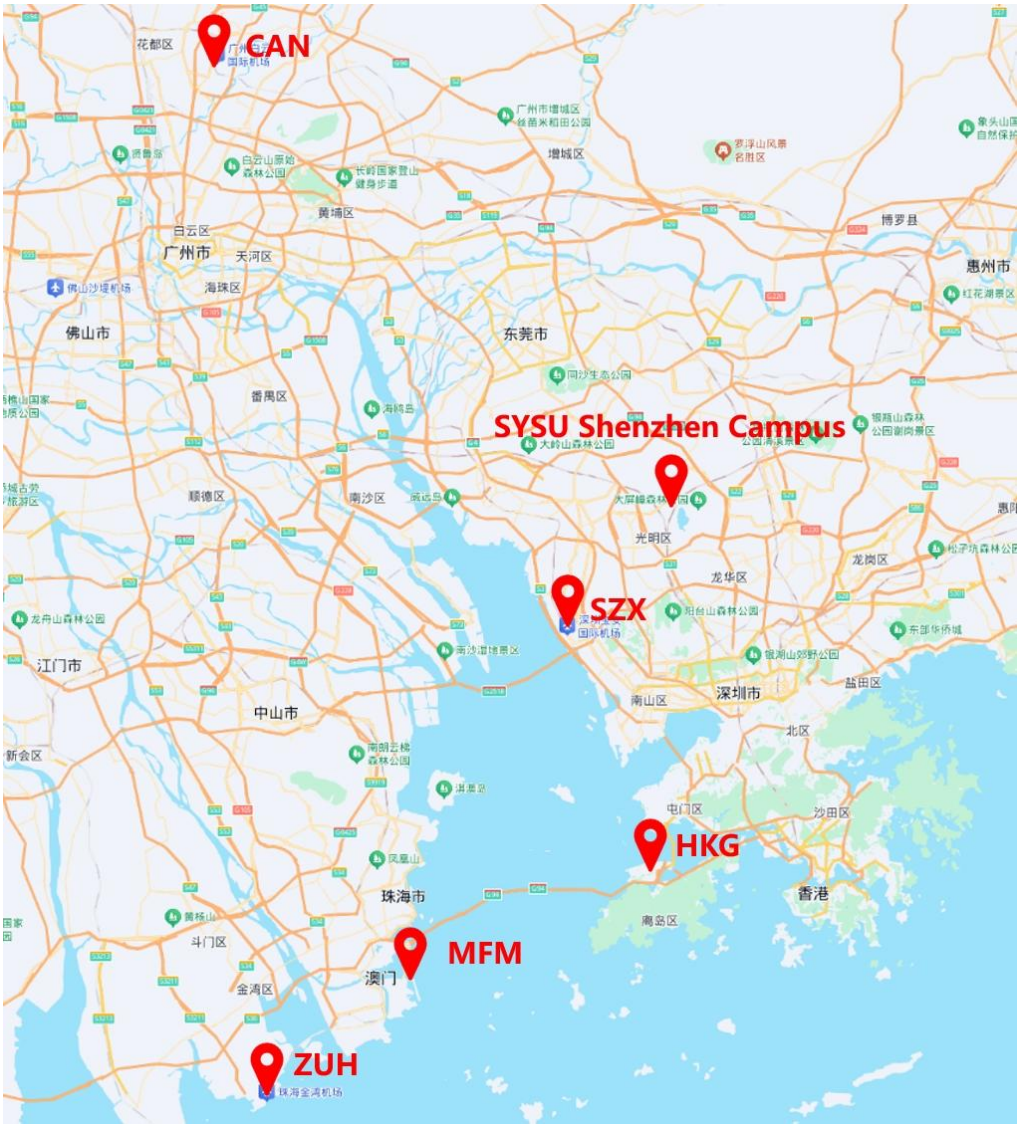
	Plenary Session	Parallel Session
August 10	Sun Yat-sen Hall (1st floor)	Meeting room l, 2, 3, 4, 5 (2nd floor)
August 11	Sun Yat-sen Hall (1st floor)	Meeting room l, 2, 3, 4, 5 (2nd floor)
August 12	Sun Yat-sen Hall (1st floor)	/
August 13	Sun Yat-sen Hall (1st floor)	Meeting room 4, 5 (2nd floor)
August 14	Sun Yat-sen Hall (1st floor)	/

2.3 Wi-Fi:

Wi-Fi Name (SSID): SYSU-AVSC
Password: 12345678

2.4 Lunch & dinner:

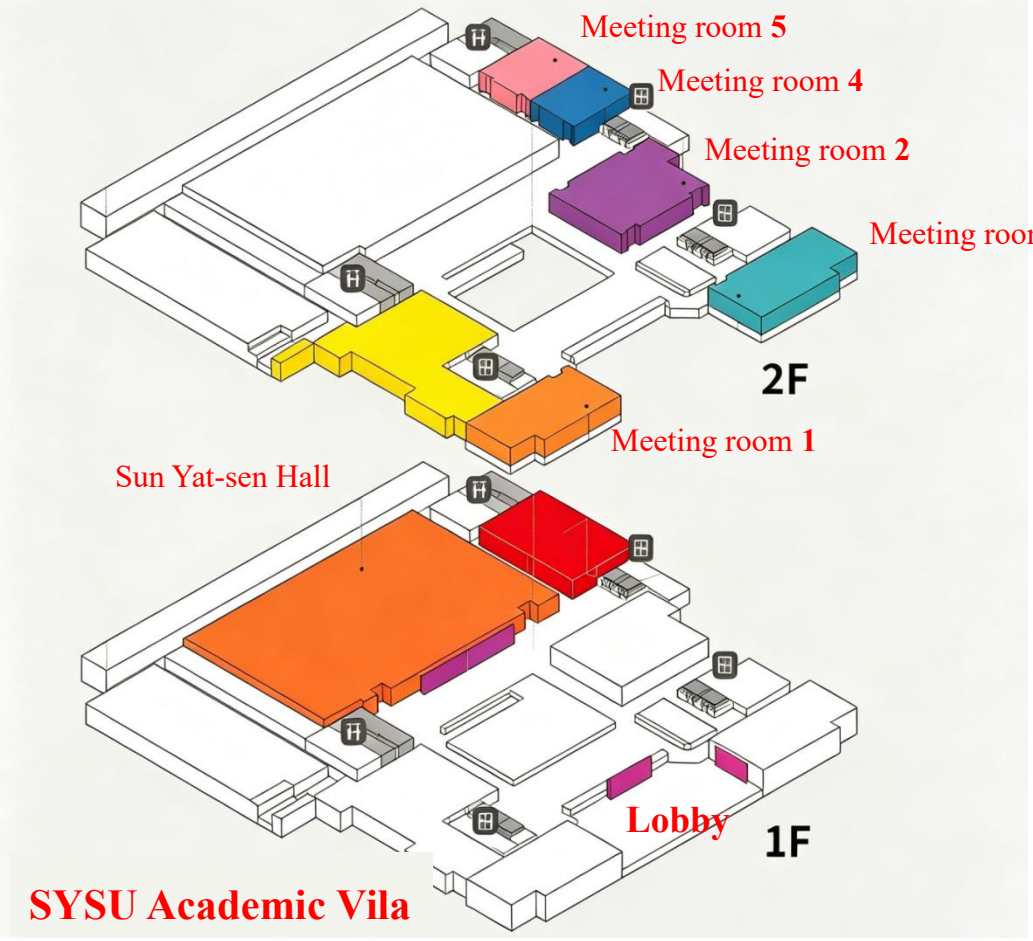
a) Dinner on August 11 will be provided by the conference in the Vila.
b) Participants are responsible for their own meals at other times. A map of dining venues will be provided at the registration.
c) Buffet reservations should be made at the registration desk one day in advance.
d) Payment can be made at the restaurant before dining.



SYSU Shenzhen Campus and Nearby Airports

SYSU Shenzhen Campus Map

SYSU Academic Vila



Meeting Room

3. Program

Program at a glance

<table>
<tr><th>Date
Time</th><th>August 9
(Sun)</th><th>August 10
(Mon)</th><th>August 11
(Tue)</th><th>August 12
(Wed)</th><th>August 13
(Thu)</th><th>August 14
(Fri)</th></tr>
<tr><td>0845-0900</td><td rowspan="10"></td><td>Opening
Photo</td><td></td><td></td><td></td><td></td></tr>
<tr><td>0900-0945</td><td>Pl</td><td>Pl</td><td>Pl</td><td>Pl</td><td>Pl</td></tr>
<tr><td>0945-1030</td><td>Pl</td><td>Pl</td><td>Pl</td><td>Pl</td><td>Pl</td></tr>
<tr><td>1030-1100</td><td colspan="5">Coffee Break</td></tr>
<tr><td>1100-1145</td><td>Pl</td><td>Pl</td><td>Pl</td><td>Pl</td><td>Pl</td></tr>
<tr><td>1145-1230</td><td>Pl</td><td>Pl</td><td>Pl</td><td>Pl</td><td>Pl</td></tr>
<tr><td>1230-1245</td><td rowspan="2">Lunch</td><td rowspan="2">Lunch</td><td rowspan="2">Lunch</td><td rowspan="2">Lunch</td><td>Closing</td></tr>
<tr><td>1245-1400</td><td rowspan="4"></td></tr>
<tr><td>1400-1600</td><td rowspan="4">Registration</td><td>Pa</td><td>Pa</td><td rowspan="3">Free
Discussion</td><td>Pa</td></tr>
<tr><td>1600-1630</td><td colspan="2">Coffee Break</td><td>Coffee
Break</td></tr>
<tr><td>1630-1830</td><td>Pa</td><td>Pa</td><td>Pa</td></tr>
<tr><td>1900-2100</td><td></td><td>Banquet</td><td>ISC
Meeting</td><td></td></tr>
</table>

Plenary Sessions

Plenary Sessions Sun Yat-sen Hall

August 10 (Monday) 08:45-12:30

Chair: Jianwei Mei

Opening & Group Photo		08:45-09:00
Ronggen Cai	Periodic Gravitational Lensing with Oscillating Boson Stars	09:00-09:45
Ho Jung Paik	Instrumenting the Moon as a Gravitational Wave Detector	09:45-10:30

Coffee Break

Chair:Chiang-Mei Chen

Shinji Mukohyama	Emergent time and big-bang	11:00-11:45
Sergey Sushkov	Cosmology in the theory of gravity with non-minimal derivative coupling	11:45-12:30

August 11 (Tuesday) 09:00-12:30

Chair: SungWon Kim

Xinmin Zhang	Recent Progress on Dark Energy Study	09:00-09:45
Yuko Urakawa	Searching for Axion Dark Matter with Radio Observations	09:45-10:30

Chair: Filipe Abdalla

Sungwon Kim	Gravitational Waves and Radiation by Wormhole System	11:00-11:45
Konstantin Postnov	Accretion effects in merging rates of primordial binary black holes	11:45-12:30

August 12 (Wednesday) 09:00-12:30

Chair: Sergey Sushkov

Jianwei Mei	TianQin: a mission to detect gravitational waves in space	09:00-09:45
Tomonori Totani	The 20 GeV Fermi halo: evidence for dark matter annihilation?	09:45-10:30

Chair:PengMing Zhang

Yongmin Cho	Cosmological Implications of Electroweak Monopoles	11:00-11:45
James Pinfold	The Search for Magnetic Monopoles from the TeV to the GUT Scale using Collider and Astroparticle Detectors	11:45-12:30

August 13 (Thursday) 09:00-12:30

Chair: Medeu Abishev

Yueliang Wu	Advances in the Taiji Program for Gravitational-Wave Detection	09:00-09:45
Kejia Lee	Recent progress of CPTA observation --- low frequency observation to improve DM noise	09:45-10:30

Chair: Konstantin Postnov

Chiangmei Chen	Quantum Improved Black Holes in Asymptotically Safe Gravity	11:00-11:45
Myungshin Im	7-Dimensional Telescope for Multimessenger Astronomy	11:45-12:30

August 14 (Friday) 09:00-12:30

Chair:Yu-Xiao Liu

Hu Zhan	An Overview of the Chinese Space Station Survey Telescope	09:00-09:45
Filipe Abdalla	21-cm Cosmology: Radio BAO and Cosmological Tensions	09:45-10:30

Chair: Shinji Mukohyama

Takafumi Ushiba	Overview of Large-scale Cryogenic Gravitational wave Telescope KAGRA	11:00-11:45
Li Li	Black Hole Interiors: Critical Phenomena, Kasner Dynamics, and Beyond	11:45-12:30

Parallel Sessions

Parallel Session Mon-1 （A1）

Speaker	Title	Date	Time
(Mon-1a, Meeting Room 1)		**Chair: Yu Tian**	
A1. General relativity: Theory and Mathematical developments			
Wonwoo Lee	Chaotic Particle Behavior in an Anisotropic Fluid Black Hole Immersed in a Magnetic Field	Aug 10	14:00-14:20
Petr Kotlarik	Black Holes Distorted by Their Environment: Stationary and Axisymmetric Perturbations	Aug 10	14:20-14:40
Yuan-Ceng Xu	Black hole interiors and complexity in holographic solids	Aug 10	14:40-15:00
Liang-Bi Wu	Virtual absorption modes of Schwarzschild-de Sitter spacetimes in semi-open systems	Aug 10	15:00-15:20
Nathan Thomas Carruth	Trapped surface formation: physical foundations	Aug 10	15:20-15:40
Tao Zhu	Tests of Lorentz and parity symmetry of gravity with gravitational waves	Aug 10	15:40-16:00
(Mon-1b, Meeting Room 1)		**Chair: Wonwoo Lee**	
A1. General relativity: Theory and Mathematical developments			
Peng Zhao	The characteristic initial value problem for the Einstein-Dirac system and the trapped surface formation.	Aug 10	16:30-16:50
Hao Xu	A Generalized Landauer's Principle for Unitarily Transformed Thermal Reservoirs	Aug 10	16:50-17:10
Si-Jiang Yang	The study of thermodynamics and the weak cosmic censorship conjecture	Aug 10	17:10-17:30
Fu-Guo Yang	Critical Phenomenon inside Asymptotically Flat Black Holes with Spontaneous Scalarization	Aug 10	17:30-17:50
Xiaoning Wu	Energy, memory and balence equation of polyhomogenous spacetime	Aug 10	17:50-18:10
Weihu Ma	Spacetime discreteness and PSL(2,R) phases at the Planck scale	Aug 10	18:10-18:30

Parallel Session Mon-2 （A2）

Speaker	Title	Date	Time
(Mon-2a, Meeting Room 2) **A2. Modified gravity**		**Chair: Yuxiao Liu**	
Zhongyou Mo	Quantum interference in Teleparallel Gravity	Aug 10	14:00-14:20
Hanlin Song	Multimessenger Tests of the Strong Equivalence Principle and Extra Dimensions with Binary Neutron Star Mergers	Aug 10	14:20-14:40
Udaykrishna Thattarampilly	Inflation from entropy	Aug 10	14:40-15:00
Gabriel Luz Almeida	Compact Binary Dynamics in Einstein-Scalar-Gauss-Bonnet Gravity: From Post-Newtonian Inspirals to Post-Minkowskian Scattering	Aug 10	15:00-15:20
Aray Muratkhan	Thin Accretion-Disc Transfer Functions in the q-Metric Spacetime	Aug 10	15:20-15:40
(Mon-2b, Meeting Room 2) **A2. Modified gravity**		**Chair: Hanlin Song**	
Sebastian Garcia-Saenz	Black hole instabilities and non-minimally coupled fields	Aug 10	16:30-16:50
Saikat Chakraborty	A unified framework to study f-family of gravity theories	Aug 10	16:50-17:10
Chao Zhang	Hunting for the Observational Signature of Universal Horizon and Lorentz-Violation Effects	Aug 10	17:10-17:30
Ayazhan Orazymbet	Equilibrium Structure and Stability of White Dwarfs with Isotropic and Anisotropic Pressure Distributions	Aug 10	17:30-17:50
Jorge Gigante Valcarcel	Black hole superradiance in Poincaré gauge theory	Aug 10	17:50-18:10

Parallel Session Mon-3 （A3+A4）

Speaker	Title	Date	Time
(Mon-3a, Meeting Room 3)		**Chair: Fa-Peng Huang**	
A4. Gravitational waves-Theory			
Mauricio Valencia Villegas	Shock Formation in Cosmic Domain Wall Models	Aug 10	14:00-14:20
Qiliang Zhao	Decay criteria for asymptotic freedom in plane gravitational waves	Aug 10	14:20-14:40
Yun-Long Zhang	The Generation and Detection of Chiral Gravitational Wave Backgrounds	Aug 10	14:40-15:00
Verónica Vazquez-Aceves	Inspiraling Systems in Dense Stellar Environments: Formation, Dynamics, and Detection Challenges	Aug 10	15:00-15:20
Yong-Qiang Wang	Recent Progress on Frozen Stars	Aug 10	15:20-15:40
(Mon-3b, Meeting Room 3)		**Chair: Tao Zhu**	
A3. Numerical Relativity			
A4. Gravitational waves-Theory			
Yuchen Du	Worldline Formalism, Eikonal Expansion and the Classical Limit of Scattering Amplitudes	Aug 10	16:30-16:50
Dongchan Kim	Parameter Space Search for Non-merging Ringdown Radiation from Close Hyperbolic Encounters of Two Black Holes	Aug 10	16:50-17:05
Zun Wang	Frequency-Domain Hybridization of Semi-Analytical Binary-Black-Hole Waveforms	Aug 10	17:05-17:20
Yuhe Zeng	Relativistic treatment of extreme mass ratio inspirals crossing accretion disks	Aug 10	17:20-17:35
Zhen-Hao Yang	Quasinormal mode families: Classification and competition	Aug 10	17:35-17:50
Hyeonguk Son	Application of the Post-Minkowskian Effective one-body formalism to non-qusicircular systems	Aug 10	17:50-18:05

Parallel Session Mon-4 （B2）

Speaker	Title	Date	Time
(Mon-4a, Meeting Room 4) **B2. Stringy gravity and AdS/CFT**		**Chair: Jiang Long**	
Jia-Rui Sun	Entanglement first law for timelike entanglement entropy and linearized Einstein’s equation	Aug 10	14:00-14:20
Jiaju Zhang	Distinguishability of Black Hole Microstates from AdS/CFT Correspondence	Aug 10	14:20-14:40
Jie-qiang Wu	Canonical Quantization for the Free Massive Vector Field in the Global AdS3 Spacetime with the Covariant Phase Space Formalism	Aug 10	14:40-15:00
Peng-Xiang Hao	On the States in Flat/CarrCFT correspondence	Aug 10	15:00-15:20
(Mon-4b, Meeting Room 4) **B2. Stringy gravity and AdS/CFT**		**Chair: Jiaju Zhang**	
Jun Nian	WAdS/WCFT and Kerr/CFT Correspondences Revisited	Aug 10	16:30-16:50
Jun-Kun Zhao	Universally Diverging Grüneisen Ratio of Holographic Quantum Criticality	Aug 10	16:50-17:10
Jiang Long	Carrollian correlators in black hole perturbation theory	Aug 10	17:10-17:30
Lin Chen	Constructing CFTD from TQFTD+1 and Precision Discretization of CFT2	Aug 10	17:30-17:50

Parallel Session Mon-5 （C3+C5+E6）

Speaker	Title	Date	Time
(Mon-5a, Meeting Room 5)		**Chair: Xuefeng Zhang**	
C3. Black hole			
E6. Space-based GW detection theory and experiment			
Y.-B. Bae	Multipole Moments of Black Hole Horizons in Binary Mergers	Aug 10	14:00-14:20
Kunyang Li	Modeling massive black hole multiplets dynamical evolution in lively-evolving galaxy environment for precise gravitational wave prediction	Aug 10	14:20-14:40
Yehui Hou	How Photon Polarization Swings Encode Black Hole Ringdown	Aug 10	14:40-15:00
Xuefeng Zhang	How to detect gravitational waves in high Earth orbits?--TianQin mission design overview	Aug 10	15:00-15:20
Minghui Du	Taiji Data Challenge and Preliminary Study on Multi-Source Analysis	Aug 10	15:20-15:40
Cinque McFarlane-Blake	Phase-Mediated Attractor Dynamics in Millisecond Pulsar Timing Residuals	Aug 10	15:40-15:55
(Mon-5b, Meeting Room 5)		**Chair: Haipeng An**	
C5. Dark Matter			
E6. Space-based GW detection theory and experiment			
Tan Chen	Black Hole Accretion in Self-Interacting Dark Matter Halos	Aug 10	16:25-16:45
Pengshun Luo	Search for Dark Matter and Exotic Interactions via Precision Force Measurements	Aug 10	16:45-17:05
Xing Bian	Superconducting Weak Force Sensing for Gravitational Wave Detection	Aug 10	17:05-17:25
Ruihong Gao	Laser acquisition and pointing technique for space-based gravitational wave detection	Aug 10	17:25-17:45
Ayush Hazarika	Photon ring dimming as a signature of photon-axion conversion in Janis-Newman-Winicour naked singularity	Aug 10	17:45-18:05
Yingnan Zhu	Quantitative Evaluation of Gas Damping Effects in High-Precision Gravitational Reference Sensors based on Monte Carlo Numerical Simulation	Aug 10	18:05-18:20

Parallel Session Tue-1 （A1）

Speaker	Title	Date	Time
(Tue-1a, Meeting Room 1) **A1. General relativity: Theory and Mathematical developments**		**Chair: Xiaoning Wu**	
Masakatsu Kenmoku	Covariant Energy-Momentum Tensor in General Relativity	Aug 11	14:00-14:20
Shaoqi Hou	Shaving off soft hairs and black hole image memory effect	Aug 11	14:20-14:40
Pujian Mao	Supertranslation in the bulk for generic spacetime	Aug 11	14:40-15:00
Rongxin Miao	Constraining holographic networks and parallel universes	Aug 11	15:00-15:20
Carlos Coimbra-Araujo	Merger of binary black holes and their possible outflows	Aug 11	15:20-15:40
Saken Toktarbay	Comparing Shadow Observables in Kerr and Static Quadrupolar Spacetimes	Aug 11	15:40-16:00
(Tue-1b, Meeting Room 1) **A1. General relativity: Theory and Mathematical developments**		**Chair: Masakatsu Kenmoku**	
Song He	Emergent gravitational action from non-local stress tensor deformations	Aug 11	16:30-16:50
Nitesh Kumar Dubey	From Black Holes to Stars: Rigidity Beyond Einstein Gravity	Aug 11	16:50-17:05
Rostom Karsanov	Singular Misner string fluxes and S-duality	Aug 11	17:05-17:20
Xi Wan	Critical Behavior of Photon Rings in Kerr-Bertotti-Robinson Spacetime	Aug 11	17:20-17:35
Yu-Sen Zhou	Pseudospectrum and (in)stability of black hole total transmission mode	Aug 11	17:35-17:50
Leen Alrawas	The Success of ΛCDM in Reproducing Tight Galaxy Scaling Relations	Aug 11	17:50-18:05
Nihar Ranjan Ghosh	Asymptotic Generation of Kerr Geometry from Schwarzschild via BMS Supertranslations	Aug 11	18:05-18:20

Parallel Session Tue-2 （A2+D1）

Speaker	Title	Date	Time
(Tue-2a, Meeting Room 2) **A2. Modified gravity** **D1. Dark Energy**		**Chair: Yi-Ming Hu**	
Paulo Montero-Camacho	No way out? ΛCDM will not be rescued by a high optical depth	Aug 11	14:00-14:20
Gao-Ming Deng	Quasinormal modes of charged black holes and Strong cosmic censorship in conformal Killing gravity	Aug 11	14:20-14:40
Hai-Long Jia	Spectral Butterfly Effect and Resilient Ringdown in Thick Braneworlds	Aug 11	14:40-14:55
Yu-Qi Dong	Propagation and polarization of gravitational waves on curved spacetime backgrounds in Einstein-Æther theory	Aug 11	14:55-15:10
Xiao-bin Lai	Cosmological perturbations and gravitational waves in the general Einstein-vector theory	Aug 11	15:10-15:25
Aman Awasthi	Detection Prospects of solar g mods with LISA	Aug 11	15:25-15:40
Suyog Garg	Machine learning models for gravitational waveform modelling and source parameter estimation	Aug 11	15:40-15:55
(Tue-2b, Meeting Room 2) **D1. Dark Energy**		**Chair: Yi-Ming Hu**	
Yaghoub Heydarzade	Dark Side of the Universe and Perfect Fluid Universality	Aug 11	16:25-16:45
Hussain Md Saddam	A Particle Physics Model of interacting Dark Matter and Dark Energy in Einstein – Gauss – Bonnet Gravity: Constraints from DESI BAO	Aug 11	16:45-17:05
Ibraimova Sayora	Application of the correlation curve method to increase the accuracy of determining the energy of cosmic rays above 1 tev	Aug 11	17:05-17:20
Luis Enrique Padilla Albores	Primordial black hole formation in scalar field cosmologies	Aug 11	17:20-17:35
Ahmad Al-badawi	Schwarzschild-like black hole embedded in a Dehnen-type dark matter halo and a cloud of strings	Aug 11	17:35-17:50
Venkatraja Ramalingam	Analysis of various parameters in Barrows HDE model	Aug 11	17:50-18:05
Priyanka Saha	Effects of dark energy in structure formation	Aug 11	18:05-18:20

Parallel Session Tue-3 （A4+C2+E2+E4+E5）

Speaker	Title	Date	Time
(Tue-3a, Meeting Room 3) **E2. Observational Astrophysics** **E4. Ground-based GW detection theory and experiment** **E5. PTA GW detection theory and experiment**		**Chair: Kejia Lee**	
Zhenyu Zhang	Autocorrelation signatures in time-resolved black hole flare images: Secondary peaks and convergence structure	Aug 11	14:00-14:20
Haitian Wang	Gravitational Wave Data Analysis using the F-statistic method	Aug 11	14:20-14:40
Joao Lucio dos Santos	Gravitational Lensing of Fast Radio Bursts as a Probe of Primordial Black Holes Abundance: a forecast for radio telescopes	Aug 11	14:40-15:00
Jingbo Wang	Search for single gravitational wave sources with pulsar timing array	Aug 11	15:00-15:20
Qing Yang	Nanohertz gravitational-wave background and individual sources based on cosmological simulation	Aug 11	15:20-15:40
Yin-Jie Li	Measuring Hubble constant with mass function of BBH subpopulations	Aug 11	15:40-16:00
(Tue-3b, Meeting Room 3) **A4. Gravitational waves-Theory** **C2. Neutron stars & compact objects**		**Chair: Cheng-jun Xia**	
Biping Gong	Possible Mechanism of in-phased Multi-band Radiation from 10TeV to Radio Wave Occurring in a Few Pulsars	Aug 11	16:30-16:50
Yongfeng Huang	Searching for strange quark planets with gravitational waves	Aug 11	16:50-17:10
Jinwon Kim	Evaluating Gravitational Wave Detection Rates using a Frequency and Velocity-Dependent Antenna Response	Aug 11	17:10-17:25
Qi Su	Echo Signatures of Layered Compact Objects: Perturbations of a Double-Shell Model	Aug 11	17:25-17:40
Tianhao Wu	The Impact of Spin Priors on Parameterized Tests of General Relativity	Aug 11	17:40-17:55
Rajasmita Sahoo	Deformed Magnetized Quark Stars: Structure and Gravitational Wave Signatures	Aug 11	17:55-18:10
Debabrata Dey	Universality in Space – Time ω modes of Quarkyonic Stars	Aug 11	18:10-18:25

Parallel Session Tue-4 （B1+B3+C4）

Speaker	Title	Date	Time
(Tue-4a, Meeting Room 4) **B1. Quantum gravity in curved spacetime** **B3. Other topics on Quantum gravity**		**Chair: Sung-Won Kim**	
Wei-Jia Li	Collective dynamics of holographic fracton solids	Aug 11	14:00-14:20
Wen-Cong Gan	Quantum Damping of Cosmological Shear: A New Prediction from Loop Quantum Cosmologies	Aug 11	14:20-14:40
Gaoping Long	Quantum Geometry Effects in Quantum Field Theory: Hamiltonian constraint Generates Gravity-Matter Entanglement	Aug 11	14:40-15:00
Otto Kong	Dynamical Results Showing Quantum Particles to be Kept from Black Hole Singularity	Aug 11	15:00-15:20
Cong Zhang	Covariant dynamics from static spherically symmetric geometries	Aug 11	15:20-15:40
(Tue-4b, Meeting Room 4) **B3. Other topics on Quantum gravity** **C4. Wormholes and other massive objects**		**Chair: Wen-Cong Gan**	
Xiangdong Zhang	Non-singular Inflation-Dark Energy Unification Model of Loop Quantum Cosmology	Aug 11	16:30-16:50
Hongguang Liu	Running Without Coordinates: Relational RG in Background-Independent Quantum Gravity	Aug 11	16:50-17:10
Meng-He Wu	Using precession and quasiperiodic oscillations to constrain a rotating regular black hole	Aug 11	17:10-17:30
Jingze Xia	Dynamics and Radiative Signatures of Accretion Flows onto a Kerr-like Wormhole	Aug 11	17:30-17:45
Xiao Yan Chew	Dynamics of Bronnikov-Ellis wormhole with double-null simulation	Aug 11	17:45-18:05
Zhuo-Yu Xian	Lindbladian Dynamics of Black Holes in JT Gravity and the SYK Model	Aug 11	18:05-18:20

Parallel Session Tue-5 （D2+D3+E3）

Speaker	Title	Date	Time
(Tue-5a, Meeting Room 5) **E3. Multi-Messenger Astrophysics**		**Chair: Sergey Sushkov**	
Hyung Mok Lee	Prospects of Dark Siren Cosmology	Aug 11	14:00-14:20
Xue-Ting Zhang	Pre-localization of Massive Black Hole Binaries in the Millihertz Band	Aug 11	14:20-14:40
Anson Chen	Dark Siren Constraint on Cosmology and Modified Gravity with GWTC-5	Aug 11	14:40-15:00
Pedro da Silveira Ferreira	Where Galaxies Point: First Measurement of the Large-Scale Axial Intrinsic Alignment	Aug 11	15:00-15:20
Zhiping Jin	Neutron Star Mergers and the Origin of Elements Beyond Iron	Aug 11	15:20-15:40
Yixuan Dang	Golden and Silver Dark Sirens for precise H0 measurement with HETDEX	Aug 11	15:40-16:00
(Tue-5b, Meeting Room 5) **D2. Status of Standard cosmology and alternatives** **D3. Observational Cosmology** **E3. Multi-Messenger Astrophysics**		**Chair: Fapeng Huang**	
Sheng-Feng Yan	Primordial Black Holes from non-singular cosmology	Aug 11	16:30-16:50
Chang Feng	Cosmological studies with cosmic microwave background and radio observations	Aug 11	16:50-17:10
Yang Liu	AliCPT‑1: First‑Season Data Analysis and Preliminary Results	Aug 11	17:10-17:30
Yaqiong Li	The current status of AliCPT	Aug 11	17:30-17:50
Ernazar Abdikamalov	Looking into supernovae with gravitational waves	Aug 11	17:50-18:10

Parallel Session Thu-1 （C1）

Speaker	Title	Date	Time
(Thu-1a, Meeting Room 4)		**Chair: Cosimo Bambi**	
C1. Relativistic Astrophysics			
Bei You	Reverberation lags viewed in hard X-rays from an accreting stellar-mass black hole	Aug 13	14:00-14:20
Zheng Cao	Using tidal disruption events to study the black hole accretion process and search for intermediate-mass black holes	Aug 13	14:20-14:40
Masoumeh Ghasemi Nodehi	Beyond the Kerr Paradigm: Testing GR with SKA/VLBI Astrophysical Black Holes	Aug 13	14:40-15:00
Hubing Xiao	Chasing the Neutrino Blazar Candidates	Aug 13	15:00-15:20
Ashutosh Tripathi	Multi-wavelength Quasi-periodic Oscillations in Optical and Radio Observations of Blazars	Aug 13	15:20-15:40
Ryusuke Jinno	First-order phase transitions in the early Universe: gravitational waves, black holes, and feebly-interacting particles	Aug 13	15:40-16:00
(Thu-1b, Meeting Room 4)		**Chair: Yizhong Fan**	
C1. Relativistic Astrophysics			
Cosimo Bambi	A space mission to Earth’s nearest black hole: reality or science fiction?	Aug 13	16:30-16:50
Chen Zhang	Self-Consistent Parker Bound on Magnetic Monopoles	Aug 13	16:50-17:10
Jinping Zhu	Relativistic Astronomy: Exploring the Universe and Fundamental Physics with Trans-relativistic Cameras	Aug 13	17:10-17:30
Krishna Mohana Ammenadka	Extragalactic Relativistic Jets: Probing the Multiband Emission and Jet Physics of AGN	Aug 13	17:30-17:50
Jie Yang	Impact of mass transfer on the orbital evolution of compact binaries and the correction to gravitational wave form	Aug 13	17:50-18:10
YuXin Yang	Contribution from Nonlinear Quasi-normal Modes in GW250114	Aug 13	18:10-18:25

Parallel Session Thu-2 （E1+C5）

Speaker	Title	Date	Time
(Thu-2a, Meeting Room 5)		**Chair: Qing Li**	
E1. Test of gravity (Experimental gravity)			
C5. Dark Matter			
Qing Li	Development of high-yunQ silica fiber and the research on gravitational experiments	Aug 13	14:00-14:20
Minkang Zhou	Probing gravity and constraint on spin- and velocity-dependent interaction with atom interferometer	Aug 13	14:20-14:40
Go Ogiya	Probing the properties of dark matter through the dynamical evolution of substructures	Aug 13	14:40-15:00
Hongru Liu	Micrometer-diameter high Q silica fiber for milligram-scale torsion pendulum in gravitational experiment	Aug 13	15:00-15:20
Medeu Abishev	Multimetric gravity and chronon layers	Aug 13	15:20-15:40
Ruijie Li	Research on the Dissipation-Coupling Effect in a Two-stage Pendulum System	Aug 13	15:40-15:55
Jia-Ning Chen	Extended Parameterized Spin expansion formalism for ringdown analysis with GW250114	Aug 13	15:55-16:10

Abstract (Plenary)

Aug 10 (Mon) 09:00-12:30

Periodic Gravitational Lensing with Oscillating Boson Stars

Ronggen Cai
Ningbo University

We show that oscillating (real-scalar) boson stars generically host an oscillating radial caustic. Sources near this caustic cross it every half period, thereby producing periodic caustic-crossing lensing. The resulting observables are phase locked to the lens oscillation: image-pair creation or annihilation, changing image morphology, achromatic photometric spikes, and astrometric motion. This signal provides a distinctive target for time-domain astronomy, and its detection would reveal an intrinsically time-dependent compact dark-sector object. Event-number estimates indicate a measurable discovery space with current astrometric and high-cadence photometric surveys, while null searches would constrain the abundance of such objects as dark matter. The predictions rely only on the dynamics of real-scalar condensates and extend naturally to self-interacting real scalars, including axionlike particles, and to ultralight vector bosons.

Instrumenting the Moon as a Gravitational Wave Detector

Ho Jung Paik
University of Maryland

With ground-based interferometers detecting hundreds of gravitational-wave (GW) events, GW astronomy is continuing to blossom. U.S. and European scientists are advancing plans to construct third-generation ground-based interferometers. ESA has proceeded through the mission formulation phase of space-based interferometer in a lower-frequency band, 10^(–4) to 0.1 Hz. Despite all these exciting developments, there is still a missing frequency band, 0.1 to 10 Hz. This mid-frequency band is rich with interesting astrophysical events. Coalescence and merger of intermediate-mass black holes occur in this frequency band. Coalescing stellar-mass BHs pass through this frequency band days before they reach the frequency band of LIGO and Virgo. Detection of such signals would enable a mid-frequency detector to issue an advance notice to the high-frequency GW detectors, as well as to optical, X-ray and g-ray telescopes.
Due to lack of plate tectonics, ocean waves and winds, the Moon is very quiet seismically and provides an ideal environment for GW experiments. We propose LANGO (Lunar Accelerometer Network Gravitational Observatory) to detect GWs in this frequency band. In the first phase, we propose to deploy four sensitive ambient-temperature (250 K) accelerometers in the tetrahedral or in a square configuration on the hemisphere facing the Earth. After successful operation at 250 K, LANGO would be upgraded to a cryogenic (4 K) version with over two orders of magnitude increased sensitivity, with coherent rejection of seismic noise implemented. LANGO is a full-tensor detector, capable of determining the source direction and wave polarization. The cryogenic LANGO could reach sensitivity better than 10^(-23) Hz^(-1/2) at 1-10 Hz. The LANGO accelerometers will be 10^3-10^5 times more sensitive than Apollo seismometers. With such sensitivity, LANGO will make great contribution to the advancement of lunar geophysics as well.

Emergent time and big-bang

Shinji Mukohyama
YITP, Kyoto University

We proposes a new avenue for understanding the cosmological singularity. The standard cosmological model contains a generic initial singularity usually referred to as the big bang. Herein, we present a novel idea to extend the description of our Universe beyond this limit. The proposal relies on rewriting physics in a purely Riemannian, i.e. locally Euclidean, 4-dimensional space and the emergence of Lorentzian patches owing to the interaction of all matter fields to a clock field that is responsible for a signature change. If our universe is contained within one of these patches, the initial singularity is replaced by a smooth boundary on which the signature of the physical metric flips. In this talk, we first define the model and draw the necessary conditions on its arbitrary functions for solutions to exist. Next, we prove the existence of solutions that lead to an emergent universe with a primordial (almost) de Sitter phase. To finish, we discuss the consequences of this construction for the universe on scales much larger than our observable universe: a large ``Euclidean sea" in which Lorentzian islands locally emerge and host an expanding universe potentially similar to ours. While speculative, this scenario has specific features that can be tested, and this talk sets the basis for further phenomenological investigations.

Cosmology in the theory of gravity with non-minimal derivative coupling

Sergey Sushkov
Institute of Physics, Kazan Federal University

We consider isotropic and homogeneous cosmological scenarios in the scalar-tensor theory of gravity with non-minimal derivative coupling of a scalar field to the curvature given by the term $\eta G^{\mu\nu}\nabla_\mu\phi \nabla_\nu\phi$ in the Lagrangian. In general, a cosmological model is determined by six dimensionless parameters: the coupling parameter $\zeta=\eta H_0^2$, and density parameters Ω_0 (cosmological constant), Ω_2 (spatial curvature term), Ω_3 (non-relativistic matter), Ω_4 (radiation), Ω_6 (scalar field term), and the universe evolution is described by the modified Friedmann equation. Depending on model parameters, (i) There are three qualitatively different initial state of the universe: an eternal kinetic inflation ($k=0$), an initial singularity ($k=-1$), and a bounce ($k=+1$); (ii) For all types of spatial geometry, the universe goes inevitably through the primary quasi-de Sitter (inflationary) epoch when $a(t)\propto e^{H_\eta t)}$ where $H_\eta^2={1}/{9\eta}$. The mechanism of primary or kinetic inflation is provided by non-minimal derivative coupling and needs no fine-tuned potential; (iii) There is a natural mechanism providing a change of cosmological epochs. Note that the bounce -- when the Universe's contraction is replaced by expansion -- can exist in the model with positive spatial curvature. It happens at some moment t_* when $a(t_*)=a_{min} =(3\zeta \Omega_2)^{1/2}$. It is important fact that the value a_{min} depends only on ζ and Ω_2, and does not depend on Ω_0, Ω_3 and Ω_4. We show that, though the spacetime

geometry and energy densities remain to be regular near the bounce, the scalar field has a singular behavior there. As a result, we conclude that the complete dynamical system describing the cosmological evolution in theory of gravity with non-minimal derivative coupling is singular near the bounce. For this reason, we term this scenario as a `singular' bounce. Then, we derive a complete set of equations which describe an evolution of scalar, vector and tensor modes of perturbations in the spatially flat Friedmann universe and show that all modes, including vector ones, are amplified in the quasi-de Sitter (inflationary) stage, and such the behavior is cardinally distinct from that in standard Friedmann cosmology.

Aug 11 (Tue) 09:00-12:30

Recent Progress on Dark Energy Study

Xinmin Zhang
IHEP, Chinese Academy of Sciences

This talk will include 1）brief review on the current status of the measurements of the dark energy equation of state from DESI and DES observations; 2）brief review on the Quintom dark energy theory; 3）brief introduction to the AliCPT （Ali CMB Polarization Telescope）project; 4）a new proposal of studying the dynamical property of dark energy by measuring the CMB Polarization rotation angle at AliCPT.

Searching for Axion Dark Matter with Radio Observations

Yuko Urakawa
KEK

In this talk, I will explain our recent work where we introduce several new methods to detect the imprint of axion-like particles (ALP) through radio observations.

Gravitational Waves and Radiation by Wormhole System

Sung-Won Kim
Department of Science Education, Ewha Womans University

In this presentation, we consider the wormhole systems that generate gravitational waves and emit gravitational radiation. We have discovered that single or binary wormhole systems exhibit unusual signals that differ from typical neutron star or black hole systems. We will also discuss the observational issues associated with these systems.

Accretion effects in merging rates of primordial binary black holes

Konstantin Postnov
Sternberg Astronomical Institute

Primordial black holes (PBH) formed in the early Universe may constitute a fraction of cold dark matter. They can form binaries initially or due to dynamical processes at late stages during massive CDM halos formation. We investigate the effect of baryonic accretion on PBHs after recombination on the mass distribution, merging rate and detection rate of such binaries focusing on intermediate-mass PBHs that can be potentially detected by space laser interferometer TianQin.

Aug 12 (Wed) 09:00-12:30

TianQin: a mission to detect gravitational waves in space

Jianwei Mei
Sun Yat-sen University

TianQin is a space-based gravitational wave (GW) detector expected to launch around 2035. It will detect GWs in the frequency band 0.1 mHz~1 Hz, offering the chance to detect GWs from a large variety of sources, such as massive black holes, stellar mass black holes, Galactic compact binaries, and so on. The mission was officially proposed in 2014 and has passed a couple of its main milestones. In this talk, I will introduce the mission and the main progress that has been made.

The 20 GeV Fermi halo: evidence for dark matter annihilation?

Tomonori Totani
RESCUE, University of Tokyo

Fifteen years of the Fermi Large Area Telescope (LAT) data in the halo region of the Milky Way (MW) are analyzed to search for gamma rays from dark matter annihilation. Gamma-ray maps within the region of interest ($|l| < 60$ deg, $10 \text{ deg} < |b| < 60$ deg) are modeled using known components plus a halo-like component. A statistically significant halo-like excess is found with a spectral peak around 20 GeV, and examination of the fit residual maps indicates that a spherically symmetric halo component fits the map data well. The radial profile agrees with annihilation by the smooth NFW density profile. Various systematic uncertainties are investigated, but the 20 GeV peak remains significant. The halo excess spectrum can be fitted by annihilation with a particle mass $m \sim 0.5$-0.8 TeV and cross section $\langle \sigma v \rangle \sim (5\text{-}8) \times 10^{-25}$ cm3 s^-1 for the bb channel. This cross section is larger than the upper limits from dwarf galaxies and the canonical thermal relic value, but considering various uncertainties, especially the boost effect by substructures, the dark matter interpretation of the 20 GeV “Fermi halo” remains feasible. The prospects for verification through future observations are briefly discussed.

Cosmological Implications of Electroweak Monopoles

Yongmin Cho
CQUeST, Sogang University

The cosmological implications of the electroweak monopoles are discussed. Predicted by the standard model the electroweak monopoles could play important roles in cosmology. Amply produced during the electroweak phase transition, most of them turn to the featherweight primordial magnetic black holes (PMBH) via the gravitational collapse and could explain the dark matter of the universe. Moreover, some of them become black holes and the seed of the large structure of the universe, and

some of them could also become the supermassive black holes. We discuss how to detect them experimentally.

The Search for Magnetic Monopoles from the TeV to the GUT Scale using Collider and Astroparticle Detectors

James Pinfold
Department of Physics, University of Alberta

Magnetic monopoles occupy a singular role in modern theoretical physics, emerging naturally in a wide array of frameworks—from Dirac's quantization condition to Grand Unified Theories (GUTs), electroweak symmetry breaking, and candidate theories of quantum gravity. As Joseph Polchinski famously observed: "The existence of magnetic monopoles seems to be one of the safest bets that one can make about physics beyond the Standard Model. Their properties can be studied in quantum field theory, and they are expected to exist in almost any extension of the Standard Model."- J. Polchinski, "Monopoles, Duality, and String Theory", Int. J. Mod. Phys. A 19S1, 145 (2004).
This talk surveys the status and prospects of monopole searches across the vast landscape of accessible energy scales—from the TeV regime of collider experiments to the Planck-scale physics potentially revealed through relics from the early universe. At colliders, experiments such as MoEDAL-MAPP and ATLAS, have targeted Dirac and electroweak monopoles using both Drell-Yan, photon-fusion and Schwinger production mechanisms.
At higher mass scales, inaccessible to collider production, the search continues via cosmic and astroparticle observatories. Experiments such as MACRO, SLIM, IceCube, NOVA, and the newly proposed Super-SLIM experiment span a broad range of monopole velocities and masses, with sensitivities guided by theoretical benchmarks such as the Parker bound and catalysis-induced proton decay cross sections. Unlike collider searches, these experiments probe fluxes that are motivated by cosmological and astrophysical considerations.
We shall see that the monopole is not merely a theoretical curiosity but a critical test of our most ambitious physical theories, as foundational as the Higgs boson in the architecture of fundamental physics.

Aug 13 (Thu) 09:00-12:30

Advances in the Taiji Program for Gravitational-Wave Detection

Yueliang Wu
ITP, Chinese Academy of Sciences

The Taiji program is a space-based gravitational-wave observatory targeting the 0.1 mHz–1.0 Hz frequency band via a triangular constellation of three Sun-orbiting spacecraft. Its scientific case encompasses the observation of supermassive and intermediate-mass black-hole mergers, extreme- and intermediate-mass-ratio inspirals, the formation and cosmological evolution of massive black holes, and the probing of fundamental gravity, spacetime structure, and the dark Universe. This talk delivers a concise mission overview, addressing the primary science objectives and the payload configuration. Special attention is devoted to the program's development roadmap, covering key in-orbit validation outcomes from the Taiji-1 mission, the current mission status, and the strategic vision toward full constellation deployment.

Recent progress of CPTA observation --- low frequency observation to improve DM noise

Kejia Lee
Department of Astronomy, Peking University

In the talk, we will present the results of high precision pulsar timing of 57 millisecond pulsars conducted using the the Chinese FAST 500-meter radio telescope. Particularly, we will highlight the recent efforts in reducing the dispersion measure noise by using the low-frequency radio telescope array. Future perspective of domestic facilities in the related field will be also discussed.

Quantum Improved Black Holes in Asymptotically Safe Gravity

Chiang-Mei Chen
Department of Physics, National Central University

In this talk, I will explore quantum-improved black hole solutions within the framework of asymptotic safety. In this approach, the Newton coupling becomes scale-dependent, necessitating a meaningful identification between the energy scale and a corresponding physical (length) scale to derive observable consequences for black hole spacetimes. I will argue that the requirement of consistency with the first law of black hole thermodynamics provides a physically motivated criterion for this scale-setting, particularly near the event horizon. Applying this principle, we propose a specific identification scheme that leads to a regularized geometry capable of resolving the ring singularity of Kerr black holes.

7-Dimensional Telescope for Multimessenger Astronomy

Myungshin Im
Department of Physics & Astronomy, Seoul National University

Multimessenger observation of gravitational-wave (GW) sources can teach us much more about the Universe than GW observations alone. Through optical identification of GW events, one can localize the event to sub-arcsecond accuracy, which allows us to identify the GW event host galaxy and its redshift for various astrophysical applications. Through the time evolution study of the electromagnetic-wave (EM) counterpart, one can learn astrophysical processes of kilonovae, which are known to produce the bulk of heavy elements such as gold. In this talk, we will present our past and present efforts of optical counterpart observations of GW events and information we can gather from EM follow-up of GW sources. We will describe current challenges and future efforts that might overcome the difficulties today. In particular, we will give a special emphasis on our current efforts of the multimessenger observations in Korea, the GW EM-Counterpart Korean Observatory (GECKO), and two key GECKO facilities, the 7-Dimensional Telescope (7DT) and KMTNet. 7DT is a multiple telescope system made of 16, 0.5-m wide-field telescopes that is designed to provide a wide-field spectral mapping of the sky. We will describe the 7DT system, and its early science results.

Aug 14 (Fri) 09:00-12:30

An Overview of the Chinese Space Station Survey Telescope

Hu Zhan
National Astronomical Observatories, Chinese Academy of Sciences

The 2m-aperture Chinese Space Station Survey Telescope (CSST, also known as the Xuntian Space Telescope) is a major science project of China Manned Space Program. With a Cook-type three-mirror anastigmat design, the CSST can achieve superior image quality within a large field of view. It will be equipped with 5 first-generation instruments including a Survey Camera, a Terahertz Spectrometer, a Multichannel Imager, an Integral Field Spectrograph, and a Cool Planet Imaging Coronagraph. The primary task of the CSST is to carry out a high-resolution large-area multiband imaging and slitless spectroscopy survey covering the wavelength range of 255 nm to 1000 nm. It will take the Survey Camera roughly 7 years of operation accumulated over 10 years of orbital time to image roughly 17,500 square degrees of the sky in 9 filter bands and take slitless spectroscopy of the same sky in 3 bands. In this talk, I will give a brief introduction of the project and show recent test results of the instruments.

21-cm Cosmology: Radio BAO and Cosmological Tensions

Filipe Abdalla
Department of Astronomy, USTC

The remarkable success of the standard cosmological model has been accompanied by the emergence of persistent tensions between different cosmological probes, most notably in the measurements of the Hubble constant and the amplitude of matter clustering. Whether these discrepancies point to new physics or to unrecognized systematic effects remains one of the central questions in modern cosmology. Resolving this issue requires independent measurements based on complementary observational techniques. Radio observations of the 21-cm emission from neutral hydrogen provide a powerful new avenue for measuring the large-scale structure of the Universe through intensity mapping, enabling precise determinations of the baryon acoustic oscillation (BAO) scale over a broad range of redshifts. In this talk I will review the current status of cosmological tensions and discuss how future 21-cm surveys can contribute to their resolution. I will then present the BINGO telescope, its current status, and the planned extensions (ABDUS) that will significantly enhance its scientific reach. Finally, I will highlight the growing Brazil–China collaboration that is driving these developments and positioning radio cosmology as a key component of next-generation precision cosmology.

Overview of Large-scale Cryogenic Gravitational wave Telescope KAGRA

Takafumi Ushiba
Institute for Cosmic Ray Research, University of Tokyo

KAGRA is a 3-km baseline interferometric gravitational-wave detector located in Japan. It incorporates two unique features aimed at achieving high sensitivity: the detector is constructed underground to reduce seismic noise, and cryogenic sapphire test masses are employed to suppress thermal noise.
On 1 January 2024, KAGRA sustained damage as a result of the 2024 Noto Peninsula Earthquake. Following approximately one year of recovery work, the detector was successfully restored to operation. KAGRA subsequently joined the fourth observing run (O4c) of the global gravitational-wave detector network together with LIGO and Virgo, which commenced on 11 June 2026 (UTC) and concluded on 18 November 2026 (UTC). During O4c, KAGRA achieved a binary neutron star inspiral range of 7.5 Mpc.
The LIGO–Virgo–KAGRA Collaboration is currently preparing for the next observing campaign, designated IR1, which is planned to last approximately six months. This presentation will briefly introduce the ground-based interferometric gravitational-wave detectors, with a particular focus on KAGRA, and will discuss the current status of the detector as well as its future prospects.

Black Hole Interiors: Critical Phenomena, Kasner Dynamics, and Beyond

Li Li
ITP, Chinese Academy of Sciences

The interior of black holes exhibits far richer dynamics than their exterior counterparts, offering a window into the most extreme gravitational regimes. This talk explores our recent work in understanding black hole interiors through two distinct lenses. First, I present a novel critical phenomenon inside spontaneously scalarized black holes, revealing a universal scaling law between the near-singularity Kasner exponent and the charge-to-mass ratio—with a model-independent critical exponent. Second, I show how higher-derivative corrections, inevitable from quantum gravity, fundamentally alter this picture, replacing classical Kasner dynamics with three new phases: modified Kasner eons, persistent periodic oscillations, and oscillatory spike dynamics. These findings reveal that quantum corrections impose unexpected order near singularities, offering fresh insights into strong-field gravity.

Abstract (Parallel)

Aug 10 (Mon) 14:00-16:00

Mon-1a. A1. General relativity: Theory and Mathematical developments

Mon-1a1

Chaotic Particle Behavior in an Anisotropic Fluid Black Hole Immersed in a Magnetic Field

Wonwoo Lee
CQUeST, Sogang University

We introduce anisotropic fluid black holes. We also present examples of how to obtain rotating black holes using the Newman-Janis algorithm. Furthermore, we present a solution to the Einstein-Maxwell equations describing an anisotropic fluid black hole immersed in a magnetic field and analyze particle trajectories in this geometry. Notably, the spacetime lacks a separable structure due to the absence of a Killing tensor, resulting in coupled equations of motion that render the system non-integrable. To investigate chaotic particle behavior in the geodesic motion, we examine both Lyapunov exponents and Poincaré sections.

Mon-1a2

Black Holes Distorted by Their Environment: Stationary and Axisymmetric Perturbations

Petr Kotlarik
YITP Kyoto; Astronomical Institute of CAS Prague

The standard Kerr solution describes an isolated black hole. In reality, however, astrophysical black holes reside in some matter environment. Whether in active galactic nuclei or stellar binaries, accreting matter often forms disc-like structures. Such an astrophysical environment distorts the background Kerr geometry, potentially leading to observable effects. In this talk, I will present how we can perturbatively model these systems using the Debye potential approach, and how to subsequently reconstruct the metric into the standard Weyl-Lewis-Papapetrou form.

Mon-1a3

Black hole interiors and complexity in holographic solids

Yuan-Ceng Xu
Dalian University of Technology

We study AdS black hole interiors under finite shear strain in holographic axion models for strongly-coupled systems with broken translations. Shear anisotropy eliminates the inner Cauchy horizon, forcing the deformed black hole toward a spacelike singularity. Axion-induced anisotropy collapses the Einstein-Rosen bridge at the would-be Cauchy horizon, accompanied by rapid changes in spatial anisotropy. For a power-law axion potential, large shear deformations produce a domain wall solution featuring a near-boundary Lifshitz-like scaling geometry and a near-horizon Kasner epoch with exponents set by the potential. The interior dynamics eventually enter an anisotropic Kasner universe at late times. Using the CV conjecture, we also study the complexity of holographic homogeneous solids under shear strain, finding a universal scaling relation between complexity and stress in the large-shear limit.

Mon-1a4

Virtual absorption modes of Schwarzschild-de Sitter spacetimes in semi-open systems

Liang-Bi Wu
HIAS UCAS

We present a study of virtual absorption modes (VAMs) in Schwarzschild-de Sitter (SdS) spacetime under semi-open boundary conditions, where the VAMs correspond to total transmission modes (TTMs) with the reflection amplitude being vanishing. Our numerical analysis reveals that as the reflectivity $|\mathcal{K}|$ decreases, the VAM spectra migrate systematically toward regions of less negative imaginary parts, with each overtone exhibiting a critical reflectivity at which $\text{Im}(\omega_{\text{VAM}})=0$. Using simulations based on spectral collocation methods, it is demonstrated that excitation precisely at a VAM spectrum leads to coherent perfect absorption (CPA). These results establish VAMs as the spectral signatures of CPA for exotic compact objects (ECOs).

Mon-1a5

Trapped surface formation: physical foundations

Nathan Thomas Carruth
Southern University of Science and Technology

The so-called short pulse ansatz of Christodoulou has been applied by many researchers in mathematical general relativity over the past 15 years to construct non-special solutions to the Einstein vacuum equations exhibiting dynamic trapped surface formation. This ansatz was also recently used by An to treat aspects of the cosmic censorship conjecture. However, its physical basis has remained unexplored. In this talk I will describe recent work attempting to give a physical foundation for this ansatz, and discuss potential applications. This talk will be accessible to a broad audience.

Mon-1a6

Tests of Lorentz and parity symmetry of gravity with gravitational waves

Tao Zhu
Zhejiang University of Technology

Gravitational wave (GW) observations offer a powerful tool for testing the fundamental Lorentz and parity symmetries of gravity. Any violation of these symmetries could manifest as deviations in GW propagation. In this talk, I will explore how current and future GW detections can constrain Lorentz- and parity-violating effects in gravity. I will introduce a systematic parameterization framework to describe potential deviations in GW propagation from general relativity in a cosmological background. Using this framework, we can construct modified GW waveforms, incorporating the effects of Lorentz and parity violations as predicted by various alternative gravity theories. Finally, I will present the latest results from our analysis of these modified waveforms using current GW data and discuss the prospects for placing even stronger constraints from future GW detections

Aug 10 (Mon) 16:30-18:30

Mon-1b. A1. General relativity: Theory and Mathematical developments

Mon-1b1

The characteristic initial value problem for the Einstein-Dirac system and the trapped surface formation.

Peng Zhao
Beijing Normal University

In this talk I will discuss the local existence of the characteristic initial value problem for the Einstein-Dirac system, which governs the interaction between gravity and spin-1/2 fields. To achieve this, we introduce the symmetric spinorial derivative of the Dirac field as the independent variables and derivative a “Weyl-curvature-free” equation system for them to close the bootstrap. Based on the existence results, we show that the focusing of the gravitational wave and the Weyl spinor flux leads to the formation of a trapped surface.

Mon-1b2

A Generalized Landauer's Principle for Unitarily Transformed Thermal Reservoirs

Hao Xu
Yangzhou University

Landauer's principle, a cornerstone of quantum information and thermodynamics, appears to be violated when the thermal reservoir is replaced by a squeezed thermal state (STS), owing to the additional thermodynamic resources inherently present in the squeezed state. We introduce a formal extension of the principle to such unitarily transformed thermal states. By defining an effective Hamiltonian, we rigorously establish a generalized Landauer inequality, which naturally reduces to the standard case for an ordinary thermal reservoir as a special instance. The framework further yields a consistent definition of entropy production and a proof of its non-negativity. We illustrate its utility by studying an arbitrarily moving Unruh-DeWitt detector coupled to a quantum field initially prepared in the STS. Using perturbation theory, we compute the entropy production explicitly, confirming its positivity. As a result of the symmetry breaking induced by the unitary transformation, it depends on both the proper time interval and the absolute spacetime position. Our work resolves the apparent violation of Landauer's principle with STSs. It also provides a robust tool for analyzing quantum thermodynamics in non-equilibrium and relativistic settings, with potential implications for quantum thermal machines and information protocols.

Mon-1b3

The study of thermodynamics and the weak cosmic censorship conjecture

Si-Jiang Yang
Hainan University

In this talk, I will talk about our studies on the weak cosmic censorship conjecture and it is relationship with black hole thermodynamics, especially the second law of black hole thermodynamics.

Mon-1b4

Critical Phenomenon inside Asymptotically Flat Black Holes with Spontaneous Scalarization

Fu-Guo Yang
International Centre for Theoretical Physics Asia-Pacific

We study the nonlinear interior dynamics of spontaneously scalarized black holes in Einstein-Maxwell-scalar theory with zero cosmological constant, revealing novel critical phenomena. We demonstrate that, for a wide range of scalar-electromagnetic couplings, scalarized black holes possess no smooth inner Cauchy horizon and instead evolve into a spacelike Kasner singularity. Near the critical point where scalarized black holes bifurcate from the RN solution, we establish a robust scaling relation between the Kasner exponent and the charge-to-mass ratio of the hairy black hole, opening a new window into the remarkable simplicity underlying black hole interiors.

Mon-1b5

Energy, memory and balence equation of polyhomogenous spacetime

Xiaoning Wu
AMSS, CAS

In this talk, I will discuss the motivation, Bondi energy definition and memory effects of polyhomogenous spacetime.

Mon-1b6

Spacetime discreteness and PSL(2,R) phases at the Planck scale

Weihu Ma
Fudan University

By promoting infinitesimal intervals to scale-dependent observables, we obtain a dual measurement condition that enforces a discrete doubling law and generates an equidistant spectrum of measurable lengths, leading to a scaling-deformed commutator that reduces to the Heisenberg algebra. The same consistency requirement induces a projective (\mathrm{PSL}(2,\mathbb{R})) structure on scale transformations. The associated scale fluctuations also yield a scaled position-dependent mass equation and a universal scaled Schwarzian action, providing a unified description of microscopic discreteness, deformed phase-space structure, and reparametrization dynamics.

Aug 10 (Mon) 14:00-16:00

Mon-2a. A2. Modified gravity

Mon-2a1

Quantum interference in Teleparallel Gravity

Zhongyou Mo
School of Science, Sun Yat-Sen University

In the theory of Teleparallel Gravity, the gravitational phase of a particle is given by a path-dependent integral which relates to the gravitational gauge potential. We found a way to calculate such phase and applied it to a gedanken experiment of quantum interference in Kerr-Newman spacetime. We computed the phase difference of the interferometer and found that it does not completely coincide with the result based on general relativity. Such inconsistency is unexpected, considering that Teleparallel Gravity is usually regard as an alternative but equivalent theory of general relativity. With a careful analysis, we explicitly showed that the gravitational phase defined in Teleparallel Gravity is actually not equivalent to that in general relativity.

Mon-2a2

Multimessenger Tests of the Strong Equivalence Principle and Hidden Extra Dimensions with Gravitational-Wave Observations

Hanlin Song
CAS, Institute of Mechanics

Multimessenger gravitational-wave observations provide a powerful probe of fundamental gravity in the strong-field and dynamical regime. In this work, we test possible deviations from general relativity from two complementary perspectives: a temporal variation of the gravitational constant, which is closely related to the strong equivalence principle, and the existence of hidden compact extra dimensions inspired by the Kaluza-Klein formulism. We first develop a gravitational-wave waveform model with a slowly varying gravitational constant, including its effects on both compact binary dynamics and wave propagation in an expanding universe. Applying this framework to GW170817, together with electromagnetic information from GRB 170817A, we obtain no evidence for a varying gravitational constant and constrain \dot{G}/G to [-3.36 × 10^{-9}, 5.34 × 10^{-10}] yr^{-1}. We further use GW170817 to place bounds on hidden extra dimensions and forecast the capability of the future Taiji detector. Representative multimessenger supermassive black hole binaries observed by Taiji are expected to provide significantly stronger constraints, demonstrating the potential of future space-based gravitational-wave astronomy for testing gravity beyond four dimensions.

Mon-2a3

Inflation from entropy

Udaykrishna Thattarampilly

Yangzhou University

We investigate cosmological solutions for the modified gravity theory obtained from quantum relative entropy between the metric of spacetime and the metric induced by the geometry and matter fields. The vacuum equations admit inflationary solutions, hinting at an entropic origin for inflation. Equations also admit a regime of phantom-like behavior. Assuming that the relation between slow roll parameters and CMB observables holds for gravity from entropy, the theory predicts a viable spectrum.

Mon-2a4

Compact Binary Dynamics in Einstein-Scalar-Gauss-Bonnet Gravity: From Post-Newtonian Inspirals to Post-Minkowskian Scattering

Gabriel Luz Almeida
Southeast University

This presentation explores the conservative dynamics of compact binaries in Einstein-scalar-Gauss-Bonnet (ESGB) gravity using an Effective Field Theory (EFT) framework. We present comprehensive analytical results bridging both bound inspirals and unbound scattering encounters. For bound systems, we derive the effective two-body potential for spinning black hole binaries up to the third post-Newtonian (3PN) order, computing required black hole sensitivities via novel analytic solutions for slowly rotating black holes. For unbound configurations, we compute the scattering impulse and deflection angle up to the third post-Minkowskian (3PM) order. Finally, we demonstrate the consistency of these state-of-the-art PN and PM calculations in their overlapping regimes.

Mon-2a5

Thin Accretion-Disc Transfer Functions in the q-Metric Spacetime

Aray Muratkhan
Al-Farabi Kazakh National University

We investigate the optical appearance of a geometrically thin equatorial accretion disc in the q-metric spacetime, an exact static and axially symmetric vacuum solution with an independent quadrupolar deformation. The Schwarzschild geometry is recovered at $q = 0$, while for $q \neq 0$ the surface $r = 2M$ is a curvature singularity. Using backward ray tracing from a distant nearly face-on observer, we construct the first three equatorial transfer functions, which describe the direct image and higher-order lensed disc-intersection branches. The third branch reproduces the Schwarzschild critical impact parameter and shifts systematically with the deformation parameter. After normalization by the physical monopole mass, this variation becomes substantially weaker, showing that much of the apparent displacement is caused by monopole rescaling. Inclined first-intersection maps and a minimal radiative model further show that a residual quadrupolar signature survives projection and radiative weighting, although its observable effect remains modest.

Aug 10 (Mon) 16:30-18:30

Mon-2b. A2. Modified gravity

Mon-2b1

Black hole instabilities and non-minimally coupled fields

Sebastian Garcia-Saenz
SUSTech

I will discuss a destabilization channel of black holes in general relativity induced by non-minimally coupled fields. I will focus in particular on vector fields, a case which encompasses well-known models such as the generalized Proca class of theories, although the mechanism is very generic. In the case of static and spherically symmetric backgrounds, our results show that black holes with sufficiently small mass are subject to instabilities, with a spectrum of growth rates characterized by unique features and depending non-trivially on the model parameters. Although the instability may potentially serve as a mechanism for the formation of hairy black holes, I will explain how it differs essentially from the more familiar scalarization effect. Conversely, demanding the absence of instabilities translates into interesting bounds of relevance for scenarios of dark energy and ultra-light dark matter.

Mon-2b2

A unified framework to study f-family of gravity theories

Saikat Chakraborty
Duy Tan University, Vietnam

I will introduce a neat mathematical framework that can be utilized to study, in an unified manner, different aspects of f(R), f(T) and f(Q) gravity. As an example of the application of this framework, I will show it's applicability for a comparative analysis between f(R) gravity and the trivial FLRW connection branch of f(Q) gravity, with respect to the two following questions: (1) provide a purely cosmographic measure on the deviation from GR based on the current data and (2) the behaviour of the underlying theory (more precisely, of it's deviation from GR) given a certain cosmological evolution. Time permitting, I will briefly introduce the direction about a further interesting application of this framework.

Mon-2b3

Hunting for the Observational Signature of Universal Horizon and Lorentz-Violation Effects

Chao Zhang
China University of Petroleum-Beijing

Einstein-Aether theory extends general relativity by introducing a dynamical timelike vector field that breaks Lorentz symmetry/invariance, motivated by quantum gravity approaches including loop quantum gravity models. While maintaining self-consistency and passing all observational constraints,

the theory permits superluminal gravitons that revolutionize black hole causal structure, namely, the universal horizon replaces the traditional event horizon as the true causal boundary, trapping particles of arbitrarily large speeds from within. This novel phenomenon modifies gravitational waves at the ringdown stage through altered boundary conditions and the resultant quasi-normal mode spectra, with latter being potentially detectable by future space-based observatories (LISA, TianQin, Taiji, etc.). In addition to phenomenological significance, the universal horizon thus serves as a distinctive fingerprint of Lorentz violation (and a probe to the structure of a black hole). Overcoming formidable technical challenges through reduced Lagrangian methods, this framework opens a theoretical laboratory for probing spacetime structure and revealing the nature of gravitational Lorentz-violation effects. Combining different aspects reflected from the gravitational waves at both the inspiral and ringdown stages, we shall build up a more comprehensive as well as systematic understanding towards the theory, serving for uncovering the dawn of quantum gravity plus an illustration of a, technically speaking, effective treatment of tackling problems within this area.

Mon-2b4

Equilibrium Structure and Stability of White Dwarfs with Isotropic and Anisotropic Pressure Distributions

Ayazhan Orazymbet
Al-Farabi Kazakh National University

We study the equilibrium structure and stability of white dwarfs with both isotropic and anisotropic pressure distributions. The stellar structure equations are solved numerically using the Chandrasekhar equation of state, while pressure anisotropy is introduced through a generalized prescription that closes the system. The results show that anisotropy is negligible at the stellar center and gradually increases toward the surface. The physical viability of the configurations is examined using standard stability and compactness criteria. We also analyze how the anisotropy parameter and central density influence the mass, radius, and compactness of white dwarfs. In addition, the surface gravitational redshift is calculated and found to decrease as the degree of anisotropy increases. Overall, anisotropy produces only moderate changes in the global equilibrium structure, but it may become relevant in white dwarfs affected by strong magnetic fields, rotation, or accretion in binary systems.

Mon-2b5

Black hole superradiance in Poincaré gauge theory

Jorge Gigante Valcarcel
Institute for Basic Science

We investigate the phenomenon of black hole superradiance in the presence of torsion within the framework of Poincaré gauge theory. In particular, in contrast to the classical approach of General Relativity, we show that the inclusion of torsion in the space-time geometry enables the energy extraction from rotating black holes by Dirac fermions via chiral asymmetry, while preserving the Pauli exclusion principle.

Aug 10 (Mon) 14:00-16:00

Mon-3a. A4. Gravitational waves-Theory

Mon-3a1

Shock Formation in Cosmic Domain Wall Models

Mauricio Valencia Villegas
Institute for Theoretical and Mathematical Physics, Moscow State University

We examine whether biased domain walls can develop shock waves (gradient catastrophes), a process that could be responsible for intense particle and gravitational wave emission. We show that even with the minimal bias required to avoid the domain wall problem in cosmology, generic waves remain shock-free from smooth initial data, thus suggesting that shock-induced emission channels may be fundamentally suppressed. Finally, we discuss the impact of curvature corrections on thin domain wall models. (Based on: 2604.08142)

Mon-3a2

Decay criteria for asymptotic freedom in plane gravitational waves

Qiliang Zhao

School of Fundamental Physics and Mathematical Sciences, Hangzhou Institute for Advanced Study, UCAS

The fact that the background spacetime approaches flatness is not equivalent to the dynamical system approaching free motion; the latter requires more stringent conditions. We have studied the velocity memory effect in sandwich plane gravitational waves and found that, depending on the decay rate of the wave profile, the asymptotic motion of the dynamical system can be classified into three types: strongly asymptotically free motion, weakly asymptotically free motion, and non-asymptotically free motion. We illustrated these three types with the Scarf profile, the inverse-cubic profile, and the inverse-square profile, respectively. In strongly asymptotically free motion, the particle follows strictly free asymptotic motion; in weakly asymptotically free motion, the asymptotic motion consists of free motion plus a drift term; in non-asymptotically free motion, the asymptotic motion is not free, and its detailed behavior depends on the amplitude of the gravitational wave. This classification is not an artifact of a particular coordinate system; rather, it reflects an intrinsic physical effect determined by the spacetime tidal forces.

Mon-3a3

The Generation and Detection of Chiral Gravitational Wave Backgrounds

Yun-Long Zhang
NAOC(National Astronomical Observatories, CAS)

Chiral gravitational wave backgrounds (GWBs) are predicted in many well-motivated mechanisms. We investigate the detection of Chiral GWBs using a network of detectors under arbitrary configurations. We also propose a dipole pulsar timing array, which demonstrates sensitivity to Chiral GWBs from the nanohertz to microhertz regime. [Ref: 2604.08141 & 2410.18916]

Mon-3a4

Inspiraling Systems in Dense Stellar Environments: Formation, Dynamics, and Detection Challenges

Verónica Vazquez-Aceves
International Centre for Theoretical Physics Asia-Pacific (ICTP-AP)

Within the next decade, at least two space-based gravitational-wave detectors will be operational: the Laser Interferometer Space Antenna (LISA) and one of the Chinese missions, TianQin or Taiji. These observatories will uncover a rich population of inspiraling systems whose properties reflect both their astrophysical formation channels and the complex dynamical environments in which they evolve. I will begin by outlining the main formation scenarios of inspiraling systems and discuss how these pathways shape their characteristic signatures and the challenges they pose for accurate waveform modeling.
I will then focus on the Galactic Center, where the dense stellar environment surrounding Sgr A* naturally supports the formation of extreme and extremely large mass-ratio inspirals (EMRIs and XMRIs). While isolated inspirals have been extensively studied, the dynamical interplay between coexisting EMRIs and XMRIs has remained largely unexplored. We investigate the coupled evolution of an EMRI and an XMRI orbiting Sgr A*, showing that long-range gravitational interactions between the two systems can induce measurable perturbations in their trajectories, leading to waveform deviations relative to the isolated case. These perturbations accumulate over observational timescales and may imprint detectable signatures in the data streams of LISA, TianQin, and Taiji.
Our results highlight the importance of incorporating multi-body inspiral environments into next-generation waveform modeling and search strategies. Accounting for these effects will be essential for fully exploiting the scientific potential of future space-based gravitational-wave missions.

Mon-3a5

Recent Progress on Frozen Stars

Yong-Qiang Wang
Lanzhou University

Frozen stars are ultra-compact objects that mimic black holes externally but lack an event horizon, serving as potential singularity-free alternatives to black holes. Our recent research focuses on constructing frozen star solutions within different gravitational frameworks. These objects exhibit a critical horizon where the metric function becomes nearly zero without forming a true event horizon. Extending further to pure gravity, we have discovered frozen gravitational stars in Einsteinian cubic gravity, which exist without any matter fields. Around these frozen configurations, photon orbits undergo sharp deflections near the critical horizon, closely resembling extreme black holes from the perspective of an external observer.

Aug 10 (Mon) 16:30-18:30

Mon-3b. A3. Numerical Relativity / A4. Gravitational waves-Theory

Mon-3b1

Worldline Formalism, Eikonal Expansion and the Classical Limit of Scattering Amplitudes

Yuchen Du
Southeast University

We revisit the fundamentals of two different methods for calculating classical observables: the eikonal method, which is a scattering amplitude-based method, and the worldline quantum field theory (WQFT) method. The latter has been considered an extension of the worldline effective field theory. We show that the eikonal and WQFT methods are equivalent and that calculations can be translated freely between them.
Concretely, we focus on 2-into-2 scattering processes mediated by massless force carriers. On the one hand, taking the classical limit of the QFT scattering amplitude leads to the eikonal method. On the other hand, since in the classical limit the scattering particles are almost on-shell throughout the scattering process, the worldline, a first quantized formalism, is the most efficient framework to study the scattering amplitude. This is an alternate but equivalent formalism to the quantum field theoretic (QFT) framework. By taking the classical limit of the scattering amplitude computed in the worldline, we can derive the WQFT rules of Mogull, Plefka and Steinhoff. In WQFT, the Feynman diagrams are reorganized into a new set of diagrams that facilitate the expansion. Unlike the QFT eikonal method, which works recursively in identifying the eikonal phase, the worldline-based computation allows to target and systematically extract the classical contributions directly through a specific set of WQFT diagrams. In worldline formalism the perturbative expansion of the scattering amplitude is naturally organized in diagrams which factorize (reducible) and diagrams which are new to that order (irreducible), in a one-to-one map with the structure of the amplitude in the eikonal method. This opened up the possibility to investigate and prove the conjectured exponentiation of the eikonal phase.

Mon-3b2

Parameter Space Search for Non-merging Ringdown Radiation from Close Hyperbolic Encounters of Two Black Holes

Dongchan Kim
Chung-Ang University

We present an analysis of ringdown gravitational waves from non-merging close hyperbolic encounters of two equal-mass, non-spinning black holes across the relevant parameter space. By extracting QNM-like modes from Ψ_4 observed at the north pole, we examine their consistency with Schwarzschild QNM frequencies and confirm the dominance of the fundamental $\ell = 2$ mode, together with a subdominant $\ell = 3$ mode. Notably, we find evidence for a retrograde $\ell =

2$ component in the non-merging ringdown signal. Its amplitude is comparable to that of the $\ell = 3$ mode, revealing a mode-excitation hierarchy that differs from the typical dominance of prograde modes in quasi-circular coalescences. We further construct an excitation map and study how the strength of each mode, as well as the energy and angular-momentum fluxes, varies with the impact parameter and initial velocity. These results may provide essential information for waveform modeling of this new class of radiation and for assessing the observability of hyperbolic encounters with next-generation detectors.

Mon-3b3

Frequency-Domain Hybridization of Semi-Analytical Binary-Black-Hole Waveforms

Zun Wang
Beijing Normal University

We develop a frequency-domain hybrid waveform model for binary black holes by linearly combining SEOBNRv5PHM, IMRPhenomXPHM, and IMRPhenomTPHM. The optimal coefficients are calibrated against SXS numerical-relativity waveforms using a generalized-eigenvalue scan, and the resulting hybrid waveforms show lower mismatches than the best individual approximants and, in most tested cases, NRSur7dq4. To address the limited size of the SXS catalog, we plan to repeat the calibration using NRSur7dq4 as a surrogate reference, producing a larger training set for coefficient prediction. Neural networks can then map binary parameters directly to hybrid coefficients, enabling fast waveform generation and future parameter-estimation applications.

Mon-3b4

Relativistic treatment of extreme mass ratio inspirals crossing accretion disks

Yuhe Zeng
Tsung-Dao Lee Institute, Shanghai Jiao Tong University

A small body orbiting around an accreting massive object and periodically crossing its accretion disk is a common configuration in astrophysics. In this work, we study the secular evolution of extreme mass-ratio inspirals (EMRIs), where a stellar-mass object (SMO)—such as a star or a stellar-mass black hole (sBH)—collides with the accretion disk surrounding a central supermassive black hole (SMBH). Using a perturbation method applied to EMRI geodesics, we find the following: (1) the disk tends to align the SMO regardless of its initial inclination ι relative to the disk, (2) the final orbital eccentricity of an SMO captured by the disk is low, although the eccentricity can temporarily increase when the initial inclination ι is large and the SMO is an sBH, (3) through collisions with the accretion disk alone, only a small fraction of sBHs that initially lie close to both the SMBH and the disk can be captured within the typical disk lifetime of active galactic nuclei. Two-body scatterings among SMOs in the nuclear stellar cluster play an essential role, randomly kicking sBHs toward the disk and significantly boosting the capture rate.

Mon-3b5

Quasinormal mode families: Classification and competition

Zhen-Hao Yang
YangZhou University

The perturbation spectra of black holes beyond standard vacuum black hole solutions within general relativity (GR) may exhibit complex structures with long-lived modes. This usually generates echo-like modulations on the ringdown signal, which typically originate from modified boundary conditions associated with exotic compact objects. Recent studies also reveal that they can instead arise from the multipeaked structure of the perturbation potential. However, while some case-by-case studies have been carried out, a framework for understanding the internal structure of such spectra, the physical nature of different mode families, and their dynamical excitation remains to be fully systematized. In this paper, we address this issue by proposing a potential methodology that combines frequency-domain classification with time-domain analysis, using a hairy Schwarzschild black hole that admits a double-peak perturbative potential as a theoretical platform. Our analysis of the quasinormal mode spectrum identifies two distinct families of modes: the photon sphere (PS) family, arising from delocalized scattering resonances, and the echo family, corresponding to highly localized quasibound states. We then develop a windowed energy analysis framework in the time domain, which discloses a dynamic competition for dominance between these families. In particular, our results explicitly show that this competition is sensitive to the properties of the initial perturbation source, and that higher-overtone echo modes can dominate in the observed signal, which are in contrast to the standard PS mode in GR. This study establishes the dynamic evolution of this energy competition as a new observational signature for probing new physics and further motivates a supplemental framework for analyzing long-lived ringdown signals.

Mon-3b6

Application of the Post-Minkowskian Effective one-body formalism to non-qusicircular systems

Hyeonguk Son
Chung-ang University

The Effective One-Body (EOB) formalism is a powerful semi-analytical framework designed to model relativistic binary systems with high computational efficiency.While primarily used for generating gravitational waves during quasi-circular binary mergers, this formalism has recently been extended to eccentric and non-merging systems. This talk reviews the recent advancements in applying the EOB framework to these non-quasi-circular systems. Furthermore, I evaluate the numerical accuracy of this extended model through rigorous comparisons with Numerical Relativity (NR) simulations.

Aug 10 (Mon) 14:00-16:00

Mon-4a. B2. Stringy gravity and AdS/CFT

Mon-4a1

Entanglement first law for timelike entanglement entropy and linearized Einstein's equation

Jia-Rui Sun
Sun Yat-Sen University

We extend the entanglement first law of conformal field theory (CFT) to time-like subregions. Focusing on intervals along the time direction of the boundary CFT, we show that the associated timelike entanglement entropy obeys a first-law–like relation, with an effective entanglement temperature inversely proportional to the temporal size of the interval. By implementing a double Wick rotation, we obtain the exact modular Hamiltonian for a suitable hyperbolic subsystem and use it to formulate the timelike entanglement first law precisely. Our central result is a detailed proof that, in asymptotically Anti-de Sitter spacetime, this timelike entanglement first law is equivalent to linearized Einstein's equations in the bulk: the first law follows from the linearized equations and, conversely, implies them. Our results further reveal the dynamical connections between entanglement and gravity.

Mon-4a2

Distinguishability of Black Hole Microstates from AdS/CFT Correspondence

Jiaju Zhang
Tianjin University

Using the AdS/CFT correspondence, direct evidence is provided for the perturbative distinguishability between black hole microstates and the thermal state. In two-dimensional holographic conformal field theories, the subsystem fidelity can be computed via a short-interval expansion. This quantity provides both lower and upper bounds on the trace distance, thereby demonstrating that quantum gravity corrections break semiclassical indistinguishability. Potential subtleties in computing the subsystem fidelity from the operator product expansion of twist operators in two-dimensional conformal field theories are also discussed.

Mon-4a3

Canonical Quantization for the Free Massive Vector Field in the Global AdS3 Spacetime with the Covariant Phase Space Formalism

Jie-qiang Wu

Institute of Theoretical Physics, Chinese Academy of Sciences

In this work, we take a canonical quantization for the free massive vector field in the global AdS3 spacetime with the covariant phase space formalism. Here, by taking use of the covariant phase space formalism, we simplify the canonical transformation step of the canonical quantization.

Mon-4a4

On the States in Flat/CarrCFT correspondence

Peng-Xiang Hao
Hetao Institute of Mathematics and Interdisciplinary Sciences (HIMIS)

Carrollian conformal field theories (CarrCFTs) are proposed as the dual field theories in one dimension lower for flat spacetime holography. We investigate the reconstruction of bulk local states in flat spacetime using states from CarrCFTs. For massive excitations in the bulk, the reconstruction can be achieved through states in what is known as the induced representation. In this scenario, we observe a match between the Hilbert spaces of the bulk and the boundary.

Aug 10 (Mon) 16:30-18:30

Mon-4b. B2. Stringy gravity and AdS/CFT

Mon-4b1

WAdS/WCFT and Kerr/CFT Correspondences Revisited

Jun Nian
University of Chinese Academy of Sciences

Motivated by the slice holography introduced à la de Boer and Solodukhin and the latest advances in the (JT gravity)/(Schwarzian theory) duality, we revisit the field-theory duals of gravity theories on the warped AdS3 background and on the near-horizon extreme Kerr (NHEK) geometry. Using this framework, we systematically construct the holographic description, clarify several longstanding conceptual issues, and uncover new mathematical structures underlying these correspondences. This talk is based on some of my recent joint work with a collaborator.

Mon-4b2

Universally Diverging Grüneisen Ratio of Holographic Quantum Criticality

Jun-Kun Zhao
Institute of Theoretical Physics, Chinese Academy of Sciences

Quantum criticality is a hallmark of strongly correlated electron systems, as seen in heavy-fermion materials and high-temperature superconductors. Holographic duality provides a powerful framework to investigate these systems by translating them into weakly coupled classical gravity living in one higher dimension. Here, we harness this approach to study a field-induced quantum critical point with dynamical exponent $z=3$ in Einstein-Maxwell-Chern-Simons theory. Our analysis of its thermodynamic properties reveals a new universality class. Notably, we identify a diverging Gr\"uneisen ratio with universal scaling $\sim T^{-2/3}$, a behavior that closely mirrors recent experiments on the heavy-fermion material~CeRh$_6$Ge$_4$. These findings advance our understanding of metallic quantum criticality and highlight the potential of holographic duality as a tool for studying correlated quantum matters.

Mon-4b3

Carrollian correlators in black hole perturbation theory

Jiang Long
Huazhong University of Science and Technology

We clarify the relationship between the two-point Carrollian correlator and massless scattering in black hole background. It turns out that there are two kinds of Carrollian correlators at the null boundaries of each asymptotically flat spacetime.
The correlator from $\mathscr I^-$ to $\mathscr I^+$ should be regularized by subtracting the flat space analog, and it is the position space version of the reflection amplitude of massless scattering. On the other hand, the correlator from $\mathscr I^-$ to the future horizon $\mathcal H^+$ is absent in flat space, and it is the position space version of the transmission amplitude. The poles of the Carrollian correlators are governed by the null geodesics from $\mathscr I^-$ to $\mathscr I^+$ or $\mathcal H^+$, and they define two kinds of classical equations in Carrollian space. These equations establish the relationship between the Shapiro time delay and the deflection angle for light rays and should be understood as the dual descriptions of the quasinormal modes (QNMs) and the branch cut of the Green's function. We find that the time delay contains a logarithmic/quadratic behavior for the correlator from $\mathscr I^-$ to $\mathscr I^+/\mathcal H^+$ for small deflection angles. On the other hand, the time delay is always increasing linearly for both correlators when the deflection angle is large.

Mon-4b4

Constructing CFTD from TQFTD+1 and Precision Discretization of CFT2

Lin Chen
Ningbo University

In recent years, the concepts and techniques of topological field theory have received growing attention in the field of high energy physics, such as symTFT. In this talk, I will show that the path integral of conformal field theories in D dimensions (CFTD) can be constructed by solving for eigenstates of a renormalization group (RG) operator following from the Turaev-Viro formulation of a topological quantum field theory in D+1 dimensions (TQFTD+1), explicitly realizing the holographic relation between a symmetric theory and a TQFT. Generically, exact eigenstates corresponding to symmetric TQFTD follow from Frobenius algebra in TQFTD+1. For D= 2, we construct eigenstates that produce 2D rational CFT path integrals exactly, which curiously connect a continuous-field theoretic path integral with the Turaev-Viro state sum. We also devise and illustrate numerical methods for D= 2, 3 to search for CFTD as phase transition points between symmetric TQFTD.

Aug 10 (Mon) 14:00-16:00

Mon-5a. C3. Black hole / E6. Space-based GW detection

Mon-5a1

Multipole Moments of Black Hole Horizons in Binary Mergers

Y.-B. Bae
Chung-Ang University

Black hole horizons carry rich geometric information about the strong-field dynamics of binary mergers. Their multipole moments provide a coordinate-invariant characterization of how horizons are deformed by gravitational interactions, but computing them has remained challenging: conventional methods require the horizon to be approximately axisymmetric, which fails near merger. We present a new numerical method that computes horizon multipole moments without any symmetry assumption, by reshaping the horizon into a round sphere via a conformal map. Applied to an equal-mass, non-spinning binary merger, the method yields smooth multipole moments throughout inspiral, merger, and ringdown. We discuss the resulting evolution of the quadrupole mode and its connection to the emitted gravitational waveform.

Mon-5a2

Modeling massive black hole multiplets dynamical evolution in lively-evolving galaxy environment for precise gravitational wave prediction

Kunyang Li
Center for Computational Astrophysics, Flatiron Institute

Low-frequency gravitational-wave experiments — pulsar timing arrays, LISA, and TianQin — need not just how often massive black holes (MBHs) merge, but the parameters carried to coalescence: masses, mass ratio, spins, eccentricity, and the delay since galaxy assembly. These depend on dynamical regimes that cosmological galaxy simulations cannot resolve. We extend RAMCOAL, a subgrid model in the RAMSES hydrodynamical code, to follow MBH binaries and now triplets — from galactic scales down to coalescence during the simulation. Black holes evolve from sink particles through a dynamical-friction phase into bound binaries hardened by stellar scattering, gas torques, circumbinary-disc coupling, and gravitational-wave emission, all within the live, evolving galaxy. When a later merger delivers a third MBH that drives the system chaotic, the model maps the interaction onto a library of three-body outcomes and updates the surviving binary, allowing exchanges, recoils, and ejections. Using isolated-galaxy tests, we show that the encounter geometry alone can change which pair finally coalesces, the eccentricity carried into the gravitational-wave band, and the merger delay (~0.3 to ~3.5 Gyr in our two configurations). By keeping coalescence, accretion, spin, and recoil coupled to the host galaxy, RAMCOAL aims to provide pre-coalescence source properties and electromagnetic

context for multimessenger predictions.

Mon-5a3

How Photon Polarization Swings Encode Black Hole Ringdown

Yehui Hou
Tsung-Dao Lee Inst., Shanghai Jiao Tong U

A light ray perturbed by a gravitational wave during propagation can inherit its waveform and imprint observable signatures on the observer's screen. In this work, we develop a covariant framework for polarized photon transport in a perturbed spacetime and apply it to Kerr ringdown, computing the resulting time-resolved polarization oscillations. We find that photons grazing the black hole exhibit polarization locked to the gravitational perturbation: the polarization angle tracks the ringdown in the time domain, with swings of up to ∼10 ∘ and a phase determined by the azimuthal mode number. This opens a new observational channel for probing black hole mergers and ringdown.

Mon-5a4

How to detect gravitational waves in high Earth orbits?--TianQin mission design overview

Xuefeng Zhang
Sun Yat-sen University

The TianQin mission plans to deploy three drag-free controlled satellites in circular high Earth orbits with a 10^5 km radius, which form a nearly equilateral-triangle constellation set almost vertical to the ecliptic. TianQin features a geocentric concept. A key question is how to detect gravitational waves in high Earth orbits? To answer it, mission studies need to identify unique challenges, technical solutions, and pros/cons. In this talk, we summarize main progresses on TianQin's mission studies. These include orbit and constellation, space environment, science payload, and satellite platform, which help to form a feasible "Chinese Design."

Mon-5a5

Taiji Data Challenge and Preliminary Study on Multi-Source Analysis

Minghui Du
Institute of Mechanics, Chinese Academy of Sciences

Space-based gravitational wave detection missions (e.g., LISA in Europe, Taiji and Tianqin in China) aim to capture gravitational wave signals in the 0.1 mHz – 1 Hz band, advancing astrophysics, cosmology, and fundamental physics. Their target sources include massive binary black holes, extreme mass-ratio inspirals, compact binaries inside and outside the Milky Way, stellar-mass binary black

holes, and astrophysical/cosmological stochastic gravitational wave backgrounds. Reliable data analysis methods are essential to convert raw measurements into scientific deliverables. Compared with existing ground-based gravitational wave detection, the overlapping of numerous unknown signals and the difficulty in predicting noise characteristics are prominent features of space-based data, posing severe challenges for future scientific data analysis. This talk will briefly introduce the "Taiji Data Challenge" simulated datasets and the associated open-source analysis software, report preliminary progress in multi-source data analysis, and discuss potential issues in practical data analysis.

Mon-5a6

Phase-Mediated Attractor Dynamics in Millisecond Pulsar Timing Residuals

Cinque McFarlane-Blake
Independent Researcher

I present a phase-space analysis of NANOGrav 15-year millisecond pulsar timing residuals using Phase-Mediated Attractor Dynamics (PMAD). By constructing cosine-delta sequences from residual state embeddings and projecting onto stiff (lowvariance) axes, reveals consistent low-dimensional manifolds underlying the stochastic residuals. Across multiple pulsars, I find a robust dimensional collapse onto 5–6 stiff axes, with intermittent bursty trajectories reminiscent of chaotic attractors. Angular Lyapunov proxies and basin-depth measures quantify local phase contraction and metastable organization, suggesting universal phase-space scaffolds beyond individual pulsar red noise. The pipeline and datasets are released for reproducibility.
Code + Data: https://doi.org/10.5281/zenodo.18168102

Aug 10 (Mon) 16:30-18:30

Mon-5b. C5. Dark Matter / E6. Space-based GW detection

Mon-5b1

Black Hole Accretion in Self-Interacting Dark Matter Halos

Tan Chen
International Center for Theoretical Physics Asian-Pacific, University of Chinese Academy of Sciences

We investigate black hole accretion in self-interacting dark matter (SIDM) halos using a self-gravitating fluid model with thermal conduction. We develop a robust one-dimensional spherically symmetric hydrodynamic code based on an operator-splitting finite-volume method. Simulating both Singular Isothermal Sphere (SIS) and Navarro--Frenk--White (NFW) profiles, we find that black hole growth is regulated by the competition between gravity-driven inflow and SIDM heat transport. Our results demonstrate that an SIS-like environment facilitates rapid accretion, allowing a $100\,\mathrm{M_{\odot}}$ seed to grow to $10^4\,\mathrm{M_{\odot}}$ within $2\,\mathrm{Myr}$. Furthermore, we show that larger initial black hole masses, steeper density profiles, and higher scattering cross sections significantly enhance the accretion rate. This study provides a comprehensive fluid-dynamical picture of black hole growth in SIDM halos.

Mon-5b2

Search for Dark Matter and Exotic Interactions via Precision Force Measurements

Pengshun Luo
Huazhong University of Science and Technology

While astronomical observations confirm the existence of dark matter, its physical nature remains unknown. For ultralight dark matter (ULDM), its large number density can induce a continuous force on macroscopic targets, allowing detection through precision acceleration measurements. In particular, when the ULDM wavelength matches the target's scale, coherent scattering from all nucleons quadratically enhances the signal.
Here, we analyze data from the MICROSCOPE space mission to constrain the dark matter–nucleon scattering cross section. Designed to test the Weak Equivalence Principle by measuring the differential acceleration of two concentric cylinders with exceptional precision, MICROSCOPE is also uniquely sensitive to a potential dark-matter wind. We demonstrate that the nested-cylinder geometry of MICROSCOPE gives rise to a novel interference effect in ULDM wave scattering, where the scattering amplitudes from the two cylinders interfere and redistribute the induced force. By developing a comprehensive theoretical framework to model this signal, we analyze the MICROSCOPE data to set leading constraints on the dark matter–nucleon coupling for ULDM masses in the range of 10^(-3)–10^(-2) eV, reaching cross sections as small as 10^(-52) cm^2 [1].
On the other hand, ultralight dark matter bosons may act as force carriers, mediating spin-dependent exotic interactions. In a complementary effort, we have experimentally searched for such forces using a precision cantilever sensor and modulated spin sources, establishing the most stringent constraints on such interactions at the micrometer scale [2].

[1] Macroscopic quantum interference in dark matter wave scattering with MICROSCOPE, Cheng-Tao Fu, Pengshun Luo, Rui Luo, Jie Sheng, Chuan-Yang Xing, arXiv:2606.07008.
[2] Improved limits on the spin- and velocity-dependent exotic interaction in the micrometer range, Sumin Li, Wenbo Zhang, Rui Luo, Jinquan Liu, Pengshun Luo, Physical Review Letters 134, 251601 (2025); arXiv:2501.10973.

Mon-5b3

Superconducting Weak Force Sensing for Gravitational Wave Detection

Xing Bian
Chinese Academy of Sciences

Recently, a superconducting weak force sensor based on macroscopic quantum effects has been developed at the Institute of Mechanics, Chinese Academy of Sciences. This sensor is designed for future lunar-based gravitational wave detection as well as ground-based gravitational wave detectors. Currently, the sensor has achieved an acceleration sensitivity of ~2×10^(-12) m s^(-2) Hz^(-1/2) @ 1 Hz and a displacement sensitivity of ~1.9×10^(-14) m Hz^(-1/2) @ 1 Hz, measured in a standard ground-based laboratory environment. In this presentation, we will discuss the fundamental principles of the sensor and the methods used to evaluate its sensitivity.

Mon-5b4

Laser acquisition and pointing technique for space-based gravitational wave detection

Ruihong Gao
Institute of Mechanics, Chinese Academy of Sciences

The laser acquisition and pointing technique is one of the key technologies for space based gravitational wave detection missions. As a result, the research and verification of its principle and methodology is of great significance. In this talk, some progresses of the topic will be presented, including high precision laser center positioning method, noise analysis for the differential wavefront sensing technique and ground based laser acquisition and pointing simulation system.

Mon-5b5

Photon ring dimming as a signature of photon-axion conversion in Janis-Newman-Winicour naked singularity

Ayush Hazarika
International Center for Theoretical Physics Asia-Pacific (ICTP-AP), University of Chinese Academy of Sciences

The possible existence of axions in the Universe introduces the intriguing possibility of photon-axion conversion in strong magnetic fields, particularly near compact objects like supermassive black holes or even naked singularity. In this study, we investigate the conversion of photons into axions in the vicinity of a Janis-Newman-Winicour (JNW) spacetime, a well-known naked singularity solution. We calculate the conversion probability and find that it is significantly influenced by the characteristic parameter of the JNW spacetime. The potential observational signatures of this conversion would be

the dimming of photon ring in the x-ray and gamma-ray spectrum. Our findings suggest that compact objects like M87* could be prime candidates for detecting photon-axion conversion effects, provided future advances in high-resolution observations. Our analysis also suggests that the scattering of photons during the propagation through plasma is insignificant for the estimation of the conversion probability.

Mon-5b6

Quantitative Evaluation of Gas Damping Effects in High-Precision Gravitational Reference Sensors based on Monte Carlo Numerical Simulation

Yingnan Zhu
Huazhong University of Science and Technology

In the context of space-borne gravitational-wave (GW) detection, residual gas damping noise induced by thermal molecular motion represents the primary limitation on the sensitivity of gravitational reference sensor (GRS) operating within the mHz band. This study reconstructed and unified the microscopic physical image that characterizes the various gas damping effects in high-vacuum free molecular flows for high-precision GRS. This facilitates the execution of a comprehensive analytical modeling of the total gas damping effects on the test mass (TM) within the sensitive probe geometry. An improved Monte Carlo (M-C) numerical simulation method was also developed by tracking molecular scattering processes on the TM and quantifying momentum transfer from molecular fluctuations. The normal and tangential damping force noise acting on the TM was systematically validated by this method. The results demonstrate exceptional agreement with proposed theoretical models, exhibiting minimal relative deviations of 8.7% and 0.14%, respectively. Furthermore, the study revealed a crucial conclusion that the tangential gas damping noise acting on the TM is independent of electrode gaps in all directions. This accurate model of residual gas damping noise was subsequently applied to the TianQin mission. A full frequency band residual gas damping noise power spectral density (PSD) in scientific mode was demonstrated. Assuming a conservative sealed-housing configuration (i.e., no effective venting to an external reservoir), it is recommended that the electrode gap along the sensitive axis be maintained at a minimum of 5 mm to ensure compliance with the TianQin residual acceleration noise requirement. This finding is determined by the excellent agreement between the PSD and theoretical model prediction within the observation band. The incorporation of potential venting features has been identified as a means of reducing proximity-enhanced damping, thereby relaxing this constraint.

Aug 11 (Tue) 14:00-16:00

Tue-1a. A1. General relativity: Theory and Mathematical developments

Tue-1a1

Covariant Energy-Momentum Tensor in General Relativity

Masakatsu Kenmoku
Emeritus Professor of Nara Women's University

The fully covariant gravitational energy-momentum tensor is given in the generalized canonical formulation. By this covariant formulation, the gravitational energy is obtained in any coordinate system.

Tue-1a2

Shaving off soft hairs and black hole image memory effect

Shaoqi Hou
Wuhan University

Soft hairs of black holes are the Noether charges associated to the generalized Bondi-Metzner-Sachs symmetries. In this work, the images of soft-haired Kerr black holes were studied. For an eternal black hole, the image is rotated, dilated and drifting compared to that of the bald counterpart in the celestial plane. The rotation and the dilation are independent of the time, while the drifting is at a constant speed and in a fixed direction. These effects all depend on angular directions. The soft hair of an astronomical black hole can change due to the emission of the gravitational or electromagnetic wave from the various physical processes occurring in the vicinity of the horizon. Then, the image roams in the observer's view, causing the image memory effect, the smoking gun for the existence of the soft hair. The magnitude of the image memory effect of a huge, spinning black hole accompanied by a much smaller one was estimated. It turns out that this effect is proportional to the mass of the large black hole, increases with its spin, but decreases with the mass ratio. Due to the limited angular resolution of the current and the future detectors, this effect is hard to be detected, if the impact of the cosmological expansion is ignored.

Tue-1a3

Supertranslation in the bulk for generic spacetime

Pujian Mao
Tianjin University

Supertranslations are usually defined as asymptotic symmetries associated with spacetime boundaries, such as null infinity and black hole horizons. We show that supertranslations admit a natural, coordinate-independent extension into the bulk of spacetime, realized as transitions between families of null hypersurfaces. This construction applies to generic spacetimes in arbitrary dimensions and unifies the realizations of supertranslations at null infinity and black hole horizons. The bulk supertranslation is connected to boundary supertranslation by characteristic flows. Within this framework, the gravitational wave memory effect corresponds to a shift of null hypersurfaces in the bulk. As explicit examples, we compute bulk supertranslations in Minkowski spacetime in arbitrary dimensions and in four-dimensional Schwarzschild spacetime, where we uncover a novel curvature-induced memory effect with observable consequences for light propagation.

Tue-1a4

Constraining holographic networks and parallel universes

Rongxin Miao
Sun Yat-sen University

We discuss the gravity dual of networks and its applications in parallel universes. We demonstrate that unitarity and causality impose significant constraints on holographic networks and parallel universes. We construct traversable parallel universes that adhere to these unitarity and causality constraints. Unlike traversable wormholes, our parallel universes satisfy the null energy condition.

Tue-1a5

Merger of binary black holes and their possible outflows

Carlos Coimbra-Araujo
Parana Federal University

Currently, binary black hole systems (BBHs) are widely studied in astrophysics, mainly because mergers of stellar-mass black holes are now detected in the form of gravitational waves. Although many recent studies have focused on the final stages of BBHs, where the black holes are surrounded by a final circumbinary disk, the structure of these systems before disk formation remains largely unexplored. In this work, we will present the history of circumbinary disk formation by investigating possible modifications induced by the presence of a secondary black hole in the structure of the accretion disk surrounding the primary black hole. We will also discuss the possible specific characteristics of the accretion flow during the merger process and how this can help in identifying these systems not only through gravitational waves, but also – within a broader framework of multi-messenger astronomy – by identifying the electromagnetic emission spectrum of the system and also the possible emission of ultra-high-energy cosmic rays.

Tue-1a6

Comparing Shadow Observables in Kerr and Static Quadrupolar Spacetimes

Saken Toktarbay
Al-Farabi Kazakh National University

Abstract: Black-hole shadows provide a useful way to test the geometry of compact objects in the strong-field regime. In this talk, we compare shadow observables in the Kerr spacetime and in a static quadrupolar spacetime described by the Zipoy–Voorhees, or q-metric. The q-metric is treated as a reference model that isolates quadrupolar deformation without rotation.

We discuss the photon sphere, the critical impact parameter, and the angular radius of the shadow for the q-metric, and compare them with the corresponding Kerr shadow observables computed from spherical photon orbits. The comparison is made by matching the vertical angular radius of the shadow on the observer's sky. This gives a size-level correspondence between the Kerr spin parameter and the quadrupole parameter q.

The correspondence should not be interpreted as a full degeneracy between the two geometries, since the complete shadow contours remain different. Rather, it shows how the overall angular scale of a Kerr shadow can be partly reproduced by a static quadrupolar deformation. This helps separate shadow observables related mainly to size from those that are more sensitive to the detailed spacetime geometry.

Aug 11 (Tue) 16:30-18:30

Tue-1b. A1. General relativity: Theory and Mathematical developments

Tue-1b1

Emergent gravitational action from non-local stress tensor deformations

Song He
Ningbo University

We study the gravitational effective action induced, at first order in the deformation parameter, by non-local \(T\bar T\)-like deformations of quantum field theories. Using a heat-kernel formulation, we extract the local geometric terms generated by stress-tensor two-point functions, and apply the construction to free fermions, massive Maxwell theory, and second-order Yang-Mills theory. While the resulting coefficients are generally model dependent, conformal field theories contain a universal sector fixed by the central charge \(C_T\). After regularization and renormalization, this sector yields finite, scheme-independent contributions organized into a finite set of curvature invariants. We further analyze trace-trace deformations, for which the relevant contact terms are determined by the Weyl anomaly, and derive the corresponding finite gravitational action for a general class of minimal non-local kernels. These results provide a quantum effective-action realization of induced gravity in which universal conformal data determine calculable contributions to the emergent geometric response.

Tue-1b2

From Black Holes to Stars: Rigidity Beyond Einstein Gravity

Nitesh Kumar Dubey
Indian Institute of Astrophysics, Bengaluru

The final equilibrium stage of stellar evolution may result in either a black hole or a compact object such as a white/black dwarf or neutron star. In general relativity, both stationary black holes and stationary stellar configurations are known to be axisymmetric, and black hole rigidity has been extended to several higher curvature modifications of gravity. In contrast, no comparable result had previously been established for stationary stars beyond general relativity. In this talk, I present our work where we extend the stellar axisymmetry theorem to a broad class of diffeomorphism invariant metric theories. Assuming asymptotic flatness and standard smoothness requirements, we show that the Killing symmetry implied by thermodynamic equilibrium inside the star uniquely extends to the exterior region, thereby enforcing rotational invariance. This demonstrates that axisymmetry of stationary stellar configurations is not a feature peculiar to Einstein gravity but a universal property of generally covariant gravitational theories, persisting even in the presence of higher curvature corrections.

Tue-1b3

Singular Misner string fluxes and S-duality

Rostom Karsanov
Moscow State University

We uncover the physical nature of the electric and magnetic monopoles discovered by McGuire and Ruffini on Misner strings accompanying charged nutty black holes, showing that these strings carry singular, nonuniform fluxes of electric and magnetic fields. These fields inevitably have nonzero divergence, thereby simulating the effective electric and magnetic charge densities along the strings. The latter create a complex short-range electromagnetic hair zone around the horizon, making the combined Misner-Dirac strings classically observable. Typical features of this new type of hair are presented. We also note that rotation can act as a hair generator even in the absence of NUT. The generalization to the case of gravielectric and gravimagnetic fields will also be discussed.

Tue-1b4

Critical Behavior of Photon Rings in Kerr-Bertotti-Robinson Spacetime

Xi Wan
Ningbo University

In this work, we investigate the critical behavior of photon rings in the Kerr–Bertotti–Robinson spacetime, describing a rotating black hole immersed in a background magnetic field. We analyze the radial and angular motions of photons under the small magnetic field approximation. Focusing on unstable spherical orbits, we determine three key parameters, γ, δ, and τ, which characterize radial compression, azimuthal advancement, and time delay. We then examine how these parameters depend on the black hole spin, magnetic field strength, and observer inclination for both on-axis and off-axis observers, and we further analyze the properties of higher-order images through near-critical lens equations. The results show that the magnetic field modifies the geodesic structure, and leads to observable changes in the fine structure of photon rings, providing a useful framework for probing magnetized black hole environments.

Tue-1b5

Pseudospectrum and (in)stability of black hole total transmission mode

Yu-Sen Zhou
University of Science and Technology of China

Total transmission modes (TTMs) are modes with complex frequencies that propagate across a black hole spacetime without reflection. Recently, it is found that suitably tailored time-dependent scattering

can excite these complex modes and suppress the reflected signal for the entire duration of the process, a phenomenon referred to as virtual absorption. Motivated by this, we present a study of the spectrum stability of TTMs using pseudospectrum and condition numbers. We focus on perturbations of d-dimensional Tangherlini black holes and recast the TTM problem as a generalized eigenvalue problem by utilizing the Eddington-Finkelstein coordinates. The results show that TTMs are generically spectrally unstable, with sensitivity increasing for higher overtones, in close analogy with quasinormal modes. A notable exception is the purely imaginary TTM in the positive imaginary axis in higher dimensions. Its pseudospectrum contours are nearly concentric, and its condition number is orders of magnitude smaller than those of the overtones, indicating enhanced spectral stability. As the spacetime dimension decreases, the condition number grows and becomes much larger in 4 dimensions in both the energy norm and the L^2 norm, suggesting possible spectral instability, although a definitive cross-dimensional conclusion is limited by the lack of a uniform physically preferred norm. Additionally, we confirm that purely imaginary TTMs occur for gravitational vector perturbations, whereas genuinely complex TTM families appear only in sufficiently high dimensions, $d \geqslant 8$, extending earlier claims that placed the onset at $d \geqslant 10$.

Tue-1b6

The Success of ΛCDM in Reproducing Tight Galaxy Scaling Relations

Leen Alrawas
NYU

We use the NIHAO cosmological simulations to study the relation between the dark matter halo core radius and the stellar disk radius in 33 galaxies with masses 1010−1012 M⊙. We confirm that ΛCDM can reproduce the tight observed correlation, supporting baryonic–dark matter interactions within gravity. Tracing the relation over time, we find two evolutionary paths: some galaxies contract, while others undergo an expansion, yet all converge to the global relation at redshift zero. This work strengthens the link between central dark matter profile slopes and stellar mass, offering new insight into galaxy evolution.

Tue-1b7

Asymptotic Generation of Kerr Geometry from Schwarzschild via BMS Supertranslations

Nihar Ranjan Ghosh
Indian Institute of Technology Guwahati

The Bondi-van der Burg-Metzner-Sachs (BMS) group, as the asymptotic symmetry group of asymptotically flat spacetimes, plays a central role in connecting infrared structures of gravity with soft theorems and gravitational memory. In this work, we investigate the extent to which BMS supertranslations can relate physically distinct black hole geometries. Focusing on the Schwarzschild and Kerr solutions, we show that the asymptotic structure of the Kerr spacetime can be generated from the Schwarzschild geometry via two successive supertranslations. These transformations yield a Kerr-

like geometry at null infinity and reveal two distinct classes of supertranslation functions. The first, composed of l=1 spherical harmonics, corresponds to center-of-mass displacements and encodes the translational sector of the BMS group. The second, characterized by an infinite series of even-parity Legendre polynomials (l≥2), captures the intrinsic mass multipole structure of the Kerr spacetime. Our result illustrates how BMS supertranslations can act as symmetry transformations linking asymptotically flat black hole geometries, and that they encode physically meaningful soft hair consistent with the multipole structure of rotating black holes. This work supports a unified description of soft degrees of freedom in black hole spacetimes and underscores the role of infinite-dimensional asymptotic symmetries in gravitational physics.

Aug 11 (Tue) 14:00-16:00

Tue-2a. A2. Modified gravity

Tue-2a1

No way out? ΛCDM will not be rescued by a high optical depth

Paulo Montero-Camacho
Peng Cheng Laboratory

Recent BAO and Type Ia supernovae measurements have indicated a growing preference for evolving dark energy, challenging the standard ΛCDM model. This trend appears to be worsening as new data releases from DESI add to the tension. Simultaneously, the 2-sigma cosmological constraint on the sum of the neutrino masses is starting to show discrepancy with oscillation experiments. To resolve these tensions, it has recently been proposed by two independent groups that unknown systematics might affect low-ℓ CMB polarization data as omitting this dataset shifts the optical depth to a higher value ($\tau \approx 0.09$), which appears to resolve the tension with ΛCDM and relax the neutrino mass bounds. In this talk, I demonstrate that such high τ values are in significant conflict with independent epoch of reionization (EoR) observations, which are in agreement with low-ℓ CMB polarization measurements. Furthermore, I show that a joint analysis excluding low-ℓ polarization but incorporating EoR data fails to recover $\tau \approx 0.09$, suggesting that neglecting low-ℓ CMB polarization is insufficient to resolve the current ΛCDM crisis.

Tue-2a2

Quasinormal modes of charged black holes and Strong cosmic censorship in conformal Killing gravity

Gao-Ming Deng
China West Normal University

Quasinormal modes of black holes and Strong cosmic censorship are investigated in the context of Conformal Killing Gravity for the first time. Using the pseudo-spectral method, we compute the quasinormal modes frequencies across various parameters. Numerical results manifest that for black holes far from extremality, the lowest quasinormal modes frequency $-\mathrm{Im}(\omega)/\kappa-$ remains below 1/2. While, as the black holes approach extremality, the lowest mode's $-\mathrm{Im}(\omega)/\kappa-$ exceeds 1/2, leading to a violation of Strong cosmic censorship. What's more, we also further decode the fascinating effects of coupling parameters.

Tue-2a3

Spectral Butterfly Effect and Resilient Ringdown in Thick Braneworlds

Hai-Long Jia
Lanzhou University

The quasinormal mode spectrum is a unique fingerprint linking gravitational-wave observations to extra-dimensional geometry. In this Letter, we show that thick braneworlds exhibit a spectral butterfly effect: infinitesimal deformations of the effective potential trigger dramatic migrations of quasinormal modes, challenging the presumed stability of this fingerprint. Frequency-domain instabilities depend sensitively on the perturbation's location and strength. In the time domain, near-brane perturbations primarily modify the early ringdown, while far-brane perturbations generate clean late-time echoes. Crucially, the graviton zero mode remains localized, preserving four-dimensional gravity. Despite this pronounced spectral fragility, the observable early-stage signal under current detector sensitivities is still dominated by the original fundamental mode. Hence, thick braneworlds display a nontrivial coexistence of a fragile spectrum and a resilient ringdown, supporting the continued use of the standard fingerprint in present-day gravitational-wave astronomy while revealing its hidden sensitivity.

Tue-2a4

Propagation and polarization of gravitational waves on curved spacetime backgrounds in Einstein-Æther theory

Yu-Qi Dong
Lanzhou University

In this talk, we analyze the propagation and polarization properties of high-frequency gravitational waves in Einstein-Æther theory on vorticity-free and slowly varying backgrounds at both leading and next-to-leading orders within the geometric optics approximation. The linear perturbation analysis is performed in the background Æther-orthogonal frame, in which the axes of the gravitational wave sound cones remain perpendicular to these hypersurfaces, thereby simplifying the analysis. The leading-order results show that Einstein-Æther theory admits two tensor modes, two vector modes, and one scalar mode, consistent with the findings in the flat spacetime background. We further derive the dispersion relations and linear stability conditions for these modes in curved backgrounds. At next-to-leading order, we obtain the amplitude evolution equations, finding that the graviton number is conserved for the tensor modes but not for the vector and scalar modes. Next-to-leading-order effects also induce mixing among polarization modes. Our study demonstrates that, after imposing the GW170817 constraint on the propagation speed of gravitational waves, the vector modes mixed with the leading-order tensor modes cannot be used to distinguish between general relativity and Einstein-Æther theory. On the other hand, the mixing between scalar modes and the leading-order tensor modes leads to distinct predictions in the two theories, providing a promising avenue to test Einstein-Æther gravity through the detection of polarization mixing in gravitational waves.

Tue-2a5

Cosmological perturbations and gravitational waves in the general Einstein-vector theory

Xiao-bin Lai
Lanzhou University

We investigate the stability and gravitational waves (GWs) in the four-dimensional general Einstein-vector theory on a cosmological background. To study the stability, we systematically perform a Hamiltonian analysis at the linear perturbation level. The stability conditions are easily satisfied for

tensor perturbations, but they impose nontrivial constraints on the parameter space for vector and scalar perturbations. In particular, in the presence of a nonzero background vector field, the scalar sector fails to satisfy the stability conditions in the general parameter space. However, imposing the plane-wave condition relaxes these conditions, making them achievable. In the small-scale limit, we further investigate the GW properties of the general Einstein-vector theory within the stable parameter space, including the number of independent modes, their propagation speeds, and observational constraints from GW experiments. We find that there can be at most two tensor modes, two vector modes, and one scalar mode. Notably, without imposing the plane-wave ansatz, no scalar GWs exist within the stable parameter space. Furthermore, vector GWs are forbidden if tensor GWs propagate exactly at the speed of light.

Tue-2a6

Detection Prospects of solar g mods with LISA

Aman Awasthi
Indian Institute of Technology Bombay

The detection of solar gravity (g) modes remains one of the outstanding challenges in helioseismology. Space-based gravitational-wave observatories provide a complementary avenue for probing these low-frequency oscillations through their time-varying gravitational fields. Motivated by earlier studies suggesting that solar oscillation modes could be detectable by a LISA-type interferometer, I revisit this problem using modern solar models, updated detector sensitivities, and improved constraints on mode amplitudes.
Standard solar models are constructed using MESA, while mode eigenfrequencies and eigenfunctions are computed with GYRE. I evaluate the gravitational response of solar oscillation modes, focusing on quadrupolar ($l = 2$) g-modes with azimuthal orders $m = 0$ and $m = 2$. The analysis incorporates both historical and current LISA sensitivity estimates and includes a comparison with the TianQin mission in the relevant low-frequency regime.
To assess theoretical uncertainties, I consider solar models based on both the GS98 and AGSS09 abundance compilations. The resulting gravitational responses are found to be nearly identical, indicating that uncertainties associated with solar metallicity have a negligible impact on the predicted signals. These results provide an updated assessment of the detectability of solar g-modes by future space-based interferometers and highlight the potential of gravitational-wave observatories as probes of stellar interiors.

Tue-2a7

Machine learning models for gravitational waveform modelling and source parameter estimation

Suyog Garg
The University of Tokyo

Calculation of likelihood that a detected gravitational signal is the same signal that we expect to theoretically detect for any particular system with some source parameters, requires calls to theoretical waveform approximations. This likelihood has to be calculated with around a million theoretical waveforms belonging to different sampled sets of parameters from the chosen parameter space. This

task is computationally expensive and time consuming, especially for cases where the binary sources have complicated characteristics or when marginalized single parameter estimation is desired, for instance, for the luminosity distance to the source. I will introduce some encoder-decoder style neural network models that we have developed to solve these issues and yield fast and accurate approximations of gravitational waveforms.

Aug 11 (Tue) 16:30-18:30

Tue-2b. D1. Dark Energy

Tue-2b1

Dark Side of the Universe and Perfect Fluid Universality

Yaghoub Heydarzade
Department of Mathematics, Bilkent University, Türkiye

We present a generalization to our previous theorem for FLRW spacetimes within the framework of generic metric gravity theories. In earlier work, we proved that, in the absence of matter fields, the field equations of any metric gravity theory constructed from the curvature tensor and its covariant derivatives reduce in FLRW spacetime to the Einstein equations with an effective perfect-fluid source. In the present work, we extend this result to a broad class of scalar-vector-tensor theories in which the gravitational action contains arbitrary scalar and vector fields together with their covariant derivatives at any order. We prove that, under the symmetry conditions imposed by FLRW geometry, the metric field equations necessarily take the Einstein form with an effective perfect-fluid source, supplemented by the corresponding scalar and vector field equations. This result shows that FLRW metrics belong to the class of universal metrics: the tensorial structure of the gravitational field equations is solely fixed by the symmetry of the FLRW spacetime and is independent of the specific form of the gravitation theory, while the resulting cosmological dynamics remains theory dependent. We illustrate our theorem using recently proposed Einstein-scalar and Einstein-Proca theories.

Tue-2b2

A Particle Physics Model of interacting Dark Matter and Dark Energy in Einstein–Gauss–Bonnet Gravity: Constraints from DESI BAO

Hussain Md Saddam
Zhejiang University of Technology

We present a particle physics inspired unified framework for dark matter and dark energy within Einstein–Gauss–Bonnet (EGB) gravity. A GB-coupled scalar field \phi drives the late-time cosmic acceleration, while a coherent scalar field \psi, motivated by particle physics, serves as a dark matter candidate. The two fields interact through a potential W(\phi, \psi), and we study two distinct model choices for this interaction. The non-minimal coupling of \phi to the GB curvature term introduces a time-dependent speed of gravitational waves (GWs); imposing consistency with current GW observations fixes this speed to unity, rendering the GB coupling function model-independent. We analyze the dynamical stability of the system by casting it as an autonomous dynamical system, and discuss the choice of initial conditions required for a stable background evolution. The model parameters are constrained using a combination of early- and late-time observational probes, including Cosmic Microwave Background (CMB) data, DESI Baryon Acoustic Oscillation (BAO) measurements, the Pantheon+ Type Ia supernova sample, and the DES-SN5YR (Dovekie) dataset. Both models are found to be physically viable and consistent with the ΛCDM trend for Pantheon+ and DES samples. However, incorporating DESI BAO data reveals a statistically significant deviation from flat ΛCDM, particularly at intermediate redshifts. Upon further inclusion of Roman Space

Telescope mock data, this departure becomes more pronounced at higher redshifts, yielding strong statistical preference over flat ΛCDM and highlighting the potential of next-generation surveys to discriminate between dark sector models.

Tue-2b3

Application of the correlation curve method to increase the accuracy of determining the energy of cosmic rays above 1 tev

Ibraimova Sayora
Institute of physics and technology

In this paper, a method is proposed that improves the accuracy of energy determination in direct measurements of cosmic rays with energies of TeV and higher. The problems of determining the primary energy using a thin ionization calorimeter are considered in detail. They are caused by large fluctuations in shower development, a decrease in the statistics of the analyzed events with increasing energy, and the need to increase the thickness of the calorimeter to measure particles of higher energies.

Tue-2b4

Primordial black hole formation in scalar field cosmologies

Luis Enrique Padilla Albores
Rikkyo University

In this talk, I will discuss how primordial black holes can form in non-standard stages of the early Universe dominated by scalar fields. I will focus on three representative scenarios: slow reheating with a quadratic potential, a quartic scalar field, and a massless scalar field.
The main goal is to understand when scalar fields can be effectively described as perfect fluids during gravitational collapse, and when this analogy breaks down. I will show that while a quartic scalar field behaves very similarly to a radiation fluid even in the nonlinear regime, the massless scalar field exhibits a different type of critical behavior, including log-periodic oscillations associated with discrete self-similarity.
Overall, the talk will highlight how primordial black hole formation can be used as a probe of the microphysics of scalar fields in the early Universe.

Tue-2b5

Schwarzschild-like black hole embedded in a Dehnen-type dark matter halo and a cloud of strings

Ahmad Al-badawi
AL-Hussein Bin Talal University

We investigate a Schwarzschild-like black hole embedded in a combined environment consisting of a Dehnen-type dark matter halo and a cloud of strings. We first construct the corresponding composite spacetime metric and examine its geometric properties, including the horizon structure, curvature

invariants, and the validity of the classical energy conditions. Subsequently, we explore the geodesic dynamics of test particles by analyzing the effective potential, circular orbits, and the innermost stable circular orbit (ISCO). We also study the optical appearance of the black hole by computing its shadow and assessing how the surrounding dark sector components modify its observable features. Our results elucidate the influence of dark matter distributions and string clouds on black hole geometry and dynamics, highlighting characteristic signatures that could serve as potential observational probes with current and future astrophysical facilities.

Tue-2b6

Analysis of various parameters in Barrows HDE model

Venkatraja Ramalingam
GITAM University

HDE model like Barrow HDE how it affects the large-scale structure and expansion rate of the universe. The various parameters are numerically evaluated and analysis done.

Tue-2b7

Effects of dark energy in structure formation

Priyanka Saha
Phd student, IIT Kanpur, India

We present an extension of the spherical top-hat collapse model in a cosmological framework where the dark sector is composed of two interacting scalar fields. In this setup, one scalar field exhibits rapid oscillations on cosmological timescales and is interpreted as a viable dark matter candidate, while the second scalar field evolves smoothly and represents dark energy in the form of either a canonical quintessence field or a non-canonical phantom field. We develop a generalized top-hat–like model to investigate the gravitational collapse of a slightly overdense spherical region in the presence of such a coupled dark sector. Particular attention is given to the role of non-minimal coupling between the scalar fields and its impact on the dynamics of collapse. Our analysis demonstrates that the behavior of dark energy during collapse is highly sensitive to the coupling strength. Specifically, we find that dark energy can exhibit both clustered and unclustered behavior depending on the magnitude of the interaction. These results provide new insights into the role of dark energy in nonlinear structure formation and highlight the importance of dark sector interactions in shaping cosmic evolution.

Aug 11 (Tue) 14:00-16:00

Tue-3a. E2. Observational Astrophysics / E4. Ground-based GW / E5. PTA

Tue-3a1

Autocorrelation signatures in time-resolved black hole flare images: Secondary peaks and convergence structure

Zhenyu Zhang
Ningbo University

The strong gravitational field of a black hole bends light, forming multilevel images, yet extracting precise spacetime information from them remains challenging. In this study, we investigate how gravitational lensing leaves unique and detectable signatures in black hole movies using autocorrelation analysis. By examining the two-dimensional autocorrelation of a movie depicting a hot spot orbiting a Kerr black hole, as viewed by a near-axis observer, we identify a persistent secondary peak structure induced by gravitational lensing. Notably, these secondary peaks converge toward an approximately fixed point in the time-angle lag domain, largely independent of the orbital radius of the hot spot. This key property suggests that combining future flare observations with precise autocorrelation analysis could effectively disentangle lensing effects from orbital dynamics, enabling direct measurement of black hole parameters.

Tue-3a2

Gravitational Wave Data Analysis using the F-statistic method

Haitian Wang
Dalian University of Technology

Gravitational-wave observations offer a powerful way to probe compact binary coalescences and test strong-field gravity. In this talk, I will present a preliminary study on gravitational-wave data analysis using the F-statistic, focusing on its applications to black-hole ringdown and full inspiral–merger–ringdown analyses. By analytically maximizing over amplitude-related parameters, the method reduces the dimensionality of the parameter space and improves sampling efficiency. Injection studies and applications to events such as GW150914, GW231028, GW190412, and GW190814 show that the F-statistic can recover source parameters efficiently and help assess evidence for sub-dominant ringdown modes. These results suggest that the F-statistic is a promising tool for future gravitational-wave data analyses.

Tue-3a3

Gravitational Lensing of Fast Radio Bursts as a Probe of Primordial Black Holes Abundance: a forecast for radio telescopes

Joao Lucio dos Santos
University of Heidelberg

The Fast Radio Bursts (FRBs) are some of the most intriguing radio phenomena measured in radio astronomy \cite{lorimer}. These energetic bursts have extremely high radio luminosities, corresponding to $\sim 10^{36} \,–\, 10^{44}$ $\mathrm{erg \,s}^{-1}$, which is not far from gamma ray bursts. Since their discovery in 2007, several investigations have been proposed to model their sources and also to use their data for astrophysical and cosmological constraints. Among such efforts, we highlight lensing effects in the propagation of the FRBs, which could be used to constrain Primordial Black Holes (PBHs) \cite{munoz, chime}. These black holes would be produced in the earliest stages of the Universe and could have masses below $1\mathrm{M_{\odot}}$ \cite{carr}. There are several surveys constraining the possible values of mass and fraction of these black holes, and among these proposals lies the lensing effects of FRBs. In this work, we briefly review some generalities about lensing effects for point sources, and we present a forecast for LOFAR, FAST, and BINGO telescopes. These radio telescopes may characterize several FRBs in the coming years. LOFAR and FAST are operating radio telescopes and are expected to be upgraded in the next few years. BINGO \cite{bingo} is a radio telescope under construction in Brazil that may be promising to detect FRBs. The forecast is based on the design features of each of these radio telescopes, and also on the current dataset of 131 confirmed FRB signals, reported by different surveys. Our forecast suggests that LOFAR would be suitable to characterize $f_{\mathrm{PBH}} \sim 16\%$ for lenses around $1\mathrm{M_{\odot}}$, while FAST and BINGO yields to $f_{\mathrm{PBH}} \sim 39\%$ for lenses with $10^{1}\,\mathrm{M_{\odot}}$ and $10^{-2}\,\mathrm{M_{\odot}}$, respectively.

Tue-3a4

Search for single gravitational wave sources with pulsar timing array

Jingbo Wang
Lishui university

TBA

Tue-3a5

Nanohertz gravitational-wave background and individual sources based on cosmological simulation

Qing Yang
Shenzhen Technology University

Recent pulsar timing array observations have provided evidence for a nanohertz gravitational-wave background, but its astrophysical origin remains unclear. In this talk, I will present our recent work using cosmological simulations to generate multiple realizations of a mock observable universe that self-consistently incorporates the cosmic large-scale structure, enabling a robust statistical analysis of SMBBH populations and their GW signatures. We predict the resulting nanohertz gravitational-wave background, including its amplitude, spectrum, and anisotropic properties under different hardening timescales. We also forecast the number and signal-to-noise distribution of individually resolvable sources for future Chinese PTA and SKA PTA observations.

Tue-3a6

Measuring Hubble constant with mass function of BBH subpopulations

Yin-Jie Li
PMO

The cosmic expansion rate can be directly measured with gravitational-wave (GW) data of the compact binary mergers by jointly constraining the mass function of the population and the cosmological model via the so-called spectral sirens. Such a method relies on the features in the mass functions, which may originate from some individual subpopulations and hence become blurred/indistinct due to the superposition of different subpopulations. we propose a novel approach to constrain the cosmic expansion rate with subpopulations of GW events, named multispectral sirens.

Aug 11 (Tue) 16:30-18:30

Tue-3b. A4. Gravitational waves-Theory / C2. Neutron stars

Tue-3b1

Possible Mechanism of in-phased Multi-band Radiation from 10TeV to Radio Wave Occurring in a Few Pulsars

Biping Gong
Huazhong University of Science and Technology

The multi-band emission of the Crab pulsar like pulsars can range from 10 TeV to radio wave, setting unprecedented constraints on mechanism and location pulsar emission.
Here presents a mechanism based on a forced magnetic reconnection in the vicinity of pulsar light cylinder, which not only well accounts for in phased multi-band emission, but also off set Gamma-ray component of the Crab pulsar like pulsars.

Tue-3b2

Searching for strange quark planets with gravitational waves

Yongfeng Huang
Nanjing University

Strange-quark matter (SQM) may be the true ground state of hadronic matter, indicating that the observed pulsars may actually be strange stars (SSs), but not neutron stars. According to the SQM hypothesis, the existence of a hydrostatically stable sequence of SQM stars has been predicted, ranging from 1 to 2 solar mass SSs, to smaller strange dwarfs and even strange planets. While gravitational wave (GW) astronomy is expected to open a new window to the universe, it will shed light on the search for SQM stars. Here we show that due to their extreme compactness, strange planets can spiral very close to their host SSs without being tidally disrupted. Like inspiraling neutron stars or black holes, these systems would serve as new sources of GW bursts, producing strong GWs at the final stage. The events occurring in our local universe can be detected by upcoming GW detectors, such as Advanced LIGO and the Einstein Telescope. This effect provides a unique probe to SQM objects and is hopefully a powerful tool for testing the SQM hypothesis.

Tue-3b3

Evaluating Gravitational Wave Detection Rates using a Frequency and Velocity-Dependent Antenna Response

Jinwon Kim

Chung-Ang University

Current gravitational wave (GW) data analysis and parameter estimation largely rely on the Long Wave Approximation (LWA) and assume a stationary center-of-mass for the source. However, for sources exhibiting high velocities or emitting at high frequencies—such as the post-merger phase of binary neutron stars—these conventional approximations break down. The relative motion of the source induces a relativistic beaming effect, while the finite arm length of detectors introduces frequency-dependent phase cancellations. In this study, we derive a generalized, frequency- and velocity-dependent antenna response function by relaxing the LWA and rigorously evaluating the null geodesics within the detector. Furthermore, we apply this comprehensive response model to calculate and compare the expected detection rates across various current and next-generation GW detectors.

Tue-3b4

Echo Signatures of Layered Compact Objects: Perturbations of a Double-Shell Model

Qi Su
Beijing University of Technology

Gravitational-wave echoes provide a possible probe of near-horizon and interior structures of ultracompact objects. In this talk, I investigate echo waveforms in a layered compact-object model with fixed total mass but different internal mass distributions. Using time-domain perturbation evolution, I compare the echo signals of single-layer and double-layer configurations. The results show that the early echo is mainly affected by phase shifts, while the late echo can be significantly enhanced when the inner photon-sphere scale approaches the outer shell. The frequency-domain spectra also exhibit additional peaks as the layer structure changes. These results suggest that gravitational-wave echoes may encode information about the internal layered structure of black-hole-like compact objects.

Tue-3b5

The Impact of Spin Priors on Parameterized Tests of General Relativity

Tianhao Wu
Guilin university of technology

Spin priors play a fundamental role in gravitational-wave parameter estimation, yet their impact on parameterized tests of General Relativity (GR) remains insufficiently understood. In this work, we systematically investigate how spin prior choices affect the 1.5PN deviation parameter using real gravitational-wave events. We quantify prior-induced effects through the Jensen--Shannon divergence (JSD) and median shifts of posterior distributions. We find that the effective precession spin parameter exhibits significantly stronger prior sensitivity than the effective inspiral spin . While is generally robust across most events, GW231123_135430 exhibits a noticeable discrepancy, with a JSD at the level. Examining the median shift, we note that events with very short inspiral durations, such as

GW231028_153006, GW231123_135430, and GW191109_010717, show more pronounced shifts, indicating increased sensitivity in low-information regimes. We further explore the relationship between the prior sensitivity of spin parameters and that of . No significant correlation is observed when spin parameters are inferred within the standard GR framework. However, when is included in the analysis, a strong correlation emerges between and , which we attribute to partial parameter degeneracy at the 1.5PN order. A leave-one-out test shows that the observed correlation is sensitive to the inclusion of specific events, indicating that it is partially driven by a subset of high-sensitivity events. Our results demonstrate that spin-prior choices can propagate into parameterized tests of GR in a non-trivial and model-dependent manner, and may mimic or reshape apparent deviations from GR.

Tue-3b6

Deformed Magnetized Quark Stars: Structure and Gravitational Wave Signatures

Rajasmita Sahoo
National Institute of Technology Tiruchirappalli, India

Strong magnetic fields in compact stars induce pressure anisotropy, leading to deviations from spherical symmetry and modifying their global properties. In this work, we investigate the structure and gravitational wave emission of magnetized quark stars within the γ-metric formalism, which provides an effective description of spheroidal deformation caused by anisotropic stresses. The equation of state for magnetized quark matter is constructed by considering both unpaired magnetized strange quark matter (MSQM) and paired magnetized color–flavor locked (MCFL) phases. Using the modified stellar structure equations, we compute the mass–radius relations for different magnetic field strengths and analyze the resulting stellar deformation. We further estimate the quadrupole moment, ellipticity, and the corresponding gravitational wave strain amplitudes from rotating magnetized quark stars. Our results show that strong magnetic fields significantly influence both the equilibrium structure and the gravitational wave signatures of compact stars.

Tue-3b7

Universality in Space–Time ω modes of Quarkyonic Stars

Debabrata Dey
Institute Of Physics, Bhubaneswar, India

The ω-mode oscillations of gravitational waves offer a direct probe of the dense interior of neutron stars, providing insights unavailable through electromagnetic observations. This study investigates the ω-mode spectrum of compact stars composed of quarkyonic matter---a hybrid phase characterized by a smooth crossover between nucleonic and quark matter treated as quasi-particles. Using the Relativistic Mean-Field (RMF) theory with the G3 and IOPB-I parameterizations, we model the stellar core as quarkyonic matter surrounded by a hadronic mantle. The equation of state (EOS) is controlled by two key parameters: the transition density n_t and the QCD confinement scale $\Lambda_{\rm cs}$, which are tuned to satisfy current astrophysical constraints on mass and

radius. Employing the phase-amplitude method within a full general relativistic framework, we compute the complex eigenfrequencies---i.e., oscillation frequencies and damping times---for the fundamental and first excited ω-modes. Our results show that the inclusion of a quarkyonic core produces a distinct ω-mode signature, clearly differentiating these stars from pure hadronic or conventional hybrid stars. The spectrum exhibits a strong parametric dependence on the EOS, with the intrinsic stiffening effect of quarkyonic matter systematically shifting oscillation frequencies and damping times. Importantly, we find that although the EOS varies significantly, the ω-mode frequencies follow approximate universal relations,. These findings establish quarkyonic ω-modes as promising candidates for future gravitational wave asteroseismology.

Aug 11 (Tue) 14:00-16:00

Tue-4a. B1. Quantum gravity in curved spacetime / B3. Other topics on Quantum gravity

Tue-4a1

Collective dynamics of holographic fracton solids

Wei-Jia Li
Dalian University of Technology

Fractonic phases of matter, a class of states in which collective excitations with constrained mobility exist, were originally discovered in the study of quantum error-correcting codes in solvable lattice spin models such as Haah's code and the X-cube model. Recently, they have also drawn the attention of the high-energy physics community due to the UV/IR mixing that arises when coarse-graining these lattice models. In this talk, I will introduce a (3+1)-dimensional holographic model of fracton solids and investigate the low-energy collective dynamics systematically. By computing the quasinormal modes of black holes, we obtain all the hydrodynamic excitations on the boundary, including two acoustic phonons, a longitudinal diffusive mode, and a subdiffusive collective mode. In addition, it is found that the latter remains gapless when translational symmetry is explicitly broken. These results suggest that the subdiffusive mode is inherently protected by the charge-dipole symmetry in solids and is qualitatively unaffected by broken spacetime symmetries.

Tue-4a2

Quantum Damping of Cosmological Shear: A New Prediction from Loop Quantum Cosmologies

Wen-Cong Gan
Jiangxi Normal University

We study the dynamics of the Bianchi I universe in modified loop quantum cosmology (mLQC-I) and uncover a robust mechanism for isotropization: the shear is dynamically suppressed after the bounce and decays rapidly in the quantum post-bounce regime, independently of the equation of state of standard matter sources. This naturally drives the Universe toward a homogeneous and isotropic expanding phase without fine-tuning. Our results show that mLQC-I provides a new quantum-gravitational mechanism for suppressing anisotropies, absent in other bounce models.

Tue-4a3

Quantum Geometry Effects in Quantum Field Theory: Hamiltonian constraint Generates Gravity-Matter Entanglement

Gaoping Long
Jinan University

In this talk, I will address a foundational challenge in quantum field theory on curved spacetime by developing a consistent framework in spherically symmetric loop quantum gravity. I will introduce a methodology for defining meaningful superpositions of quantum geometry and matter states near the

semiclassical apparent horizon. This is achieved by identifying a restricted subspace of the gravitational phase space, which ensures unitary equivalence among Fock representations of a scalar field across different quantum geometries. Within the resulting well-defined state space, I derive weak solutions to the quantum Hamiltonian constraint of general relativity near the semiclassical apparent horizon. Furthermore, I generalize the Hartle-Hawking vacuum state to this quantum geometric framework. The resulting state exhibits the inherent entanglement between geometry and matter, which arises from the quantum Hamiltonian constraint of general relativity. This work establishes a principled framework for studying geometry-matter entanglement and offers new insights into the quantum foundations of the black hole information paradox.

Tue-4a4

Dynamical Results Showing Quantum Particles to be Kept from Black Hole Singularity

Otto Kong
NCU

A covariant Hamiltonian formulation of Heisenberg quantum dynamics for a particle with spin in curved spacetime is presented, with an application to a black hole metric. An interesting special quantum effect is obtained as a positive contribution to the acceleration in the radial direction inside the black hole. Our analysis shows that it is the dominant contribution as we approach the singularity, indicating that quantum particles cannot fall into the singularity. A nontrivial quantum matter distribution is hence to be expected around the center of a black hole.

Tue-4a5

Covariant dynamics from static spherically symmetric geometries

Cong Zhang
Beijing Normal University

This work reveals a fundamental link between general covariance and Birkhoff's theorem. We extend Birkhoff's theorem from general relativity to a broad class of generally covariant gravity theories formulated in the Hamiltonian framework. Conversely, we show that each one-parameter family of static, spherically symmetric spacetimes determines a class of covariant theories, each of which has that family of spacetimes as its entire vacuum solution space. Our systematic and model-independent framework applies to a wide range of spacetimes, including observationally inferred, quantum-gravity-inspired, and regular black holes. It provides a universal tool for probing their dynamical origins and enables the reconstruction of the underlying covariant theories from observational data, including gravitational-wave and black-hole- shadow measurements.

Aug 11 (Tue) 16:30-18:30

Tue-4b. B3. Other topics on Quantum gravity / C4. Wormholes

Tue-4b1

Non-singular Inflation-Dark Energy Unification Model of Loop Quantum Cosmology

Xiangdong Zhang
South China University of Technology

Unifying the early-universe inflationary paradigm with late-time cosmic acceleration, while resolving the initial Big Bang singularity, remains one of the most profound challenges in modern cosmology. In this talk, we propose a non-singular quintessential inflation model embedded within the effective dynamics of Loop Quantum Cosmology (LQC) based on a Generalized Regularization Scheme. The quantum geometry effects naturally replace the initial singularity with a quantum bounce, followed by a phase of superinflation that sets robust initial conditions for the subsequent slow-roll inflation. A viable late-time dark energy epoch and address the coincidence problem is then also achieved.

Tue-4b2

Running Without Coordinates: Relational RG in Background-Independent Quantum Gravity

Hongguang Liu
Westlake University

In background-independent theories, the RG scale cannot be an external coordinate momentum. Coarse-graining requires fundamentally both relational observables (physical degrees of freedom) and a relational scale (physical resolution). I will introduce an RG framework where the cutoff is defined by (k_{rel}, Δ_{rel}): a relational scale and a spectral operator ordering modes. This separates coordinate artifacts from essential running, distinguishes scale-setting from background evolution, and reframes fixed points as the scale-invariance of relational observables. We will illustrate these principles in a cosmological model.

Tue-4b3

Using precession and quasiperiodic oscillations to constrain a rotating regular black hole

Meng-He Wu
Neijiang Normal University

In this talk, I will present our collaborative work on the frame-dragging effect around a rotating regular black hole with a Minkowski core. By perturbing bound timelike circular orbits, we obtain the periastron and Lense-Thirring precession frequencies, which are then used to model QPOs from five

X-ray binary sources. Using MCMC simulations, we constrain the black hole parameters and obtain an upper bound on the quantum-gravity parameter at the 95% confidence level. We also study the precession of a test gyroscope in this spacetime and find that the quantum-gravity effect suppresses the precession frequencies compared with the Kerr case. These results suggest that QPOs and gyroscope precession can serve as useful probes of rotating regular black holes and possible quantum-gravity effects.

Tue-4b4

Dynamics and Radiative Signatures of Accretion Flows onto a Kerr-like Wormhole

Jingze Xia
TDLI

Wormholes are a theoretically motivated alternative to black holes and may be testable with horizon-scale observations. We perform GRMHD simulations and GRRT calculations for accretion flows onto a Kerr-like wormhole using a Kerr black-bounce metric with throat parameter. By exploring different spins in both 2D and 3D simulations, we find that frame dragging affects the flow dynamics on both sides of the wormhole. Ray-traced 230 GHz images show that emission from the throat vicinity can dominate over the usual Kerr black hole case, producing strong variability and clear quasi-periodic signatures in the light curves. These features provide promising observational clues for testing wormholes as exotic compact objects.

Tue-4b5

Dynamics of Bronnikov-Ellis wormhole with double-null simulation

Xiao Yan Chew
Jiangsu University of Science and Technology

We investigate the dynamical collapse of Bronnikov-Ellis (BE) wormhole using the double-null formalism, where its throat is characterized by the coincidence of two curves $r_{,u} = 0$ and $r_{,v} = 0$. The emission of two ingoing pulses: normal scalar and phantom fields in the wormhole spacetime reveals two distinct instability scenarios: a normal scalar field triggers gravitational collapse into a black hole where the singularity $r=0$ hidden by the event horizon ($r_{,u}=0$ and $r_{,v}=0$); while a phantom field drives inflationary expansion of wormhole, decoupling two asymptotic regions with the cosmological horizon ($r_{,u}=0$ and $r_{,v}=0$). The process of two scenarios can be accelerated by increasing the amplitude of pulses but can be delayed by increasing the wormhole's mass. Additionally, the collisions of two identical pulses from ingoing and outgoing null directions in the massless BE wormhole fail to cure the instabilities because the two scenarios can still occur, but the formation of a black hole can be delayed for the collision of normal and phantom fields. Interestingly, the strategic tuning of emission timing for outgoing phantom field to collide with ingoing normal scalar field can temporarily stabilize the wormhole throat by restoring the coincidence of $r_{,u}$ and $r_{,v}$ again after their separation. This offers us valuable insights into extending

the lifetime of a traversable wormhole.

Tue-4b6

Lindbladian Dynamics of Black Holes in JT Gravity and the SYK Model

Zhuo-Yu Xian
Free University of Berlin

We study the open-system dynamics of black holes and their quantum-mechanical duals using Lindblad evolution. Starting from the SYK model, we apply a Lindblad master equation to an initial Gibbs state and change its temperature and entropy. We construct an analogous Lindbladian dynamics for black holes in JT gravity based on the Schwarzian action, which provides a quantum framework for the non-unitary evolution of black holes. We also extend this framework to compute the operator size under Lindbladian evolution of an initial thermal state, which is holographically related to the evolution of the dual wormhole length.

Aug 11 (Tue) 14:00-16:00

Tue-5a. E3. Multi-Messenger Astrophysics

Tue-5a1

Prospects of Dark Siren Cosmology

Hyung Mok Lee
Seoul National University

Gravitational-wave observations provide direct measurements of the luminosity distances to compact-binary sources, without the need for external distance calibration. However, their cosmological utility is limited by large localization uncertainties, because redshift information cannot be obtained from gravitational waves alone. Multi-messenger events, such as GW170817, allow host-galaxy identification through electromagnetic counterparts, but such events are expected to remain rare. The Hubble constant inferred from GW170817 is consistent with other measurements, although with large uncertainty. Reducing statistical errors will require a much larger sample of gravitational-wave sources with identified host galaxies.
Observations in the mid-frequency band around 0.1 Hz can substantially improve both sky localization and luminosity-distance measurements. Several proposed space-based detector concepts operating in this band could localize sources to volumes containing only a single plausible host galaxy, enabling unique host-galaxy identification even in the absence of electromagnetic counterparts. With detectors of moderate sensitivity, the typical redshift horizon could be extended to approximately 0.1 for binary neutron-star mergers and approximately 0.3 for binary black-hole mergers. Such capabilities would enable dark sirens to provide powerful constraints on cosmological parameters, potentially reaching a precision competitive with that achieved by cosmic microwave background measurements.

Tue-5a2

Pre-localization of Massive Black Hole Binaries in the Millihertz Band

Xue-Ting Zhang
Max Planck Institute for Gravitational Physics (Albert Einstein Institute)

The space-borne gravitational-wave (GW) detectors will open a new mass and redshift regime, allowing us to observe massive black hole binaries (MBHBs) throughout the Universe. A subset of these systems is expected to produce electromagnetic (EM) counterparts, offering a unique opportunity to follow the continuous evolution of massive black holes through joint GW and EM observations. Realizing this potential, however, requires low-latency, high-throughput data-analysis pipelines that can extract reliable source parameters and sky localizations from space-borne data streams fast enough to trigger EM follow-up. In this work we develop a fast, normalising flow-based inference pipeline designed for early-warning analysis of MBHB signals in a TianQin-like configuration. Our method combines a learned embedding of the detector time series with a neural spline flow (NSF) to perform

amortized Bayesian inference, producing posterior samples for the main source parameters in roughly one minute per event. For a representative MBHB whose merger occurs 15 minutes after the end of the analyzed GW observation, the pipeline achieves pre-merger sky localizations of order about 20 square degree, recovers the same number of sky modes as a reference parallel-tempered Markov chain Monte Carlo (PTMCMC) analysis, and yields parameter uncertainties of comparable scale, while still operating within a practically useful pre-merger warning window. These results demonstrate that NSF-based inference can deliver accurate, near-real-time parameter estimation for space-borne MBHB GW signals, and that the resulting early-warning localizations are sufficiently precise to make rapid EM follow-up.

Tue-5a3

Dark Siren Constraint on Cosmology and Modified Gravity with GWTC-5

Anson Chen
International Center for Theoretical Physics Asian-Pacific, University of Chinese Academy of Sciences

The latest gravitational-wave transient catalog, GWTC-5, released by the LIGO-Virgo-KAGRA (LVK) collaboration, significantly increases the total number of detected gravitational wave (GW) events. Using 236 dark sirens (events without electromagnetic counterparts) from GWTC-5, we perform hierarchical Bayesian analysis to constrain the Hubble constant and modified gravity models in association with galaxy catalogues as part of the LVK. We obtain $H_0 = 71.0^{+9.0}_{-7.1}$ km/s/Mpc by combining dark siren constraint and bright siren constraint from GW170817, which is the tightest GW-based constraint to date. We also constrain the scalar-tensor theories and higher-dimensional theories of gravity through luminosity distance deviation, finding that the results are consistent with General Relativity.

Tue-5a4

Where Galaxies Point: First Measurement of the Large-Scale Axial Intrinsic Alignment

Pedro da Silveira Ferreira
Zhejiang University

We present evidence for a large-scale axial intrinsic alignment (LAIA), a coherent preferred orientation shared by galaxies and cosmic-web filaments. LAIA provides a new statistical-isotropy test based on the orientation field of galaxy-scale and filamentary structures, complementary to CMB- and large-scale-structure-based probes of the cosmological principle. Applying a new estimator to the Dark Energy Survey Year 3 weak-lensing shape catalog, we reconstruct the galaxies' orientation field and identify a coherent preferred axis on dipolar angular scales. Spirals' semi-minor axes and ellipticals' semi-major axes point toward a common direction, with a morphology-dependent amplitude hierarchy consistent with tidal-torquing physics. We further extend the analysis beyond galaxy shapes by measuring a consistent axial pattern in cosmic-web filament orientations from SDSS, providing an

independent and physically distinct tracer of the underlying large-scale tidal field. Remarkably, because the DES and SDSS footprints are substantially different, the agreement is not driven by the galaxies and filaments occupying the same local environments. Instead, it points to a common large-scale axial pattern traced independently by galaxy morphologies and by the cosmic web. Their statistical compatibility with the galaxy-based preferred axis therefore provides a non-local, cross-survey, and cross-observable consistency test, rather than a simple measurement of galaxy--host-filament alignment. The signal disfavors the null hypothesis at approximately 4sigma, persists across spatial and redshift splits, and remains robust against a broad suite of realistic survey-systematics tests. We validate the estimator and assess the physical interpretation using N-body-based mock catalogs, including Euclid Flagship 2 and MICECAT v2 with intrinsic alignments. If confirmed, LAIA would reveal a statistically significant preferred axis in the orientation field of galaxies and filaments, potentially tracing a large-scale tidal field imprinted during structure formation. This work introduces a new observational bridge between galaxy evolution, intrinsic alignments, cosmic-web physics, weak-lensing systematics, and tests of statistical isotropy, offering a compass that links morphology, angular momentum, environment, and cosmology.

Tue-5a5

Neutron Star Mergers and the Origin of Elements Beyond Iron

Zhiping Jin
Purple Mountain Observatory, Chinese Academy of Sciences

The origin of the heaviest elements in nature is a fundamental scientific question. The production of these elements relies primarily on the rapid neutron capture process (r-process). Theoretical studies show that neutron star mergers (including binary neutron star and neutron star black hole mergers) provide a neutron-rich environment and are a significant astrophysical site for the production of r-process elements. These newly synthesized, unstable heavy nuclei decay radioactively and power optical-infrared transients known as kilonovae. Kilonova signals in several short gamma-ray bursts (e.g. GRB 130603B and 050709) and some peculiar long bursts (e.g. GRB 060614) provide evidence of the production of heavy elements. The first multi-messenger observation of a binary neutron star merger (GW170817, GRB 170817A and AT2017gfo) in 2017 confirmed this scenario. Analysis of kilonova light curves and spectra allows constraints to be placed on the mass, speed, and chemical composition of matter ejected from each merger. Using multi-messenger data from gamma-ray bursts, kilonovae and gravitational waves, the local neutron star merger rate is jointly constrained. The results show that neutron star mergers can explain the abundance of heavy elements in the Milky Way. Next-generation gravitational wave detectors together with existing and future Chinese facilities will detect neutron star mergers out to redshifts of 2-4 and accumulate large kilonova samples. This will enable precise measurements of the enrichment history of r-process elements in our universe.

Tue-5a6

Golden and Silver Dark Sirens for precise H0 measurement with HETDEX

Yixuan Dang
Penn State University

Gravitational waves (GWs) from compact binary coalescences are standard sirens that provide a direct measure of the source's luminosity distance, enabling an independent measurement of the Hubble constant (H0). While a bright siren—a GW event with an identified electromagnetic (EM) counterpart—provided the first such constraint, most detections, currently dominated by black hole mergers, lack EM signatures. A measurement of H0 is still possible with these dark sirens by statistically associating GW events with galaxies in existing catalogs based on the sky localization. In this work, we explore the potential of two subsets of sirens: rare golden dark sirens, for which a single galaxy dominates the H0 posterior, and silver dark sirens, which are far more common but have a larger set of plausible host galaxies. Using the fifth internal data release of the Hobby–Eberly Telescope Dark Energy Experiment (HETDEX), we assess the suitability of the Visible Integral-field Replicable Unit Spectrograph (VIRUS) for spectroscopic follow-up of dark sirens. VIRUS exposures of the standard HETDEX depth provide precise redshifts and exquisite completeness within $z = 0.2$. After a single year of observations with the upgraded LIGO-A# network, the combined sample of golden and silver dark sirens with $z \leq 0.2$ and follow-up VIRUS observations can potentially yield a few-percent constraint on H0. Our predictions suggest that spectroscopic redshift surveys such as HETDEX can play a key role in realizing high-precision cosmology with dark sirens in the near future. Standard-siren distance measurements offer a critical, fully independent path to the local value of H0 to resolve the Hubble tension.

Aug 11 (Tue) 16:30-18:30

Tue-5b. D2. Standard cosmology / D3. Observational Cosmology / E3. Multi-Messenger

Tue-5b1

Primordial Black Holes from non-singular cosmology

Sheng-Feng Yan
Chengdu University of Technology

This talk explores how PBHs can distinguish between inflationary and non-inflationary cosmic origins. While PBHs were historically proposed as dark-matter candidates and supermassive black hole seeds, we emphasize their role as probes of the small-scale primordial power spectrum. Different cosmological paradigms predict distinct PBH mass functions: inflation typically requires a blue-tilted, small-scale enhancement, whereas bouncing or emergent universes generate fluctuations during a contracting phase, yielding unique mass-function slopes and cutoffs. We highlight two key developments. First, CMB μ-distortion constraints provide a powerful independent bound on PBH formation; recent work shows that using a relativistic compaction-function formalism (instead of simple curvature thresholds) shifts the allowed PBH abundance, confirming PBHs remain viable SMBH seeds within current limits. Second, we extend PBH studies to non-inflationary settings, modeling collapse criteria in bouncing universes via horizon dynamics and pressure-wave propagation, and exploring emergent universes where scalar fields and curvatons generate viable perturbations. By combining SMBH mass-function data, μ-distortion limits, and paradigm-specific predictions, this framework offers a path to test inflation versus bounce/emergent origins. Future progress requires tighter μ-distortion forecasts, refined non-Gaussian collapse modeling, and better accounting of PBH accretion and merger histories.

Tue-5b2

Cosmological studies with cosmic microwave background and radio observations

Chang Feng
University of Science and Technology of China

Observations of the cosmic microwave background (CMB) and radio wavelengths can probe multiple evolutionary stages spanning the early to late Universe, which feature large-scale structures and long-timescale processes. These observations are therefore of fundamental importance for investigating core physical problems concerning dark matter, dark energy, and gravitational waves. Future CMB polarization observations, with unprecedented sensitivity and resolution, may detect more exotic early- and late-Universe polarization signals, posing potential challenges to the standard cosmological model. The CMB formed when photons decoupled from the photon-baryon plasma during hydrogen recombination, as free electrons were captured to form neutral atoms. Similarly, the redshifted 21 cm line of neutral hydrogen can also trace dark-matter-dominated large-scale structures across a wide range of redshifts and spatial scales. This talk will present the scientific objectives, recent research progress, and future plans for cosmological studies centered on the cosmic microwave background (CMB) and neutral hydrogen.

Tue-5b3

AliCPT-1: First-Season Data Analysis and Preliminary Results

Yang Liu
IHEP

We present the first-season results from the Ali CMB Polarization Telescope (AliCPT), the first ground-based CMB experiment in the Northern Hemisphere dedicated to the high-altitude search for primordial gravitational waves via B-mode polarization. Observations were carried out at the Ali site in Tibet (5250 m a.s.l.) from early February to mid-April 2026, covering approximately 20% of the sky at 90 and 150 GHz. We describe the instrument performance, calibration using Jupiter, focal plane characterization, and detector noise properties. We measure the angular power spectra using cross-spectra between the AliCPT maps and the Planck satellite at the corresponding frequencies (100 GHz and 143 GHz, respectively). The resulting power spectra show clear detection of CMB anisotropies, with the acoustic peaks consistent with the Planck 2018 ΛCDM best-fit model, validating the instrumental design and observational strategy for future B-mode searches.

Tue-5b4

The current status of AliCPT

Yaqiong Li
Institute of High Energy Physics, CAS

The cosmic microwave background (CMB) is the relic afterglow of the Big Bang, and its polarization patterns encode vital clues about the earliest moments of the universe. In particular, the B-mode polarization serves as a unique signature of primordial gravitational waves, which would provide direct evidence for cosmic inflation. The Ali CMB Polarization Telescope (AliCPT), led by the Institute of High Energy Physics (IHEP) and located at 5,250 m in the Tibetan Ali region, is the first Northern-Hemisphere ground-based facility dedicated to this challenging B-mode search. AliCPT-1 achieved first light in April 2025 and has since been operating stably, with routine observations and remote data transmission fully validated. The ongoing survey is already producing scientific-grade sky maps, and planned upgrades will further enhance detector sensitivity and observational coverage. In this talk, I will present the current status of AliCPT, including its observational performance, data quality, and operational experience. I will also introduce the key detector technologies developed independently by our team, which are crucial for minimizing systematic uncertainties and achieving the sensitivity required to detect primordial B-mode polarization.

Tue-5b5

Looking into supernovae with gravitational waves

Ernazar Abdikamalov
Nazarbayev University

Gravitational waves from core-collapse supernovae provide a unique probe of the deep interiors of dying massive stars. Unlike electromagnetic radiation, they carry direct information about the processes occurring inside the collapsing core. In this talk, I will briefly overview how these signals can constrain key properties of the supernova engine and dense matter, and discuss what can be learned from these observations.

Aug 13 (Thu) 14:00-16:00

Thu-1a. C1. Relativistic Astrophysics

Thu-1a1

Reverberation lags viewed in hard X-rays from an accreting stellar-mass black hole

Bei You
Wuhan University

The X-ray-emitting corona near a black hole (BH) is too small to be directly imaged, but the rapid variability is used to infer the geometry by measuring time lags caused by coronal X-rays reflecting off the disk, known as rever beration lags. Though reverberation lags have previously been detected for some supermassive BHs in active galactic nuclei (AGNs), detecting them from stellar-mass BHs poses much greater challenges due to their size being over a million times smaller. Previous measurements of reverberation lags for stellar mass BHs were limited to energies below 10 keV. Here, we report the detection of the Compton hump reverberation, peaking at about 30 keV, from an X-ray binary. The accompanying detection of an iron line feature at about 6.4 keV confirms the X-ray reverberation scenario and provides strong evidence that accretion flows in AGNs and X-ray binaries are governed by an ubiquitous process.

Thu-1a2

Using tidal disruption events to study the black hole accretion process and search for intermediate-mass black holes

Zheng Cao
Institute of High Energy Physics, Chinese Academy of Science

In this talk I will present our results on finding intermediate-mass black holes (IMBHs) using tidal disruption events (TDEs). IMBHs are black holes with mass between 100 and 10^6 solar masses. While few have been found so far, IMBHs are believed to be important stepping-stones in the growth of supermassive black holes. Through accretion disc modelling and X-ray spectroscopy, I will demonstrate how the presence of an IMBH can be derived for a TDE, when a star is ripped apart by the tidal forces of a black hole. As the result of my thesis, we have found evidence of IMBHs in four TDE systems by analysing the data from XMM-Newton, NuSTAR, Swift, and NICER. I will also highlight the spectral and timing features found in IMBH-TDEs, connecting such systems with other classes of transients.

Thu-1a3

Beyond the Kerr Paradigm: Testing GR with SKA/VLBI Astrophysical Black Holes

Masoumeh Ghasemi Nodehi

Xinjiang Astronomical Observatory, CAS

We propose testing General Relativity (GR) in strong gravitational fields using synchrotron radiation and radio observations. Although GR has been well validated in weak-field contexts for over a century, precise tests in strong-field regimes remain difficult. Astrophysical black holes are expected to be described by the Kerr metric in GR, but their actual spacetime geometries have yet to be confirmed. Current strong-field tests, particularly in X-rays, suffer from a degeneracy between spin measurements and deviations from GR. Overcoming this parametric degeneracy is therefore a central challenge in strong-field gravity research. Relativistic electrons in cosmic rays, interacting with magnetic fields, emit synchrotron radiation. In this study, we use such emission to probe strong gravity by comparing Kerr and non-Kerr metrics. We analyze how parameters such as spin, inclination, magnetic field strength, and spectral index affect synchrotron flux density in non-Kerr spacetimes. Furthermore, we evaluate the potential of SKA and VLBI data for testing strong-field gravity through synchrotron and radio observations, which will also enhance our understanding of supermassive black holes and surrounding plasma, especially by combining SKA and VLBI observations.

Thu-1a4

Chasing the Neutrino Blazar Candidates

Hubing Xiao
Shanghai Normal University

Blazars are promising candidates for high-energy neutrino sources; however, the physical origin of their neutrino emission remains uncertain. In this talk, we present our studies on both the selection of neutrino blazar candidates (NBCs) and the modeling of their broadband spectral energy distributions (SEDs) within a hadronic framework. To estimate the maximum possible neutrino output, we adopt a scenario in which the high-energy emission is dominated by pγ interactions, while the contribution from leptonic inverse Compton scattering is strongly suppressed. Our model predicts prominent proton synchrotron emission peaking in the MeV band for most sources, with 99 out of 103 NBCs exhibiting proton synchrotron peaks in the range of 0.1–100 MeV. This result highlights the MeV band as a key observational window for distinguishing between leptonic and hadronic scenarios. Based on the model-predicted maximum neutrino fluxes, we find that neutrino emission from some NBCs may be detectable by current and next-generation observatories. These results provide testable predictions for future multi-messenger observations and offer new insights into the composition and radiation mechanisms of blazar jets.

Thu-1a5

Multi-wavelength Quasi-periodic Oscillations in Optical and Radio Observations of Blazars

Ashutosh Tripathi
Xinjiang Astronomical Observatory

Quasi-periodic Oscillations (QPOs) have been observed in supermassive black holes (SMBH) across the electromagnetic spectrum. The claimed timescales range from a few tens of minutes to days, weeks, and even a decade. Different models have been proposed to explain these QPOs which are primarily based on the timescales of periodicity. In this talk, I will present the QPOs detected in the optical and radio light curves of blazars, which constitute the special class of SMBH. I will show the recent results obtained using the optical data from Transiting Exoplanet Survey Satellite (TESS) which opens the new and exciting field of studying days' timescale variability in these objects. I will also present the recent result where we found interesting radio variability which includes the discovery of a QPO signal affected by flare. I will describe the practical problems encountered in analyzing these light curves (irregularity, gaps, stationarity, etc.) and introduced ways to resolve them using advanced time series analysis methods such as CARMA and recurrence analysis. I will also discuss the plausible models used to describe quasi-periodicity of the order of days and years found in optical and radio observations respectively.

Thu-1a6

First-order phase transitions in the early Universe: gravitational waves, black holes, and feebly-interacting particles

Ryusuke Jinno
Kobe University

The possibility of first-order phase transitions in the early Universe is drawing attention in view of gravitational wave observations planned for the 2030's. In this talk I will report updates on Higgsless simulations for gravitational wave production, discuss primordial black hole formation from strong phase transitions, and explore possible characteristic imprints of feebly interacting particles on the gravitational waves during first-order phase transitions.

Aug 13 (Thu) 16:30-18:30

Thu-1b. C1. Relativistic Astrophysics

Thu-1b1

A space mission to Earth's nearest black hole: reality or science fiction?

Cosimo Bambi
Fudan University

Black holes are the sources of the strongest gravitational fields in the present-day Universe, offering unparalleled opportunities to test Einstein's theory of General Relativity in the strong-field regime. In this talk, I will examine the prospect of sending small spacecraft on an interstellar mission to the nearest black hole. While highly speculative and fraught with technical challenges, such an endeavor is not entirely beyond the realm of possibility. Although the necessary technology does not yet exist, it may become available within the next 20 to 30 years. The mission itself could span 80 to 100 years, yet the scientific return would be profound and potentially unattainable through other means.

Thu-1b2

Self-Consistent Parker Bound on Magnetic Monopoles

Chen Zhang
Northeastern University (China)

Magnetic monopoles arise generically in unified theories and offer a natural explanation of charge quantization. Beyond collider searches and cosmic-ray experiments, their flux is constrained by Parker-type bounds requiring galactic magnetic fields to survive monopole energy extraction. We formulate a self-consistent Parker bound anchored in the lowest eigenmode of the galactic mean-field dynamo and convert the resulting limit to the present flux. Small-scale turbulent fields both seed this eigenmode and set the monopole velocity via stochastic acceleration before energy extraction from the coherent field. These unavoidable effects substantially modify the standard extended Parker bound at low and intermediate masses, yielding flux limits robust to primordial magnetic fields (PMFs); PMFs strong enough to alter them lie in regimes constrained by Lyman alpha data or testable by 21-cm and cosmological probes.

Thu-1b3

Relativistic Astronomy: Exploring the Universe and Fundamental Physics with Trans-relativistic Cameras

Jinping Zhu

The University of Hong Kong

The prospect of sending trans-relativistic probes into space opens a new observational window: relativistic astronomy. A trans-relativistic camera naturally acts as a spectrograph, a lens, and a wide-field imager due to relativistic Doppler boosting and light aberration effects, enabling astronomical observations from a fundamentally different perspective. In this talk, I will present a series of studies exploring the scientific potential of relativistic astronomy. I will first discuss how observations performed in the probe comoving frame can provide unique capabilities for studying astrophysical objects and extending astronomical observations to new wavelength and parameter regimes. I will then describe methods to determine the probe motion in flight by comparing source positions observed in the Earth and probe frames, allowing accurate reconstruction of both velocity and moving direction. Building on this framework, relativistic cameras may serve as novel tools for testing the foundations of special relativity through measurements of light aberration and relativistic Doppler effects. Such observations can further constrain generalized relativistic theories and place limits on fundamental quantities such as photon mass. These studies suggest that future trans-relativistic probes may not only become unique astronomical observatories but also laboratories for testing fundamental physics.

Thu-1b4

Extragalactic Relativistic Jets: Probing the Multiband Emission and Jet Physics of AGN

Krishna Mohana Ammenadka
Xinjiang Astronomical Observatory (XAO), Chinese Academy of Sciences (CAS)

Active Galactic Nuclei (AGN) are among the most luminous objects in the universe, residing at the centers of galaxies and powered by the accretion of matter onto supermassive black holes. The resulting highly collimated bipolar outflows, known as relativistic jets, transport angular momentum away from the central engine and profoundly influence the interstellar and intergalactic medium, shaping the evolution of both the host galaxy and its large-scale environment. As sites of coalescing supermassive black holes, AGN represent one of the primary science drivers of gravitational wave astronomy. In this talk, I will present results from our long-term multiwavelength temporal and spectral energy distribution studies of the blazar 3C 279 [Krishna Mohana A et al. 2024, MNRAS, 527, 6970; 2025, ApJ, 989, 125] over the ~14-year (2008–2022) Fermi-LAT observing period, complemented by an analysis of bright moving knots in multi-epoch Very Long Baseline Array (VLBA) maps to identify physical changes in the jet responsible for the observed multiwavelength variability. Some of the variations are consistent with the predictions of shock-in-jet models, while others are better explained by a changing Doppler beaming factor as the knot trajectory bends slightly at a small viewing angle to the jet. Broadband SED modeling reveals that the observed flaring activity is primarily driven by an enhancement in the Doppler boosting factor, coupled with variations in the emitting electron population. The emission region is predominantly located outside the broad-line region (BLR) at ~6.4×10^3 R_s, though during two exceptionally bright γ-ray states it approaches the outer BLR boundary at ~1.3×10^3 R_s, indicating a dynamic shift in the jet dissipation zone during periods of elevated activity. Additionally, drawing from previous and ongoing work, I will discuss how long-term multiwavelength variability studies can serve as a powerful tool to identify and characterize

close binary supermassive black hole systems in blazars, particularly in cases where the binary separation falls below the angular resolution limit of current imaging facilities.

Thu-1b5

Impact of mass transfer on the orbital evolution of compact binaries and the correction to gravitational wave form

Jie Yang
Lanzhou university

In this study, we integrate a perturbed Keplerian formalism with post-Newtonian corrections to simulate the relativistic orbit of a WD around a rotating IMBH, explicitly resolving the narrow phase near pericentre where Roche-lobe overflow initiates MT. We find that GW emission and MT exert competing influences on the orbit: MT episodes can increase both orbital period and eccentricity, potentially enabling the WD to avoid complete tidal disruption and even escape. We further quantify the GW phase evolution induced by MT, identifying parameter regimes in which GW detectors could observe a 1 rad phase shift over observational time-scales. Finally, we propose that the orbital expansion driven by MT may lead to the disappearance of quasi-periodic eruptions.

Thu-1b6

Contribution from Nonlinear Quasi-normal Modes in GW250114

YuXin Yang
Sun Yat-sen University

We report evidence for nonlinear gravitational effects in the ringdown signal of gravitational wave event GW250114. Using Bayesian inference, we find that the inclusion of a nonlinear quasi-normal mode (220Q)—a second-order harmonic predicted by general relativity—is statistically favored over the standard linear model (440 mode) when analyzing the post-merger oscillations. Specifically, models incorporating the 220Q mode yield higher Bayes factors than those including only the linear 440 mode, and produce remnant black hole parameters (mass and spin) more consistent with full numerical relativity simulations. This suggests that nonlinear mode coupling contributes significantly to the ringdown phase, opening a new avenue to probe strong-field gravity beyond linear approximations.

Aug 13 (Thu) 14:00-16:00

Thu-2a. E1. Test of gravity (Experimental gravity) / C5. Dark Matter

Thu-2a1

Development of high-Q silica fiber and the research on gravitational experiments

Qing Li
Huazhong University of Science and Technology

Our team has developed the torsion pendulum with high-Q silica fiber. The pulling machine based on the CO2 laser was built. The diameters of silica fibers rang from several micrometers to a few micrometers. Systematic investigations were conducted into the dynamic behavior of the quality factor (Q value)—the core parameter determining the sensitivity of the torsion pendulum—quantitatively evaluating gas squeeze-film damping, magnetic coupling, and interface damping introduced by different adhesives, thus providing a basis for low-noise system integration. Based on the high-Q silica fiber, our team used the time-of-swing method to precisely determine the gravitational constant G in 2018. The obtained G value only has a relative uncertainty of 11.64 ppm.
At present, breakthroughs in micro-torsion pendulum have pushed the test mass down to the milligram scale, significantly shortening the measurement distance and thereby greatly enhancing the gravitational signal to be measured. Future research plans to utilize this high-Q silica fiber to explore new physical phenomena about the intersection of gravitation and quantum mechanics, with force sensitivity approaching the quantum limit.

Thu-2a2

Probing gravity and constraint on spin- and velocity-dependent interaction with atom interferometer

Minkang Zhou
Huazhong University of Science and Technology

Precision atom interferometers have shown high performance in gravity measurements and fundamental research. First of all, I will present a high precision Bragg atom interferometer which is used to measure the gravitational acceleration with an ultrahigh sensitivity of 2.2×10-8m/s2. Then, I will present an atom-interferometric test of the parity-odd spin- and velocity-dependent (SVD) interaction between the spin-polarized proton and unpolarized nucleons. The test utilizes the Bragg atom interferometer loaded with 87Rb atoms, of which the single unpaired proton within the nuclei plays the role of the test spin. The differential measurement of the acceleration of the atom in two well- chosen inner states is designed to eliminate the influence from the polarized electron in the 87Rb atom. Moreover, the atom interferometer is particularly placed in the cave laboratory within the Yujia Mountain in the campus, and the mountain source of unpolarized nucleons allows to improve test of the SVD interaction on the length scale around 5-100m. Our experiment provides a new constraint on

the coupling of the SVD interaction exerting to the spin-polarized proton at λ=10 m, resulting in a substantial sensitivity improvement over the previous limit. Our work extends the scope of atom interference measurements and shines a new light on the testing of new physics with polarized-atom interferometer.

Thu-2a3

Probing the properties of dark matter through the dynamical evolution of substructures

Go Ogiya
Zhejiang University

In the standard framework, cosmic structures grow in a hierarchical manner: smaller systems form first and subsequently merge to build larger ones. This picture implies that massive hosts, such as luminous galaxies and galaxy clusters, are surrounded by numerous substructures. The microscopic characteristics of dark matter are encoded in the number and spatial distribution of these subhalos, which may be probed through radiation produced when dark matter particles annihilate or decay. Combining high-resolution numerical simulations with analytic techniques, we investigate the dynamical evolution of subhalos, a key ingredient for reliably modeling the spatial distribution of annihilation and decay signals. We study the survival of the earliest dark matter condensations, known as prompt cusps, and analyze how galactic stellar and gaseous disks contribute to the disruption of subhalos. In addition, we explore how interactions with host galaxies can reshape ordinary satellite galaxies into unusual systems that possess very little, or even no, dark matter.

Thu-2a4

Micrometer-diameter high Q silica fiber for milligram-scale torsion pendulum in gravitational experiment

Hongru Liu
Huazhong University of Science and Technology

The torsion pendulum is a sensitive mechanical oscillator whose thermal noise fundamentally limits the measurement sensitivity of torque. Using suspension fiber with high quality factor and small diameter can effectively reduce the thermal noise. In particular, micrometer-diameter silica fibers are highly desirable for milligram-scale torsion pendulums in gravitational experiments, space-based gravitational wave detection, and macroscopic quantum effect tests. However, the preparation of ultra-thin silica fibers remains challenging: manual pulling with hydrogen oxygen flame suffers from poor repeatability and difficulty in reaching the micrometer scale, while CO2 laser based machines reported in literature largely rely on empirical parameter setting and lack a validated process model.
Here we present a CO2 laser based pulling machine to produce micrometer diameter silica fibers with high Q. The machine uses a 10.6 μm CO2 laser to heat the silica rod, which is then pulled by guided rails to form the fiber. We developed an analytical model of the heating and pulling process and experimentally verified the model by pulling fibers under various parameters. With this machine, we

have successfully prepared silica fibers of 10 cm length, achieving a smallest diameter of 1.7±0.3 μm. A pulled fiber was welded to a mirror using the CO2 laser, and the quality factor of the torsion pendulum was measured to be (4.02 ± 0.04)×105 at room temperature, demonstrating the low mechanical dissipation of the fabricated fiber. This work provides a reproducible, model guided fabrication method for ultra thin silica fibers and offers technical support for developing more sensitive milligram scale torsion pendulums in next generation gravitational experiments.

Thu-2a5

Multimetric gravity and chronon layers

Medeu Abishev
Al Farabi Kazakh National University

We propose a multimetric formulation of gravity within the PZL chronostructural framework, in which the chronon layer hierarchy $\{Ch_{12k}\}$ is promoted from a tower of vacuum-energy sources to a family of coexisting effective geometries. The construction is anchored on two established results of the framework. First, the $C^3 \otimes C^4$ cell structure of the dodecad layer Ch_{12} uniquely fixes the metric–affine connection as a sum of the Levi-Civita part, a spatial contortion K (triadic torsion) and a temporal distortion L (Weyl non-metricity), with K and L mutually orthogonal; in the first-order formulation both satisfy algebraic equations of motion, establishing ghost-freedom at the two-derivative level, the absence of a vDVZ discontinuity, and exact reduction to general relativity in vacuum. Second, the layer tower yields an effective cosmological constant dominated entirely by the fundamental layer, $\Lambda\_eff \sim (\tau_1/T)^2\ \ell\_P^{-2} \sim 10^{-122}\ \ell\_P^{-2}$, matching the observed order of magnitude, with $k \geq 2$ contributions suppressed by three independent mechanisms.

Thu-2a6

Research on the Dissipation-Coupling Effect in a Two-stage Pendulum System

Ruijie Li
Huazhong University of Science and Technology

A two-stage pendulum system, comprising a lower torsion pendulum and an upper torsion pendulum, is widely employed in gravitational experiment. While prior research primarily focused on the vibration isolation capability of the magnetic damper, this study investigates the dissipation coupling effect between the upper and lower torsion pendulums through theoretical analysis and experimental validation. The dynamic model of the two-stage pendulum system is analyzed, and expressions for the Q value of each stage are derived. An experimental apparatus is designed and constructed to modulate the Q value of the upper torsion pendulum and then measure the response of the lower torsion pendulum. Results indicate that when the magnetic field applied to the upper torsion pendulum exceeds 5 mT, a decrease in the Q value of the upper torsion pendulum leads to a reduction in the Q value of the lower torsion pendulum—from 1.6×10^5 to 9×10^4. In the gravitational experiment with

a silica fiber after using the magnetic damper, the Q value of the lower torsion pendulum can be reduced by approximately half, effectively doubling the anelastic effect. This work offers valuable insights into the dissipation coupling effect of two-stage pendulum system in the gravitational experiment and aids in assessing noise sources in precision measurement.

Thu-2a7

Extended Parameterized Spin expansion formalism for ringdown analysis with GW250114

Jia-Ning Chen
University of Chinese Academy of Science

We present an extended parameterized spin expansion formalism for black-hole ringdown analyses, in which the effective length scale $\tilde{\ell}$ and the scaling index $\tilde{p}$ of quasinormal-mode deviations are sampled simultaneously. Applying this framework to GW250114 with pyRing, we analyze both the 220 and $220+221$ mode contents under different consistency conditions on the effective coupling γ. We find that the current ringdown data provide little information on the scaling index $\tilde{p}$, whose posterior remains largely prior-dominated. The inferred constraint on $\tilde{\ell}$ is strongly shaped by the allowed parameter-space geometry induced by the γ condition. For the representative case $\gamma<1$, evidence-weighted marginalization over the ringdown start time gives $\tilde{\ell}_{90}\simeq83\,{\rm km}$. A Kullback--Leibler analysis further shows that, after accounting for the effective prior induced by $\gamma<1$, the likelihood-driven information gain on $\tilde{p}$, $\tilde{\ell}$, and $\log\gamma$ is negligible. These results indicate that present ringdown observations have limited constraining power on the enlarged ParSpec parameter space, and that prior geometry plays a central role in generalized ringdown tests.