United Nations
Educational, Scientific and
Cultural Organization

ICTP-AP
INTERNATIONAL CENTRE FOR
THEORETICAL PHYSICS ASIA-PACIFIC

E-mail: ictp-ap@ucas.ac.cn

Web: https://ictp-ap.org

PROGRESS REPORT

ICTP-AP

2022-2023

University of Chinese Academy of Sciences

ICTP-AP
International Centre
for Theoretical Physics Asia-Pacific
国际理论物理中心-亚太地区

ICTP-AP Introduction

The International Centre for Theoretical Physics (ICTP-AP) is a non-profit organization and will carry out high-level scientific research, education and training in basic science such as frontiers of theoretical physics and the relevant interdisciplinary areas. It is China's first UNESCO category 2 Centre in the area of basic science.

Since its establishment in 2019, ICTP-AP has provided many opportunities for advanced education, training and research in basic science such as frontiers of theoretical physics and the relevant interdisciplinary areas for scientists from Asia-Pacific region and other countries. Its mission is to become an international hub for high-level conferences, schools and workshops.

国际理论物理中心（亚太地区）(International Centre for Theoretical Physics Asia-Pacific，英文简称“ICTP-AP”，以下简称“中心”）是联合国教科文组织在国内基础科学方面设立的第一个二类中心，是进行基础科学前沿与相关交叉科学领域高水平科研、教育和培训的非营利性组织。

中心成立于 2019 年，自成立以来，已为来自亚太地区和全世界的科学家提供大量机会，参与基础科学尤其理论物理前沿及相关交叉学科领域高水平科研、教育和培训项目，并致力于发展成为区域性国际一流科学研究中心、国际化人才培养基地、开放型国际学术交流平台。

Contents

目录

01 2023 Timeline
14 ICTP-AP Platform
41 Talent Cultivation
54 Partners
03 ICTP-AP Research
19 ICTP-AP Seminars
52 Governance
55 Publications
08 Talent Development
30 Outreach Activities
53 Scientific and Administrative Staff

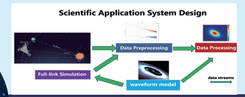
2023 TIMELINE

2023 TIMELINE

2023.01

2023年1月，中心承担的“空间科学”先导专项“科学应用系统关键技术攻关”任务顺利完成结题验收，包括技术及科研档案验收。

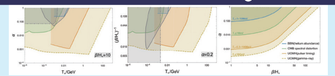
The subject “Key Technology in Scientific Application System” under the Strategic Priority Research Program “Space Science” undertaken by ICTP-AP has been reviewed and accepted, including its technology and archives.



2023.02

刘京和他的合作者提出了原始黑洞产生的新机制，并从天体物理观测数据中对宇宙学一阶相变的性质给出了严格的约束。相关论文发表于顶级期刊《物理评论快报》（Phys. Rev. Lett.130, 051001）上。

Jing Liu, a postdoctoral fellow of ICTP-AP and his collaborators have proposed a new mechanism for the productions of primordial black holes, and given rise to rigorous constraints on the properties of cosmological first-order phase transitions from the astrophysical observational data. The relevant paper has been published on Phys. Rev. Lett. 130, 051001.



2023.03

来自意大利的PIFI访问学者Francesco教授来中心访问，为期两个月。在他访问期间，他和中心的教授们进行交流，并在他的研究领域展开学术报告。

Professor Francesco Hautmann, a PIFI scientist from Italy visited ICTP-AP and stayed for two months. During his stay, he has interacted with professors of ICTP-AP, delivered academic report in his research area .

2023.04

2023年4月16日，量子宇宙物理前沿论坛分论坛在湖南省长沙市湖南大学成功举办。此次分论坛的主题是“粒子物理和物质的起源”。

The sub-forum of the Forum on Frontiers of Quanta to Cosmos Physics has been successfully held in Hunan University in the city of Changsha, Hunan Province on April 16th, 2023. This sub forum focused on the theme of “Particle Physics and Origin of Matter”.

2023.05

2023年5月14日-22日，亚太地区引力与宇宙学在浙江省杭州市千岛湖两山人才基地成功举办。

今年5月，中心与杭高院共同承办中国科学院大学国际学生前沿与交叉科学春季学校。来自十几个不同国家，不同专业背景的留学生积极报名参加此次活动。

The Asia-Pacific School and Workshop on Gravitation and Cosmology (APSW-GC) has been held in the “Eco-Economy” Senior Talent Hub by the side of beautiful Qiandao Lake in Chun'an County, Hangzhou from May 14 to May 22, 2023.

ICTP-AP co-hosted the 2023 Spring School on Frontier and Interdisciplinary Sciences for the Overseas Students in IC-UCAS with the Hangzhou Institute for Advanced Study (HIAS) in May at HIAS, with over 40 international students from more than ten countries and various disciplines participating in the program.

2023.06

6月17日，国际学院和国际理论物理中心（亚太地区）联合举办首届国际龙舟比赛。中心师生组队参加比赛。

The first International Dragon Boat Race held by the International College of UCAS and ICTP-AP kicked off on June 17. Students and faculty of ICTP-AP took part in the competition.

2023.07

2023年6月30日至7月3日，中心在北京举行优秀学生夏令营。来自全国21所高校的40多名学生慕名而来，与中心各位导师面对面近距离交流，深入了解国科大国际理论物理中心（亚太地区）。

2023 ICTP-AP Summer School was held from June 30th to July 3rd in Beijing. Over forty students coming from 21 different universities came to Beijing for this activity. During this four-day-long activity, students had a better understanding of ICTP-AP, UCAS and communicated with supervisors face-to face.

2023.08

年骏副教授申请到国家自然科学基金委面上项目。

Associate Professor Jun Nian has successfully applied for the General Program of National Science Foundation of China (NSFC).

2023.09

中国科学院大学中外文明与文化交流中心揭幕仪式在今年九月份举行，中心是该中心的承办单位之一。

The Chinese-Foreign Center for Civilization and Cultural Exchange of UCAS was unveiled in September and Yueliang Wu, Academic Vice President of UCAS and ICTP-AP is a co-host of the center.

今年9月，中心在中关村校区举办中秋联欢会，面向国内外学生。30多名学生积极报名参加此次活动。

ICTP-AP held a celebration party for students from home and abroad to observe the Mid-Autumn Festival this September at Zhongguancun Campus, over thirty students signed up for the event and actively took part in this activity.

2023.10

中心张君副教授获得国家自然科学基金委优秀青年科学基金项目（海外）资助。

Associate Professor Jun Zhang received Excellent Young Scientists Fund (Overseas) of NSFC.

2023年10月15日，第三届中国空间科学大会在浙江省湖州市开幕。引力波宇宙太极实验室承办了“空间引力波探测和精密测量与引力宇宙”专场论坛。

The third China Space Science Assembly was unveiled on 15th October,2023 in Huzhou city, East China's Zhejiang province. Taiji Laboratory of Gravitational Wave Universe hosted a special forum on “Space-based Gravitational Wave Detection and Precision Measurement and Gravitational Cosmology”.

2023.11

今年11月至12月期间，中心举办了引力波数据探索：编程与分析训练营，来自全国各地的400多名学生报名参加。

ICTP-AP has organized Gravitational Wave Data Exploration: Programming and Analysis Workshop from November to December and over 400 students from across the country signed up for this program.

ICTP-AP RESEARCH

Professor Yue-Liang Wu's Group

Members:
one postdoctoral fellow, three PhD students, one master's student

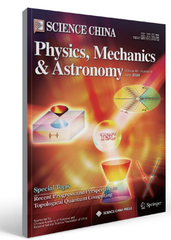
Research Area:
Particle Physics, Quantum Field Theory, Hyper-unified Field Theory, Gravity Universe

课题组成员：
1位博后，3名博士生，1名硕士生

研究方向：
粒子物理，量子场论，统一场论，引力宇宙

Highlight:
Professor Yue-Liang Wu proposed the Gravitational Quantum Field Theory. This theory describes gravity with a new equivalent gauge field that has dual frame indicators instead of the traditional metric field. Meanwhile, with this new gauge field, the theory of gravity can be incorporated into the framework of quantum field theory to realize the unity of gravity and quantum field theory. Relative paper has been published on SCIENCE CHINA Physics, Mechanics & Astronomy.

科研亮点：
吴岳良教授提出引力量子场论。根据引力量子场论这一新理论，可以用一个具有双标架指标的规范场取代传统的度规场来等效地描述引力，同时，借助这个新的规范场，可以将引力理论纳入量子场论的框架中，实现引力和量子场论的统一。相关论文已发表在《中国科学：物理学，力学，天文学》期刊。



Associate Professor Jun Nian's Group

Members:
one postdoctoral fellow, one PhD student and three master's students, one scientific research assistant

Research Area:
Jun's research group focuses on the physics problems in gravitation and black holes, including black hole thermodynamics and statistical mechanics, quantum effects of black holes, quantum field theory in curved spacetime, and theoretical computation of gravitational waves.

课题组成员：
1位博后，1博士，3名硕士生和1名科研助理

研究方向：
本课题组主要关注引力和黑洞的物理问题，主要包括黑洞的热力学和统计力学、黑洞的量子效应、弯曲时空的量子场论、引力波的理论计算等。

Highlight:
In 2023, Associate Professor Jun Nian independently studied the information paradox of rotating black holes and proposed a new model based on the spacetime structure of rotating black holes and quantum field theory. This method provides new insights into the celebrated problem of the black hole information paradox problem. Jun Nian and his collaborators proposed a Cardy formula for 3D super-conformal field theories and applied it to studying AdS black hole entropy. Supervised by Jun Nian, student Weijie Tian studied the gravitational waves of supermassive Kerr black holes and computed their waveforms rigorously using conformal field theory. And another student, supervised by Prof. Jun Nian, Li Feng worked with some experts from Tsinghua University and Harvard University on the operators in 4D superconformal field theories. They found some evidence supporting the correspondence between these operators, the gravitons, and the black holes in AdS space.

工作亮点：
2023年，年骏副教授独立完成关于旋转黑洞信息悖论的研究，提出基于旋转黑洞的时空结构和量子场论的新模型，为尝试黑洞信息悖论这一著名难题提供新的思路。他还和合作者提出三维超对称共形场论的 Cardy 公式，及其在AdS黑洞熵中的应用。

在年骏副教授指导下，学生田伟杰通过共形场论，研究超大质量黑洞产生的引力波，并借助共形场论严格计算其波形。他的学生冯黎和清华大学、美国哈佛大学的几位专家合作，研究四维超对称共形场论中的算符，并发现一些这些算符和AdS空间中的引力子、黑洞之间相对应的证据。

Associate Professor Jun Zhang's Group

Members:
1 Postdoc, 1 PhD, 2 Master's students and 1 scientific researcher assistant

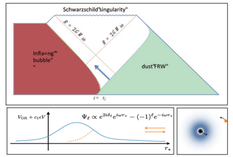
Research Area:
physics of early universe, gravitational theories beyond general relativity and gravitational waves

课题组成员：
1位博后，1名博士，2名硕士和1位科研助理

研究方向：
早期宇宙物理、超出广义相对论的引力理论及相关唯象以及引力波观测

Highlight:
Recently, our group investigated vacuum tunneling that may occur during inflation and lead to nucleation of vacuum bubbles. After inflation, such a bubble could either collapse in to a primordial black hole, or keep expansion and forms a baby universe hidden behind the horizon of a primordial black hole.
We also constructed inspiral waveform templates in gravitational EFTs, and imposed constraints on higher dimensional operators by analysis gravitational waves observed by LIGO-Virgo-KAGRA. We further investigated the prospects of testing gravitational theories and searching for new particles with multi-band gravitational wave observations.
We recently investigated the cloud evolution in progenitor evolution of black hole binaries, and found that superradiant clouds could avoid depletion due to the common envelope evolution and leave detectable signatures in gravitational waves emitted by the binaries. This is important for searching new particles with black hole superradiance.

工作亮点：
在最近的研究中，本课题组考察了暴胀中的真空隧穿过程以及该过程的观测效应。我们发现暴胀时期的真空隧穿会产生不同大小的真空泡。
我们在引力有效场论的框架下构建了双黑洞并合的引力波波形，并通过分析LIGO-Virgo-KAGRA观测的引力波信号对有效场论的高维算符做出了限制。此外，我们还对如何联合空间与地面的多波段引力波观测，检验引力理论和寻找新粒子进行了研究。
在最近的工作中，我们详细地研究了恒星质量双黑洞形成过程中超辐射云的演化，并发现对于现实的双黑洞系统，超辐射云有可能留存到双黑洞旋进后期。这对于用黑洞超辐射寻找新粒子有着重要的意义。



Associate Professor Huaike Guo's Group

Members:

1 Postdoc, 1 PhD and 1 Master's student

Research Area:

The research of Guo's group is focused on the study of fundamental problems with gravitational waves, including studies on the theory side and on experimental detection as a member of the LIGO-Virgo-KAGRA collaborations and of the Taiji program for space-based gravitational wave detection.

Highlight:

The group's research in 2023 is mostly on the study of gravitational waves from cosmological first order phase transitions, an area Guo has been working on for a long time. In 2023, several major Pulsar Timing Array (PTA) experiments announced evidence of nano-Hertz stochastic gravitational waves. The research result of Guo and his collaborators has once again been adopted in the search for phase transition gravitational waves (arxiv:2007.08537). In addition, Guo proposed the effect of dissipative effects as new observables for phase transition gravitational waves through their impact on the spectral shape, which can serve as a new portal for particle physics studies. Guo and his collaborators also found quite significant errors of previously used formulas through numerical simulations (arxiv:2310.04654). These results are important for searches by terrestrial and space-based detectors, and also by PTA experiments.

课题组成员：

1位博后，1名博士和1名硕士

研究方向：

课题组的研究集中在以引力波为工具研究基本科学问题方面，包含相关理论研究以及在地面引力波实验LIGO-Virgo-KAGRA（LVK）合作组和空间引力波探测“太极计划”的实验探测工作。

工作亮点：

课题组在2023年的工作集中在早期宇宙一阶相变引力波方面，这也是课题负责人郭怀珂此前长期从事的研究方向。2023年世界几大脉冲星测时阵列实验相继发布了纳赫兹频段随机引力波背景存在的证据。郭怀珂和合作者此前的研究结果（arxiv:2007.08537）也继2021年后再次被北美纳赫兹引力波天文台（NANOGrav）应用于相变引力波的探测中。郭怀珂和合作者进一步采用更为准确的引力波能谱对实验数据进行了诠释（arxiv:2307.02259）。此外郭怀珂还提出相变过程中等离子体内的耗散效应会改变引力波的能谱，进而可以作为引力波探测的新观测量（arxiv:2310.10927），这一研究打开了研究粒子物理的新手段。此外郭怀珂和合作者通过数值模拟发现此前经常采用的公式有较大误差（arxiv:2310.04654）。这一系列研究结果对地面、空间和脉冲星测时阵列实验的探测均有重要意义。

Postdoc's Work

博后工作总结

He Wang's Work:

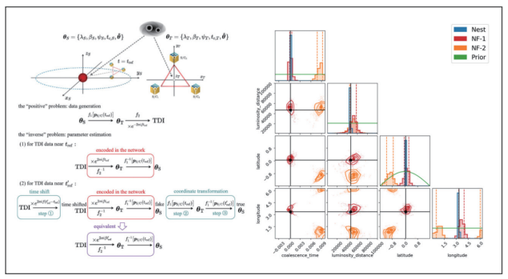
Dr. He Wang mainly focuses on gravitational wave (GW) data analysis during at ICTP-AP. His work primarily relies on leveraging artificial intelligence (AI) and deep learning to expedite the detection and analysis of gravitational wave signals, particularly those from massive black hole binaries. His research outcome has paved the way for a transformative shift from terrestrial to space-based GW detection, thereby significantly enhancing the efficiency of GW data analysis. This has been a stepping stone towards the broader goal of unraveling the mysteries of the universe through advanced GW observation techniques.

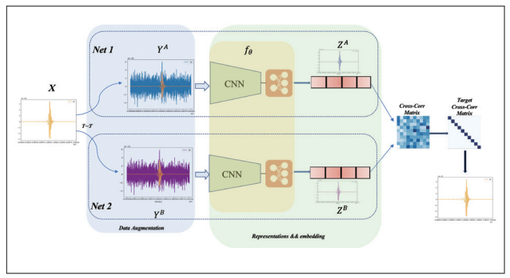
王赫博士的主要研究领域是引力波数据分析。他主导了几项关键研究，主要依赖于利用人工智能和深度学习方法来加速引力波信号的识别和分析，特别是来自超大质量双黑洞并合系统的引力波信号。这些研究成果为从地基向空基的引力波信号搜寻的转变铺平了道路，从而显著提高了引力波数据处理的效率。这是朝着通过先进的空间引力波探测技术，揭开宇宙奥秘的重大科学发现所迈出的重要一步。

Yutong Wang's work:

Dr. Yutong Wang has published a paper that introduces a self-supervised learning model for gravitational wave (GW) signal identification. In his work, to address the computational cost in the signal search of space-based GW detection, he and his team proposed a self-supervised learning model that uses synthetic Gaussian noise and binary signals from double mass black holes (MBHB), considering the datasets corresponding to different space-based GW detectors as gravitational wave twins in the contrastive learning method. It is proved that self-supervised learning can be an efficient approach for GW signal identification.

王宇彤博士在他的文章里介绍了一种用于引力波信号识别的自监督学习模型。为了解决在空基引力波探测的信号搜索中，计算成本过高的问题，其团队提出了一种自监督学习模型：通过使用合成的高斯噪声以及双超大质量黑洞（MBHB）信号，并将不同空基引力波探测器中所对应的包含同一信号的数据集视为对比学习方法中的引力波孪生（Gravitational wave twins），展示了自监督学习在引力波信号识别中会是一种高效的方法。





Ju Chen's Work:

Dr. Ju Chen participated in the writing of the noise study report of space-borne gravitational wave detector and studies the detectability of circular polarization of the stochastic gravitational wave background under different alternative LISA-Taiji networks. He also applied for the general fund of China Postdoctoral Science Foundation and the special fund for theoretical physics.

陈举博士参与了空间引力波探测器噪声分析报告撰写。针对不同LISA-太极联网构型下随机背景引力波圆偏振的测量能力开展研究，申请博士后科学基金面上项目以及理论物理专款博士后项目。

Jing Liu's work:

Dr. Jing Liu and his collaborators have proposed that the randomness of vacuum tunneling during cosmological first-order phase transitions can lead to super horizon perturbations, and stronger constraints on the rate and intensity of the phase transition can be obtained through current observations of small-scale curvature perturbations. They investigate the NY gravity model and predicts a primordial gravitational wave background with strong polarization and anisotropy during inflation.

刘京博士和他的合作者提出了宇宙学一阶相变中真空隧穿的随机性可以造成超视界扰动，并可以通过目前对小尺度曲率扰动的观测给出一阶相变速率和强度以更强的限制。他们通过LIGO-Vigo　O3的数据限制超慢滚暴涨，在NY引力模型中预言了暴涨时期带有强极化和各向异性的原初引力波背景。

Yuan Zhong's work:

In three-dimensional flat holography, the BMS field theory exhibits an infinite-dimensional BMS_3 symmetry, which is powerful to settle down many universal results. Dr. Yuan Zhong has considered a certain low-temperature limit of the BMS field theory and calculate the leading thermal correction to the Rényi entropy for a single interval on the cylinder from the replica trick and the uniformizing map and provided another method from the entanglement first law and the modular Hamiltonian as a double check in his paper.

在三维平面全息中，BMS场论表现出了无穷维的BMS_3对称性，这一对称性有力的给出了许多普遍性的结果。仲原博士在他的文章中采用BMS场论的某一特定低温极限，并运用副本技术和通用映射计算了圆柱体上的单个线段区域的Rényi熵的领头热修正。并使用纠缠第一定律和模哈密顿中提供了另一种计算纠缠熵热修正的方法，作为双重检验。

TALENT DEVELOPMENT

ICTP-AP has attached great importance to the cultivation of young scientists and worked to create a favorable academic environment for young talents while providing support for them to apply for talent programs. This year, three new postdocs and two tenure-track assistant professor who just returned from abroad have joined our team.

In 2023, Associate Professor Jun Nian received the General Program of the National Natural Science Foundation of China (NSFC), and Associate Professor Jun Zhang has received the Science Fund Program for Distinguished Young Scholars (Overseas). Dr. He Wang has won the fund for young scientists in data and the three new postdocs have successfully applied for the CAS Special Research Assistant Program.

中心高度重视青年科学家的培养，着力打造良好的氛围和环境，支持青年科学家的发展，助力人才项目申请。今年，中心新加入三位博后工作者和两位长聘教授。

2023年，在中心平台的依托下，年骏副教授申请到国家自然科学基金委面上项目，张君副教授获得海外优青。王赫获得青年数据科学家项目资助。同时三位新晋博后皆成功申请到中国科学院特别研究助理资助项目。

Our New Members

新成员

Teng Ma
Tenure-track assistant professor
马腾：长聘副教授

Research Interests:

Effective Field Theory and Scattering Amplitudes:
phenomenology of effective field theory, connections between effective field theories and their ultraviolet completions, and applications of scattering amplitudes in effective field theory and particle physics.

*** Dark matter, Particle Cosmology, and General Relativity from Scattering Amplitudes:**
exploring the nature of dark matter and its phenomenology, gravity waves, particle physics in early universe, and applications of scattering amplitudes in general relativity calculations.

*** Electroweak Symmetry Breaking:**
model building of electroweak symmetry breaking, probing Higgs naturalness, and phenomenology of new physics.

*** Search for New physics and Collider Phenomenology:**
new approaches to probing new physics, collider constraints and smoking-gun signatures in various new physics models, discriminating different models via collider signatures, new signals and new techniques at future colliders.

研究兴趣：

有效场论和散射振幅：
有效场论的现象学，有效场论与其紫外完备性之间的联系，以及有效场论和粒子物理学中散射振幅的应用。

暗物质、粒子宇宙学和散射振幅中的广义相对论：
探索暗物质的本质和现象学，引力波，早期宇宙中的粒子物理学，以及在广义相对论计算中散射振幅的应用。

电弱对称性破缺：
电弱对称性破缺的模型构建，探索希格斯自然性，以及新物理现象学。

寻找新物理和对撞机现象学：
探索新物理的新方法，对撞机约束和各种新物理模型中的明显迹象，通过对撞机迹象区分不同模型，未来对撞机上的新信号和新技术。

2023 Joined Postdocs

新成员

Jiageng Jiao / 矫佳庚

Graduation school
Academy of Mathematics and System Science, CAS
Research Area
Gravitational Wave Astronomy, Gravity Test

Shuang Wang / 王双

Graduation school
School of Physics Science from UCAS
Research Area
to use optical simulation methods to study the optical properties of general light beams in gravitational wave detection, such as spot size, spot center position, propagation direction, divergence Angle, waist surface position, optimal spot size, optimal rotation Angle, and wavefront errors caused by propagation.

Gong Cheng / 程功

Graduation school
National Astronomical Observatories, CAS
Research Area
Dark Matter Detection
Gravitational Waves from Cosmological First Order Phase Transitions

Visiting Scientists

访问学者

In order to improve the international academic atmosphere of the centre, ICTP-AP has always advocated international exchanges and welcomed visitors from all the world to carry our academic cooperation.

为加强中心国际化建设，提高中心国际化科研氛围，中心长期欢迎访问学者来中心开展学术交流与合作。

A PIFI scientist from Italy visited ICTP-AP in February 2023 and stayed for two months. During his stay, he has interacted with professors of ICTP-AP, delivered academic report in his research area and opened a small class that open to all the students of UCAS. As the first foreign visitor to the centre, this is also Professor Hautmann's first time in China and everything he experienced in China has left a deep impression on him.

2023年2月，来自意大利的PIFI访问学者Francesco对中心进行为期两个月的交流访问。访问期间开展学术讲座，设置研究生小课堂，面向国科大全体学生。作为中心的第一位外国访问学者，这也是Francesco本人第一次来到中国，这里的一切都让他印象深刻。

Andrew Miller

Andrew Miller is a postdoc at the National Institute of Subatomic Physics (Nikhef) and Utrecht University, in the Netherlands, where he works on new probes of dark matter, primordial black holes and neutron stars, as well as on machine learning techniques to mitigate noise disturbances in the LIGO/Virgo data.

Andrew Miller 是荷兰国家亚原子物理研究所 (Nikhef) 和乌得勒支大学 (Utrecht University) 的博士后，主要研究暗物质、原初黑洞和中子星的新探测方法，以及减轻 LIGO/Virgo 数据中噪声干扰的机器学习技术。

Invited by Professor Huaike Guo, Andrew visited ICTP-AP from the end of September to the end of November to collaborate with Prof. Guo on synergies between dark matter and gravitational waves. They are working on the development of a method to search for gravitational waves from so-called "mini-" extreme mass ratio inspirals(mini-EMRIs), a term they coined together earlier, which are hypothetical systems in which an exotic sub-solar mass compact object (e.g. a primordial black hole) orbits around an ordinary 10-100 solar mass compact object or around a neutron star. This is part of the effort, within and beyond the LIGO-Virgo-KAGRA collaborations, to search for subsolar exotic compact objects.

应中心郭怀珂教授的邀请，Andrew于9月底至11月底来中心访问，与郭怀珂合作研究用引力波探测暗物质的工作。他们致力于开发一种方法来探测两人此前提出的所谓“迷你”极端质量比旋进系统辐射的引力波。这种系统由一个亚太阳质量的奇异致密星体（如原始黑洞）围绕一个普通的10-100太阳质量的致密天体或围绕一个中子星旋进。他们的这一工作旨在探测亚太阳质量的奇异致密星体，这是一个在地面引力波探测实验LIGO-Virgo-KAGRA合作组内和组外正在进行的研究方向。

Andrew said that during his stay here, he has had a very nice experience interacting with the scientists here at informal lunches and seminars about a variety of topics. The people here are very welcoming and enjoyable to be around.

Andrew表示，在他访问期间，会在午餐和研讨会上与中心的科学家对不同的话题进行交流和讨论，这种感觉非常好。中心的人员也都非常友好热情。

Visitors

Professor Wei-Tou Ni, from National Tsing Hua University
Post Doctor Teng Ma, from Israel Institute of Technology

Professor Francesco Hautmann, from Oxford University
Professor Francesco Sannino, from Federico II University
Professor John Ellis, from CERN
Professor Yang Bai, from Wisconsin University
Professor Wei-Tou Ni, from National Tsing Hua University
Post Doctor Hongkai Liu, from Israel Institute of Technology
Post Doctor Andrew Miller, from Utrecht University
Professor Imtak Jeon, from Asia Pacific Center for Theoretical Physics

Exchange Students

Undergraduate student Li Feng, from Wuhan University
Undergraduate student Muchun Chen, from Wuhan University
Undergraduate student Dian Jiao, from Nanjing Normal University

ICTP-AP PLATFORM

Taiji Program in Space for Gravitational Universe

Taiji Program in Space Gravitational wave physics 空间太极计划

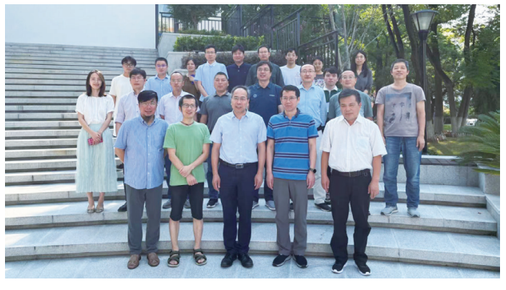
空间太极计划

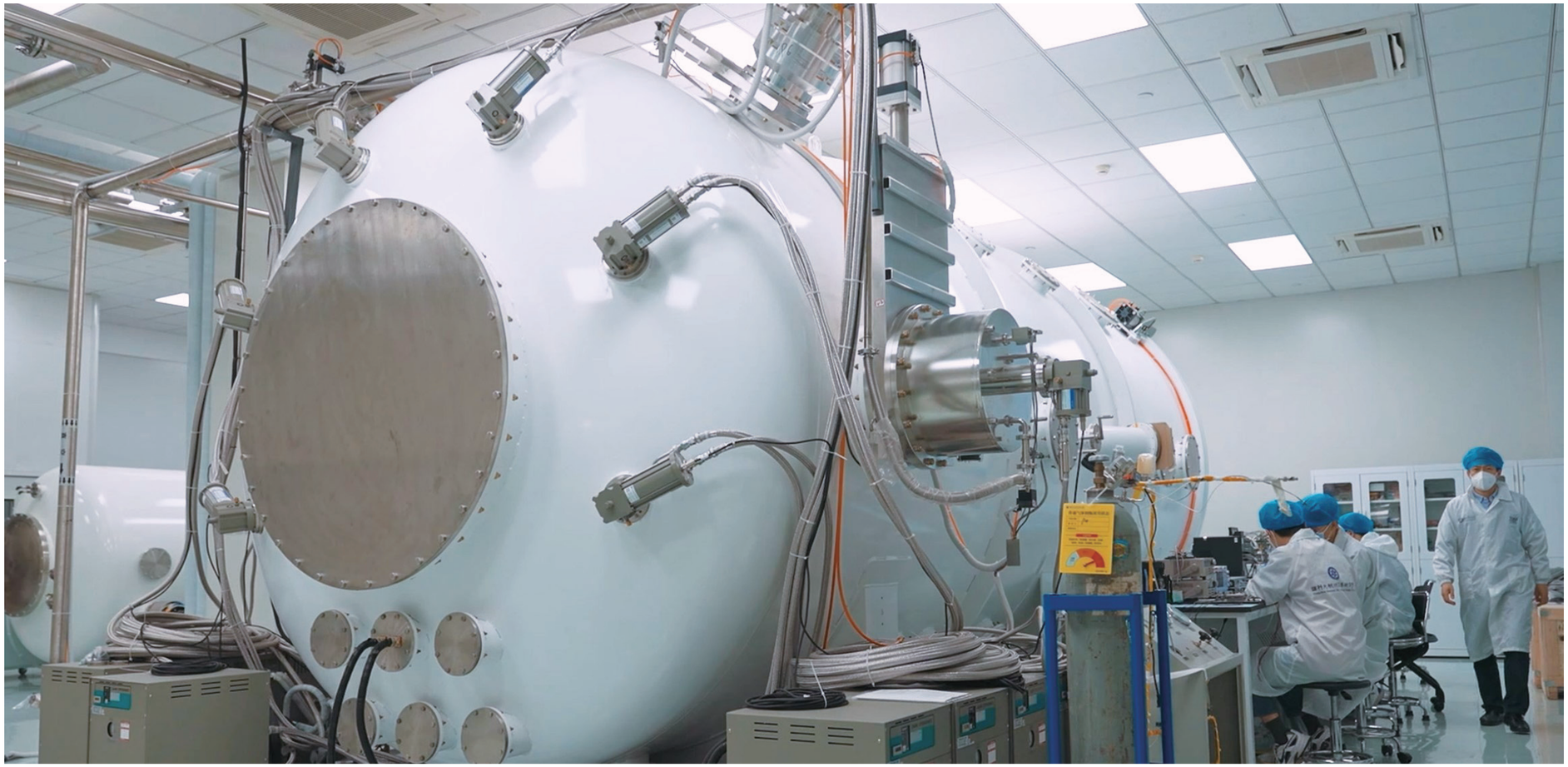
ICTP-AP has led the Research on Spaceborne Frequency-Stabilized Laser Technology and Time Delay Interferometry Technology project, which is a special subject of the GW detection program from the Ministry of Science and Technology. The total fund of the project is 22.75 million yuan and the implementation period is from November 2021 to October 2026. A mid-term exchange conference has been held in Shanghai by ICTP-AP and Shanghai Institute of Optics and Fine Mechanics, CAS on August 10th, 2023. On this meeting, leaders of the program and the subject gave a report on their progress respectively, and experts present at the conference had discussed with them and provided some valuable insights.

In addition, ICTP-AP has received a fund from a special innovation unit program of Fundamental Research Funds for the Central Universities, which is mainly utilized to support the “Taiji Program” through gathering a research team to carry out research on space gravitational wave detection so as to lay a solid foundation for the scientific research of the “Taiji Program”. In 2023, CAS launched the Space Prospecting Series of Scientific Satellites Special Advance Research Project, in which the Laboratory team took the lead in the "Taiji-2 satellite Forward Research", with an implementation period from September 2023 to August 2025, and a total funding of 98 million yuan.

中心牵头科技部“引力波探测”专项“星载激光锁臂稳频技术与时间延迟干涉技术研究”项目，总经费为2275万元，执行期为2021年11月至2026年10月。2023年8月10日下午，中心联合中国科学院上海光机所组织于上海组织召开了“2023年度项目年中交流会”，项目和课题负责人分别作项目研究进展和课题研究进展报告，项目责任专家及领域专家出席讨论并提出了宝贵的建议。

另外，中心获校自主部署创新单元类经费支持，主要针对“太极计划”来建立，凝聚一支空间引力波探测研究团队，开展空间引力波探测相关研究，为“太极计划”的科学产出奠定基础。2023年，中国科学院启动太空探源系列科学卫星攻坚专项预先研究项目，其中实验室团队牵头“太极二号预先研究”，执行年限2023年9月至2025年8月，总经费9800万元。





引力波宇宙太极实验室是“太极计划”的核心支撑平台。太极实验室（杭州）围绕光学干涉技术研发测试、无拖曳技术研发测试、载荷总体集成测试等内容，已建设完成光学干涉技术研发测试平台、空间推进技术研发测试平台、有效载荷地面集成测试平台、弱力测量平台，深空探测平台和公共支撑平台。实验室已投入设备采购金额1.2亿，30万以上设备46台。2023年10月，以太极实验室为基础筹建的浙江省引力波精密测量重点实验室（培育）以优秀的成绩通过验收。

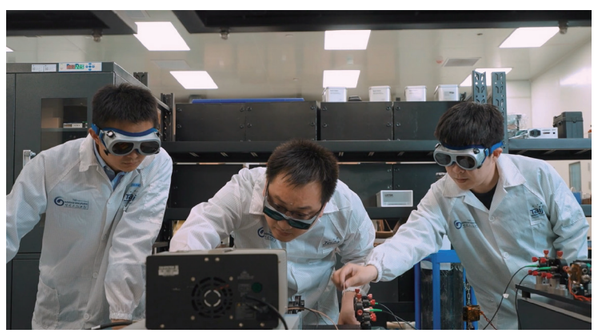
引力波宇宙太极实验室（北京）承担太极计划的科学应用系统建设、预先研究、成果推广、数据管理、论证评估、国际合作、科普公益等工作，为太极项目发展提供科学、技术和管理全面支撑。

Taiji Laboratory for Gravitational Wave Universe

太极实验室

Taiji Lab is the core supporting platform for Taiji Program. Focusing on the development and testing of optical interference technology, drag-free technology, and payloads integration, Taiji Lab（Hangzhou）has completed the research-development and testing platforms for optical interference technology, space propulsion technology, payload ground integration, weak force measurement, deep space exploration and public support. The laboratory has invested 120 million yuan in purchasing equipment, including 46 sets of equipment, which is worth of over 300,000 yuan per set. In October 2023, the Key Laboratory of Gravitational Wave Precision Measurement of Zhejiang Province (Cultivation) built on the basis of Taiji Laboratory passed acceptance with excellent result.

Taiji Lab(Beijing) undertakes the construction of scientific application system of Taiji Program, forward research, data management, evaluation, international cooperation and science popularization, etc. It will provide comprehensive support scientific, technological and management support for Taiji Program.



High-performance Computing Platform

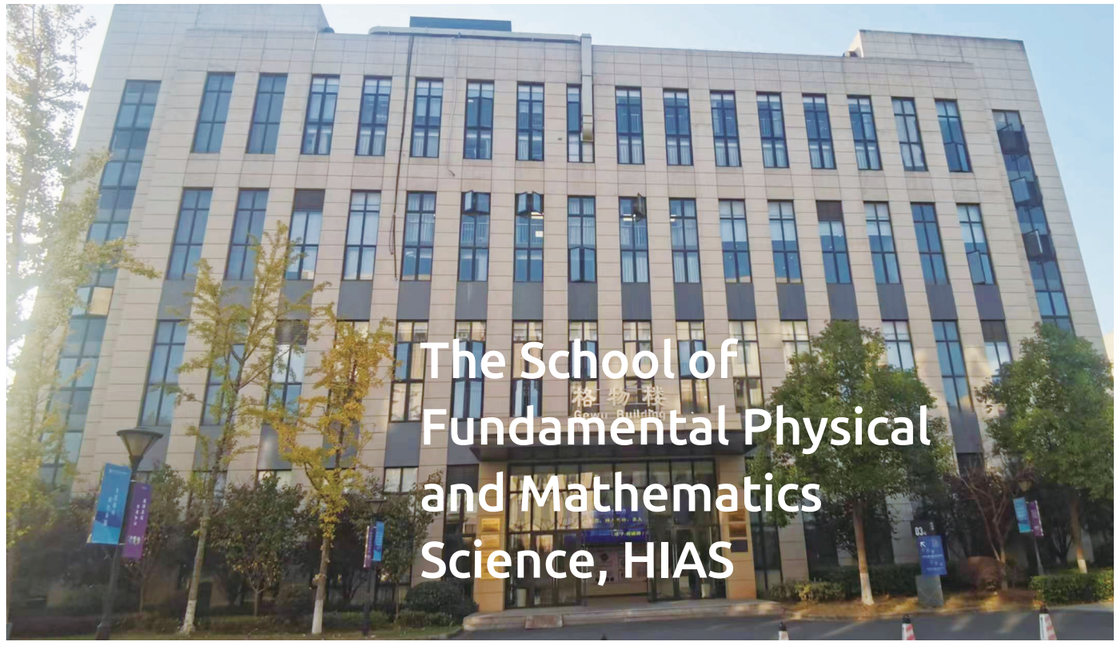
高性能计算平台

Currently, ICTP-AP is equipped with 207 computing nodes for C++, Fortran, and python programming operations. The servers are mainly distributed in Yanqi Lake Campus and Zhongguancun Campus of UCAS.

In order to meet the need of Scientific Application System, ICTP-AP will purchase 50 CPU cluster systems, including 2 physical CPUs, 256 CPU cores, 1TB RAM, 40 GPU systems, including 2 Instinct MI250X GPU cards, one data storage system assembled with 2,048 16TB hard disks for a total of 30 petabytes of storage and 20 workstations, including i7 CPUs, 16G RAM, and 1TB SSDs in the future for the processing of gravitational wave data and data storage so as to ensure the smooth launch of Taiji-2 satellite.

目前，中心配有207个计算节点，用于C++、Fortran以及python的编程运算。服务器主要分布于中国科学院大学雁栖湖校区和中关村校区。

为太极二号的顺利启动，围绕科学应用系统的需求，未来将购置50台CPU集群系统（2颗物理CPU，256个CPU核心、1TB内存）、40台GPU系统（2块Instinct MI250X GPU卡）、1套数据存储系统（装配16TB硬盘2048块，共30PB存储）和20台工作站（i7CPU，16G内存，1TB固态硬盘），用于引力波数据处理和数据存储。



杭高院数理学院

专任教师34人
34 supervisors

在校生93人
93 students

ICTP-AP and ITP, CAS jointly established the School of Fundamental Physical and Mathematics Science, Hangzhou Institute for Advanced Study (HIAS), UCAS in 2019.

As of the end of 2022, there are 34 supervisors, including two CAS academicians and two Distinguished Young Scholars, 27 professors and 6 associate professors. In terms of the student number, there are 93 students including 76 master's degree candidates and 17 doctoral degree candidates.

国科大杭州高等研究院基础物理与数学科学学院（简称“数理学院”）成立于2019年12月28日，由中科院理论物理研究所和联合国教科文组织国际理论物理中心（亚太地区）共同建设。

截至2022年底，有专任教师34人，包括两院院士2人、“杰青”2人；教授（研究员）27人、副教授（副研究员）6人。在校生93人，其中硕士研究生76人、博士研究生17人。

ICTP-AP SEMINARS

ICTP-AP seminars is a weekly activity organized by ICTP-AP. The speakers are invited by the professors of ICTP-AP and they are from distinguished universities and institutes from home and abroad.

中心讨论会每周举行，由中心的教授邀请来自世界各地知名学府和研究所的嘉宾进行学术分享和讨论。

01

March 2, 2023 Low rank 4d N=2 SCFTs

Abstract: We propose a universal formula for the rank of 4d N=2 SCFTs of class S so that a complete search of low rank theories is possible. Various physical quantities of those theories, such as the central charges, flavor symmetry, associated vertex operator algebra and Higgs branch, etc can then be work out explictly. One of interesting consequence of our results are the prediction of many new dualities of 4d theories and isomorphisms of 2d vertex operator algebra.

Speaker: Wenbin Yan

Affiliation: Tsinghua University

02

March 9,2023 Gravitational-Wave Tests of Gravitational Theory

Abstract: The first detection of GWs from binary black hole merger made by LIGO in Spetember, 2015 confirms another important prediction made by GR 100 years ago. Despite all the tests that GR has passed, GR is still inconsistent with quantum mechanics. We will discuss how to test gravitational theories with GW observations in a theory agnostic way, such as constraining extra polarization modes in GWs, graviton mass and parity-violation.

Speaker: Qingguo Huang

Affiliation: Institute of Theoretical Physics, CAS

03

March 16,2023 General Neutrino Interaction in the Neutrino-extended Standard Model Effective Field Theory

Abstract: Neutrino Oscillation is a well-established phenomenon that cannot be explained by the Standard Model (SM), indicating the presence of physics beyond the SM (BSM) in the neutrino sector. The absence of BSM signals at the LHC may indicate that the new physics scale is beyond the kinematic reach of our high energy experiments. Thus, it is crucial to search for new physics without any theoretical bias. In this presentation, I will introduce the Neutrino-Extended Standard Model Effective Field Theory (vSMEFT), which offers a diverse range of phenomenology in both low-energy and high-energy observables. I will further discuss its applications in B meson decay.

Speaker: Hongkai Liu

Affiliation: Israel Institute of Technology

04

March 23, 2023 Phase Transition and Gravitational Waves from Strongly Coupled Dark Matter

Abstract: We go beyond the state-of-the-art by combining first principal lattice results and effective field theory approaches as Polyakov Loop model to explore the non-perturbative dark deconfinement-confinement phase transition and the generation of gravitational-waves in a dark Yang-Mills theory. We further include fermions with different representations in the dark sector. Employing the Polyakov-Nambu-Jona-Lasinio (PNJL) model, we discover that the relevant gravitational wave signatures are highly dependent on the various representations. We also find a remarkable interplay between the deconfinement-confinement and chiral phase transitions. In both scenarios, the future Big Bang Observer and DECIGO experiment have a higher chance to detect the gravitational wave signals.

Speaker: Dr. Zhiwei Wang

Affiliation: University of Electronic Science and Technology of China

05

March 30,2023 Exact Holographic Tensor Networks -- Constructing CFTD from TQFTD+1

Abstract: We propose a class of lattice renormalization group (RG) operators, each operator determined by a topological order T in D+1 space-time dimensions. Eigenstates of the RG operators produce TQFTs / CFTs with categorical symmetry characterized by the TQFT_{D+1}. We give examples in D= 1,2,3. Particularly, at D=2, symmetric CFT's are obtained as phase transition points between topological eigenstates characterized by Frobenius algebra in the TQFT_3. We also show that one can obtain the 3D Ising model as an eigenstate of the RG operator constructed from the Dijkgraaf-Witten Z2 lattice gauge theory in 4D, and numerically search for the critical temperature. We also explore the relation of the RG operator with holographic tensor networks capturing some features of the AdS/CFT correspondence.

Speaker: Lingxin Kong

Affiliation: Tsinghua University

06

April 16, 2023 Dirty gravitational waves

Abstract: The black hole binaries detected so far by gravitational wave detectors have been “clean" sources of gravitational waves: the binary dynamics were solely determined by gravity. Next generation gravitational-wave detectors, such as LISA, will in addition be sensitive to a number of “dirty” sources, affected by matter in their environment. For example, black hole binaries located in active galactic nuclei can be accelerated by the nearby supermassive black hole, or accrete material from its disk. Compact bodies spiralling directly into the supermassive black hole can migrate in the disk, in a way analogous to forming planets. Detecting these effects will add to the complexity of the LISA mission, but could also shed light on the origin of gravitational wave sources.

Speaker: Laura Sberna

Affiliation: Max Planck Institute for Gravitational Physics

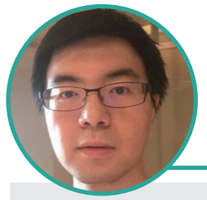
07

April 13, 2023 Emergence and breakdown of semiclassical picture in quasiparticle states

Abstract: Quasiparticles are collective modes in many-body systems that can mimic semiclassical particles under certain circumstances. I will talk about the emergence of semiclassical features in quasiparticle states of quantum spin chains using two quantum information quantities, entanglement entropy and subsystem distance. I will also demonstrate how the semiclassical description fails for a different measure, Shannon entropy.

Speaker: Jiaju Zhang

Affiliation: Tianjin University



08

April 18, 2023 Revising inelastic dark matter direct detection by including the cosmic ray acceleration

Abstract: The null signal from collider and dark matter (DM) direct detector experiments makes the interaction between DM and visible matter too small to reproduce the correct relic density for many thermal DM models. The remaining parameter space indicates that two almost degenerated states in the dark sector, the inelastic DM scenario, can co-annihilate in the early universe to produce the correct relic density. Regarding the direct detection of the inelastic DM scenario, the virialized DM component from the nearby halo is nonrelativistic and not able to excite the DM ground state, even if the relevant couplings can be considerable. Thus, a DM with a large mass splitting can evade traditional virialized DM direct detection. In this talk, we connect the concept of cosmic-ray accelerated DM in our Milky Way and the direct detection of inelastic scattering in underground detectors to explore spectra that result from several interaction types of the inelastic DM. We find that the mass splitting less than about 1 GeV can still be reachable for cosmic ray accelerated DM with mass range from 1 MeV to 100 GeV and sub-GeV light mediator.

Speaker: Chih-Ting Lu

Affiliation: Nanjing Normal University

09

April 20,2023 Integrable boundary states: From quench dynamics to AdS/CFT

Abstract: Integrable boundary states are fascinating quantum states which can be defined for a wide range of integrable models. In the first part of the talk, I will give the definition of integrable boundary states in QFT and then discuss the generalizations to spin chains and 1D Bose gas. I will then discuss their important properties. As an example, I will discuss an intriguing state called crosscap state, which can be defined universally for all the aforementioned models. In the second part of the talk, I will present applications of integrable boundary states. These include quench dynamics in statistical mechanics and the computation of certain correlation functions in AdS/CFT correspondence.

Speaker: Yunfeng Jiang

Affiliation: South-east University

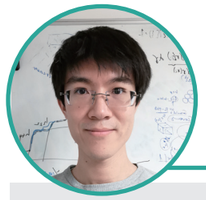
10

April 27, 2023 Supersymmetric black holes beyond indices

Abstract: I will discuss a constructive enumeration of 1/16-BPS states in the maximally supersymmetric Yang-Mills in four dimensions, and search for ones that are not of multi-graviton form. I will show you a handful of such states for gauge group SU(2) at relatively high energies, resolving a decade-old enigma. Along the way, I will prove a non-renormalization theorem about the exactness of the enumeration in perturbation theory under some assumptions. Finally, I will give some preliminary results on the 1-loop anomalous dimensions of near BPS operators at high energies. This could potentially match with the result on the gravity side from the supersymmetric Schwarzian theory.

Speaker: Qiming Zhang

Affiliation: Tsinghua University



11

May 6, 2023 Search for gravitational waves from public LIGO/Virgo data

Abstract: Since their first direct discovery in 2015, gravitational waves have contributed significantly to knowledge about astrophysics and fundamental physics. I will first introduce the Open Gravitational-wave Catalog (OGC) [1], an independent search result using open-source software and public LIGO and Virgo data. Then I will overview the scientific implications of these results and introduce looking for higher-order ringdown mode from the most massive events and its tests of general relativity.

Speaker: Yifan Wang
Affiliation: Max Planck Institute for Gravitational Physics (Albert Einstein Institute)

12

May 25, 2023 Double copy for form factors

Abstract: In this talk, I will show that the double copy picture can be extended to form factors, which are a class of matrix elements involving local gauge invariant operators. This extension reveals two intriguing features. First, certain spurious poles, initially concealed within the gauge form factors, emerge as physical propagators in gravity. Second, these spurious poles reveal new factorization-type relations for form factors. I will also illustrate that this picture is applicable to a broad range of local operators. This talk is based on a series of works with Guanda Lin (2111.12719, 2211.01386, and one to appear).

Speaker: Gang Yang
Affiliation: Institute of Theoretical Physics, CAS

13

June 1, 2023 Gravitational wave astrophysics about super-massive black holes

Abstract: Supermassive black holes (SMBHs) are observed to reside in the center of most galaxies. The fundamental relationship between the SMBHs and their host galaxies indicates common evolution histories. The formation and evolution history of SMBHs is barely known due to the limit of current observations. The formation and merger of SMBH binaries happen as a natural consequence of the merger of their host galaxies. The mechanism that drives the SMBH binary to merge is under debate. The observations of SMBHs and binaries are required to address these problems. I will introduce our recent works on probing the delay time of SMBH binary mergers through future space-based gravitational wave detectors (such as LISA) and on detecting SMBH binaries at sub-parsec separations with VLBI (such as Event Horizon Telescope). The existence of SMBH also influences the dynamical evolution and gravitational radiation of small binaries revolving around it. I will also talk about the relativistic dynamical evolution of a stellar binary in the vicinity of a spinning SMBH, and discuss the characteristic of gravitational waves from this stellar binary excited to the LISA band.

Speaker: Yun Fang
Affiliation: NAOC, CAS

14

June 5, 2023 Characterizing stochastic gravitational waves for space missions

Abstract: Stochastic gravitational waves (GW) will be a target source for the space-borne mission, encompassing the galactic foreground, astrophysical background, and cosmological background. In this presentation, I will discuss our research on the detectability of space missions for stochastic gravitational waves, particularly focusing on the galactic foreground originating from double white dwarf (DWD) binaries. In the case of a single mission such as LISA, a stochastic GW can be distinguished from instrumental noises by combining multiple time-delay interferometry data channels. For the LISA-TAIJI network, the stochastic GW can be characterized by analyzing the correlated signal and eliminating uncorrelated noise between their data.

Speaker: Wang Gang
Affiliation: Shanghai Astronomical Observatory, CAS

15

June 15,2023 The TsT/TTbar correspondence

Abstract: IIB string theory on AdS3 with NS-NS flux admits two CFT descriptions, a WZW model on the string worldsheet, and a holographic dual CFT at the asymptotic boundary. This example of AdS3/CFT2 correspondence allows us to build a class of toy models of holographic dualities beyond the AdS/CFT correspondence by deforming the two CFTs. On the string theory side, we can perform a TsT transformations (T-duality, shift, and T-duality), leading to a new string background that interpolates locally AdS3 in the IR and linear dilaton background in the UV. On the boundary, the holographic dual is conjectured to be a single trace version of TTbar deformation. As supporting evidence, we find a matching of the deformed spectrum, the thermodynamics of black holes, and correlation functions.

Speaker: Wei Song
Affiliation: Tsinghua University

16

June 29,2023 Breaking bad degeneracies with Love relations: Improving gravitational-wave measurements through universal relations

Abstract: The distance-inclination degeneracy limits gravitational-wave parameter estimation of compact binary mergers. Such a degeneracy can be partially broken by including higher-order modes or precession when modeling the waveform of a binary that contains a black hole. But what about binary neutron stars, for which these effects are suppressed? In this talk, I will introduce a new parameterization of the tidal effects in the binary neutron star waveform, exploiting the binary Love relations, that breaks the distance-inclination degeneracy. The binary Love relations prescribe the tidal deformability of a neutron star as a function of its source-frame mass in an equation-of-state insensitive way, and thus allows direct measurement of the redshift of the source. If the cosmological parameters are assumed to be known, the redshift can be converted to a luminosity distance, and the distance-inclination degeneracy can thus be broken. With the distance better constrained, one may also be able to measure the source-frame masses to higher precision. I will demonstrate this new approach with a range of binary neutron-star observing scenarios using Bayesian parameter estimation on synthetic data. In particular, I will give a forecast about when and how much this new approach will improve real gravitational wave measurements of binary neutron stars.

Speaker: Yiqi Xie
Affiliation: University of Illinois Urbana-Champaign

17

June 30,2023 Not Quite Black Holes and Gravitational Wave Echoes

Abstract: Current observations of astrophysical black holes only confirm the GR predictions at the order of the horizon size, with no direct implications regarding physics immediately outside the horizon. On the other hand, near-horizon corrections might be fundamental to understanding the mysterious features of black holes. In this talk, I will discuss the possibility of not quite black holes (horizonless ultracompact objects) being the endpoint of gravitational collapse. I will also introduce a theoretical candidate with interesting implication for black hole physics. Then, I will focus on the smoking gun signal for such objects in general, namely, gravitational wave echoes, which provides an efficient way to probe quantum gravity effects outside of the macroscopic objects. I will talk about the recent progress made in echo searches, in particular the model-agnostic search methods that account for large theoretical uncertainties of the echo waveform.

Speaker: Jing Ren

Affiliation: High Energy Physics Institute of CAS

18

July 24,2023 “QCD-Collapsed Domain Walls”

Abstract: “For a discrete symmetry that is anomalous under QCD, the domain walls produced in the early universe from its spontaneous breaking can naturally annihilate due to QCD instanton effects. We point out that the QCD phase transition within some domains with an effective large QCD theta angle could be a first-order one. This class of domain-wall models predicts an interesting gravitational wave spectroscopy with frequencies spanning more than ten orders of magnitude, from nanohertz to 100 Hz.”

Speaker: Yang Bai

Affiliation: Wisconsin Univ

19

July 26,2023 Effective Field Theories for Electroweak Physics and Dark Matter

Abstract: Early applications of effective field theory is on using chiral Lagrangian to describe experimental results of low energy QCD. In recent years, effective field theories have also been used in phenomenological studies of electroweak physics and dark matter. In this talk, I will discuss some of our recent progress on electroweak precision measurements, dark matter effective field theory, minimal dark matter, composite Higgs, pseudo Nambu-Goldstone dark matter, etc.

Speaker: Honghao Zhang

Affiliation: Sun Yat-Sen University

20

August 29, 2023 Gravitation-Photon Conversion in Atoms and Extremely High Frequency Gravitational Wave Detections

Abstract: Graviton-Photon conversion (GRAPH) is an important method to detect high-frequency gravitational waves (HFGW), the basic formalism and applications will be introduced in this talk. From graviton to photon conversion (G to P), we present key features of GRAPH in a static transverse background of eletric or magnetic field; then we derive the cross section of graviton-atom interaction in a background of spherical electric field, the result makes it possible to catch MeV level gravitons from the unverse with current or upgraded neutrino facilities; we will also discuss about corresponding atrophysical souces and the limitation on their properties. From photon to graviton conversion (P to G), we introduce an experiment using entangled photon pairs with one beam of them passing through a magnetic tunnel, to examine the energy quantization of gravitational field by counting missing photons.

Speaker: Gui-Rong Liang

Affiliation: Southern University of Science and Technology

21

September 7, 2023 Effective Field Theories: Effective Pathway to New Physics

Abstract: The null results of the LHC BSM searches suggest a paradigm shift from model building to effective description. At the same time, intensity frontier data offer low energy probe of new physics. Effective field theories at different scales: SMEFT, HEFT, LEFT, ChPT, nuclear EFT, etc should be utilized with matching and running to avoid large Log among scales. I will talk about all these EFTs, along with examples on B/L and CP fundamental symmetries. Then I will focus on how EFTs help organize and identify various new physics resonances at future colliders, the EFT inverse problem.

Speaker: Jianghao Yu

Affiliation: Institute of Theoretical Physics, CAS

22

September 14, 2023 Gravitational waves from phase transitions during inflation

Abstract: The large excursion of the inflation may trigger phase transitions in the spectator sector that couples to the inflation field. Such phase transitions can produce gravitational waves. In this talk, I will discuss the properties of the gravitational waves produced in this way. I will discuss both first- and second-order phase transitions. The phase transitions during inflation can also produce large curvature perturbations, which will lead to secondary gravitational waves after inflation. I will show that it is possible to use the secondary gravitational waves produced in this way to explain the gravitational wave signals observed recently by pulsar timing array collaborations.

Speaker: Haipeng An

Affiliation: Tsinghua University

23

September 20,2023 Stasis in an Expanding Universe: Overview, Concrete Realizations, and Observational Consequences

Abstract: One signature of an expanding universe is the time-variation of the cosmological abundances of its different components. For example, a radiation-dominated universe inevitably gives way to a matter-dominated universe, and critical moments such as matter-radiation equality are fleeting. In this talk, we point out that this lore is not always correct, and that it is possible to obtain a form of “stasis” in which the relative cosmological abundances \Omega_i of the different components remain unchanged over extended cosmological epochs, even as the universe expands. Moreover, we demonstrate that such situations are not fine-tuned, but are actually global attractors within certain cosmological frameworks, with the universe naturally evolving towards such long-lasting periods of stasis for a wide variety of initial conditions. The existence of this kind of stasis therefore gives rise to a host of new theoretical possibilities across the entire cosmological timeline, ranging from potential implications for primordial density perturbations, dark-matter production, and structure formation all the way to early reheating, early matter-dominated eras, and even the age of the Universe.

Speaker: Dr. Fei Huang

Affiliation: Weizmann Institute of Science (WIS)

24

September 21, 2023 Holographic QCD - baryons and nuclei from solitons

Abstract: In this talk, I will motivate strongly coupled physics using the holographic principle and in particular QCD, which is known to be notoriously difficult at low energies. Using Weinberg's principle of symmetries, a short review of the chiral Lagrangian and its relation to the Skyrme model, we review the emergence of the baryons as instantons in the Witten-Sakai-Sugimoto model and their relation to Skyrmions in the chiral Lagrangian-type theories. We further discuss the various limits of the Sakai-Sugimoto model at small and large 't Hooft coupling and how the model can be put on the same footing as a much simpler hard-wall model. We then discuss the problem of many baryons, corresponding to the multi-instantons case and how it may be approximated by a homogeneous Ansatz in the limit of finite/large baryon densities. We also comment on relations to other models and how the strong dynamics essentially is encoded into the background geometry of Yang-Mills-Chern-Simons-type theories.

Speaker: Prof. Sven Bjarke Gudnason

Affiliation: School of Mathematics and Statistics of Henan University.

25

September 22, 2023 PycWB: A Python Gravitational Wave Unmodelled Search Pipeline for Machine Learning Era

Abstract: Unmodelled searches and reconstruction is a critical aspect of gravitational wave data analysis, requiring sophisticated software tools for robust data analysis. In this talk, I will introduce PycWB, a user-friendly and modular Python-based framework developed to enhance such analyses based on the widely used unmodelled search and reconstruction algorithm Coherent Wave Burst (cWB). The PycWB architecture facilitates efficient dependency management and the use of parallel computation for performance enhancement. Moreover, the use of Python harnesses its rich library of packages, facilitating post-production analysis and visualization. The PycWB framework is designed to improve the user experience and accelerate the development of unmodelled gravitational wave analysis in machine learning era.

Speaker: Yumeng Xu

Affiliation: University of Zurich

26

September 27, 2023 Probing the Supersymmetric Grand Unified Theories at the Future Proton-Proton Colliders and Hyper-Kamiokande Experiment

Abstract: Particle physics studies elementary particles and the fundamental interactions between them. There are four fundamental interactions in nature: gravitational, strong, weak, and electromagnetic interactions. The Standard Model of Particle Physics describes the main phenomena other than gravity and is confirmed by current experiments. But in order to explain new physics beyond the Standard Model, we need to expand it. At the same time, the quest for naturalness, beauty, and simplicity of pure theory leads us to the construction of supersymmetric grand unification models, which describe in a unified way elementary particles and their strong, weak, and electromagnetic interactions and predict proton decay. We propose to utilize future proton-proton collider experiments such as FCC_{hh} and SppC and proton decay experiments such as the Hyper-Kamiokande experiment to explore the supersymmetric grand unified theory and provide a concrete scientific goal for these experiments.

Speaker: Tianjun Li

Affiliation: Institute of Theoretical Physics, CAS

27

October 11, 2023 Continuous gravitational-wave probes of neutron stars and dark matter

Abstract: The third observing run of advanced LIGO, Virgo and KAGRA brought unprecedented sensitivity towards a variety of quasi-monochromatic, persistent gravitational-wave signals. Continuous waves allow us to probe not just the existence of asymmetrically rotating neutron stars, but also different forms of dark matter, thus showing the wide-ranging astrophysical implications of using a relatively simple signal model. I will describe the major results from searches for neutron stars and dark matter that were performed in O3, and demonstrate the synergies between these fields.

Speaker: Andrew Miller

Affiliation: National Institute of Subatomic Physics (Nikhef) and Utrecht University

28

October 19,2023 “Was There an Electroweak Phase Transition?”

Abstract: The possible existence of beyond Standard Model physics at the TeV scale or below has important implications for the thermal history of electroweak symmetry-breaking. A first order phase transition -- not possible in the minimal Standard Model with a 125 GeV Higgs boson -- would provide the preconditions for electroweak baryogenesis and the generation of primordial gravitational radiation. I discuss recent developments in assessing this possibility that rely on the combination of EFT methods and non-perturbative (lattice) computations. I also discuss implications for high energy collider phenomenology and next generation gravitational wave searches.

Speaker: Michael Ramsey-Musolf

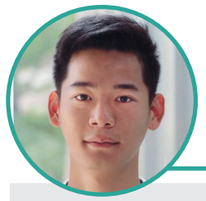
Affiliation: Tsung-Dao Lee Institute/Shanghai Jiao Tong University; the University of Massachusetts Amherst.

29

October19,2023 Entanglement Hamiltonians: Probing Topological Phenomena with Quantum Information Insights

Abstract: In recent years, the interplay between quantum information theory and condensed matter physics has yielded profound insights into the nature of topological phases of matter. This talk delves into the pivotal role played by the entanglement Hamiltonian in unraveling emergent topological phenomena. I will discuss two of my recent works: (1) arXiv 2211.04510, which discusses a conjecture for extracting topological invariants from commutators of the entanglement Hamiltonian; and (2) arXiv 2310.01475, presenting a generalization of the Lieb-Schultz-Mattis Theorem to open quantum systems, where the entanglement Hamiltonian emerges as a natural successor to the physical Hamiltonian.

Speaker: Yingfei Gu
Affiliation: Tsinghua University



30

October 26, 2023 Black holes, wormholes and firewalls

Abstract: The study of black hole system has been a major focus of quantum gravity researchers. It serves as a valuable theoretical laboratory for testing our understanding of general relativity and quantum mechanics, and more fundamentally, the connection between spacetime and quantum entanglement. Recent years, significant progress has been made with the development of a simple holographic model that is called the Sachdev-Ye-Kitaev (SYK) model. We will review the duality between SYK model and Jackiw–Teitelboim (JT) gravity, which governs the gravitational dynamics of near-extremal black holes, including numerical simulations of SYK correlators dominated by gravitational effects. This talk will then be followed by a discussion of recent theoretical advances on black hole physics based on the SYK/JT duality, including the traversable wormhole protocol, the Page curve of Hawking radiation, and the formation of firewalls in black hole typical states due to large baby universe emission process. We will emphasize on the role of spacetime wormholes in these developments.

Speaker: Zhenbin Yang
Affiliation: Tsinghua University

31

October 30, 2023 Strong Gravity Frontier of Particle Physics

Abstract: In the vicinity of black holes, particle density can significantly increase, acting as efficient transducers. This is evident in the superradiant generation of ultralight bosons, which can attain Planck-scale field values. Within this dense boson environment, we witness the occurrence of non-perturbative particle production—a phenomenon previously associated primarily with the early-universe cosmology. Additionally, particle dark matter can accumulate outside black holes forming spike structures. This talk will explore their impact on various observational channels associated with black holes, such as the high-energy neutrino observatories and Event Horizon Telescope.

Speaker: Yifan Chen
Affiliation: Niels Bohr Institutes, University of Copenhagen

OUTREACH ACTIVITIES

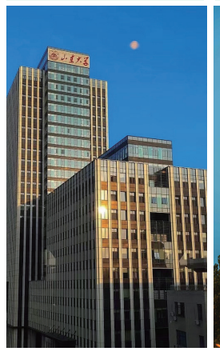
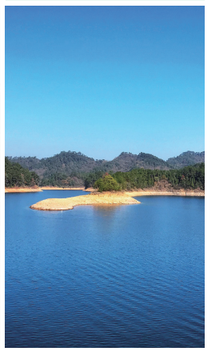
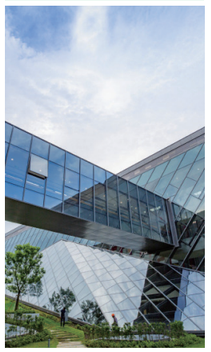
The year 2022 to 2023 marked the International Year of Basic Sciences for Sustainable Development (IYBSSD), which is designated by the United Nations (UN) to stress the significance of basic sciences.

Over the year 2022 to 2023, ICTP-AP has organized a large Forum on Frontiers of Quanta to Cosmos, with six sub-forums focused on Particle Physics and Origin of Matter, Unified Field Theory and Origin of Universe, Dark Universe and Black Hole Physics, Nuclear and Plasma Physics, Gravitational Waves and Precision Measurement Physics, and Fundamental Physics and Quantum Century respectively being held across China.

2022 2023
IYBSSD
International Year of Basic Sciences for Sustainable Development

联合国为肯定基础科学的重要性，决定将2022-2023年定为国际基础科学促进可持续发展年（IYBSSD）。

自2022至2023年间，中心在中国各地举办量子-宇宙物理前沿论坛和分论坛。分论坛的主题分别是粒子物理与物质起源，统一场论和宇宙起源，暗宇宙和黑洞物理，核与等离子体物理，引力波和精密测量物理，基础物理和量子世纪。

Qingdao (120°33E，36°07N)	Beijing (116°20E，39°56N)	Changsha (112°59E，28°12N)	Hangzhou (120°12E，30°16N)	Suzhou (120°58E，31°30N)
				

Qingdao

青岛站

The sub-forum themed on “Gravitational Wave and Precision Measurement Physics” and “Dark Universe and Black Hole Physics” has been successfully held in Shandong University (Qingdao Campus) in March,2023, and it has been broadcasted live on several online platforms, with over 400,000 audience watching online.

2023年3月，分论坛“引力波与精密测量”，“暗宇宙与黑洞物理”在山东大学（青岛）校区成功举办。该论坛在线上全程直播，吸引40万以上人次观看。

Beijing

北京站

The Frontiers of Quanta to Cosmos Physics Forum was held in Yanqi Lake Campus of UCAS on 21st March, 2023. ICTP-AP has invited two CAS Academicians Bingsong Zou and Baonian Wan to deliver academic reports in nuclear and plasma physics so as to attract more young talents to devote themselves into the research of this field.

2023年3月21日，“基础科学国际年”中国活动之“从极小量子粒子到极大膨胀宇宙”量子-宇宙物理系列前沿论坛在中国科学院大学雁栖湖校区举行。论坛邀请邹冰松、万宝年两位院士带来有一定科普性质的报告，以期更广泛的受众群提升对核与等离子体物理的理解，吸引更多青年学子投身相关领域的研究。

Changsha

长沙站

Another sub-forum with the theme of “Particle Physics and Origin of Matter” has been successfully held in Hunan University in the city of Changsha, Hunan Province on April 16th, 2023. The intriguing speeches delivered by the scientists has attracted over 320,000 audience watching online and offline.

Among the audience, there is a group of high-school students who are curious about the mysterious universe and they were deeply touched by the world of physics depicted by the scientists. Professors also shared their own experience with the students and encouraged them to pursue their science dreams.

2023年4月16日，以“粒子物理与物质的起源”为主题的分论坛在湖南省长沙市湖南大学成功举办。科学家们在现场的报告妙趣横生、引人入胜，吸引32万余人次线上线下观看。

此次论坛还邀请了一群满怀好奇的高中生。他们对科学家们所描述的科学世界充满无限向往。教授们通过自己的人生经历，鼓励学生持之以恒，勇敢地追逐他们的科学梦。

Meeting in Hangzhou

相约杭州

The Asia-Pacific School and Workshop on Gravitation and Cosmology (APSW-GC) has been held in the “Eco·Economy” Senior Talent Hub by the side of beautiful Qiandao Lake in Chun’an County, Hangzhou in this May. Over ten invited foreign physicists coming from afar and giving lectures on gravity cosmology.

This event provided a platform for the experts and scholars from China and overseas to exchange their academic ideas with each other so as to promote the academic cooperation among scientists and the training of graduate and doctoral students in the Asia-Pacific Region in the field of gravitation and cosmology.

今年5月，亚太地区引力与宇宙学学校在景色宜人的杭州市千岛湖“两山基地”成功举办。十多位来自全球各地的物理学家齐聚此地，共享一场物理学盛宴。

专家学者们借此契机，探讨学术观点，促进了学术交流与合作。此次活动也是对亚太地区引力和宇宙学领域的高层次人才培养的助力。

Asia-Pacific School and Workshop on Gravitation and Cosmology

Suzhou

苏州站

The last sub-forum of the Frontiers on Quanta-Cosmos Physics Forum has been successfully held in Nanjing University (Suzhou Campus) on October 24th, 2023.

Director of the research centre for the history of science and technology from Nankai University Baichun Zhang, Professor Shiyu from University of Chinese Science and Technology, Professor Hui Liu, Vice President of the School of Physics from Nanjing University, and CAS academician Yueliang Wu from UCAS have delivered wonderful and insightful speeches at the forum, attracting thousands of viewers online and offline.

2023年10月24日，量子宇宙物理前沿论坛最后一场分论坛在南京大学苏州校区举办。

本次论坛邀请了来自南开大学科学技术史研究中心主任张柏春，中国科技大学教授施郁，南京大学物理学院副院长刘辉，国科大学术副校长吴岳良进行精彩的报告。此次论坛以线上线下相结合的方式召开。

Meeting Nobel Prize Winner Online

与诺奖得主相约云端

The Nobel Prize Winner Lecture, sponsored by the China Education Association for International Exchange (CEAIE) and co-organized by the ICTP-AP and other organizations, were held online.

2023年3月，由中国教育国际交流协会主办，国际理论物理中心（亚太地区）等单位协办的诺奖大师讲座在线上举办。

The invited speaker is Giorgio Parisi, an Italian Physicist and Nobel Prize in Physics 2021 winner, who is known as “the most creative and influential theoretical physicist”. His research area is quantum field theory, statistical mechanics and complex system. The topic of his speech is Cross-scale “complex system”: Explore the simplest scientific laws in the world.

此次讲座的嘉宾——乔治·帕里西（Giorgio Parisi），意大利理论物理学家，2021年诺贝尔物理学奖获得者，被誉为“近几十年来最具创造力和影响力的理论物理学家之一”。主要研究领域是量子场论、统计力学以及复杂系统。他的演讲主题是：跨尺度“复杂系统”：谈略世界中最简科学规律。

TOPAC 2023:

The Topics of Particle, Astro and Cosmo Frontiers was held in the Tsung-Dao Lee Institute (TDLI) of Shanghai Jiao Tong University from 2nd to 4th June, 2023. Huaike Guo, the assistant professor of ICTP-AP was one of the organizers of the seminar.

2023年6月2日至4日，粒子物理、天体和宇宙学前沿课题研讨会（TOPAC: Topics of Particle, Astro and Cosmo Frontiers）在上海交通大学李政道研究所举行。中心郭怀珂副教授是此次论坛的召集人之一。

World Laureates Forum

世界顶尖科学家论坛

The sixth World Laureates Forum (WLA) was held on 6th-8th November in Shanghai. Themed "Science Leads Transformation", this year's forum will focus on promoting high-level dialogue between scientists and advocating for scientific and technological innovation as a means of exploring future development strategies. Professor Yue-Liang Wu was invited to attend the forum and joined in the round table discussion.

11月6日-8日，第六届世界顶尖科学家论坛在上海开幕。本届顶科论坛以“科学引领变革，重塑世界韧性”为年度主题，邀请全球科学家共同探索未来发展方略。中心主任吴岳良受邀参加此次论坛，并进行圆桌讨论。

Chinese-Foreign Center for Civilization and Cultural Exchange

中外文明与文化交流中心

The Chinese-Foreign Center for Civilization and Cultural Exchange of UCAS was unveiled in September, marking the beginning of a new chapter in cultural integration.

Yueliang Wu, director of ICTP-AP, attended the ceremony and expressed high expectations for the Chinese-Foreign Center for Civilization and Cultural Exchange, hoping that it would become a significant platform for international cultural exchange between Chinese and foreign students, thereby contributing to the “Belt and Road Initiative” and the building of a community with a shared future for mankind.

中国科学院大学中外文明与文化交流中心揭幕仪式在今年九月份举行，标志着文化融合的崭新篇章正式拉开序幕。

中心主任吴岳良出席揭牌仪式，并对国际交流平台中外文明与文化交流中心寄予厚望，期望它成为中外学生国际文化交流的重要舞台，助力国家“一带一路”倡议及人类命运共同体建设。

Workshop on Multi-front Exotic phenomena in Particle and Astrophysics (MEPA 2023)

Workshop on Multi-front Exotic phenomena in Particle and Astrophysics (MEPA 2023) focused on the latest theoretical achievements and specialized discussions in the fields of axions, dark photons, fractionally charged particles, magnetic monopoles, and other exotic particles, which are at the forefront of new physics. It will also encompass comprehensive overviews of cutting-edge experimental progress and technical discussions.

Huaike Guo, was invited to give a report on the (Non-)Topological Solitons: Detection with Gravitational Waves at the workshop. This workshop is conducted off line, hosted at a scenic lakeside hotel in Chaohu, Hefei and its aim is to promote research and academic exchanges in interdisciplinary areas such as particle astrophysics, cosmology, and the study of dark matter candidates beyond the standard model.

MEPA2023聚焦于轴子、暗光子、分数电荷粒子与磁单极子等新物理前沿理论与实验研究方向的最新理论成果综述与专题讨论、前沿实验进展综述与实验技术研讨。

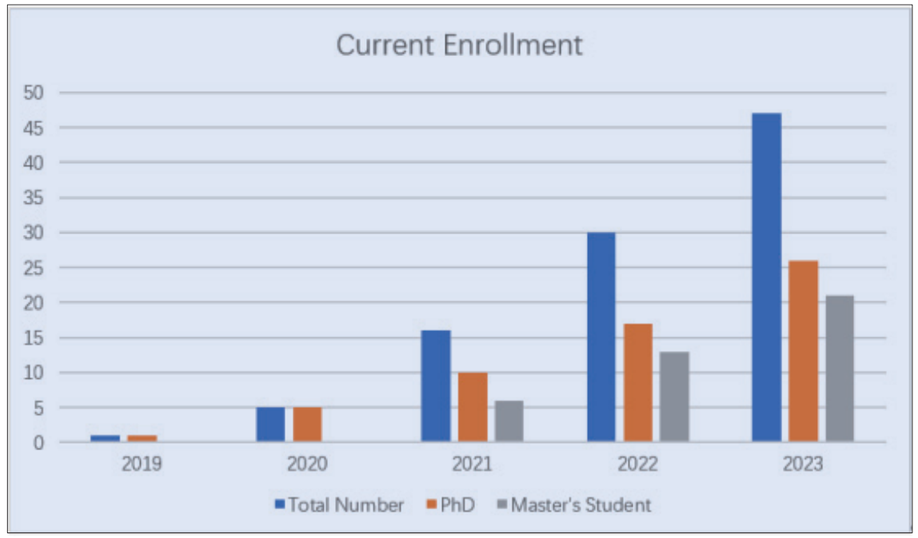
中心助理教授郭怀珂受邀参加此次研讨会，并发表报告。此次研讨会采用线下会议形式，旨在推动粒子天体物理宇宙学等相关交叉方向、暗物质候选粒子等超越标准模型新物理课题的研究与学术交流。

Talent Cultivation
群英荟萃

Student Enrollment
招生

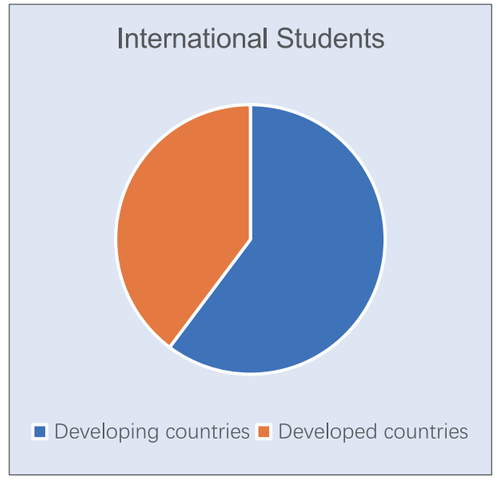
The scale of students has increased year by year and the total number has reached 43. In 2023, ICTP-AP has enrolled 17 graduate students, including nine PhD students and eight master's students, and the recommended student ration has reached 88%. All of them are all top students selected from most prestigious universities across the country.

目前，中心的在校生人数已达到48人。其中，2023年，中心共招收17名研究生，其中博士生9名、硕士生8名。推免生比例达到88%。这些学生均是来自全国知名学府的佼佼者。



As a Category 2 centre of UNESCO, we have been actively playing our role in the cultivation of talents in under-developed countries and regions. In 2023, ICTP-AP and the International College of UCAS have jointly cultivated a total of 2,004 international students from 100 countries around the world with over 60% overseas students coming from developing countries, and the number of doctoral students has reached 1,276 this year with a 10% year-on-year increase.

作为联合国教科文组织的二类机构，我们一直关注欠发达国家和地区人才的培养。2023年，中心与国科大国际学院联合培养的国际生共2004人，来自100个国家，其中，来自发展中国家的学生占留学生总人数60%以上；今年，博士研究生在读人数达到1276人，同比增长10%。



Spring School for International Students

留学生春季学校

ICTP-AP co-hosted the 2023 Spring School on Frontier and Interdisciplinary Sciences for the Overseas Students in IC-UCAS with the Hangzhou Institute for Advanced Study (HIAS) in May at HIAS, with over 40 international students from more than ten countries and various disciplines participating in the program.

今年5月，中心与杭高院共同承办中国科学院大学国际学生前沿与交叉科学春季学校。来自十几个不同国家，不同专业背景的留学生积极报名参加此次活动。

Aside from the lectures given by professors, students also visited some labs at HIAS, such as Taiji Laboratory, Liangzhu Museum and Huanglong Sports Centre which is an Asian Games venue. Students not only gained interdisciplinary knowledge in this Spring School, but also learned about the cultural, historic and economic development of the beautiful city of Hangzhou.

此次春季学校日程包括讲座和参观。学生们参观了杭高院校园内的实验室，比如太极实验室，良渚博物馆和亚运会场馆之一——黄龙体育馆。不仅丰富了学生们跨科学的知识，还让他们加深了对杭州这座城市的历史文化和经济发展。

2023 ICTP-AP Summer School

夏季学校

2023 ICTP-AP Summer School was held from June 30th to July 3rd in Beijing. Over forty students coming from 21 different universities came to Beijing for this activity. During this four-day-long activity, students had a better understanding of ICTP-AP, UCAS and communicated with their ideal supervisors face-to face.

2023年6月30日至7月3日，中心在北京举行优秀学生夏令营。来自全国21所高校的40多名学生慕名而来，与中心各位导师面对面近距离交流，深入了解国科大国际理论物理中心（亚太地区）。

ICTP-AP also arranged a campus tour on Yanqi Lake Campus and a group discussion at the end of the day. This special experience would become an invisible treasure for them in their college life and inspire them to continue their pursuit in excellence.

中心还为同学们安排了雁栖湖校区校园观光日，观光结束后，学生们分组展开一场精彩的讨论。相信此次特殊的经历将成为他们大学生涯中一份无形的财富，鼓励着他们不断追求卓越。

Under the Moon

情满中秋

ICTP-AP held a celebration party for students from home and abroad to observe the Mid-Autumn Festival this September at Zhongguancun Campus, over thirty students signed up for the event and actively took part in this activity.

Thanks to this activity, students got to take a break from the digital world and travelled back to thousand years ago to experience the romance of ancient Chinese people. Students from ICTP-AP also enjoyed this activity and they felt more connected to each other after the celebration party.

今年9月，中心在中关村校区举办中秋联欢会，面向国内外学生。30多名学生积极报名参加此次活动。

此次活动内容形式丰富多彩，妙趣横生。中外学生，放下电子设备，携手穿越千年，沉浸式参与体验民俗文化，感受古人的浪漫情怀。

2023 Track and Field Games

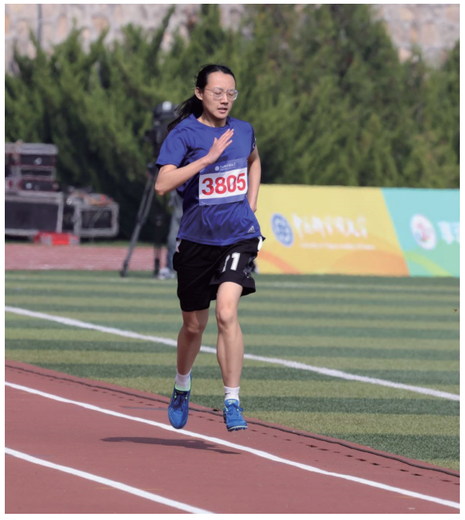
田径运动会

The 2023 Track and Field Sports Game was held on October 13th to 14th,2023. This year, ICTP-AP made its debut at the opening ceremony with 15 faculty including professors, postdocs and administrative staff and 20 students walking in the square team.

2023年田径运动会在10月13日举行。今年，中心方阵首次亮相开幕式。方阵由15名教职工和20名学生共同组成。

Athletes of ICTP-AP spared no effort in their games and has won prizes for the center. Dr. Yinghui Liu has won the third prize in long jump and postfoc Shuang Wang has won the champion of the 100 final, breaking the record of UCAS and Dr. Haihong Jia ranked the eighth in the long jump. What's more, the student of ICTP-AP, Qiyan Zhang has won the champion of the 400 meters final and broke the record of UCAS.

中心运动员在比赛中斩获佳绩。刘颖慧博士在立定跳远项目中获得季军，王双博后在100米决赛中拿下冠军，并打破学校记录。中心硕士生张琪琰在女子400米决赛中斩获冠军，并打破学校记录。



Taiji Lab has launched a program called Taiji Data Challenge in 2022 for those who are enthusiastic about data science and programming, aiming to inspire innovative thinking and problem solving through simulated data. This year, we have launched a new serial activity called Taiji Data Workshop. Gravitational Wave Data Exploration: Programming and Analysis Workshop is the first program of the event, which is expected to cultivate more high-quality talent who can participate in the Space-based GW detection deeply through weekly practice and in-depth discussion.

2022年，太极实验室向广大数据科学和编程爱好者推出了挑战性项目《太极数据挑战》（Taiji Data Challenge），旨在通过模拟数据激发大家的创新思维和解决问题的能力。今年，我们全新推出了《太极数据讲习班》（Taiji Data Workshop）系列活动，作为首期项目，《引力波数据探索：编程与分析实战训练营》期待通过每周的实战练习和深度讨论，培养更多能够深入参与空间引力波探测项目，以及相关领域研究的高质量后备人才。

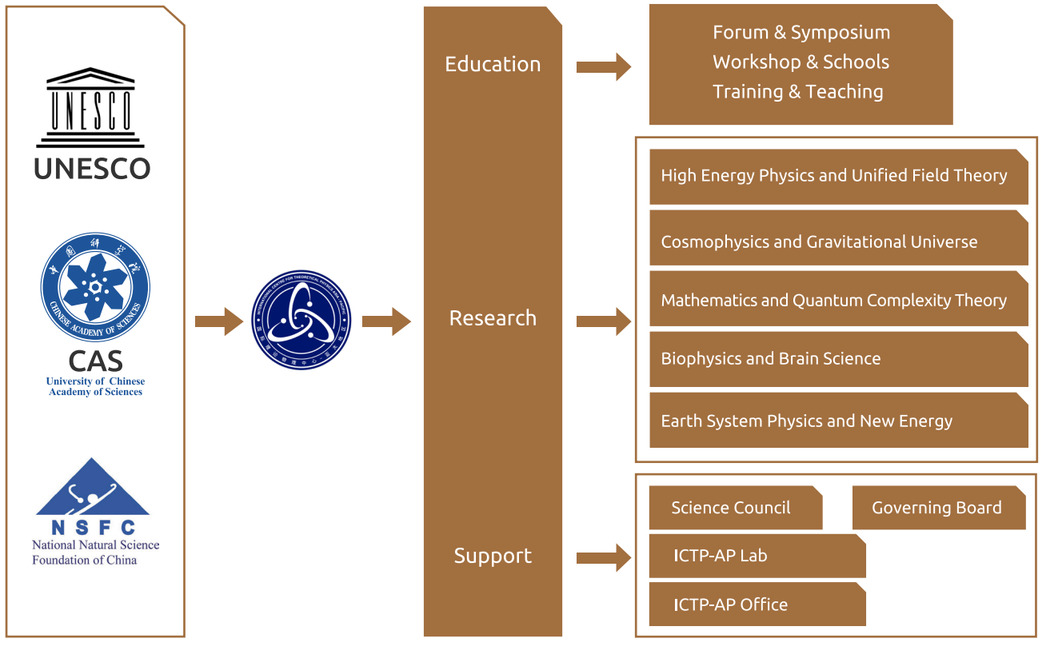
Governance
组织机构

ICTP-AP will organize governing board meeting regularly to give a report on its annual working progress and submit its development plan for the next stage and the Governing Board is composed of the leaders from UCAS, ICTP, bureau of International Cooperation of CAS, NSFC and UNESCO office in Beijing.

ICTP-AP also has an International Science Council, which is composed of experts and scholars from the world to provide academic guidance for the centre. These experts are experienced in high-level scientific research and international exchange, they will work with ICTP-AP to promote the cooperation and exchange between ICTP-AP and other international institutes.

中心定期召开理事会会议，进行工作汇报和总结，提出下一阶段发展计划。理事会成员由国科大，国际理论物理中心，中国科学院国际合作局，联合国教科文组织驻京办事处、国家自然科学基金委员会和中心领导共同组成。

中心设立国际科学委员会对中心进行学术指导。学术委员会委员由来自世界各地在基础科学领域有丰富科研经理和国际交流经验的专家和学者组成，国际科学委员会和中心一起携手促进中心与其他国际机构的合作。



Scientific and Administrative Staff
科学及行政人员

DIRECTOR

Yueliang Wu

VICE DIRECTOR

Song He

Office Director

Min Zhang

ADMINISTRATIVE PROFESSIONAL STAFF

Executive Secretary, Jiejin Zhao

Media and Liaison Secretary, Fanzi Meng

Scientific Research Program Secretary, Yinghui Liu

Students Affair Secretary, Le Zhang

Projects Supporting Secretary, Haihong Jia

Associate Professor

Jun Nian

Jun Zhang

Huaike Guo

Teng Ma

Postdoctoral Fellow

Yutong Wang	Yuan Zhong
He Wang	Jiageng Jiao
Ju Chen	Shuang Wang
Jing Liu	Gong Cheng

Research Assistant

Jiahang Hu

Jibin He

Rafia Waqar

Partners
合作伙伴

Academy of Mathematics and Systems Science, CAS

Asia-Pacific Center for Theoretical Physics, Korea

Bureau of International Cooperation, CAS

Changchun Institute of Optics, Fine Mechanics and Physics, CAS

China Jinping Underground Laboratory

Chinese Society of Space Research

Hangzhou Institute for Advanced Study of UCAS

Hunan University

Innovation Academy for Microsatellites of CAS

Innovation Academy for Precision Measurement Science and Technology, CAS

Institute for the History of Natural Sciences, CAS

Institute of High Energy Physics of CAS

Institute of Mechanics, CAS

Institute of Physics, CAS

Institute of Theoretical Physics of CAS

Nanjing University

National Astronomical Observatories, CAS

National Natural Science Foundation of China

National Space Science Center, CAS

Shandong University

Shanghai Astronomical Observatory, CAS

Shanghai Institute of Optics and Fine Mechanics, CAS

University of Chinese Academy of Sciences

Zhejiang University of Technology

Publications

SCI

01	Taiji data challenge for exploring gravitational wave universe, Ren Zhixiang, et al., FRONTIERS OF PHYSICS, 2023 18 6 64302
02	Custodial symmetry violation in scalar extensions of the standard model, Song Huayang, et al., CHINESE PHYSICS C, 2023 47 10 103103
03	Algorithm for symbol integrations for loop integrals, He Song, et al., PHYSICAL REVIEW D, 2023 108 4 L041702
04	Space-based gravitational wave signal detection and extraction with deep neural network, Zhao Tianyu, et al., COMMUNICATIONS PHYSICS, 2023 6 1 212
05	A Systematic Approach for Inertial Sensor Calibration of Gravity Recovery Satellites and Its Application to Taiji-1 Mission, Zhang Haoyue, et al., REMOTE SENSING, 2023 15 15 3817
06	Emergent unitarity, all-loop cuts and integrations from the ABJM amplituhedron, He Song, et al., JOURNAL OF HIGH ENERGY PHYSICS, 2023 7 212
07	Unitarity bounds on extensions of Higgs sector, Lu Bo-Qiang, et al., JOURNAL OF HIGH ENERGY PHYSICS, 2023 6 209
08	Implication of the island rule for inflation and primordial perturbations, Piao Yun-Song, PHYSICAL REVIEW D, 2023 107 12 123509
09	Ξc - Ξ′ c mixing from lattice QCD, Liu Hang, et al., PHYSICS LETTERS B, 2023 841 137941
10	Glueballs at physical pion mass, Chen Feiyu, et al., CHINESE PHYSICS C, 2023 47 6 63108
11	W-boson mass anomaly from a general SU(2) L scalar multiplet, Wu Jiajun, et al., CHINESE PHYSICS C, 2023 47 6 63103
12	Gravidynamics, spinodynamics and electrodynamics within the framework of gravitational quantum field theory, Wu Yue-Liang, SCIENCE CHINA-PHYSICS MECHANICS & ASTRONOMY, 2023 66 6 260411
13	Constructing the general partial wave and renormalization in effective field theory, Shu Jing, et al., PHYSICAL REVIEW D, 2023 107 9 95040
14	Complete NLO operators in the Higgs effective field theory, Sun Hao, et al., JOURNAL OF HIGH ENERGY PHYSICS, 2023 5 43
15	Distance between various discretized fermion actions, Zhao Dian-Jun, et al., PHYSICAL REVIEW D, 2023 107 9 L091501
16	Complete NNLO operator bases in Higgs effective field theory, Sun Hao, et al., JOURNAL OF HIGH ENERGY PHYSICS, 2023 4 86
17	Cutting the traintracks: Cauchy, Schubert and Calabi-Yau, Cao Qu, et al., JOURNAL OF HIGH ENERGY PHYSICS, 2023 4 72
18	Rapid search for massive black hole binary coalescences using deep learning, Ruan Wen-Hong, et al., PHYSICS LETTERS B, 2023 841 137904
19	Inflation in Weyl scaling invariant gravity with R3 extensions, Wang Qing-Yang, et al., PHYSICAL REVIEW D, 2023 107 8 83511
20	Constraining deviations from spherical symmetry using γ-metric, Chakrabarty Hrishikesh, et al., PHYSICAL REVIEW D, 2023 107 8 84020
21	Alleviating both H0 and S8 tensions: Early dark energy lifts the CMB-lockdown on ultralight axion, Ye Gen, et al., PHYSICS LETTERS B, 2023 839 137770
22	Instability of spherically symmetric black holes in quadratic gravity, Held Aaron, et al., PHYSICAL REVIEW D, 2023 107 6 64060
23	Spectral stability of near-extremal spacetimes, Yang Huan, et al., PHYSICAL REVIEW D, 2023 107 6 64045
24	Investigating Higgs self-interaction through di-Higgs plus jet production at a 100 TeV hadron collider, Chai Kangyu, et al., PHYSICAL REVIEW D, 2023 107 5 55031
25	Binary geometries, generalized particles and strings, and cluster algebras, Arkani-Hamed, et al., PHYSICAL REVIEW D, 2023 107 6 66015
26	Neural-network solutions to stochastic reaction networks, Tang Ying, et al., NATURE MACHINE INTELLIGENCE, 2023 5 4 376 385
27	Azimuthal asymmetry in cosmic-ray boosted dark matter flux, Xia Chen, et al., PHYSICAL REVIEW D, 2023 107 5 55012
28	What can we learn from the total width of the Higgs boson?, Cao Qing-Hong, et al., CHINESE PHYSICS C, 2023 47 3 33101
29	Enhanced cosmic-ray antihelium production from dark matter annihilation through light mediators, Ding Yu-Chen, et al., JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS, 2023 3
30	Boosting the 21 cm forest signals by the clumpy substructures, Kadota Kenji, et al., JOURNAL OF COSMOLOGY AND ASTROPARTICLE PHYSICS, 2023 3 17
31	Exploring the nature of black hole and gravity with an imminent merging binary of supermassive black holes, Zhong Xingyu, et al., SCIENCE CHINA-PHYSICS MECHANICS & ASTRONOMY, 2023 66 3 230411
32	Muon g-2 with overlap valence fermions, Wang Gen, et al., PHYSICAL REVIEW D, 2023 107 3 34513
33	Earth shielding and daily modulation from electrophilic boosted dark particles, Chen Yifan, et al., PHYSICAL REVIEW D, 2023 107 3 33006
34	Muon g-2 anomaly from a massive spin-2 particle, Huang Da, et al., PHYSICAL REVIEW D, 2023 107 3 35008
35	New relations for tree-level form factors and scattering amplitudes, Dong Jin, et al., JOURNAL OF HIGH ENERGY PHYSICS, 2023 2 76
36	Gluonic evanescent operators: two-loop anomalous dimensions, Jin Qingjun, et al., JOURNAL OF HIGH ENERGY PHYSICS, 2023 2 39
37	Gravitational Waves and Electromagnetic Radiation from Charged Black Hole Binaries, Benavides-Gallego, et al., SYMMETRY-BASEL, 2023 15 2 537
38	Tensor networks for unsupervised machine learning, Liu Jing, et al., PHYSICAL REVIEW E, 2023 107 1 L012103
39	Constraining First-Order Phase Transitions with Curvature Perturbations, Liu Jing, et al., PHYSICAL REVIEW LETTERS, 2023 130 5 51001
40	Covariant color-kinematics duality, Hopf algebras and permutohedra, Cao Qu, et al., PHYSICAL REVIEW D, 2023 107 2 26022
41	Resonant electric probe to axionic dark matter, Duan Junxi, et al., PHYSICAL REVIEW D, 2023 107 1 15019
42	Contributions to the muon g - 2 from a three-form field, Huang Da, et al., JOURNAL OF HIGH ENERGY PHYSICS, 2023 1 117
43	The Forward Physics Facility at the High-Luminosity LHC, Feng Jonathan L., et al., JOURNAL OF PHYSICS G-NUCLEAR AND PARTICLE PHYSICS, 2023 50 3 30501
44	Notes on Worldsheet-Like Variables for Cluster Configuration Spaces, He Song, et al., SYMMETRY INTEGRABILITY AND GEOMETRY-METHODS AND APPLICATIONS, 2023 19 1 24
45	Estimation of far-field wavefront error of tilt-to-length distortion coupling in space-based gravitational wave detection, Tao Ya-Zheng, et al., CHINESE PHYSICS B, 2023 32 2 24212

EI

01	Probing hadron-quark transition through binary neutron star merger, Guo Ling-Jun, et al., arXiv, 2023
02	Constraints on NJL four-fermion effective interactions from neutrinoless double beta decay, Pacioselli Luca, et al., arXiv, 2023
03	Gravitational Waves of Non-Extremal Kerr Black Holes from Conformal Symmetry, Nian Jun, et al., arXiv, 2023
04	Thermal Corrections to Rényi Entropy in BMS Field Theory, Zhong Yuan, arXiv, 2023
05	Distinguishing nanohertz gravitational wave sources through the observations of ultracompact minihalos, Liu Jing, arXiv, 2023
06	Test of macroscopic realism with coherent light, Wang Hui, et al., arXiv, 2023
07	Positivity-causality competition: a road to ultimate EFT consistency constraints, González Mariana Carrillo, et al., arXiv, 2023
08	Cosmic Birefringence from Neutrino and Dark Matter Asymmetries, Zhou Ren-Pen, et al., arXiv, 2023
09	W-boson Mass Anomaly from High-Dimensional Scalar Multiplets, Wu Jiajun, et al., arXiv, 2023
10	Calibration of the in-orbit center-of-mass of TaiJi-1, Wei Xiaotong, et al., arXiv, 2023
11	Double copy for tree-level form factors II: Generalizations and special topics, Lin Guanda, et al., arXiv, 2023
12	qecGPT: decoding Quantum Error-correcting Codes with Generative Pre-trained Transformers, Cao Hanyan, et al., arXiv, 2023
13	Testing the n_s-H_0 scaling relation with Planck-independent CMB data, Peng Ze-Yu, et al., arXiv, 2023
14	A full waveform model for arbitrarily axis-symmetric black hole mergers, Li Song, et al., arXiv, 2023
15	Gravidynamics, spinodynamics and electrodynamics within the framework of gravitational quantum field theory, Wu Yue-Liang, Science China: Physics, Mechanics and Astronomy, 2023 66 6
16	Neural-network solutions to stochastic reaction networks, Tang Ying, et al., Nature Machine Intelligence, 2023 5 4 376-385
17	Jumpstarting (elliptic) symbol integrations for loop integrals, He Song, et al., arXiv, 2023
18	Decoding stringy near-supersymmetric black holes, Chang Chi-Ming, et al., arXiv, 2023
19	Can supermassive black holes triggered by general QCD axion bubbles?, Li Hai-Jun, et al., arXiv, 2023
20	Estimation of far-field wavefront error of tilt-to-length distortion coupling in space-based gravitational wave detection, Tao Ya-Zheng, et al., Chinese Physics B, 2023 32 2
21	Tensor networks for unsupervised machine learning, Liu Jing, et al., Physical Review E, 2023 107 1
22	Gravitational Wave Probes on Self-Interacting Dark Matter Surrounding an Intermediate Mass Black Hole, Kadota Kenji, et al., arXiv, 2023

EI

23	Probing higher-spin particles with gravitational waves from compact binary inspirals, Liu Hao-Yang, et al., arXiv, 2023
24	The ABJM Amplituhedron, He Song, et al., arXiv, 2023
25	Diurnal modulation of electron recoils from DM-nucleon scattering through the Migdal effect, Qiao Mai, et al., arXiv, 2023
26	Distinguishing thermal histories of dark matter from structure formation, Huang Fei, et al., arXiv, 2023
27	Universal Cardy-Like Behavior of 3D A-Twisted Partition Functions, Amariti Antonio, et al., arXiv, 2023
28	Did we hear the sound of the Universe boiling? Analysis using the full fluid velocity profiles and NANOGrav 15-year data, Ghosh Tathagata, et al., arXiv, 2023
29	A complete tree-level dictionary between simplified BSM models and SMEFT (d ≤ 7) operators, Li Xu-Xiang, et al., arXiv, 2023
30	Testing Realistic SO(10) SUSY GUTs with Proton Decay and Gravitational Waves, Fu Bowen, et al., arXiv, 2023
31	Shadow of general rotating black hole, Meng Kun, et al., arXiv, 2023
32	Cutting the traintracks: Cauchy, Schubert and Calabi-Yau, Cao Qu, et al., arXiv, 2023
33	Explaining Pulsar Timing Array Observations with Primordial Gravitational Waves in Parity-Violating Gravity, Fu Chengjie, et al., arXiv, 2023
34	Parameter inference for coalescing massive black hole binaries using deep learning, Ruan Wen-Hong, et al., arXiv, 2023
35	Enhanced curvature perturbations from spherical domain walls nucleated during inflation, Zeng Zhen-Mi, et al., arXiv, 2023
36	Is Yang-Mills Theory Unitary in Fractional Spacetime Dimensions?, Jin Qingjun, et al., arXiv, 2023
37	On networks of space-based gravitational-wave detectors, Cai Rong-Gen, et al., arXiv, 2023
38	Primordial black holes from null energy condition violation during inflation, Cai Yong, et al., arXiv, 2023
39	Simulation of IBM's kicked Ising experiment with Projected Entangled Pair Operator, Liao Hai-Jun, et al., arXiv, 2023
40	Supermassive primordial black holes in multiverse: for nano-Hertz gravitational wave and high-redshift JWST galaxies, Huang Hai-Long, et al., arXiv, 2023
41	A high-precision result for a full-color three-loop three-point form factor in N "4 SYM, Guan Xin, et al., arXiv, 2023
42	Space-based gravitational wave signal detection and extraction with deep neural network, Zhao Tianyu, et al., Communications Physics, 2023 6 1

EI

43	Implications of GWTC-3 on primordial black holes from vacuum bubbles, He Jibin, et al., arXiv, 2023
44	Universality of the Collins-Soper kernel in lattice calculations, Shu Hai-Tao, et al., arXiv, 2023
45	Emergent unitarity, all-loop cuts and integrations from the ABJM amplituhedron, He Song, et al., arXiv, 2023
46	Gravitational wave sources for Pulsar Timing Arrays, Bian Ligong, et al., arXiv, 2023
47	RI/(S)MOM renormalizations of overlap quark bilinears with different levels of hypercubic smearing, Bi Yujiang, et al., arXiv, 2023
48	On-shell Operator Construction in the Effective Field Theory of Gravity, Li Hao-Lin, et al., arXiv, 2023
49	Exploring the nature of black hole and gravity with an imminent merging binary of supermassive black holes, Zhong Xingyu, et al., Science China: Physics, Mechanics and Astronomy, 2023 66 3
50	Variational quantum simulation of thermal statistical states on a superconducting quantum processer, Guo Xue-Yi, et al., Chinese Physics B, 2023 32 1
51	Advancing Space-Based Gravitational Wave Astronomy: Rapid Detection and Parameter Estimation Using Normalizing Flows, Du Minghui, et al., arXiv, 2023
52	A Systematic Approach for Inertial Sensor Calibration of Gravity Recovery Satellites and Its Application to Taiji-1 Mission, Zhang Haoyue, et al., arXiv, 2023
53	Taiji Data Challenge for Exploring Gravitational Wave Universe, Ren Zhixiang, et al., arXiv, 2023
54	Constraining First-Order Phase Transitions with Curvature Perturbations, Liu Jing, et al., Physical Review Letters, 2023 130 5
55	Nucleon Electric Dipole Moment from the θ Term with Lattice Chiral Fermions, Liang Jian, et al., arXiv, 2023
56	Ξc-Ξ′ cmixing From Lattice QCD, Liu Hang, et al., arXiv, 2023
57	A Systematic Approach for Inertial Sensor Calibration of Gravity Recovery Satellites and Its Application to Taiji-1 Mission, Zhang Haoyue, et al., Remote Sensing, 2023 15 15
58	Detecting extreme-mass-ratio inspirals for space-borne detectors with deep learning, Yun Qianyun, et al., arXiv, 2023
59	SRF Cavity Searches for Dark Photon Dark Matter: First Scan Results, Tang Zhenxing, et al., arXiv, 2023
60	Transverse-Momentum-Dependent Wave Functions of Pion from Lattice QCD, Chu Min-Huan, et al., arXiv, 2023
61	Lattice Calculation of the Intrinsic Soft Function and the Collins-Soper Kernel, Chu Min-Huan, et al., arXiv, 2023

Looking Forward

The year of 2023 is the ending year of the Mid-term Strategic Plan of ICTP-AP (2019-2023), and it is also the first year for the next five-year plan. Looking back at the past five years, we can see that our achievements did not come easily.

2023年是中心中期战略发展计划的收官之年，也是下一个五年计划的开局之年。回首过去五年，成绩来之不易。

In the next five years, we are hoping to continue the collaboration with other domestic institutes and universities, and meantime further strengthen our cooperation and exchanges with ICTP and expand our centre's influence in the international academic community. ICTP-AP will continue to uphold the mission and strategic objectives of UNESCO.

中心将继续与国内科研院校保持合作，同时加强中心与国际理论物理中心的交流与合作，持续提高中心的国际影响力。中心将继续坚持为实现联合国教科文组织的使命与战略目标不懈奋斗。