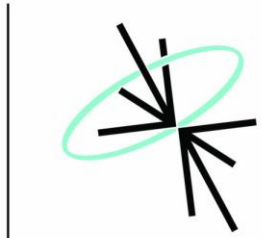


4th International Symposium on the History of Particle Physics
10 – 13 November 2025

The Rise and Internationalization of Particle Physics in China

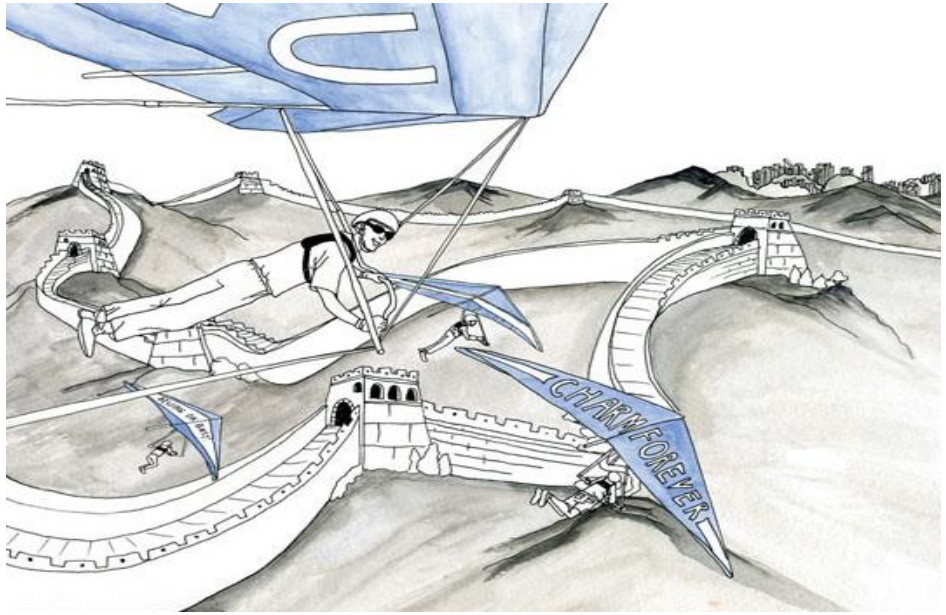
Liu Jinyan

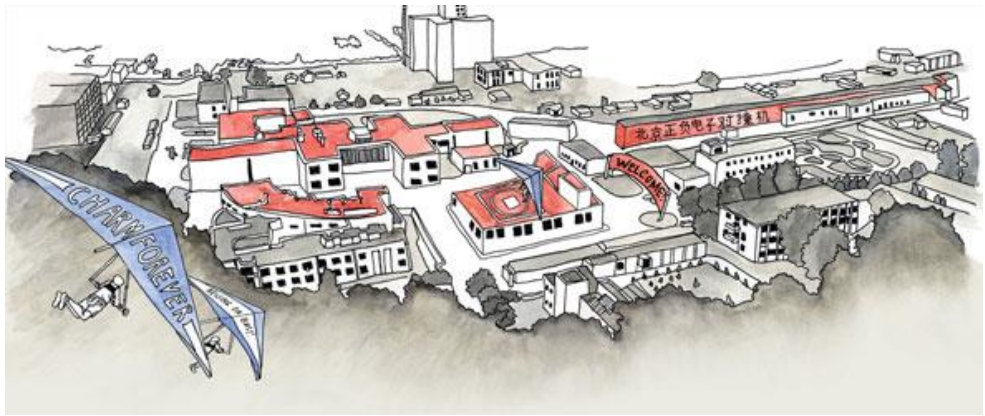
Institute for the History of Natural Sciences, CAS

13 Nov. 2025 Geneva

Chasing charm in China

05/01/09 Kelen Tuttle





Illustrations: Sandbox Studio

symmetry
dimensions of particle physics

American scientists are flocking to the Beijing Electron Positron Collider, whose recent upgrades make it the premier place to study charm quarks and their kin.

Outline

I. How Particle Physics rose in China? (Background)

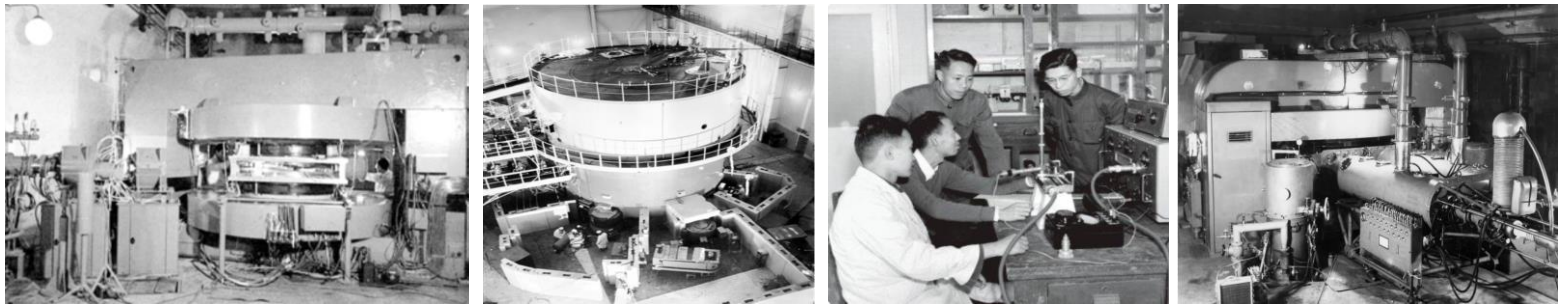
II. Chinese Particle Physics Internationalization (Exp. & Theo.)

III. Discussion

I. Early Stage of Particle Physics in China

- Chinese physicists imported particle physics into China (1940s)
- Particle physics under the umbrella of nuclear physics (atomic bomb)
- Chinese scientists in Dubna (1956-1965)
- Mao Zedong--philosophical issue in particle physics (Straton model)
- Zhou Enlai--diplomacy/political tool

Huanwu Peng in DIAS (1943)



Ning Hu with W. Pauli

Hongyuan Zhu with P. M. Blackett

Mao Zedong receipted S. Sakata (1964)

Beijing Elementary Particle Group for Straton model

$\bar{\Sigma}^-$ (Dubna)

Guangzhao Zhou (Dubna)

- Liu Jinyan. Chinese Physicists' Construction of the Straton Model in Social Context, CAHST 2 (2018)1: 085-122.
- LIU Jinyan, WANG Fang, Alexey ZHEMCHUGOV. Chinese Scientists in Dubna (1956–1965), CAHST 5 (2021)2: 031-088.

I. Early Stage of Particle Physics in China

- How to develop China's own particle physics

  A-bomb success; withdrew from JINR; career transition; accelerator design discussions

- China-US relationship thawed: CY Yang, TD Lee, CS Wu and Samuel Ting came back to China

  cultural revolution, bridge maker of the international cooperation

- Fulfill MAO Zedong and Zhou Enlai's last wish—Deng Xiaoping era

H. Kissinger visited China (July 1971)

Zhou & Yang

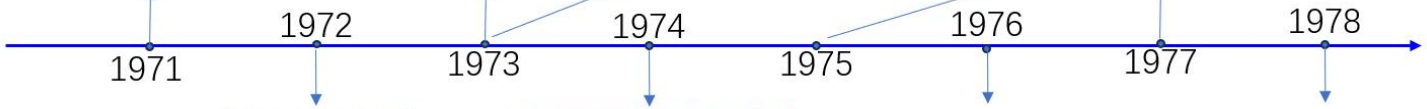
Zhou & Wu, Yuan

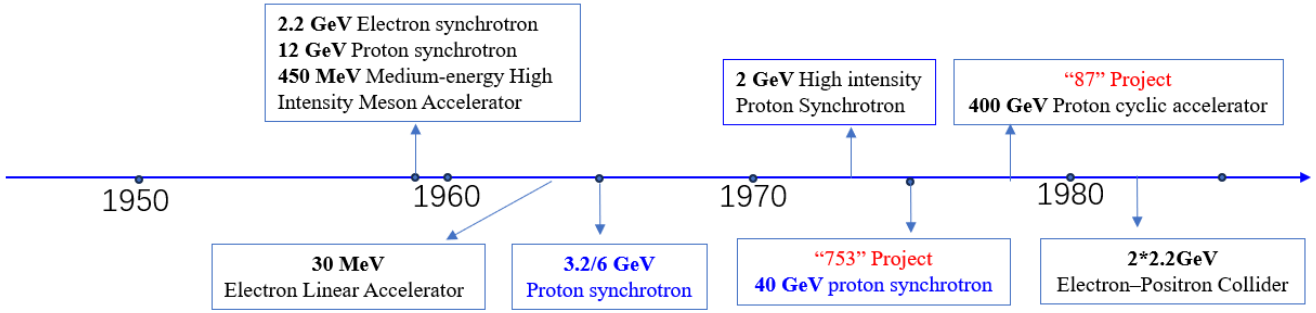
Mao, Zhou &Yang

Deng & Ding

Zhou & Lee

Mao & Lee





- Jinyan Liu, Baichun Zhang, Yueliang Wu.Yang Chen Ning: Promoter of China-US Science and Technology Exchange and Cooperation. Studies in the History of Natural Sciences, 40 (2021)3: 374-386.(in Chinese)
- Jinyan Liu, Tian Miao. Tsung-Dao Lee: The Promoter of China's Basic Research and a Scientific Bridge Builder between China and the World since the 1970s. CAHST 7 (2023)2: 081-121.

I. Early Stage of Particle Physics in China

☐ Founded of IHEP-CAS (1973) and ITP-CAS (1978)

- ***High energy physics*** *is at the forefront of modern physics and basic theoretical disciplines, its breakthroughs will surely lead to innovations of technology, besides effectively promoting international scientific exchanges……*
- *In addition to research on the internal structure of elementary particles and cosmic rays, there is a call for pre-research on high-energy accelerator and detector technology to master the technology, train talent and narrow the gap with the international community.* ——**18 physicists' letter to Premier Zhou in Aug 1972**

Chinese high energy physics delegation
(Beijing, 1973)

Zhang Wenyu with W. Panofsky
(SLAC, 1973)

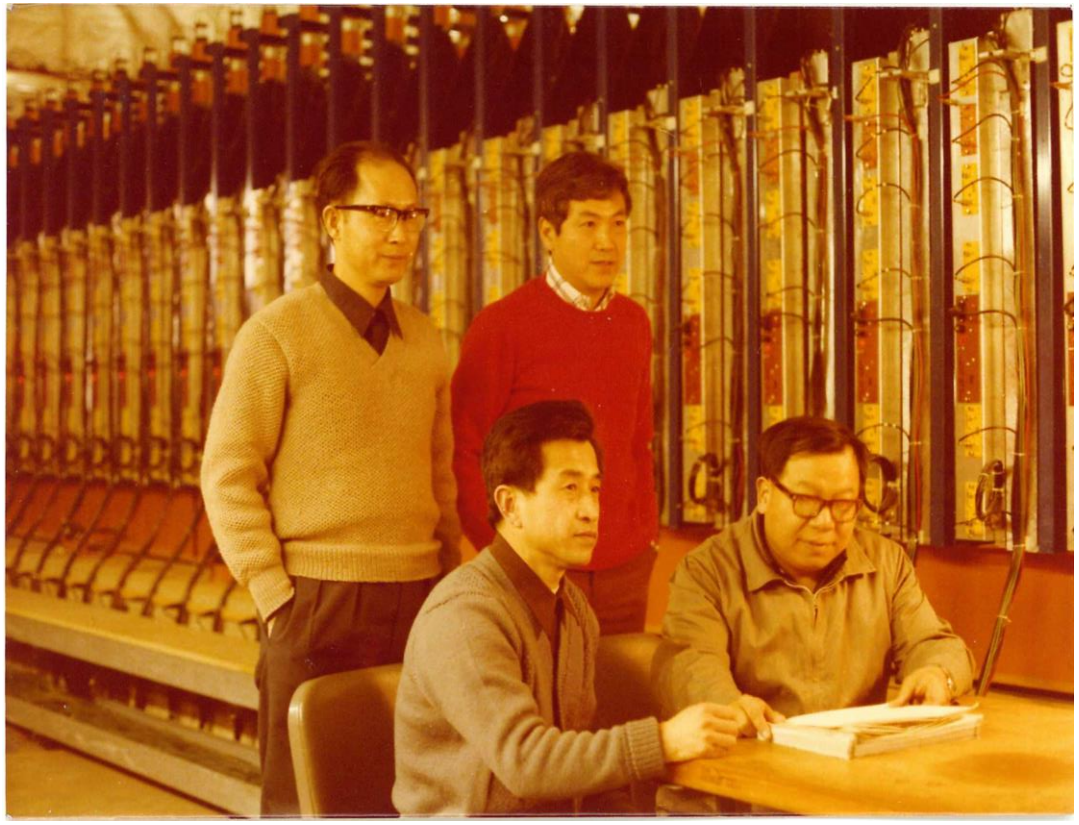
Chinese high energy physics delegation
(BNL, 1973)

II. Rise and Internationalization

- Chinese high energy physicists in DESY and Fermi Lab (1978)

Tang Xiaowei, Zheng Zhipeng et al joined DESY Mark-J experiment (1979)

- The discovery of the gluon (Three-jet event)



Chinese physicists in FNAL (1978-1980)

- Test of the Weinberg-Salam Model

People's Daily

人民日报 RENMIN RIBAO

The team led by Professor Samuel Ting discovered the gluons

丁肇中教授领导的实验小组发现胶子

这种新粒子发现引起全世界科技界极大兴趣

我科学院高能物理研究所唐孝威等二十多位科学工作者参加这项实验研究

新华社北京九月四日电　引起全世界科学技术界极大兴趣的新粒子——胶子的发现，是由著名美籍物理学家丁肇中教授领导的高能物理实验小组，最近在西德汉堡的一台高能加速器上找到实验证据的。中国科学院高能物理研究所唐孝威等二十多位科学工作者也参加了这项实验研究工作。

我国科学工作者收到了丁肇中小组发表的一篇论文，这篇论文公布了这种胶子存在的实验数据。

刚从丁肇中教授领导的小组归来的中国科学院高能物理研究所科学工作者在一次学术报告会上说，丁肇中教授领导的小组自一九七八年十一月在西德汉堡电子同步加速器中心，利用一台目前世界上能量最高的加速正负电子的对撞机寻找新的粒子，并研究高能物理的新现象。他们经过半年多的努力，在对一种称为"喷注"现象进行分析的过程中，在质心能量从二百七十四亿到三百一十六亿电子伏特的范围内，找到了四百四十六个喷注事例，并对这些事例的能流分布进行了大量的分析计算后，首次找到了胶子存在的实验证据。这一重要发现对于加深人类对物质微观结构的认识，具有重大意义。

物质是由分子组成的，分子是由原子组成的，原子是由电子和原子核组成的。原子核是由质子和中子组成的。质子、中子这一类粒子统称为强子，它们是由层子组成的。近十年来，科学家们曾经预言，层子之间的很强的相互作用力，是通过一种称为胶子的新粒子传递的。它们象胶水一样，以很强的力量，把层子和层子"粘"在一起。但是，胶子是否真的存在，一直是个悬而未决的问题。过去，实验上已经证实了五种层子的存在。但是，一直没有找到胶子存在的实验证据。丁肇中教授领导的小组进行的实验，首次回答了这个问题，从实验上证实了胶子的存在，从而引起了全世界高能物理学界极大的兴趣，这也是对高能物理领域中目前流行的强作用的理论一个有力的支持。

丁肇中教授领导的小组除有我国科学工作者参加外，还有美国麻省理工学院、西德电子同步加速器中心、西德亚琛大学物理研究所、荷兰核子和高能物理研究所的科学家参加。

在这台加速器上工作的其他实验小组也陆续找到了胶子存在的实验证据。

Breakthrough in the collision experiment between μ neutrino and electron

1979年9月8日　星期六　第四版

μ中微子和电子碰撞实验取得重大成果

美中两国专家密切合作又传来振奋人心的消息

理论作出严格检验从而给这个理论以有力支持

实验取得很多事例和精确得多的实验数据足以对温伯格—萨拉姆

新华社北京九月七日电　继我国二十多位科学工作者在著名美籍物理学家丁肇中教授领导下，找到一种新的粒子——胶子存在的实验证据之后，从美国费米实验室又传来一个振奋人心的消息：美籍物理学家莫玮教授等和中国科学院高能物理研究所派往费米实验室工作的科学工作者王祝翔、李金、张家铨合作，在进行μ中微子和电子碰撞的实验中，取得了鼓舞人心的结果。

我国著名物理学家朱洪元教授在中国科学院高能物理研究所举行的一次学术报告会上说，这个重大成果是美国费米实验室所长莱德曼教授，在发给中国科学院高能物理研究所所长张文裕教授的电报中宣布的。他说，莱德曼教授在电报中还说："中国组在这些新的和重要的结果中，贡献很大。"

在谈到这项重要实验的意义时，朱洪元教授说，二十世纪微观物理学的一大进展就是发现除牛顿所发现的引力相互作用和十九世纪确立的电磁相互作用外，还有两种新的相互作用，即：强相互作用和弱相互作用。引力相互作用在宇观现象中起基本的作用。其他三种相互作用长期以来被认为是微观世界的三种最基本的、不同的相互作用。但是，十多年前出现了一种新的理论，这就是美国科学家温伯格和巴基斯坦科学家萨拉姆提出的理论。这个理论认为，弱相互作用和电磁相互作用有着极为密切的内在联系，这就在更深入的水平上，把人类对微观世界中相互作用的认识，初步统一了起来。如果这个理论是正确的，那就促使人们更加相信，强相互作用也有可能和电磁相互作用、弱相互作用统一起来。他说，十九世纪确立的电和磁的统一理论，奠定了现代文明的基础。可以肯定，如果这三种基本的作用力统一起来，人们对微观世界的认识，将会产生革命性的飞跃，并对人类的社会生活带来巨大影响。

朱洪元教授还谈了美中两国科学家关于μ中微子和电子碰撞的实验和这种理论的关系。他说，温伯格—萨拉姆理论必须用各种可能的实验来检验。一个十分重要的实验是这次美中两国科学家共同进行的μ中微子和电子相碰撞的实验。因为μ中微子和电子碰撞的过程，不牵涉到强相互作用，是检验电、弱作用理论的非常直接的实验，但是这个过程是个十分稀有的现象，实验本身的难度极高。过去十年中，各国科学家经过努力，只观察到了很少一些事例，因而对温伯格—萨拉姆理论的正确与否，难于做出判断。莱德曼教授在电报中所说"取得了鼓舞人心的结果"，是美中两国科学家合作进行的实验取得了很多事例和精确得多的实验数据，足以对温伯格—萨拉姆理论作出严格的检验，从而给这个理论以有力的支持。

II. Rise and Internationalization

They had to learn how to behave in a modern technically developed country. At that time in China there were practically no cars. The main means of moving around was bicycles. …So when these 12 people came from Institute of High Energy Physics (IHEP) in Beijing… Sam Ting had a colleague at that time, Susan Marks, who he later married. *Susan became a kind of mother hen to the Chinese group, teaching them how to behave, how to cross the roads, how to do shopping and things like that*. It was amusing to see her sometimes walking around DESY or outside being followed by a line of Chinese people like a group of young chicks following their mother. Over the following years physicists came and went. All of them, of course, had been selected before they came to Hamburg. All were excellent scientists. The leader of the first group was Tang Xiaowei and there were also Zhen Zhi Peng and Chen Hesheng, who both became directors of IHEP.

Herwig Schopper and James Gillies. Herwig Schopper: Scientist and Diplomat in a Changing World (2024)

Herwig with a Chinese delegation at DESY in 1978. Sam Ting is second from right, seated next to his future wife Susan (©DESY, All rights reserved)

II. Rise and Internationalization

☐ Collaboration between China and CERN

Qian Sanqiang, Victor Weisskopf, Wu Lein-Fu, Willibald Jentschke, Léon Van Hove, Georges Charpak and Zehui He (1975 Beijing)

- ✓ Chinese experimentalists (Fang Shouxian, etc.) , theoreticians (Du Dongsheng, etc.) visited CERN-1978
- ✓ BEPC construction: CERN helped China solved construction, operation problems
- ✓ Software, Accelerator equipment, internet between CERN and IHEP (1988)—early stage

- ➢ L3 (1982-1997) : construction of hadron calorimeter, test BGO crystals, physical data analysis—Sam Ting's leadership
- ➢ ALEPH (1982-) : software, hadron calorimeter
- ➢ Later: LHC, CMS, ATLAS

LEP-L3 BGO crystal
(courtesy of Jinshan Yang)

Origins and Evolution of the Collaboration between CERN and the People's Republic of China 1971-1980 (W. O. Lock)

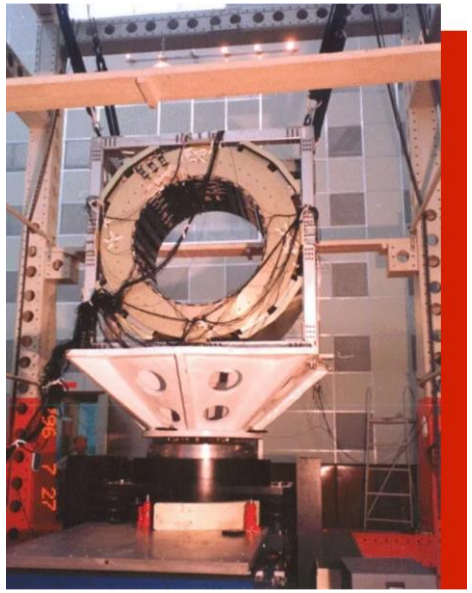
II. Rise and Internationalization (1980-2000)

➢ TD Lee promoted the collaboration between China and the U.S. in HEP

- Proposed China's State S&T Commission sign cooperation agreements with the U.S. DOE as well as major national laboratories of HEP (1979-2017, ~1000 projects)
- BNL, FNAL, SLAC aid China nurturing of talent for HEP experiments / CUSPEA
- China joined in Tevatron-D0 (t quark), AMS-large permanent magnet/Thermal Control System/data analysis

T. D. Lee with Chinese and US scientists of HEP (Jan 1979)

Chinese & US HEP signed cooperation agreement (Oct 1995, IHEP-CAS)

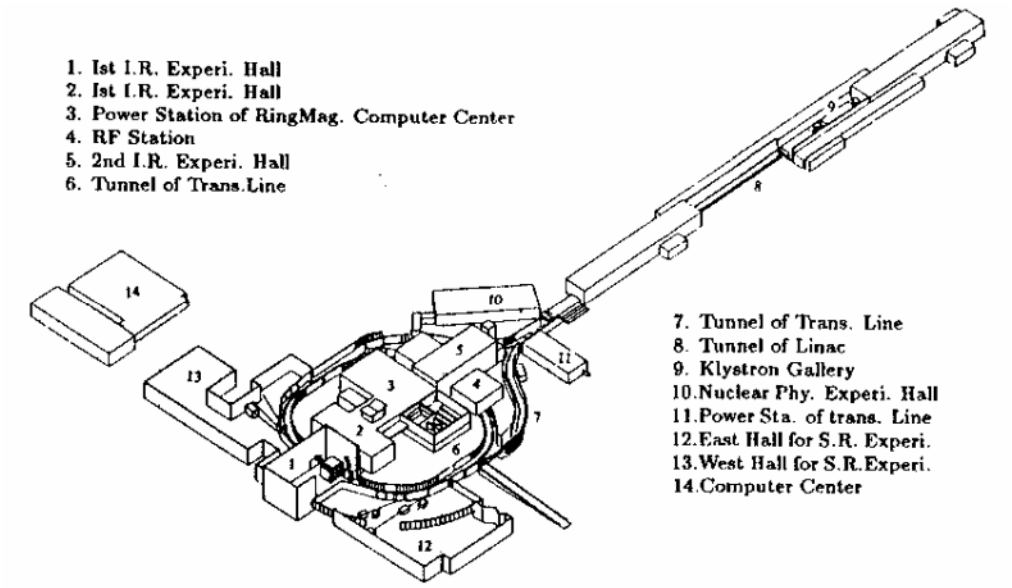


AMS-Large permanent magnet (provided by China)

IHEP-CAS: the first Chinese institution to have a fully operational world-wide Internet connection (dedicated link between SLAC and IHEP-1994).

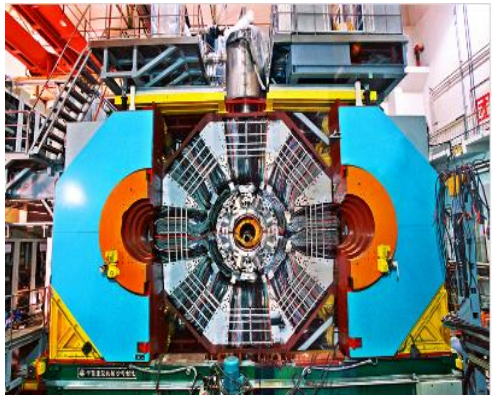
II. Rise and Internationalization (1980-2000)

➢ Beijing Electron-Positron Collider (BEPC)—the first large scientific infrastructure in China



Deng Xiaoping laying the first stone at the inauguration ceremony of the BEPC (1984, courtesy of IHEP)

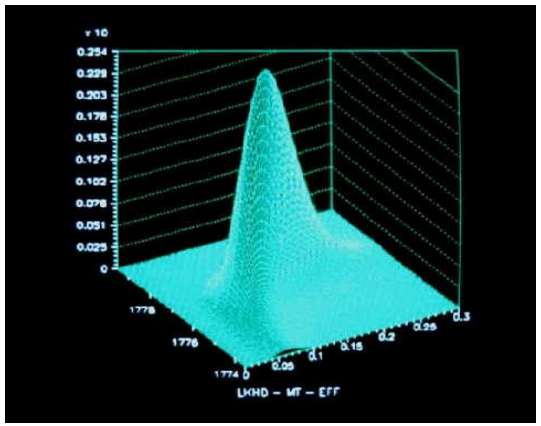
Deng Xiaoping was visiting the BEPC storage ring (1988, courtesy of IHEP)

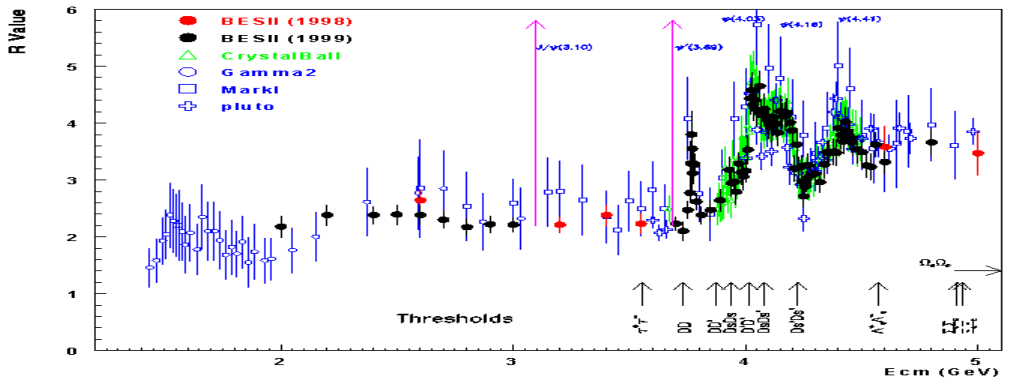


Mark-J	Zheng Zhipeng(ToF), Yu Zhongqiang (trigger system electronic), Ma Jimao (Drift Chamber), Xu Zizong, Zhang Changchun, Zhu Yongsheng, Wu Jianwu et al involved in construction of BEPC/BES
CERN	Fang Shouxian (BEPC)
Fermi Lab	Li Jin (BES-II)
Mark-J, L3	Chen Hesheng (BEPCII, CSNS)
L3, KamLAND	Wang Yifang (BES III, Daya Bay, JUNO)

II. Rise and Internationalization (1980-2000)

- **BEPCI-II/BESI-III**: Low-Energy Sector of High-Energy Physics (τ-charm physics at the τ -charm production threshold) made their unique contribution
  - Precise measurement of the **τ lepton mass** and **R-value** (2-5 GeV); $m_\tau = 1776.96^{+0.30}_{-0.27}\,MeV$ $\frac{g_\tau}{g_\mu} = 1.0005 \pm 0.0069$
  - Discovery of new particles: X (1860), X (1835), Zc (3900), Zcs(3985)
  - Upgrade: BEPCII, BESII-BESIII, using double-ring, large cross-angle collision and other technologies
  - Talent education





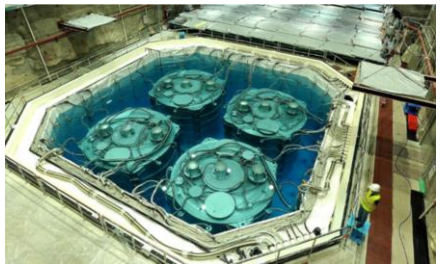
Published papers:
BESI: 30
BESII: 126
BESIII: more than 500
20%PRL, 2 Nature Physics
Members: 70 to more than 600

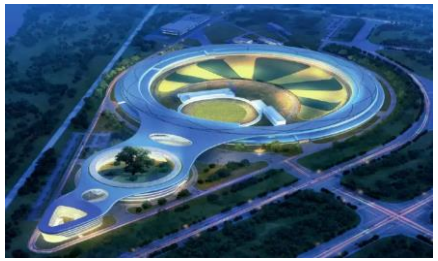
II. Rise and Internationalization (1980-2000)

- Cosmic-ray study (China-Japan, China-Italy collaboration)

Yangbajing Cosmic Ray Observatory
China-Japan: ASγ
China-Italy: ARGO

(courtesy of Tan Youheng)





Country	Main institutions	Collaboration areas	Representative projects
US	DOE, FNAL, BNL, SLAC, LBNL, ANL, JLab, ORNL	Accelerator, detector, neutrino physics, synchrotron radiation, Spallation Neutron Source, AMS	BEPC/BEPCII, Daya Bay, CSNS, AMS, D0, SSC
CERN	CERN	Accelerator, detector, LHC/HL-LHC, LEP/L3, ATLAS, CMS, ALEPH, LHCb	L3, L3+C cosmic-ray, ALEPH, ATLAS, CMS, LHC construction and up-grade
Italy	INFN, Gran Sasso National Laboratory, World Laboratory	Particle physics, cosmic-ray, dark matter, ADS, ARGO, ICARUS	LVD、ICARUS、KLOE、DAMA、ARGO-YBJ、ADS、JUNO
Germany	DESY, MPG, JLU, AvH	Accelerator, detector, MARK-J, HERA, EXFEL, QCD	MARK-J, HERA, European X-ray Free-Electron Laser, PANDA trigger system
France	LAL, IN2P3/CNRS, Atomic energy committee, FCPPL	Accelerator, Electron Injector, linear accelerator, Li battery material	ALEPH, FCPPL、TESLA-II
England	RAL, Uni. of Southampton, The Royal Society, Oxford Uni., ISIS	Detector, CSNS, CEPC, neutron scattering, space detector	ATLAS up-grade, CSNS, CEPC Silicon Tracking Detector, ISIS neutron source
Russia	JINR, LPI, BINP, MEPhI	high-altitude balloon, Cosmic ray, synchrotron radiation, BESIII, accelerator	high-altitude balloon, BESIII detector, BINP energy detect equipment
Japan	KEK, Tokyo Uni, RIKEN (Spring-8)	Accelerator, synchrotron radiation, Cosmic-ray, Belle, COMET, ILC	BEPCII, Belle/Belle-II、YNJ, AMY, COMET
South Korea	POSTECH, KAERI	Linear accelerator, High-Current Proton Linac (HPPA)	60MeV Linac export, HPPA, ADS, CSNS consult
Thailand	Chulalongkorn Uni, Suranaree Uni. of Technology, NARIT	Neutrino physics, JUNO	JUNO PMT test, Fabrication of Magnetic Field Cancellation Coils
Pakistan	Uni. of the Punjab, COMSATS, NCP	HEP experiment, detector	BESIII member, LHC, HEPS, CEPC discussion
India	CAT, TATA institute, nuclear center, VECC	Accelerator, synchrotron radiation, HEP	ACFA conference, accelerator
Others	PSI, NIKHEF, CIEMAT	HEP experiment and detector	LHC、AMS、L3+C

IHEP-CAS international collaboration (courtesy of Zheng Zhipeng and Zhang Chuang)

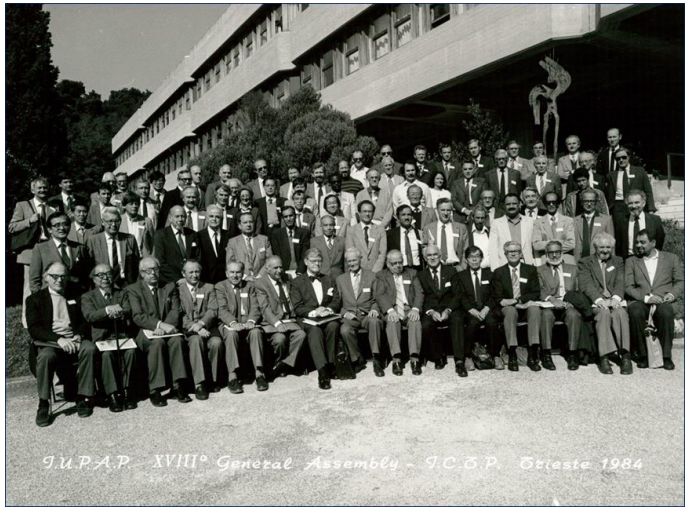
II. Rise and Internationalization (1980-2000)

☐ Theoretical Particle Physics

(courtesy of ITP CAS)

Guangzhou Conference on Theoretical Particle Physics (1980)

ZX He, YB Dai, BL Hao, HY Guo, XQ Zhu visited US (Stony Brook University, Yang office,1980)



CPS rejoined the IUPAP (1984)

Yang-Mills Guage theory conference (1984)

TD Lee, A. Zichichi and GZ Zhou CCAST World Lab opening ceremony (1986 Oct)

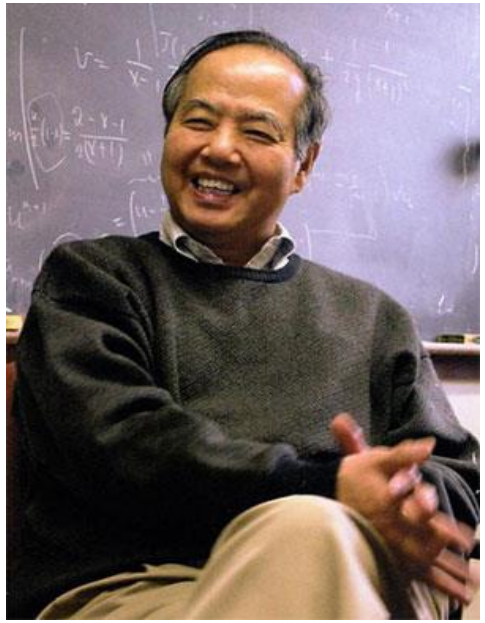
KITP CAS (2006/2007)

III. Discussion

☐ Particle physics played a special role in China – government priority

- The top leaders of China highlighted the research in High Energy physics (1960s-2000)
- A unique discipline for international cooperation (The Soviet Union, U.S., Germany, Japan, Italy, etc.)
- Distinguished Chinese-American physicists as the bridge between China and the world for the science and technology exchange and cooperation
- Open-up era: China's national strategic needs "High-Energy" to advancing Others (golden time/1980)
- From learn abroad to make their unique contribution to the international community

In memory of Herwig Schopper, Tsung Dao Lee, Chen Ning Yang and Guangzhao Zhou



T.D. Lee (1926-2024)

Guangzhao Zhou (1929-2024)

Herwig Schopper (1924-2025)

C.N. Yang (1922-2025)

Thank you for your attention!

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Dedicated to the memory of Herwig Schopper (1924-2025)

1 A photo taken during a visit by Herwig (front row, 4th from left) to China in 1977 to arrange collaboration between the Chinese Institute for High Energy Physics and DESY. The photograph was taken at a reception given by Fang Yi (front row 5th from left), who at the time was ViceChairman of the Academia Sinica. A powerful figure in China, Fang Yi went on to become one of the country's vice-premiers under Deng Xiaoping (©CERN archive, All rights reserved)