

**Manual of International Mini-Workshop
Gravitational Waves in the Early Universe
“早期宇宙中的引力波” 国际小型学术研讨会**

会议手册 Handbook

**Institute of Theoretical Physics, Chinese Academy of Sciences
Center for High Energy Physics, Peking University
中国科学院理论物理研究所/北京大学高能物理研究中心**

October 13-16, 2023

International Mini-Workshop

Gravitational Waves in the Early Universe

With the detection of gravitational waves from the merger of binary black holes by LIGO, we officially entered the era of gravitational wave cosmology. During the early universe, many interesting physical processes could generate gravitational waves, which were usually associated with new physics beyond the standard model. This opens up a new observational window for humanity to further uncover the origins of the universe and its matter content. These gravitational waves are generated at different epochs and propagate through the cosmic history until the present, which are redshifted to different frequency bands. In the recent future, various gravitational wave detection projects are planned, including CMB-S4, LiteBIRD, BICEP3/Keck Array, AliCPT utilizing the B-mode polarization of the cosmic microwave background radiation; NANOGrav, EPTA, PPTA, CPTA using pulsar timing arrays; LISA, Taiji, TianQin utilizing space-based gravitational wave interferometers; and ET, BBO for ground-based gravitational wave interferometers. Recently, the NANOGrav, EPTA, and CPTA jointly announced strong evidence for the existence of a nanohertz stochastic gravitational wave background. This has reignited our interest in gravitational waves produced in the early universe.

In order to further advance research in relevant fields, we hold this international workshop, inviting active experts who are interested in related topics to participate. The aim is to promote further combination of theory and observation in the gravitational wave cosmology, and to foster collaboration among international scholars. The website is <https://indico.itp.ac.cn/event/171/>.

Accommodation:

- (1) Xijiao Hotel, #18 Wang Zhuang Road, Haidian District, Beijing. 010-62322288
- (2) Liaoning Hotel, Jia #2 Bei Si Huan Xi Road, Haidian District, Beijing. 010-62589999

Venue: Room 6620, ITP South Building

Schedule: Register on Oct 13th (Fri). Workshop on Oct 14th (Sat) and 15th (Sun). Leave on Oct 16th (Mon).

Sponsors: This workshop is sponsored by ITP, CAS, by the Center for High Energy Physics, Peking University, and by the National Key Research and Development Program of China Grant No. 2021YFC2203004.

Organizers: Cristian Joana, Li Li, Shi Pi, Shao-Jiang Wang, Yong Zhou

小型国际学术研讨会 “早期宇宙中的引力波”

中国科学院理论物理研究所及北京大学高能物理研究中心将于 2023 年 10 月 13 日至 16 日在中国科学院理论物理研究所联合举办“早期宇宙中的引力波”小型国际学术研讨会。会议网址: <https://indico.itp.ac.cn/event/171/>。

随着 LIGO 观测到双黑洞合并的引力波, 人类正式进入引力波宇宙学时代。在早期宇宙中, 很多有趣的物理过程都能产生引力波。它们通常都和超出标准模型的新物理相联系, 是人类进一步揭开宇宙起源和物质起源的一个新的观测窗口。这些引力波诞生于宇宙的不同时期, 可能出现在许多可探测频段上。未来十几年内将有不同的引力波探测计划进行探测。其中包括间接利用微波背景辐射 B 模偏振的 CMB-S4、LiteBIRD、BICEP3/Keck Array、AliCPT; 利用脉冲星测时阵列的 NANOGrav, EPTA, PPTA, CPTA; 空间引力波干涉仪的 LISA、太极、天琴; 地面引力波探测器的 ET、BBO 等。最近, NANOGrav, EPTA, CPTA 等脉冲星测时阵列观测组同时宣布观测到纳赫兹随机引力波背景存在的强烈证据。这重新燃起了我们对早期宇宙中产生的引力波的兴趣。

为了进一步推进相关领域的研究, 我们特地组织召开此次国际学术研讨会。会议不收注册费, 食宿及交通自理。

本次会议由中国科学院理论物理研究所及北京大学高能物理研究中心联合举办, 并受到科技部国家重点研发计划“引力波探测”专项项目“宇宙弦等新颖引力波源与随机引力波背景的特征和信号识别研究”(项目号 2021YFC2203004)的资助。

住宿: 北京市海淀区海淀区王庄路 18 号西郊宾馆 010-62322288
北京市海淀区北四环西路甲 2 号辽宁大厦 010-62589999

地点: 中国科学院理论物理研究所南楼 6620 会议室

日程: 2023 年 10 月 13 日—10 月 16 日

10 月 13 日报到 (酒店不设签到处, 会议期间在会议室门口签到)

14—15 日两天会议报告, 16 日自由讨论、离会

组织者: Cristian Joana, 皮石, 李理, 王少江, 周勇

联系人: 吕律 (lvlv@pku.edu.cn)

倪清容 (niqr@itp.ac.cn, 13911992271)

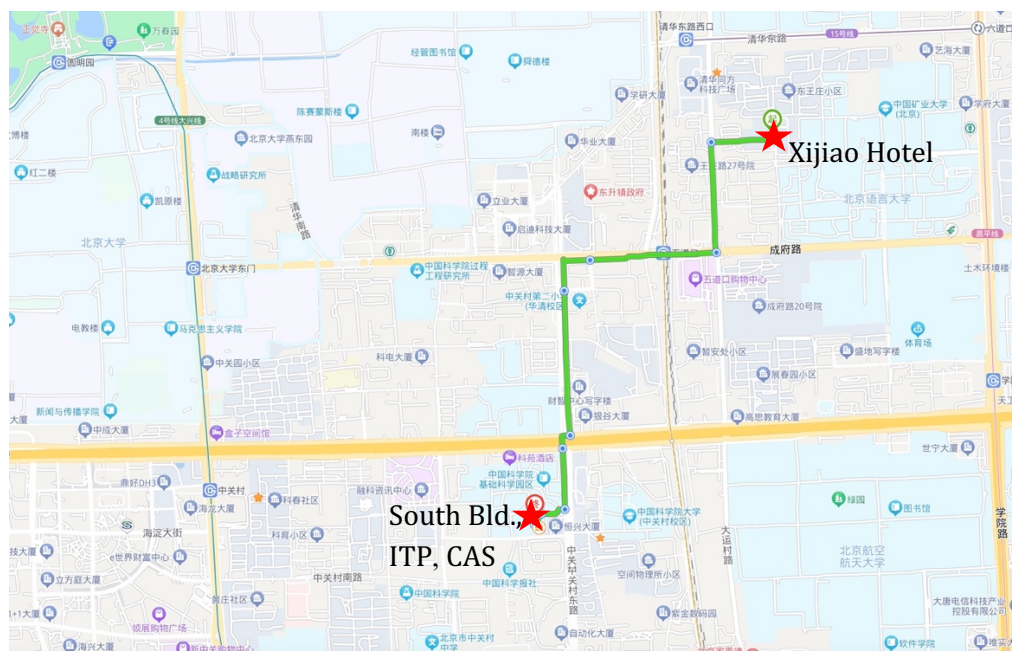
皮石 (shi.pi@itp.ac.cn, 13810683773)

王嘉宁 (wangjianing@itp.ac.cn, 18810512717)

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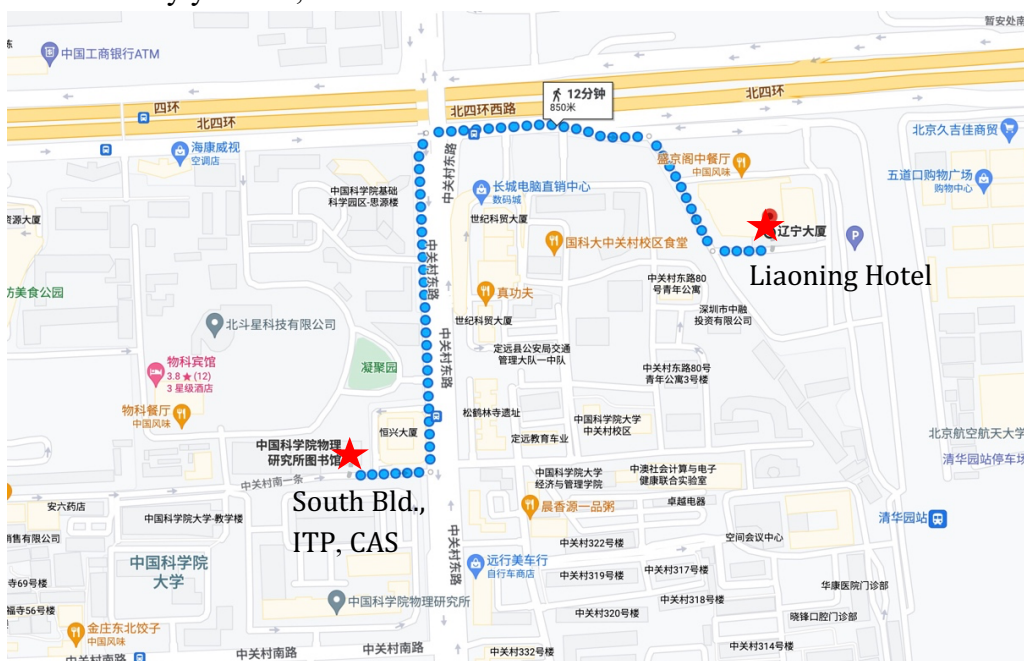
From Xijiao Hotel to ITP, CAS

We have shuttle bus to commute every morning and evening. There will be a sign of ITP on the bus. If you prefer to walk, please follow the route below:



From Liaoning Hotel to ITP, CAS

We have students to accompany you to walk from Liaoning Hotel to ITP, CAS. If you prefer to walk by yourself, follow the routine below:



If you have any problem, please contact us.

Schedule of the International Mini-Workshop
“Gravitational Waves in the Early Universe”
“早期宇宙中的引力波” 国际小型研讨会日程

10 月 14 日

会议地点：理论所南楼 6620

Opening 开幕式及特邀报告		
Time	Speaker	Title
9:00-9:10	Yue-Liang Wu 吴岳良	Opening 开幕致辞
9:10-10:00	Misao Sasaki 佐佐木节	PBH formation from highly non-Gaussian tails of probability distribution
10:00-10:20	Tea break and photo 茶歇、合影	

Fundamental Physics 基础物理		Chair: Jianxin Lu 卢建新
Time	Speaker	Title
10:20-11:10	Yue-Liang Wu 吴岳良	Progress of Taiji Program in Space

11:10- 11:40	Yizhong Fan 范一中	Neutron star mergers and the fundamental physics
11:40- 12:10	Yu-Xiao Liu 刘玉孝	Polarization modes of gravitational waves
12:10- 12:40	Yi Wang 王一	Do super-horizon PGWs stay constant?
12:40- 14:00	Lunch 午餐	

New GW Sources 新颖引力波源		Chair: Bin Chen 陈斌
Time	Speaker	Title
14:00- 14:50	Jinn-Ouk Gong 孔镇郁	Recent studies on gravitational wave
14:50- 15:20	Xin Zhang 张鑫	Exploring the nature of dark matter and dark energy with hydrogen atoms
15:20- 15:50	Haipeng An 安海鹏	Gravitational waves from phase transitions during inflation
15:50- 16:20	Ligong Bian 边立功	Topological defects in the early Universe
16:20- 16:30	Tea break 茶歇	

PGW 原初引力波		Chair: Lixin Xu 徐立昕
Time	Speaker	Title
16:30-17:00	Wen Zhao 赵文	Primordial Gravitational Waves
17:00-17:30	Taotao Qiu 邱涛涛	
17:30-18:00	Yi-Fu Cai 蔡一夫	Stochastic gravitational waves from non-perturbative resonances and non-Gaussian tails in the very early universe
18:00-18:30	Wenbiao Han 韩文标	The waveform and physics of B-EMRI
18:30-21:00	Dinner (4 th floor, Wuke Restaurant) 晚餐 (物科餐厅 4 层)	

10 月 15 日

会议地点：理论所南楼 6620

Detection 1 引力波探测一			Chair: Renxin Xu 徐仁新
Time	Speaker	Title	
9:00- 9:50	Jianwei Mei 梅建伟	TianQin Project and its progress	

9:50- 10:40	Kejia Lee 李柯伽	Progress of Chinese Pulsar Timing Array (CPTA)
10:40- 10:50	茶歇 Tea break	

Detection 2 引力波探测二		Chair: Jiliang Jing 荆继良
Time	Speaker	Title
10:50- 11:40	Hong Li 李虹	Introduction and Progress of Ali CMB Polarization Telescope (AliCPT)
11:40- 12:30	Kazunori Kohri 郡和范	New research directions in high-frequency gravitational wave
12:30- 13:00	Lunch break 午餐	

GW astronomy 1 引力波天文一		Chair: Yun-Song Piao 朴云松
Time	Speaker	Title
14:00- 14:30	Yungui Gong 龚云贵	Probe of Black hole charge with EMRIs
14:30- 15:00	Bin Hu 胡彬	Gravitational wave lensing

15:00- 15:30	Xingjiang Zhu 朱兴江	Subtracting compact binary foreground sources to reveal primordial gravitational- wave backgrounds
15:30- 16:00	Kohei Inayoshi 稻吉恒平	Gravitational waves from massive black hole binaries: the rate and strength predicted from observed high-redshift quasar populations
16:00- 16:10	Tea break 茶歇	

GW Astronomy 2 引力波天文二 Chair: Hongwei Yu 余洪伟		
Time	Speaker	Title
16:10- 16:40	Qing-Guo Huang 黄庆国	Search for Gravitational-wave background in Pulsar Timing Array
16:40- 17:10	Lijing Shao 邵立晶	Decihertz Gravitational-wave Astrophysics and Cosmology
17:10- 17:40	Kenji Kadota 门田健司	Multi-messenger probes on dark matter surrounding a black hole
17:40- 18:10	Atsuhisa Ota 太田敦久	Radiation exchange for gravitational wave equal time power spectrum
18:10- 21:00	Dinner 晚餐	

List of Participants

参会人员名单

	Name	Affiliation	E-mail
1	Haipeng An	Tsinghua University	anhp@mail.tsinghua.edu.cn
2	Yuping An	ITP, CAS	anyuping@itp.ac.cn
3	Ligong Bian	Chongqing University	lgbycl@cqu.edu.cn
4	Rong-Gen Cai	ITP, CAS/Ningbo University	cairg@itp.ac.cn
5	Yifu Cai	University of Science and Technology of China	yifucai@ustc.edu.cn
6	Bin Chen	Peking University	bchen01@pku.edu.cn
7	Qian Chen	University of CAS	chenqian192@mailsucas.ac.cn
8	Tan Chen	ITP, CAS	chentan@itp.ac.cn
9	Mei-Ning Duan	ITP, CAS	duanmeining@itp.ac.cn
10	Yizhong Fan	Purple Mountain Observatory, CAS	yzfan@pmo.ac.cn
11	Yun Fang	ITP, CAS	fang.yun@pku.edu.cn
12	Chengjie Fu	Anhui Normal University	fucj@ahnu.edu.cn
13	Qing Gao	Southwestern University	gaoqing1024@swu.edu.cn
14	Jinn-Ouk Gong	Ewha Women's University	jinn.ouk.gong@gmail.com
15	Yungui Gong	Huazhong University of Science and Technology/Ningbo University	yggong@hust.edu.cn
16	Huai-ke Guo	ICTP-AP, University of CAS	guohuaike@ucas.ac.cn
17	Zhongkai Guo	Chinese Academy of Space Technology	guozhk@amss.ac.cn
18	Xiao Guo	Hangzhou Institute of Advanced Study, CAS	guoxiao17@mailsucas.ac.cn
19	Wenbiao Han	Shanghai Observatory, CAS	wbhan@shao.ac.cn
20	Chengcheng Han	Sun Yat-Sen University	hanchengcheng800@gmail.com
21	Xin-Chen He	University of Science and Technology of China	xinchenhe@mail.ustc.edu.cn

22	Wencong Hong	ITP, CAS	hongwencong@itp.ac.cn
23	Bin Hu	Beijing Normal University	bhu@bnu.edu.cn
24	Lu Huang	ITP, CAS	huanglu@itp.ac.cn
25	Qing-Guo Huang	ITP, CAS	huanggg@itp.ac.cn
26	Kohei Inayoshi	Kavli Institute of Astronomy and Astrophysics, Peking University	inayoshi0328@gmail.com
27	Peixiang Ji	Peking University	2201110290@stu.pku.edu.cn
28	Yu'er Jiang	National Astronomical Observatory of China, CAS	yejiang@bao.ac.cn
29	Hengsen Jiao	ITP, CAS	jiaohengsen23@mails.ucas.ac.cn
30	Zhenhan Jin	ITP, CAS	jinzhenhan@itp.ac.cn
31	Jiliang Jing	Hunan Normal University	jljing@hunnu.edu.cn
32	Cristian Joana	ITP, CAS	cristian.joana@itp.ac.cn
33	Kenji Kadota	Hangzhou Institute of Advanced Study, UCAS	kadotak@gmail.com
34	Kazunori Kohri	National Astronomical Observatory of Japan/KEK	kazunori.kohri@gmail.com
35	Kejia Lee	Kavli Institute of Astronomy and Astrophysics, Peking University	kjlee@pku.edu.cn
36	Hong Li	Institute of High Energy Physics, CAS	hongli@ihep.ac.cn
37	Li Li	ITP, CAS	liliphy@itp.ac.cn
38	Zi-Han Li	ITP, CAS	lizihan@itp.ac.cn
39	Jing Liu	University of CAS	liujing@ucas.ac.cn
40	Lang Liu	Beijing Normal University	liulang@bnu.edu.cn
41	Yuxiao Liu	Lanzhou University	liuyx@lzu.edu.cn
42	Jianxin Lu	University of Science and Technology of China	jxlu@ustc.edu.cn
43	Yizhou Lu	Southern University of Science and Technology	luyz@sustech.edu.cn
44	Zhenhong Lü	ITP, CAS	lvzhenhong@itp.ac.cn
45	Wentao Luo	Deep Space Exploration Lab/University of Science and Technology of China	wtluo@ustc.edu.cn
46	Yudong Luo	Peking University	yudong.luo@pku.edu.cn
47	Xiao-han Ma	University of Science and Technology of China	mxh171554@mail.ustc.edu.cn

48	Jianwei Mei	Tianqin Center, Sun Yat-Sen University	meijw@mail.sysu.edu.cn
49	Zhizhang Peng	ITP, CAS	pengzhizhang@itp.ac.cn
50	Taotao Qiu	Huazhong University of Science and Technology	qiutt@hust.edu.cn
51	Atsuhisa Ota	Chongqing University	a3hios2t2u@icloud.com
52	Shi Pi	ITP, CAS	shi.pi@itp.ac.cn
53	Yun-Song Piao	University of CAS	yspiao@ucas.ac.cn
54	Misao Sasaki	Kavli Institute of Physics and Mathematics of the Universe, the University of Tokyo	misao.sasaki@ipmu.jp
55	Lijing Shao	Kavli Institute of Astronomy and Astrophysics, Peking University	lshao@pku.edu.cn
56	Xikai Shan	Beijing Normal University	xk_shan@mail.bnu.edu.cn
57	Haotian Sun	ITP, CAS	sun_ht@foxmail.com
58	Yong Tang	University of CAS	tangy@ucas.ac.cn
59	Ao Wang	ITP, CAS	wangao@itp.ac.cn
60	Aoying Wang	Peking University	2201110110@stu.pku.edu.cn
61	Bin Wang	Yangzhou University/Shanghai Jiaotong University	wangb@yzu.edu.cn
62	He Wang	ICTP-AP, CAS	hewang@mail.bnu.edu.cn
63	Jianing Wang	ITP, CAS	wangjianing@itp.ac.cn
64	Renjie Wang	Hangzhou Institute of Advanced Study, CAS	wangrenjie@ucas.ac.cn
65	Sai Wang	Institute of High Energy Physics, CAS	wangsai@ihep.ac.cn
66	Shao-Jiang Wang	ITP-CAS	schwang@itp.ac.cn
67	Xinpeng Wang	Tongji University	xinpengwang@tongji.edu.cn
68	Yi Wang	Hong Kong University of Science and Technology	phyw@ust.hk
69	Yutong Wang	University of CAS	wangyutong@ucas.ac.cn
70	Marcus Werner	Duke Kunshan University	marcus.werner@duke.edu
71	Yue-Liang Wu	University of CAS /	ylwu@itp.ac.cn

		Institute of Theoretical Physics, CAS	
72	Zhong-zhi Xianyu	Tsinghua University	zxianyu@tsinghua.edu.cn
73	Ke-Pan Xie	Beihang University	kpxie@buaa.edu.cn
74	Baoyu Xu	ITP, CAS	xubaoyu23@mails.uca s.ac.cn
75	Haoran Xu	Nankai University	2211971@mail.nankai. edu.cn
76	Lixin Xu	Dalian University of Technology	lxxu@dlut.edu.cn
77	Renxin Xu	Peking University	r.x.xu@pku.edu.cn
78	Zhu Yi	Beijing Normal University	yz@bnu.edu.cn
79	Hongwei Yu	Hunan Normal University	hwyu@hunnu.edu.cn
80	Wenli Yuan	Peking University	wlyuan7@gmail.com
81	Ziyan Yuwen	ITP, CAS	yuwenziyan@itp.ac.cn
82	Xiangxi Zeng	ITP, CAS	zengxiangxi@itp.ac.cn
83	Zhenmin Zeng	ITP, CAS	cengzhenmin@itp.ac.c n
84	Jian-dong Zhang	Tianqin Center, Sun Yat-sen University	zhangjd9@mail.sysu.e du.cn
85	Jun Zhang	University of CAS	zhangjun@ucas.ac.cn
86	Xin Zhang	Northeastern University	zhangxin@mail.neu.ed u.cn
87	Ying-li Zhang	Tongji University	yingli@tongji.edu.cn
88	Yun-Long Zhang	National Astronomical Observatory of China, CAS	zhangyunlong@nao.ca s.cn
89	Zhenyu Zhang	Peking University	jerryzhang@stu.pku.ed u.cn
90	Wen Zhao	University of Science and Technology of China	wzhao7@ustc.edu.cn
91	Yong Zhou	ITP, CAS	zhouyong@itp.ac.cn
92	Xingjiang Zhu	Beijing Normal University	zhuxj@bnu.edu.cn