The 2025 Beijing Particle Physics and Cosmology Symposium (BPCS 2025): Early Universe, Gravitational-Wave Templates, Collider Phenomenology

Handbook

September 25-29, 2025, Beijing

Institute of Theoretical Physics, Chinese Academy of Sciences

Introduction

The study of the early universe is inherently linked to fundamental physics, particularly the processes of particle physic. Many of these processes, such as cosmological first-order phase transitions, can generate observable stochastic gravitational wave backgrounds. The modeling of various stochastic gravitational wave backgrounds is crucial for extracting information about the fundamental physics of the early universe. The traditional research in fundamental particle physics relies on colliders and their phenomenology. In recent years, developments in effective field theory have significantly advanced the prospects of using collider phenomenology to probe new physics beyond the Standard Model.

Given the rapid advancements in the fields of early universe, gravitational-wave templates, and collider phenomenology, and recognizing the deepening integration between particle physics and cosmology, Institute of Theoretical Physics, Chinese Academy of Sciences (ITP-CAS), in collaboration with Tsung-Dao Lee Institute (TDLI) of Shanghai Jiao Tong University, Chongqing University, The International Centre for Theoretical Physics Asia-Pacific (ICTP-AP) of the University of Chinese Academy of Sciences (UCAS), University of Electronic Science and Technology of China, Institute of High Energy Physics, Chinese Academy of Sciences (IHEP-CAS), Center for High Energy Physics of Peking University, and Tsinghua University, will hold **"The 2025 Beijing Particle Physics and Cosmology Symposium (BPCS 2025): early universe, gravitational-wave templates, collider phenomenology"** from September 25 (registration) to September 29 (departure) at the Chun Hui Yuan Hot Spring Resort Hotel in Beijing (a government-procured hotel [central procurement], No. 37, Yuzhuang Section, Gaoshi Road, Shunyi District, Beijing). The symposium is supported by the National Key Research and Development Program from the Ministry of Science and Technology of China.

This symposium (https://indico.itp.ac.cn/event/349/overview) continues a series of annual conferences dedicated on the intersection of particle physics and cosmology, with each year focusing on a different central theme:

SPCS 2022: The 2022 Shanghai Particle Physics and Cosmology Symposium: Neutrino and Dark Matter Physics (SPCS 2022)

SPCS 2023: The 2023 Shanghai Symposium on Particle Physics and Cosmology: Phase Transitions, Gravitational Waves, and Colliders (SPCS 2023)

CPCS 2024: The 2024 Chengdu Symposium on Particle Physics and Cosmology: Phase Transitions, Dark Matter and Experimental Probes (CPCS 2024)

This year, we will focus on the early Universe (cosmological collider, cosmological first-order phase transitions such as electroweak/QCD, baryogenesis,

dark matter production mechanisms, primordial black hole, etc.), gravitational-wave templates (stochastic gravitational wave backgrounds from various fundamental processes in the early universe), and collider phenomenology (Standard Model precision measurements, constraints on new physics, effective field theory, etc.), engaging in in-depth discussions across theoretical, phenomenological, and experimental aspects to stimulate new ideas and collaborations. We sincerely invite experts and young researchers in related fields to attend and engage in guidance and exchange!

All conference presentations are recommended to be delivered in English. This conference does not charge a registration fee. Accommodation and catering will be arranged uniformly. However, participants are responsible for covering their own accommodation, transportation and travel expenses.

Organizing Committee (in alphabetical order by last name)

Haipeng An (Tsinghua University)

Ligong Bian (Chongqing University)

Qing-Hong Cao (Peking University)

Huai-Ke Guo (ICTP-AP, UCAS)

Jia Liu (Peking University)

Michael Ramsey-Musolf (Mu Ren) (TDLI, Shanghai Jiao Tong University, **Chair**)

Shao-Jiang Wang (ITP-CAS, **Executive Chair**)

Zhi-Wei Wang (University of Electronic Science and Technology of China)

Zhongzhi Xianyu (Tsinghua University)

Bin Yan (IHEP-CAS)

Jiang-Hao Yu (ITP-CAS, **Co-Chair**)

International Academic Committee (in alphabetical order)

Chiara Caprini, Robert R. Caldwell, Tao Han, Shinya Kanemura

Milada Margarete Mühlleitner, Germano Nardini, Jessie Shelton

Conference Information:

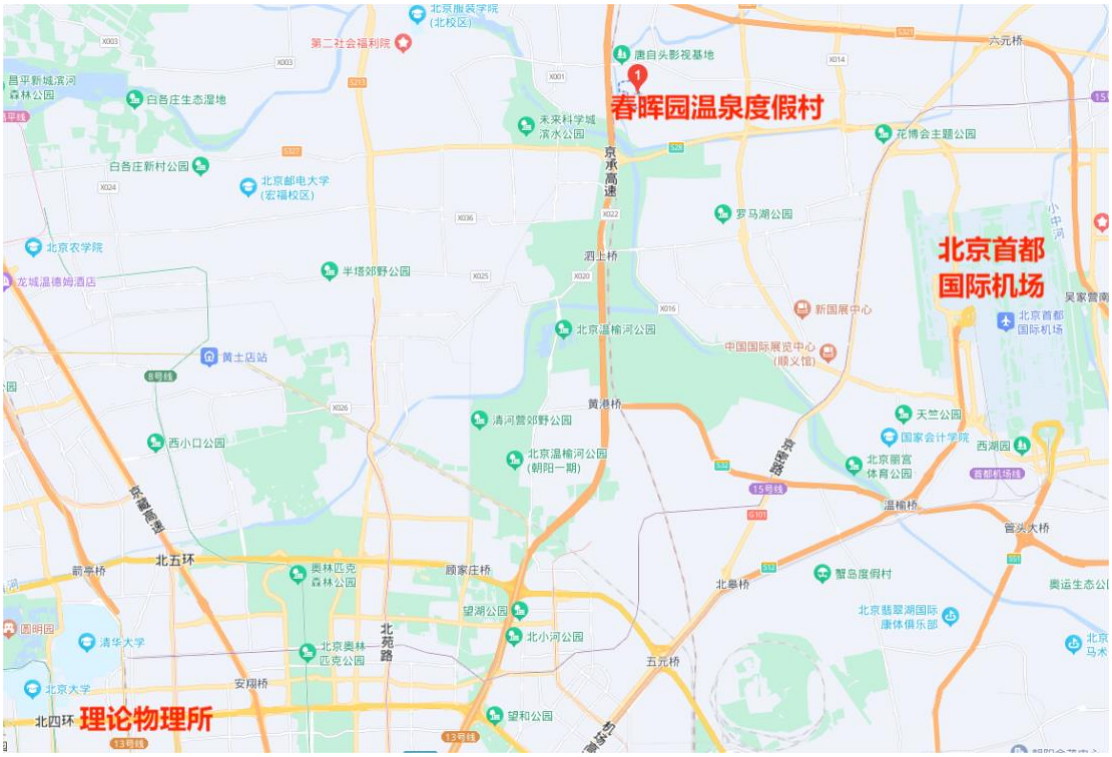
Dates:

September 25, 2025: Registration

September 26–28, 2025: Conference

September 29 afternoon, 2025: Departure

Transportation:



From Beijing Captial International Airport to the Venue Hotel

20 km: Taxi (60 Yuan, 30 minutes)

From Beijing Daxing International Airport to the Venue Hotel

90 km: Taxi (300 Yuan, 90 minutes)

From Beijing South Railway Station to the Venue Hotel

40 km: Taxi (130 Yuan, 60 minutes)

From Beijing West Railway Station to the Venue Hotel

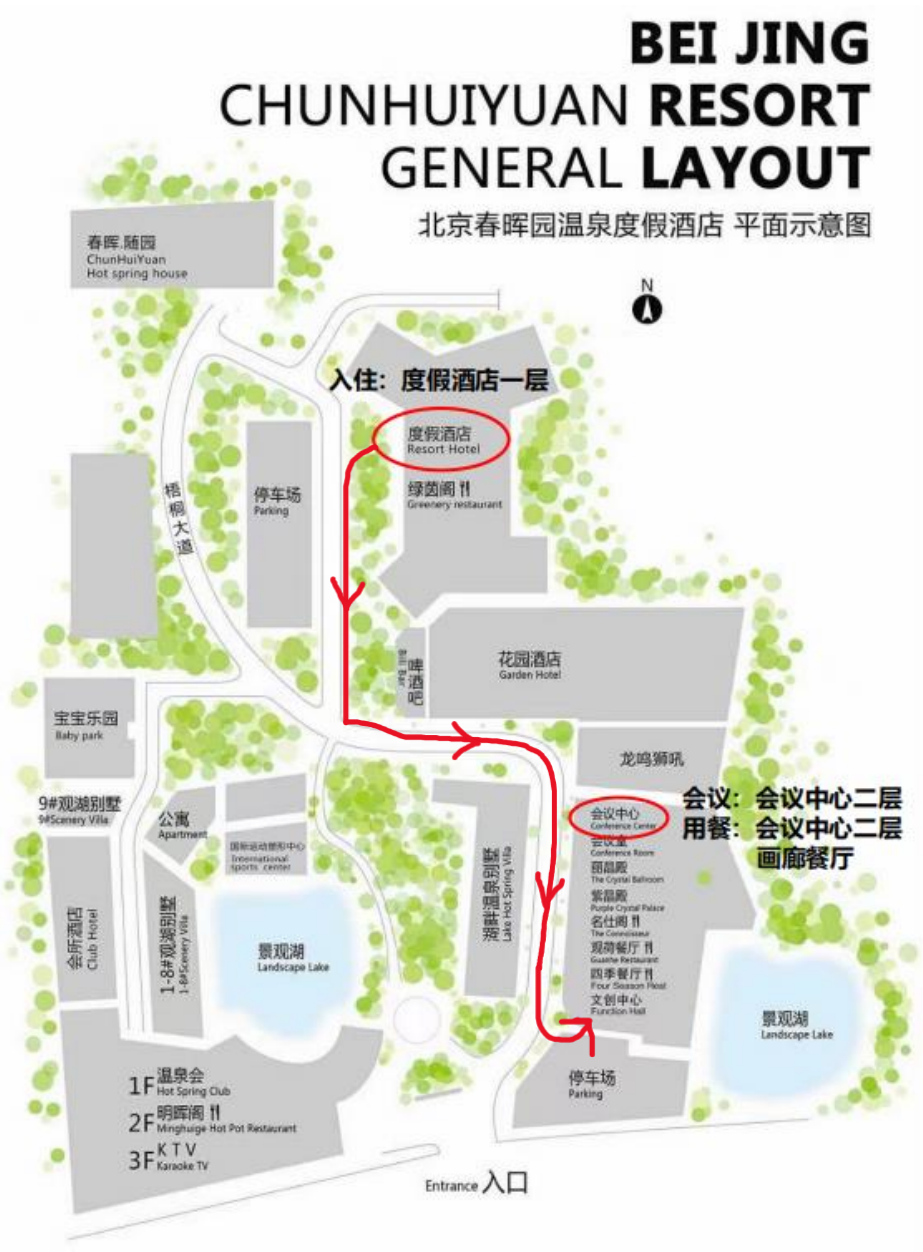
40 km: Taxi (130 Yuan, 60 minutes)

Address:

CHUN HUI YUAN RESORT
春暉園溫泉度假酒店

北京春晖园温泉度假村（北京市顺义区高泗路于庄段 37 号）

Address:YuZhuang 37#,Gaoliying Town, Shunyi District, Beijing



Registration:

Sep. 25: 14:00-20:00 (hotel lobby)
Sep. 26-29: 08:00-18:00 (conference center, second floor)

Venue:

Room 12, Second floor, Conference Center (26-28)
Room 15, Second floor, Conference Center (29,am)

Dining:

Breakfast : with your room card
Lunch and Dinner: with your meal voucher
Address: Buffet: Gallery Restaurant, Second floor , Conference Center
Barbecue: Lakeside Lawn

Date	Lunch	Restaurant	Dinner	Restaurant
25.SEP.			18:00—20:00	Buffet Restaurant
26 SEP.	12:00—14:00	Buffet Restaurant	18:00—20:00	Buffet Restaurant
27 SEP.	12:00—14:00	Buffet Restaurant	18:00—20:00	Lakeside Lawn
28 SEP.	12:00—14:00	Buffet Restaurant	18:00—20:00	Buffet Restaurant
29 SEP.	12:00—14:00	Buffet Restaurant		

WIFI: CHY(no password)

Contact:

Qingrong Ni (倪清容): 13911992271
Ye Shao (邵野经理): 13641112543

2025-09-26（Conference Room 12）		
Session 1	Chair：Jiang-Hao Yu	
08:00-08:30 Opening talk	Michael Ramsey-Musolf (TDLI)	Cosmic Phase Transitions: The Gravitational Wave - Collider Interplay
08:30-09:00	Zhong-Zhi Xianyu (Tsinghua U.)	Anatomy of Family Trees in Cosmological Correlators
09:00-09:30	Yiming Zhong (CITYUHK)	Anatomy of Parity-violating Trispectra in Galaxy Surveys
09:30-10:00	Shuntaro Aoki (RIKEN U.)	Probing New Physics through the Cosmological Collider
10:00-10:30	Break	
Session 2	Chair：Zhaofeng Kang	
10:30-11:00	Zhi-Wei Wang (UESTC)	Glueball Dark Matter
11:00-11:30	Yong Tang (UCAS)	Probing Dark Matter with Gravitational-wave Laser Interferometers in Space
11:30-12:00	Ye-Ling Zhou (HIAS-UCAS)	Testing GUT phase transition via inflated gravitational waves
12:00-14:00	Lunch (Gallery Restaurant)	
Session 3	Chair：Chengcheng Han	
14:00-14:30	Shun Zhou (IHEP-CAS)	Radiative Corrections for Precision Neutrino Physics
14:30-15:00	Xingyi Zhang (Hebei U.)	Neutrino reheating predictions with non-thermal leptogenesis
15:00-15:30	Sida Lu (SYSU)	Sub-GeV Sterile Neutrino as a Probe of Neutrino Mass Generation in the Minimal Left-Right Symmetric Model

15:30-16:00	Break	
Session 4	Chair: Ke-Pan Xie	
16:00-16:30	Zhaofeng Kang (Huazhong U. of Science and Technology)	A Dynamical Quasigluon Description of the Confinement Phase Transition
16:30-17:00	Fapeng Huang (SYSU)	New sources of gravitational waves from the early universe
17:00-17:30	Wei Chao (Beijing Normal U.)	Leptogenesis via new spectator process
17:30-18:00	Fei Huang (Weizmann Institute of Science)	Cosmological Stasis and Its Observational Signatures
18:00-20:00	Dinner（Gallery Restaurant）	
2025-09-27（Conference Room 12）		
Session 5	Chair: Michael Ramsey-Musolf	
08:00-08:30	Yang Zhang (Henan Normal U.)	Enhancing Phase Transition Calculations with Action Curve Fitting
08:30-09:00	Ryusuke Jinno (Kobe U.)	First-order phase transitions in the early Universe: gravitational waves, black holes, and feebly-interacting particles
09:00-09:30	Philipp Schicho (University of Geneva)	Perturbative cosmological phase transitions in a broad temperature range
09:30-10:00	Kun Liu (TDLI)	Search for Higgs Boson Pair Production at the ATLAS Experiment
10:00-10:30	Break + Photo	

Session 6	Chair：Fapeng Huang	
10:30-11:00	Yuichiro Nakai (TDLI)	Darkogenesis via Supercooled Phase Transition
11:00-11:30	Wei Su (SYSU)	Long lived Particle searches of Higgs sector
11:30-12:00	Yongcheng Wu (Nanjing Normal U.)	PBH from EWPT and its GW signal
12:00-14:00	Lunch (Gallery Restaurant)	
Session 7	Chair：Zhong-Zhi Xianyu	
14:00-14:30	Xiao-Dong Ma (South China Normal U.)	Effective field theory for general baryon-number-violating nucleon decays
14:30-15:00	Haolin Li (SYSU)	Operator Basis Construction in Effective Field Theories and Its Applications
15:00-15:30	Fei Teng (Fudan U.)	On-shell Approaches for Gravitational Wave Physics
15:30-16:00	Break	
Session 8	Chair：Huai-Ke Guo	
16:00-16:30	Wan-Zhe Feng (Tianjin U.)	Gauge-Invariant Analysis of Phase Transitions in Dark U(1) Sectors
16:30-17:00	Chengcheng Han (SYSU)	Cosmological Signatures of Neutrino Seesaw Mechanism
17:00-17:30	Chi Tian (Anhui U.)	Emulating gravitational wave spectra from sound waves during the cosmological FOPT
17:30-18:00	Jiang Zhu (TDLI)	Bubble wall velocity from Kadanoff-Baym equations: fluid dynamics and microscopic interactions
18:00-20:00	Dinner-Barbecue（Lakeside Lawn）	
2025-09-28（Conference Room 12）		
Session 9	Chair：Jia Liu	
08:00-08:30	Ligong Bian (Chongqing U.)	Numerical simulations on vacuum decay

08:30-09:00	Manqi Ruan (IHEP-CAS)	AI enhanced event reconstruction and physics measurements: impact at CEPC Physics reach
09:00-09:30	Xiao-Ping Wang (Beihang U.)	Reaching the Ultimate Quantum Precision Limit at Colliders: Conditions and Case Studies
09:30-10:00	Bin Yan (IHEP-CAS)	Bell Inequality Violation of Light Quarks in Dihadron Pair Production at Lepton Colliders
10:00-10:30	Break	
Session 10	Chair: Manqi Ruan	
10:30-11:00	Germano Nardini (University of Stavanger)	Gravitational-Wave Experiments and Collider Synergies: Unveiling First-Order Phase Transitions
11:00-11:30	Gang Li (SYSU)	Probing Lepton-Number-Violating New Physics at Colliders
11:30-12:00	Yandong Liu (Beijing Normal U.)	Physics Opportunities at the Muon Collider
12:00-14:00	Lunch (Gallery Restaurant)	
Session 11	Chair: Ligong Bian	
14:00-14:30	Huan Yang (Tsinghua U.)	Searching for axions with gravitational waves
14:30-15:00	Jia Liu (Peking U.)	Wess-Zumino-Witten Interactions of Axions with Three-Flavor
15:00-15:30	Xiaohui Liu (Beijing Normal U.)	Probing heavy quarkonium hadronization by energy correlators
15:30-16:00	Break	
Session 12	Chair: Zhi-Wei Wang	
16:00-16:30	Peter Athron (Nanjing Normal U.)	Hints of an electroweak phase transition and electroweak baryogenesis?
16:30-17:00	Peizhi Du (USTC)	Dark Radiation Isocurvature from Cosmological Phase Transitions

17:00-17:30	Ke-Pan Xie (Beihang U.)	Leptogenesis triggered by an electroweak phase transition
17:30-18:00	Wenxing Zhang (Hebei U.)	Testing Phase Transition and cosmological history at colliders
18:00-20:00	Dinner（Gallery Restaurant）	
2025-09-29（Conference Room 15）		
Session 13	Chair：Peizhi Du	
08:00-08:30	Lingfeng Li (ICTP-AP, UCAS)	Freeze-in of Composite Dark Sector
08:30-09:00	Xiaoyong Chu (ICTP-AP, UCAS)	The roles of bound state in dark sectors
09:00-09:30	Xiao Wang (Monash U.)	Gravitational Waves from Sound Waves
09:30-10:00	Chon Man Sou (Tsinghua U.)	Entanglement features from intermediate heavy particle in scattering
10:00-10:30	Break	
Session 14	Chair：Shao-Jiang Wang	
10:30-10:50	Xiang-Xi Zeng (ITP-CAS)	Scalar-induced gravitational waves with non-Gaussianity up to all orders
10:50-11:10	Zhuan Ning (HIAS-UCAS)	Sound waves from primordial black hole formations
11:10-11:30	Wu Yanda (TDLI)	Implications of Topological Field Configurations for Baryon Asymmetry and Dark Matter
11:30-11:50	Qingyuan Liang (ICTP-AP, UCAS)	Detecting Gravitational Waves from Comic Phase Transitions in Space
11:50-12:10	Jian-Feng He (ITP-CAS)	Strong backreaction of gauge quanta produced during inflation and the sourced GWs
12:10-14:00	Lunch (Gallery Restaurant)	
Discussions and Departure		