US-China: Scientific Partnerships — an analysis based on HEP

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Collaboration started more 30 years ago

Agreement on HEP signed on Jan. 31, 1979

First meeting in Beijing, June 10-13, 1979

During 29th meeting in IHEP, Nov. 2008

32nd meeting at BNL, Nov 2-3, 2011
A successful story: great help from US for the BEPC/BES construction

Key persons:
T.D. Lee
Pief Panofsky
Successful history of tau-charm collider
Not just help, but part of the experiment

USA (4)
University of Hawaii
University of Texas at Dallas
Colorado State University
Stanford Linear Accelerator Center

Japan (4)
Nikow University
Tokyo Institute of Technology
Miyazaki University
KEK

China (15)
IHEP of CAS
Univ. of Sci. and Tech. of China
Shandong Univ., Zhejiang Univ.
Huazhong Normal Univ.
Shanghai Jiaotong Univ.
Peking Univ., CCAST
Wuhan Univ., Nankai Univ.
Henan Normal Univ.
Hunan Univ., Liaoning Univ.
Tsinghua Univ., Sichuan Univ.
Mutual benefit

- **US contributions:**
  - Main drift chamber

- **Chinese benefits:**
  - Design review
  - Technology transfer
  - Equipments

- **US benefits:**
  - Scientific results
  - Students
BESIII: a fruitful collaboration

48 institutions, ~ 300 collaborators
Physics results

- **Light hadron physics**
  - Confirmation of BESII results: $\gamma p\bar{p}$, $\gamma \omega \phi$, $X(1835)$, ...
  - New resonances
- **Charmonium physics**
  - Improved measurements on $h_c$, $\eta_c$, $\chi_{cJ}$, ...
  - New observations of $\chi_{cJ}$, $h_c$ decays
- **Charm physics**
  - improved $f_d$ measurements
  - $\psi(3770)$ lineshape

33 papers published *(PRL 13, PRD 17, CPC 2, PLB1)*
~40 papers under internal review
AMS

Calorimeter (ECAL)
For SPEAR3 at SLAC

For PEP-II at SLAC

For NSLSII at BNL
Daya Bay: A successful story

North America (16)
BNL, Caltech, LBNL, Iowa State Univ., Illinois Inst. Tech., Princeton, RPI, UC-Berkeley, UCLA, Univ. of Cincinnati, Univ. of Houston, Univ. of Wisconsin, William & Mary, Virginia Tech., Univ. of Illinois-Urbana-Champaign, Siena

~250 Collaborators

Europe (2)
JINR, Dubna, Russia
Charles University, Czech Republic

Asia (20)
Daya Bay experiment
Major contributions from US

- All PMTs
- 4m AVs
- Veto structure
- RPC HV & gas
- AGV
- Liquid Filing system
- Detector Assembly & installation
- Software and Physics analysis
Results: observation of Electron Anti-neutrino Disappearance

- After 55 days of data taking, we observed a deficit:

\[ R = 0.940 \pm 0.011 \text{ (stat)} \pm 0.004 \text{ (syst)} \]

\[ \sin^2 2\theta_{13} = 0.092 \pm 0.016 \text{(stat)} \pm 0.005 \text{(syst)} \]

\[ \chi^2/NDF = 4.26/4, \quad 5.2 \sigma \text{ for non-zero } \theta_{13} \]
Chinese Contributions to RHIC/STAR

**Barrel MRPC MTD:**
1) ~$2.8M (0.8)
2) 2014

**Barrel MRPC TOF:**
1) ~$5.4M (1.2)
2) Completed 2010

**Si-Pixel HFT:**
1) ~$16.5M (1)
2) 2014

**HLT:** ~ $4M (0.5)

Detector operation
Data calibration, analysis, publications
PWG co-conveners
Future upgrades and eRHIC

**Groups:**
CCNU, SDU, USTC, Tsinghua Univ., SINAP, IMP
Scientific contributions from China:
PRL: 3; PRC: 7; PRD: 1; Nature: 1

April, 2011

“Observation of the Antimatter Helium-4 Nucleus”

by STAR Collaboration


March, 2010

“Observation of an Antimatter Hypernucleus”

by STAR Collaboration

Science, 328, 58(2010).
Collaboration now: all kinds

- MOUs with all major US national labs
- Exchange of visitors
  - Schools
  - Consultation & reviews for BEPCII, CSNS, ADS, ...
  - Conferences, workshops
  - Short and long term visitors, technical exchanges
- Chinese participation to US exp.: D0, STAR, AMS, ...
- US participation to Chinese exp.: BESIII, Daya Bay...
- International projects: ATLAS, CMS, ILC, ...
- Equipment exchange:
  - DoE->IHEP
    - Many during BESI/BESII, eg. BESII Drift chamber
    - Superconducting quadruple magnet from BNL for BEPCII
    - Longitudinal feedback kicker from PEP-II, SLAC for BEPCII
  - IHEP->DoE
    - Magnet for SPEAR3, PEPII, NSLS-II etc.
Future projects/collaborations

- **Particle physics**
  - BESIII, Daya Bay & their future phase
  - International projects: LHC, ILC...
  - High altitude cosmic-ray observatory: LHASSO

- **Astro-physics**
  - AMS
  - South pole telescope

- **Accelerators & related technologies**
  - Chinese Spallation Neutron Source
  - ADS
  - Beijing advanced light source

- **Detector technologies**
  - Photon detectors
  - Silicon detectors

- **Applications**
  - Neutron scattering
  - Synchrotron radiation & its extension


Superconducting cavities
Beam monitor and controls
SR beamline components
Why it is successful?

• Well designed at the beginning
• T.D. Lee and Pief Panofsky
• CAS-DOE agreement
• Mutual benefit
• Equal partner
• The nature of particle/nuclear physics: > 50 years tradition of international collaboration
Summary

- China-US collaboration on HEP is very successful. It is helpful for HEP in China, in the US and beneficial to the Science in the world.

- Although not always smooth, the collaboration is a story of success, with influence even to the bilateral relationship.

- Let’s continue to work together for a better world.