BEPCII project and ATLAS collaboration at IHEP

Guoliang TONG

IHEP, CAS

tonggl@mail.ihep.ac.cn

CPPM IN2P3 Marseille

October 18 , 2004

Outline

0. Brief Introduction of IHEP
1. Brief Introduction to BEPC I
2. BES Physics Results
3. BEPCII/BESIII Project
4. ATLAS collaboration at IHEP, CAS
5. Summary

Yangbajing International Cosmic Ray Observatiry(a.s.14300m),IHEP-INFN RPC(right),China-Japan Air Shower Array(left).

The Institute of High Energy Physics(IHEP) is the biggest and comprehensive fundamental research center in China.

The major research fields of IHEP are particle physics, accelerator physics and technologies, radiation technologies and application, including the following leading research areas:

Particle physics experiments: BES, neutrino experiments, experiments at LHC and B-factories…
Theoretical Physics: particle physics, medium and high energy nuclear physics, cosmology, field theory…
Particle astrophysics: cosmic ray, astrophysics experiments…
Accelerator physics and technology: high luminosity e^+e^- collider, high power proton accelerator, accelerator applications…
Synchrotron radiation: technology and application;
Nuclear analytical technique and application;
Free electron laser;
Nuclear detector and fast electronics;
Computing and network application;
Radiation protection.

The main research facilities at IHEP are:
Beijing Electron Positron Collider (BEPC)
Beijing Spectrometer (BES)
Beijing Synchrotron Radiation Facility (BSRF)
Beijing Free Electron Laser (BFEL)
Particle Astrophysics Lab
Yangbajing International Cosmic Ray Observatory
Nuclear Analysis Lab
Intense Slow Positron Source

IHEP has extensive cooperation with all high energy physics laboratories and participates in many important particle physics experiments in the world.

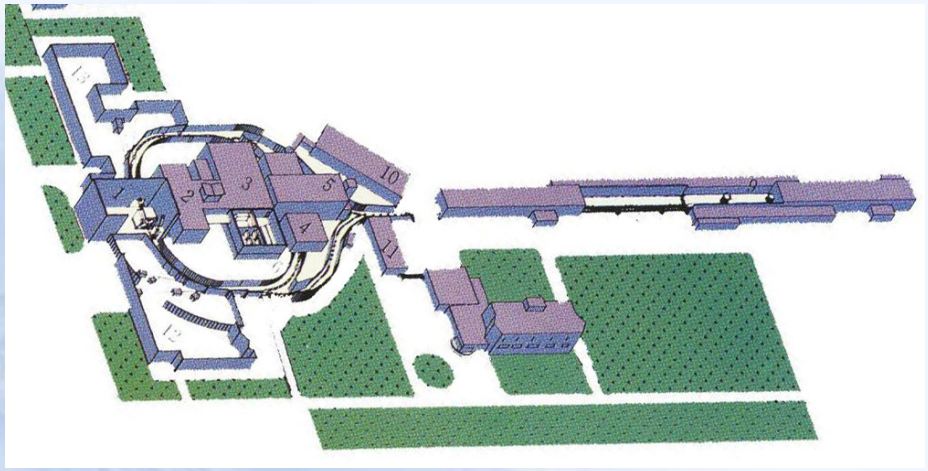
IHEP is staffed with about 1000 people, including over 650 physicists and engineers. In addition, there are 300 graduate students and post-doctors.

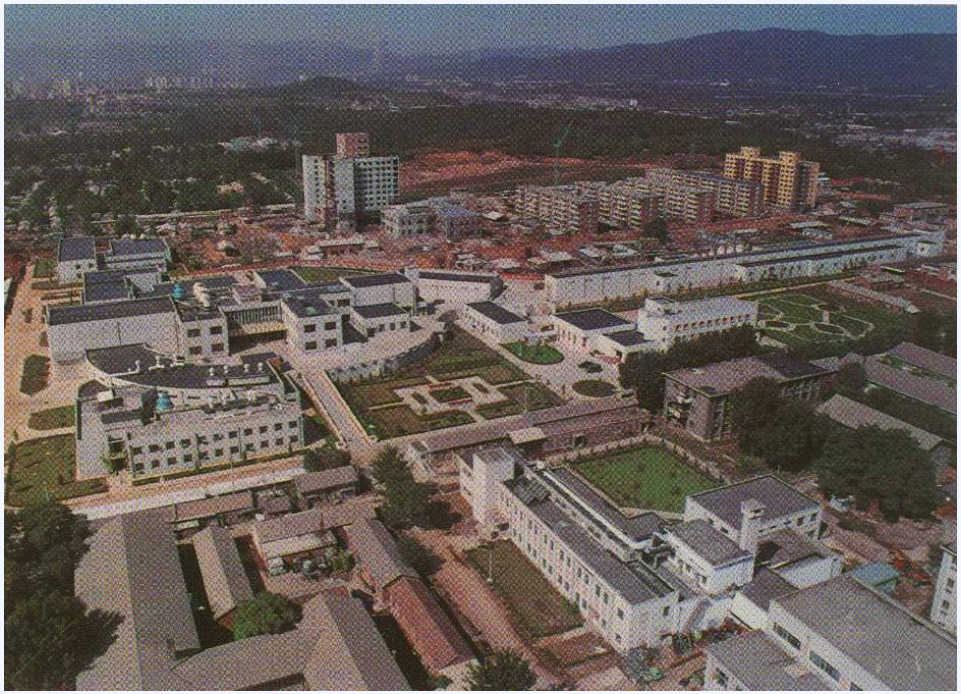
1. Brief Introduction to BEPC I

The Beijing Electron Positron Collider

L ~ 5 $\times 10^{30}$ /cm^2·s at J/ψ peak

E_{cm}~2-5 GeV

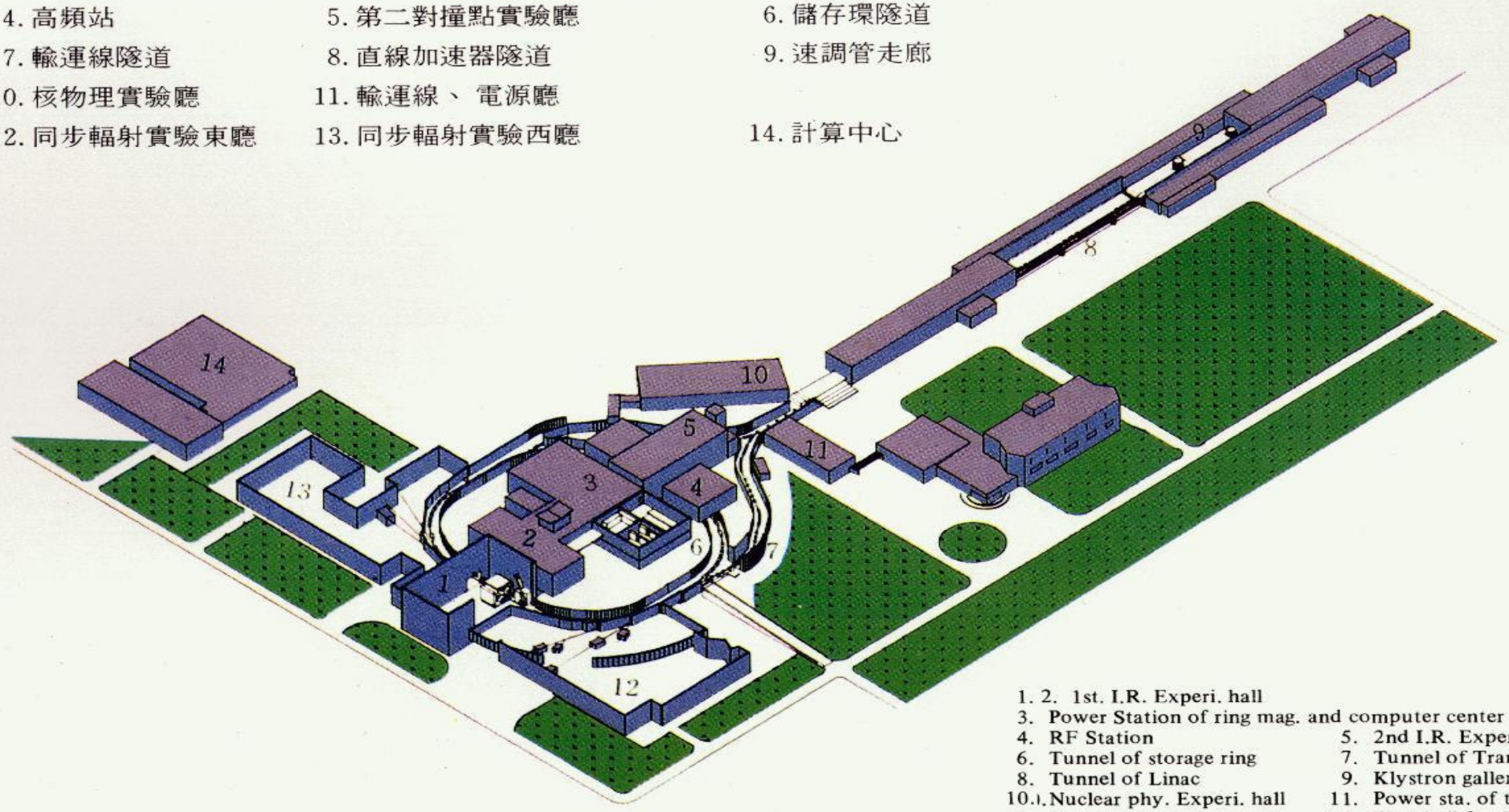




BEPC consists of Linac、Storage Ring、Detector(BES）and Synchrotron Facility(BSRF). Ground breaking in 1984，completed in 1988 within budget and according to the schedule. Soon after reached the designed performances.

北京正负电子对撞机

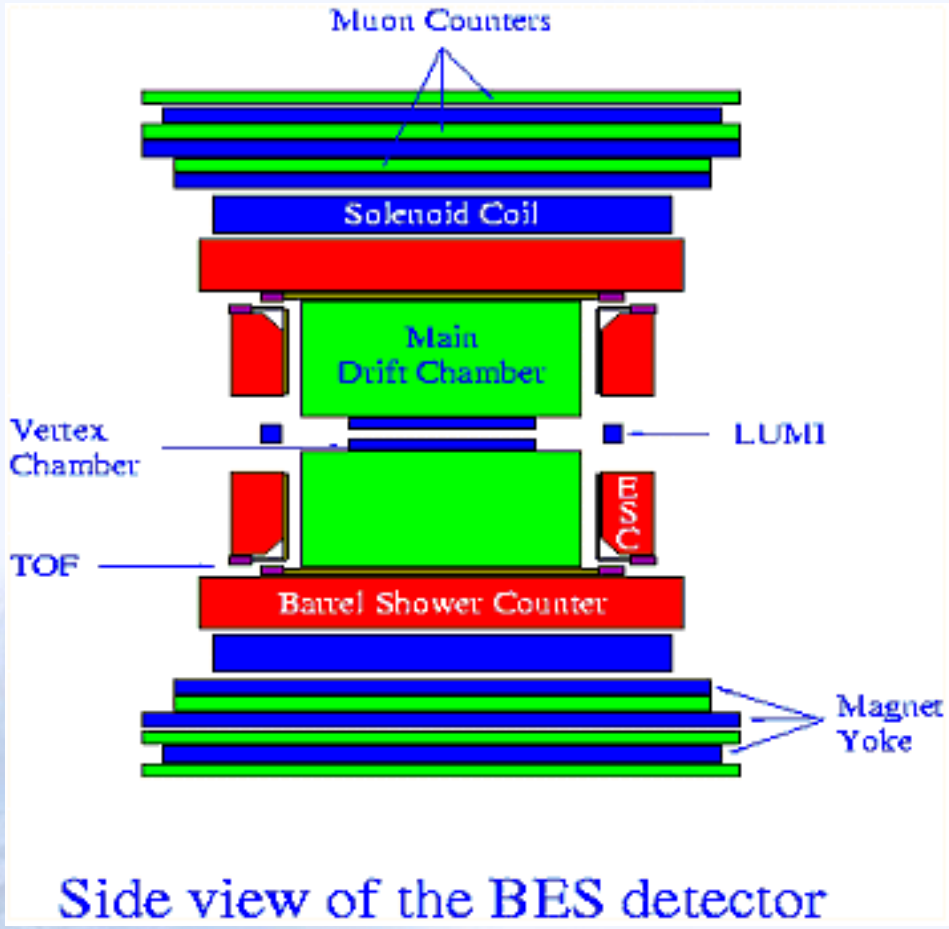
1. 2. 第一對撞點實驗廳
3. 儲存環電源廳、中央控制室
4. 高頻站
5. 第二對撞點實驗廳
6. 儲存環隧道
7. 輸運線隧道
8. 直線加速器隧道
9. 速調管走廊
10. 核物理實驗廳
11. 輸運線、 電源廳
12. 同步輻射實驗東廳
13. 同步輻射實驗西廳
14. 計算中心



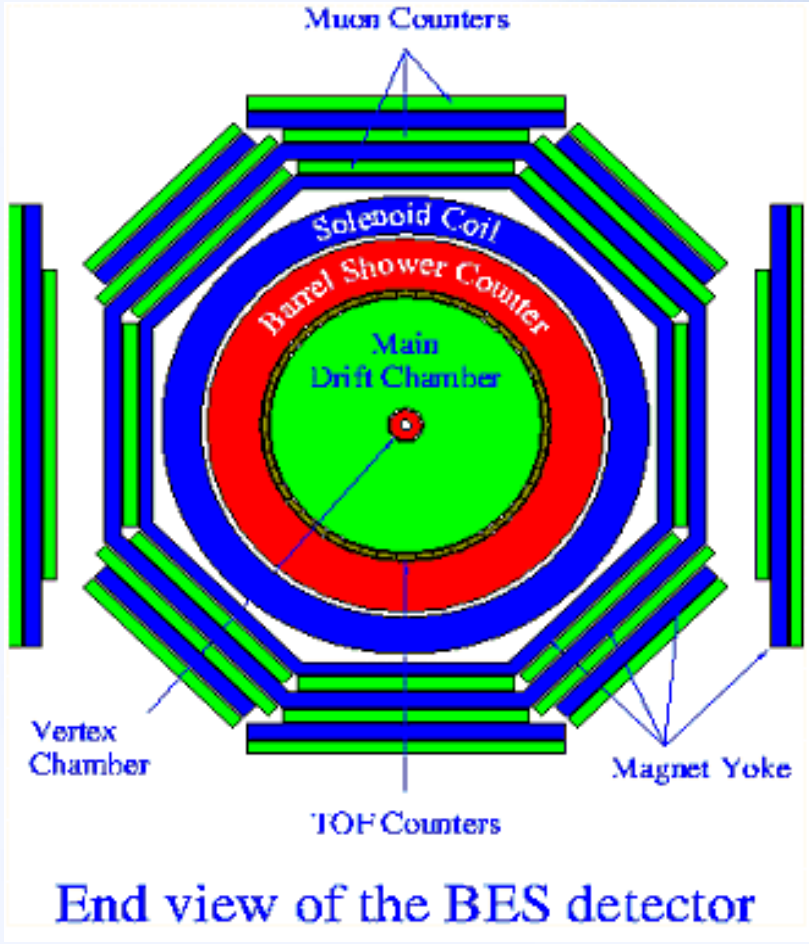
1. 2. 1st. I.R. Experi. hall
3. Power Station of ring mag. and computer center
4. RF Station
5. 2nd I.R. Experi. hall
6. Tunnel of storage ring
7. Tunnel of Trans. line
8. Tunnel of Linac
9. Klystron gallery
10. Nuclear phy. Experi. hall
11. Power sta. of trans. line
12. East hall for S. R. experi.
13. West hall for S. R. experi.
14. Computer center

Beijing Electron Positron Collider

BESII Detector (1995-1997 upgraded)



Side view of the BES detector



End view of the BES detector

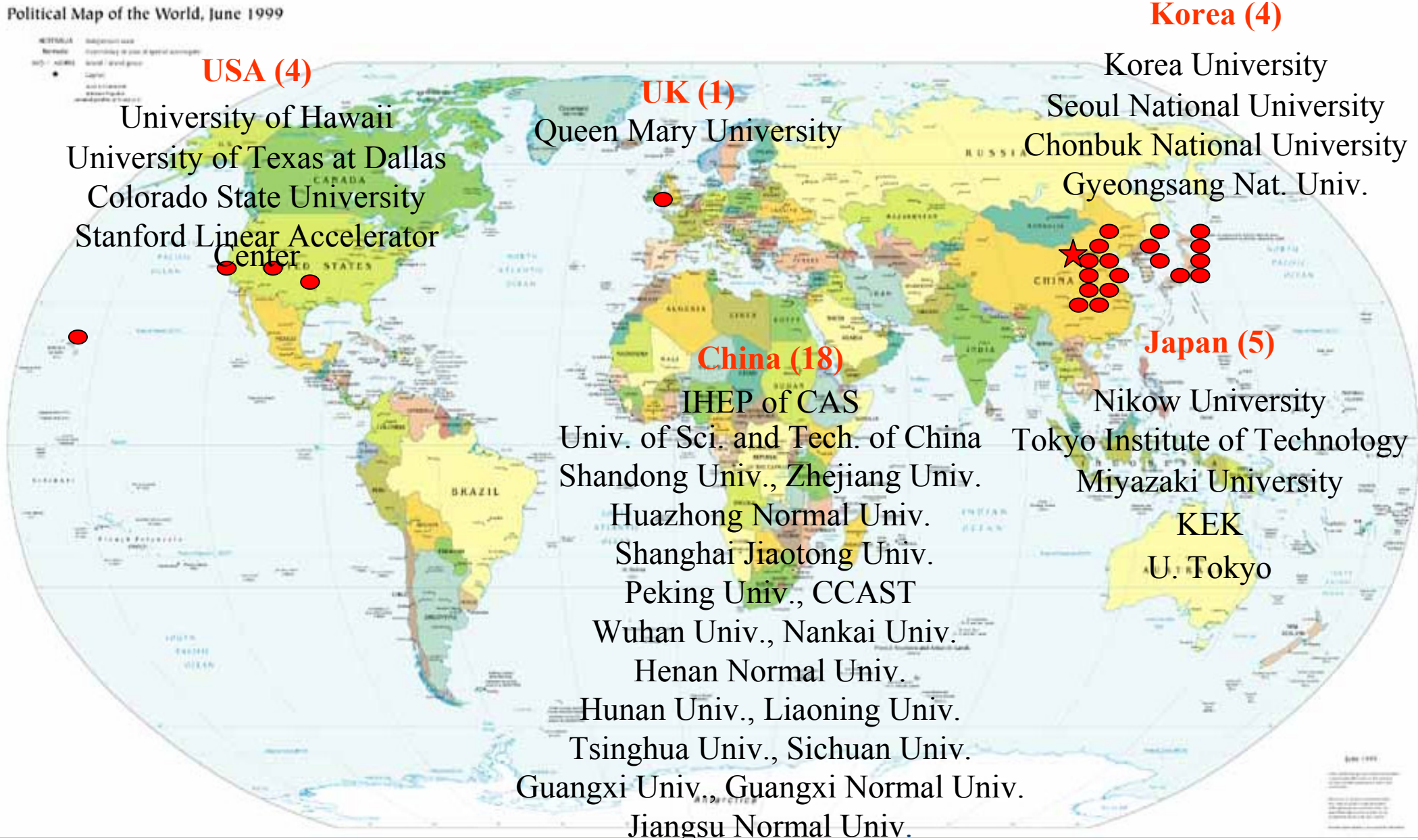
VC: σ_{xy} = 100 μm TOF: σ_T = 180 ps μ counter: $\sigma_{r\phi}$= 3 cm

MDC: σ_{xy} = 250 μm BSC: $\Delta E/\sqrt{E}$= 22 % σ_z = 5.5 cm

$\sigma_{dE/dx}$= 8.4 % σ_ϕ = 7.9 mr B field: 0.4 T

$\Delta p/p=1.8\sqrt{(1+p^2)}$ σ_z = 2.3 cm Dead time/event: 〈10 ms

The BES Collaboration



USA (4)

University of Hawaii
University of Texas at Dallas
Colorado State University
Stanford Linear Accelerator Center

UK (1)

Queen Mary University

Korea (4)

Korea University
Seoul National University
Chonbuk National University
Gyeongsang Nat. Univ.

China (18)

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.
Guangxi Univ., Guangxi Normal Univ.
Jiangsu Normal Univ.

Japan (5)

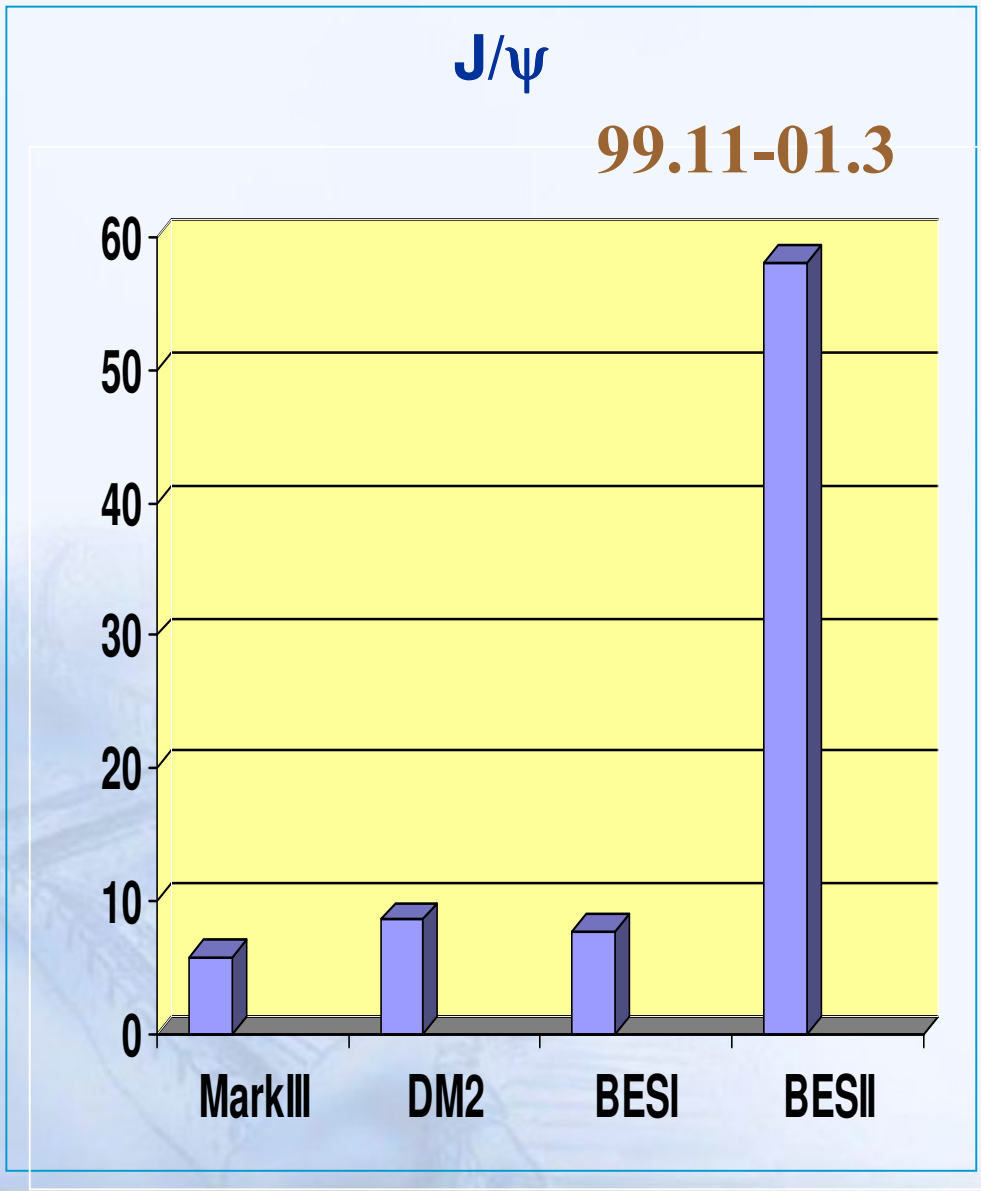
Nikow University
Tokyo Institute of Technology
Miyazaki University
KEK
U. Tokyo

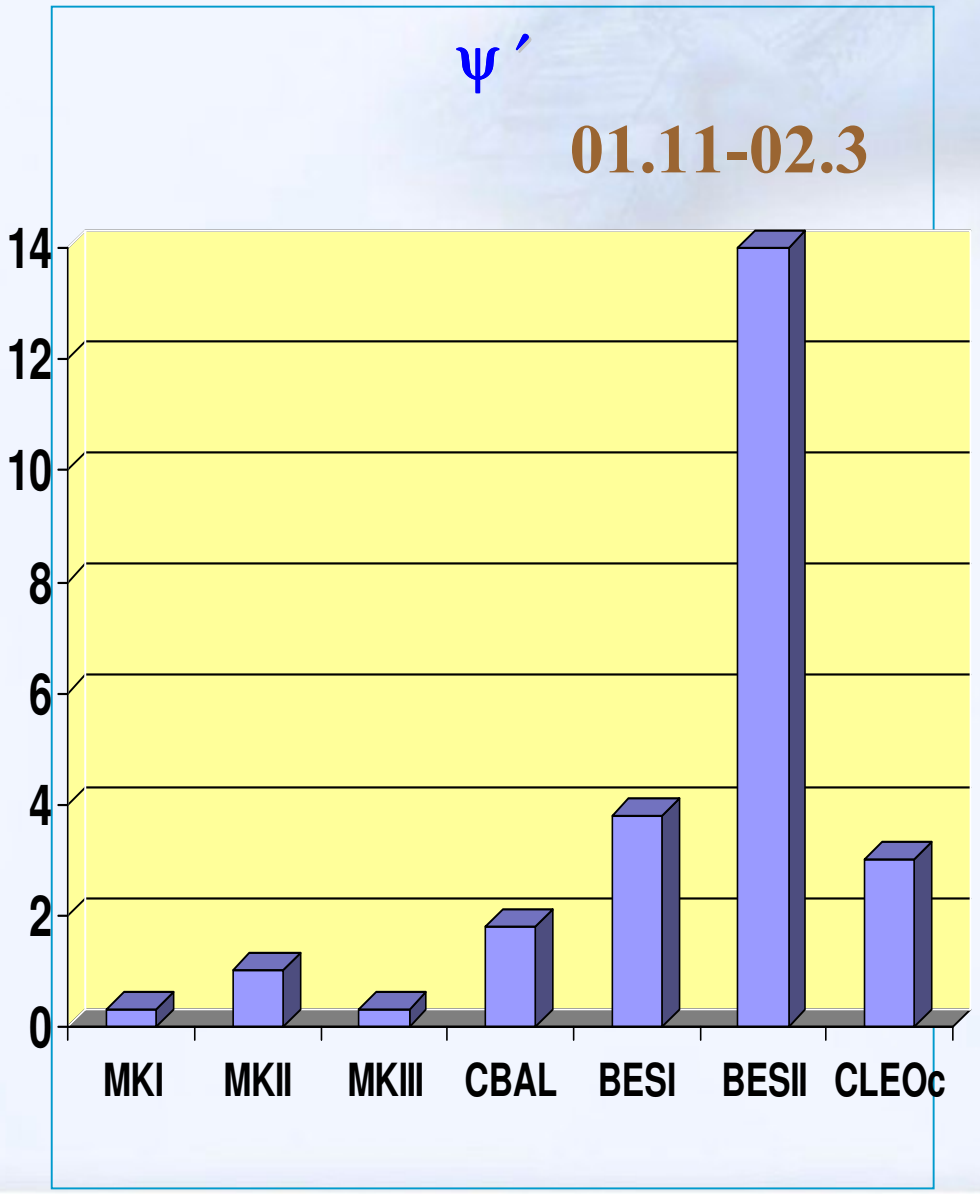
2. BES Physics Results

Data collected with BESI and BESII

E_{cm} (GeV)	Physics	BES Data	Other Lab.
3.10	J/ψ	7.8×10^6	8.6×10^6
3.69	ψ(2S)	3.9×10^6	1.8×10^6
4.03	τ	1.0×10^5	LEP
4.03	D_S, D	22.3 pb^{-1}	CLEO
3.55 m_τ scan	m_τ	5 pb^{-1}	
2-5 R scan	R value, α_{QED}, $(g-2)_\mu$	6+85 points	γγ2, MarkI Crystal Ball Pluto……
2.2,2.6,3.0	QCD		
3.1	J/ψ	5.8×10^7	
3.69	ψ(2S)	1.46×10^7	
3.78	ψ(3770)	~27 pb^{-1}	

world largest J/ψ and ψ' data samples (10^6)





BESII Detector Simulation

Understanding the detector simulation and Data/MC consistency are very important to the physics results,

BES simulation,

SOBER(BESI), detector gaussian response, no hadron interaction (from MarkIII)

SIMBES(BESII), Geant3 based, better detector responses

For example, the wire resolution is affected by the dE/dx of the MDC hits.

Impacts on Physics Results

BR($J/\psi \rightarrow \pi^+\pi^-\pi^0$) from SIMBES is about 30% higher than that from SOBER. It is also about 30% higher than PDG.

$$Br(J/\psi \rightarrow \pi^+\pi^-\pi^0) = (21.84 \pm 0.05 \pm 2.01) \times 10^{-3}$$

Babar's new result confirms our result.

Hight lights of BES Physics Results

- Precise measurement of the mass of tau lepton
- Precise measurement of R value in the energy range of 2-5 GeV
- ψ(2S) decays

  Study many decay modes and the 12% rule
- J/ψ decays

  Light hadron spectroscopy, search for multi-quark candidates
- ψ(3770) decays and D physics

In 1992, BES made a scan over tau mass production threshold and measured the tau mass,

BES

$$M\,\tau = 1776.96\ ^{+0.18+0.25}_{-0.21-0.17}$$

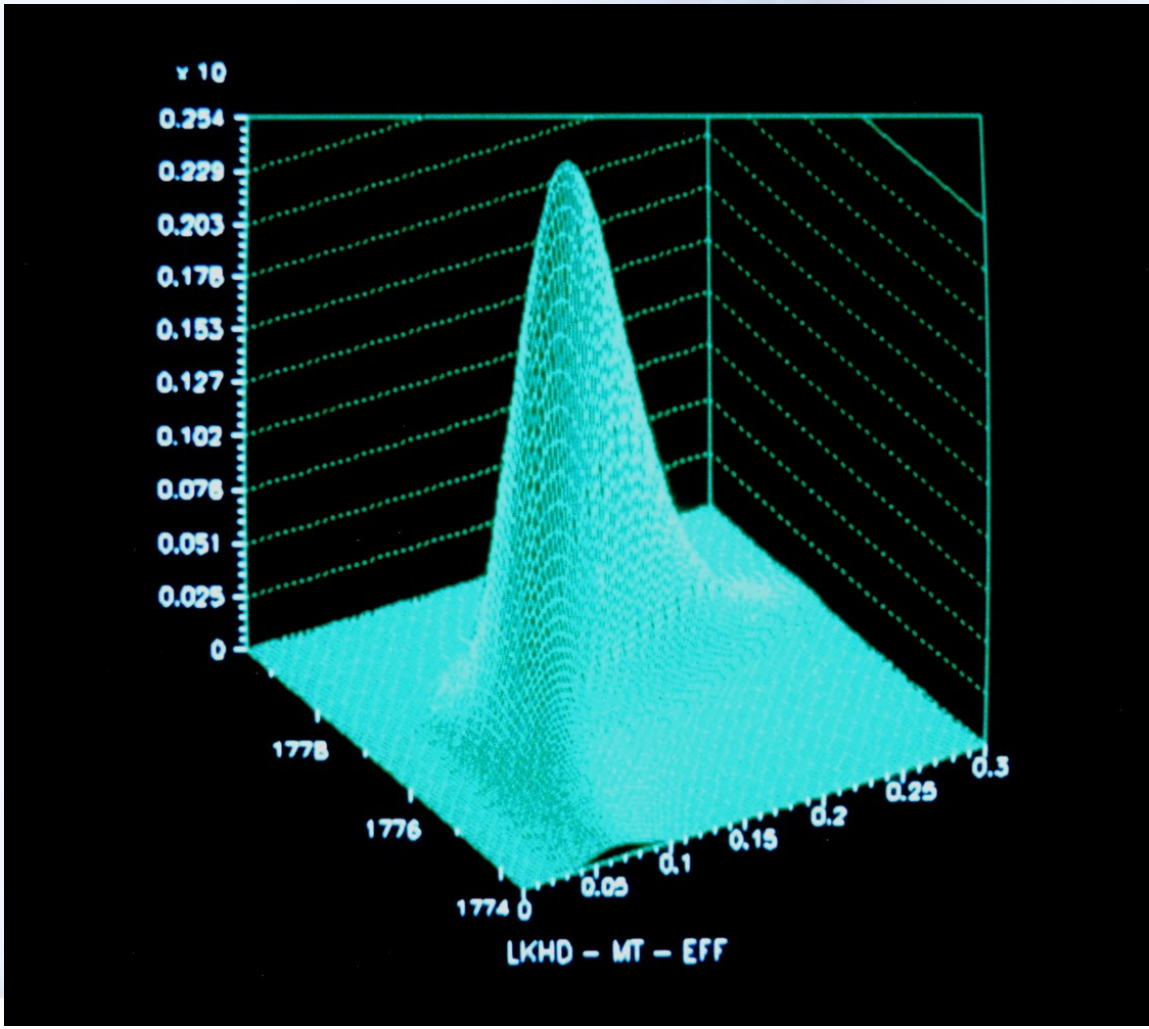
PDG

$$M\,\tau = 1776.99\ ^{+0.29}_{-0.26}$$

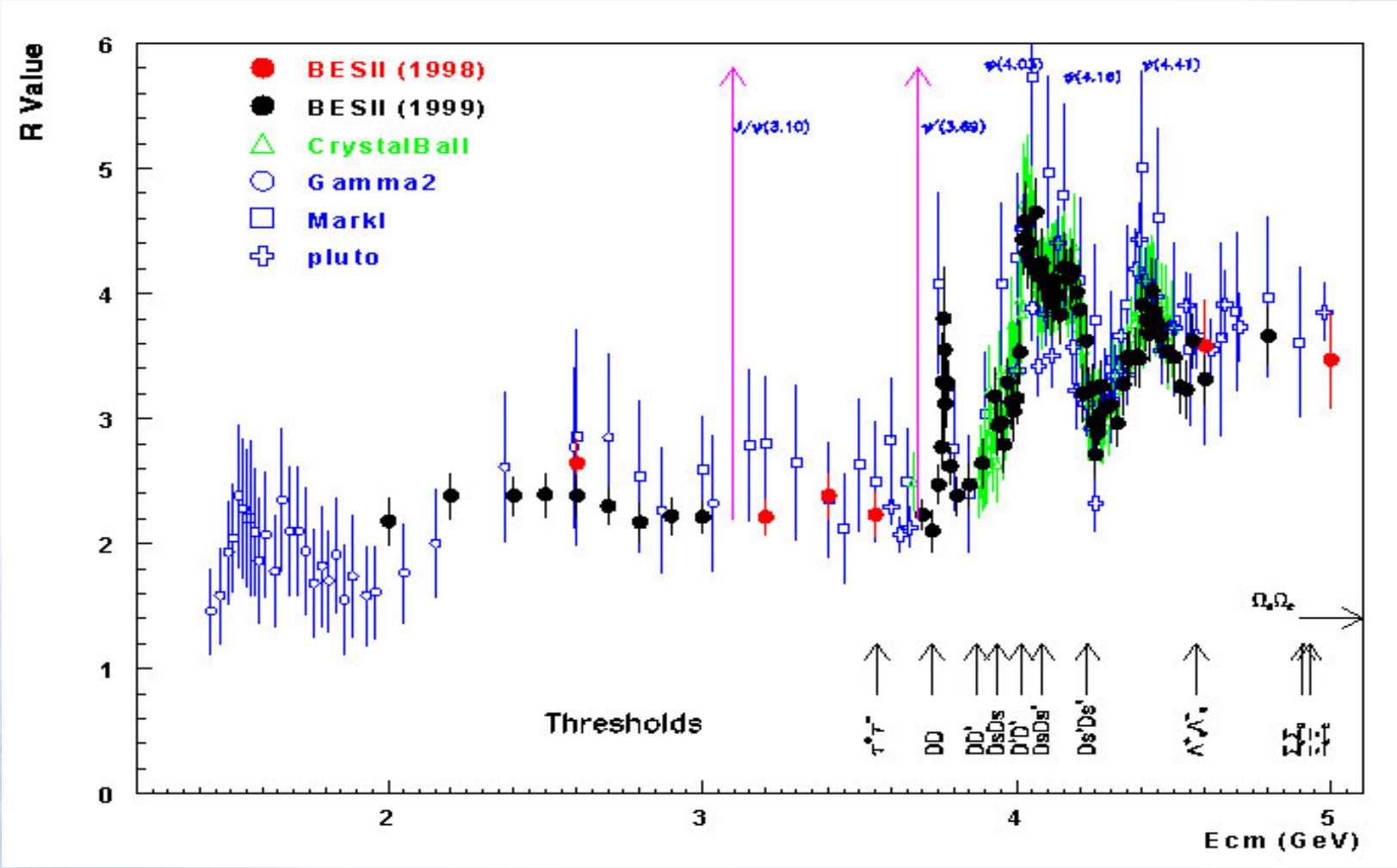
Corrected a mass shift of 7 MeV from previous measurements, proved that tau is one of the leptons.

$\mu\tau$ **-universality check:**

$$G^2_F \propto \frac{B(\tau \to \nu_\tau e \bar{\nu}_e)}{t_\tau m^5_\tau}$$



R Measurement



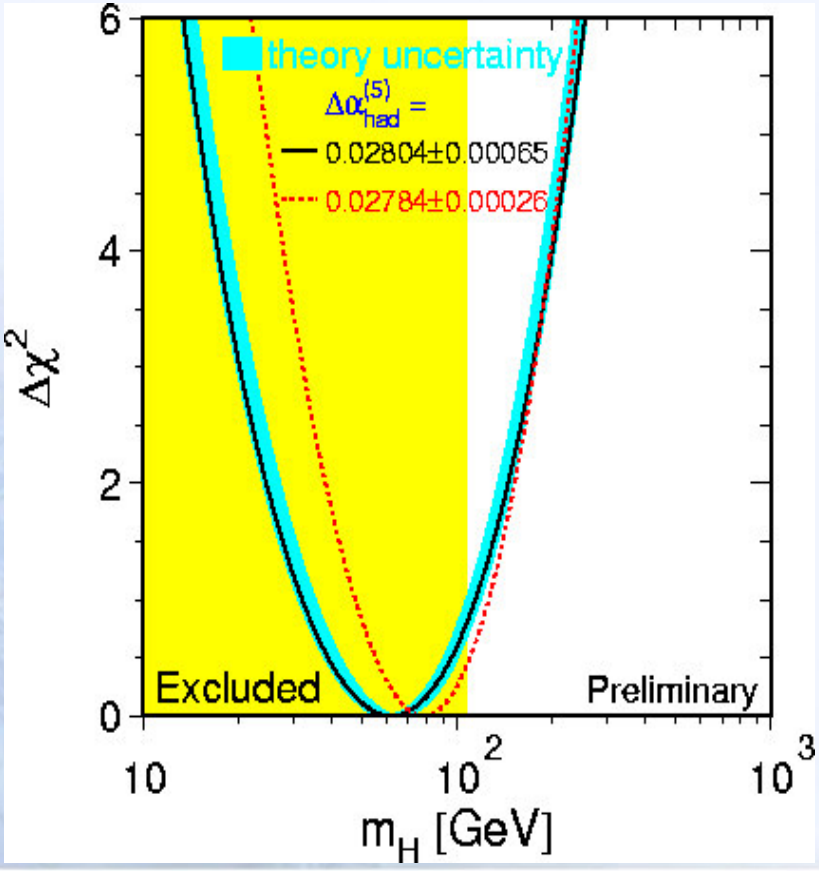
- With an average error of 6.6%, compare with 15-20% errors from previous measurements
- fine measurement of the structure at 3.7-4.5GeV

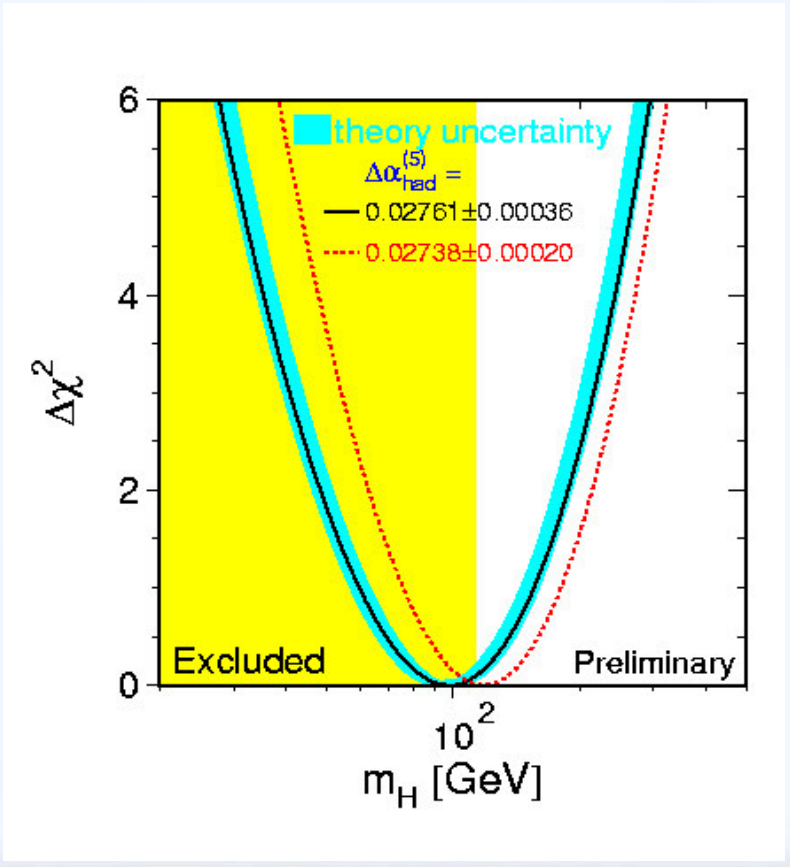
Prediction of Higgs mass from standard model

$$m_H = 62\ ^{+53}_{-30}\ GeV \qquad m_H < 170\ GeV$$

(95% C.L.)

$$m_H = 98\ ^{+58}_{-38}\ GeV \qquad m_H < 212\ GeV$$





Recent Physics Results

J/ψ Decays

Threshold enhancements in γpp and $pK\Lambda$

σ in $\omega\,\pi^+\pi^-$; κ in $K^*(892)^0K^+\pi^-$ / $K^+K^-\,\pi^+\pi^-$

Study of scalars in J/ψ decays

Many BF measurements

$\psi(2S)$ decays

12% Rule; $\psi(2S) \rightarrow \rho\pi$;

σ in $\psi(2S) \rightarrow J/\psi\ \pi^+\pi^-$;

Many decay BF measurements of $\psi(2S)$ and χ_{CJ}

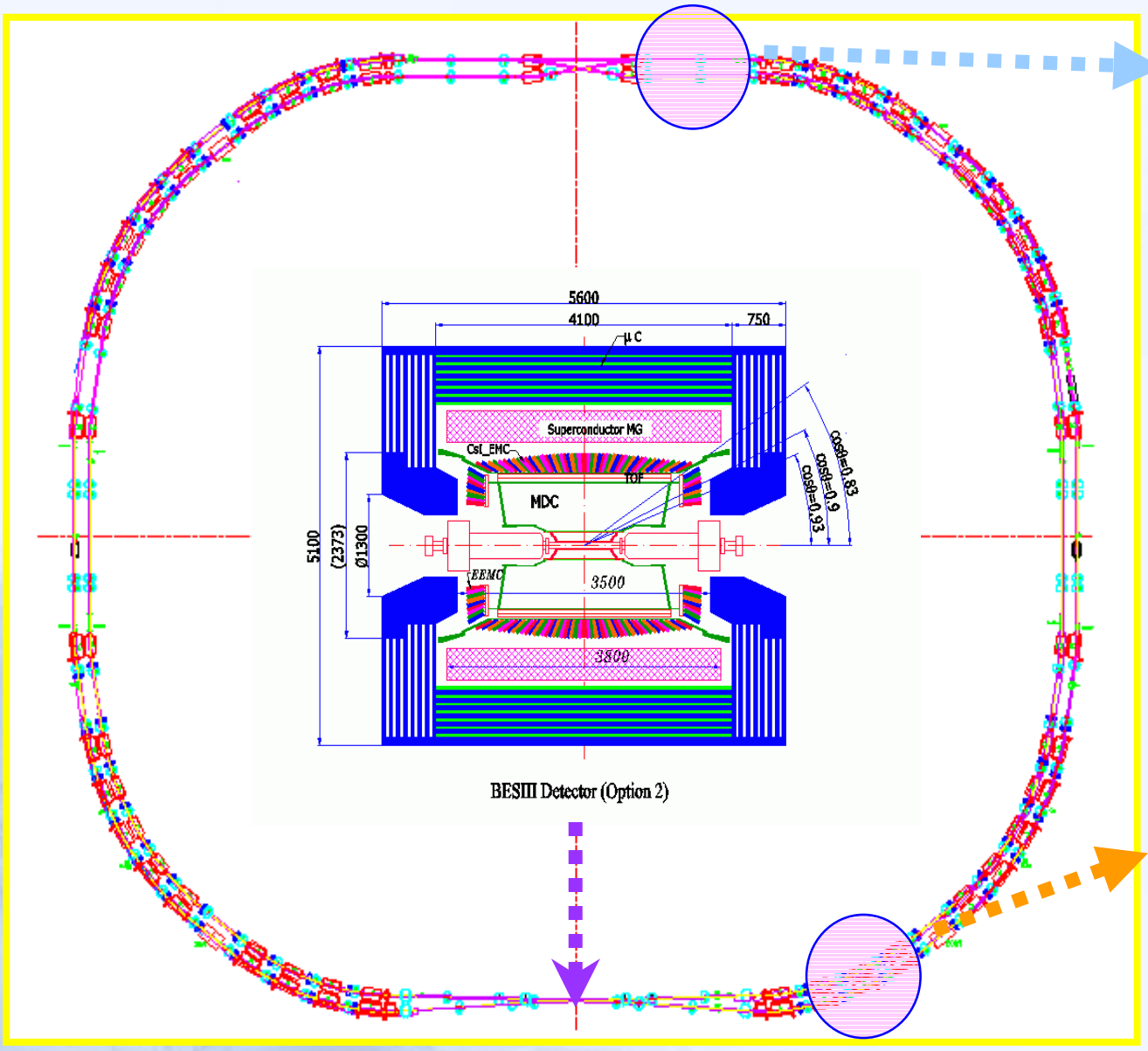
$\psi(3770)$ decays

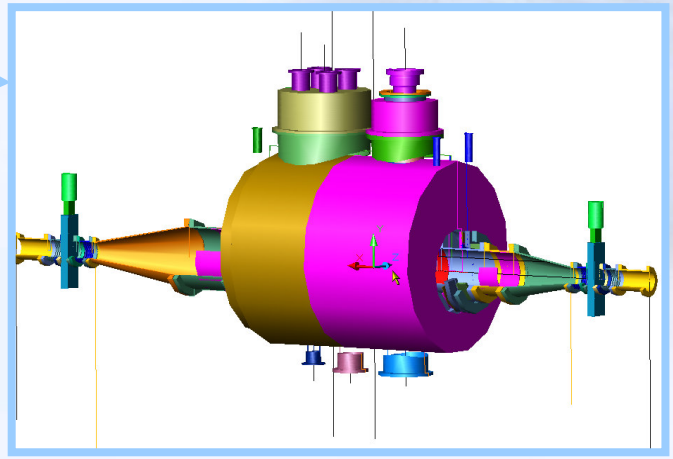
D BF measurements, (semi-leptonic, purely leptonic, hadronic decays)

DD cross-section;

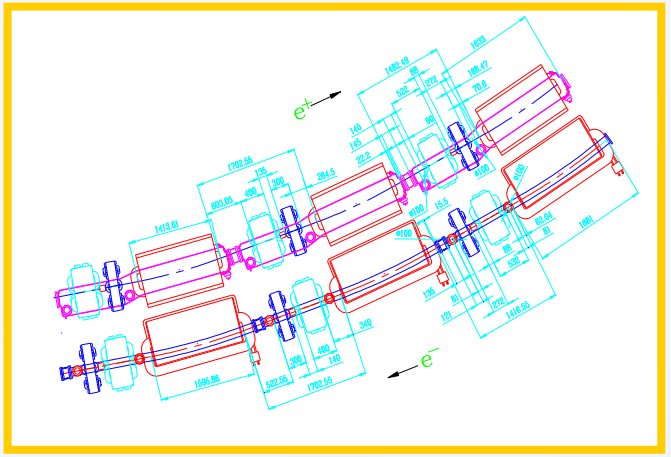
$\psi(3770)$ resonance parameters from scanning

3. BEPCII/BESIII Project





Two rings



BEPCII Design Goals

Beam energy	1 – 2.1 GeV
Optimal energy	1.89 GeV
Luminosity	1×10^{33} $cm^{-2}s^{-1}$ @ 1.89 GeV
Linac requirements	Full energy injection: 1.55 – 1.89 GeV Positron injection rate > 50 mA/min
Dedicated SR	250 mA @ 2.5 GeV

Expected Number of Events in One Year's Running

Physics Channel	C. M. Energy (GeV)	Peak Lumi. ($10^{33}cm^{-2}s^{-1}$)	Cross Section (nb)	Events per Year
J/ψ	3.097	0.6	~3400	10×10^9
τ	3.670	1.0	~2.4	12×10^6
ψ'	3.686	1.0	~640	3.0×10^9
D	3.770	1.0	~5	25×10^6
D_s	4.030	0.6	~0.32	1.0×10^6
D_s	4.140	0.6	~0.67	2.0×10^6

With such a data sample, a precise measurements are expected

BEPCII/BESIII Physic Goals

- Precise measurements of J/ψ、ψ(2S)、ψ(3770）Decays
- Precise measurement of CKM parameters
- Light quark hadron spectroscopy
- Excited baryon spectroscopy
- Other D and Ds physics:
  - precise measurement of D and Ds decays
  - measurement of $f_{D,}$ f_{Ds}
  - D^0 – $\bar{D}^0$ mixing
- Check VDM, NRQCD, PQCD, study ρπ puzzle

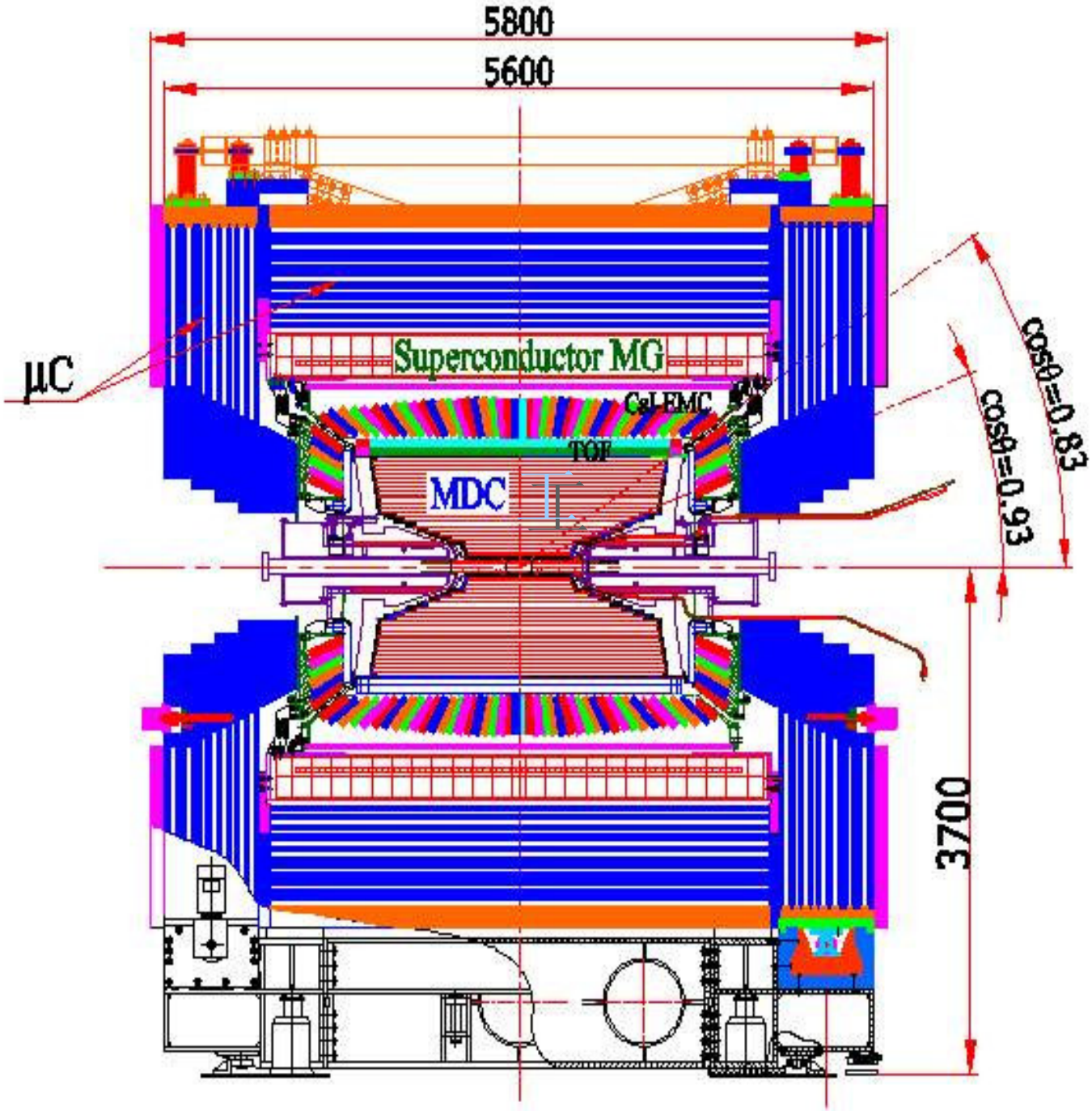
BEPCII/BESIII Physics Goals (2)

- Mechanism of hadron production，low energy QCD：

  precise R measurement

- τ physics：charged current， $m_{\nu\tau}$ and m_{τ}
- Search for new particles: $^1P_1$、η'_c?、glueballs、quark-gluon hybrid、exotic states…
- Search for new phenomena:
  - rare decays;
  - lepton number violation;
  - CP violation in J/ψ and ψ(2s) decays;

BESIII Detector



BESIII Main Parameters

system	BES III
MDC	σ_{XY} = 130 μm
	△P/P = 0.5 %(1 GeV)
	$\sigma_{dE/dx}$ = 6-7 %
EMC	△E/√E = 2.5 %(1 GeV) $\sigma_{z,\phi}$= 5-6mm (1 GeV)
TOF	σ_T = 90-100 ps Barrel 110 ps endcap
μ counter	9- 8 layers
Magnet	1.0 tesla

BESIII 和 BESII比较

子系统	BES III	BESII
MDC	σ_{XY} (μm) = 130	250
	△P/P ($^0/_0$) = 0.5 %(1 GeV)	2.4% (1 GeV)
	$\sigma_{dE/dx}$ ($^0/_0$) = 6-7 %	8.5%
电磁量能器	△E/√E($^0/_0$) = 2.5 %(1 GeV) $\sigma_{z,\phi}$(cm) = 0.6cm/ √E	22% (1 GeV) 3 cm / √E
飞行时间	σ_T (ps) = 90-100 ps barrel 110 ps endcap	180 ps barrel 350 ps endcap
μ 计数器	9- 10 layers	3 layers
磁场	1.0 tesla	0.4 tesla

BESIII Schedule

- 11/2004: supporting structure/yoke installation
- 2-3/2005: endcap muon chamber installation
- 5/2005: magnet installation
- 10/2005: magnetic field mapping
- 2/2006: EMC installation
- 3/2006: MDC/TOF installation
- 7/2006: BESIII debug and commissioning,
  Cosmic ray
- 10/2006: BESIII detector in beam-line
- 11/2006: commissioning detector/machine

BESIII Collaboration

There are about 18 Chinese institutes in BES collaboration, about 10 are actively involved in BESIII project,

Physicists from US and Japan are participating in BESIII project,

More foreign participants are welcome.

A news reported on CERN COURIER 8(2004)6

…and MENU takes eastern flavor for 10th anniversary

10 international Symposium on Meson-Nucleon Physics and the Structure of the Nucleon(MENU2004)held at IHEP on 30 August to 4 September

Previous symposia have oscillated between Europe and North America,but now BES collaboration at BEPC has become a new member of the "MENU club" through of N* production from J/psi decays over the past few years, and for the first time MENU went east.

MENU 2004 attracted about 150 participates from 23 countries around the world, and there were around 100 talks.

4. ATLAS collaboration in China and at IHEP, CAS

ATLAS collaboration in China

4.1.Brief historic review

4.2.The progress of the task undertaken

MDT Production

TGC Production

4.3.Computing and Software preparation in China

4.1 Brief Historic review

8 July, 1998 NSFC expressed the wish to have Chinese teams to participate ATLAS collaboration as a Chinese Cluster formed by IHEP CAS, Nanjing Univ., Shandong Univ. and USTC

20 September, 1999 MoU for Collaboration in the Construction of the ATLAS detector has been signed by NSFC and CERN.

Task undertaken :
32 BEE & 16 BIS.8 MDT Chambers at IHEP CAS
400 TGC Chambers at Shandong Univ.

4.2 The progress of the task undertaken

4.2.1 MDT Production(IHEP)

According to the MoU, IHEP undertakes 32 BEE & 16 BIS.8 MDT Chamber(tube) production

Progress & schedule:

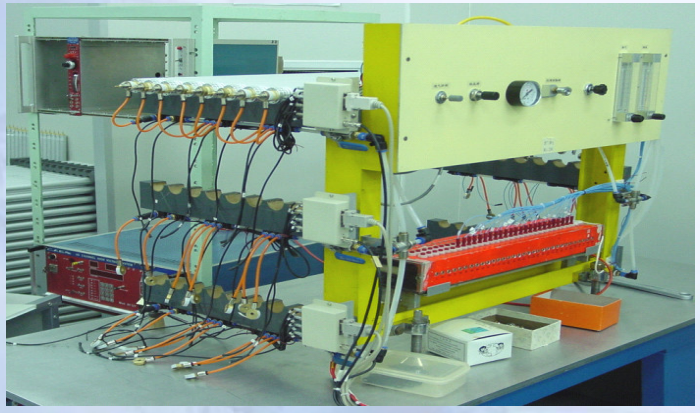
Oct. 03	**First BEE MDT chamber（Module-0) produced**
Nov. 03	**Module-0 pass Tomograph check at CERN**
March 04	**Beijing IHEP MDT site review**
Apr. 04-Dec. 05	**Mass production**

1500 MDT tubes produced and over 98% quality check
5 MDT chambers constructed

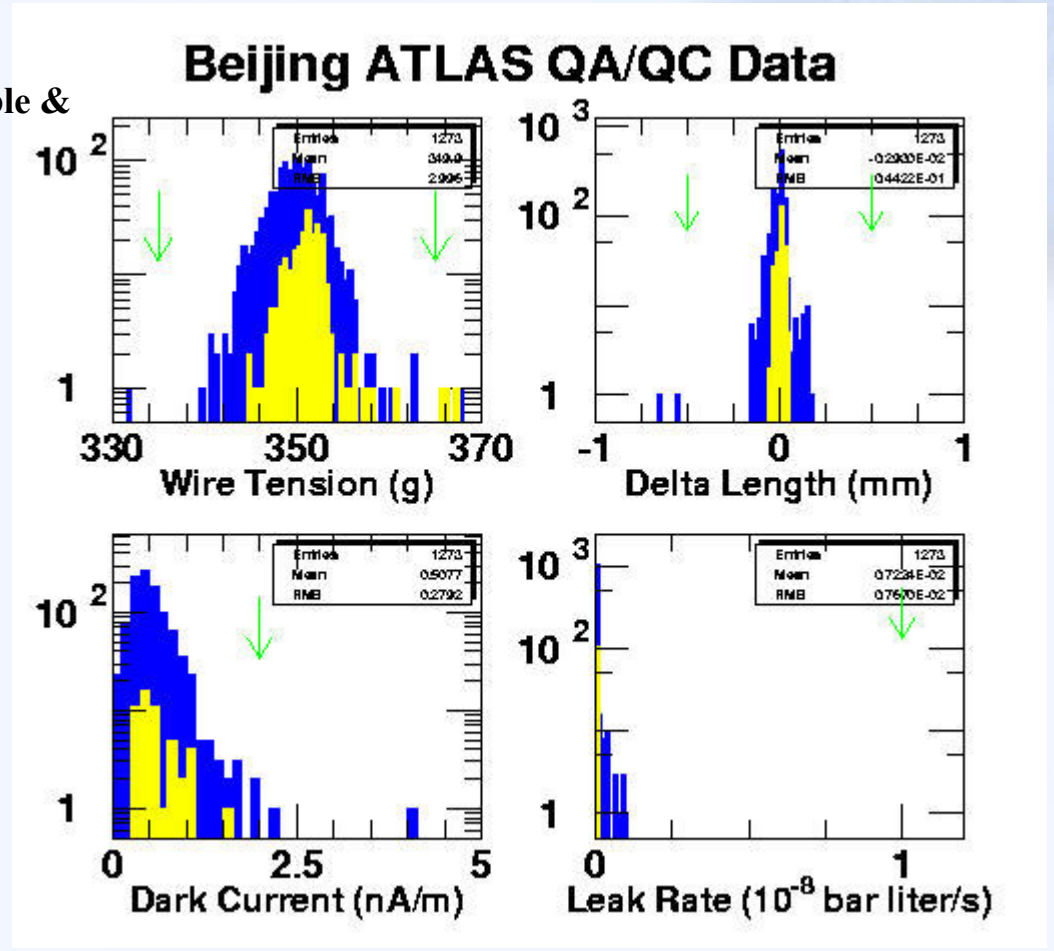
MDT tube assembling and quality control

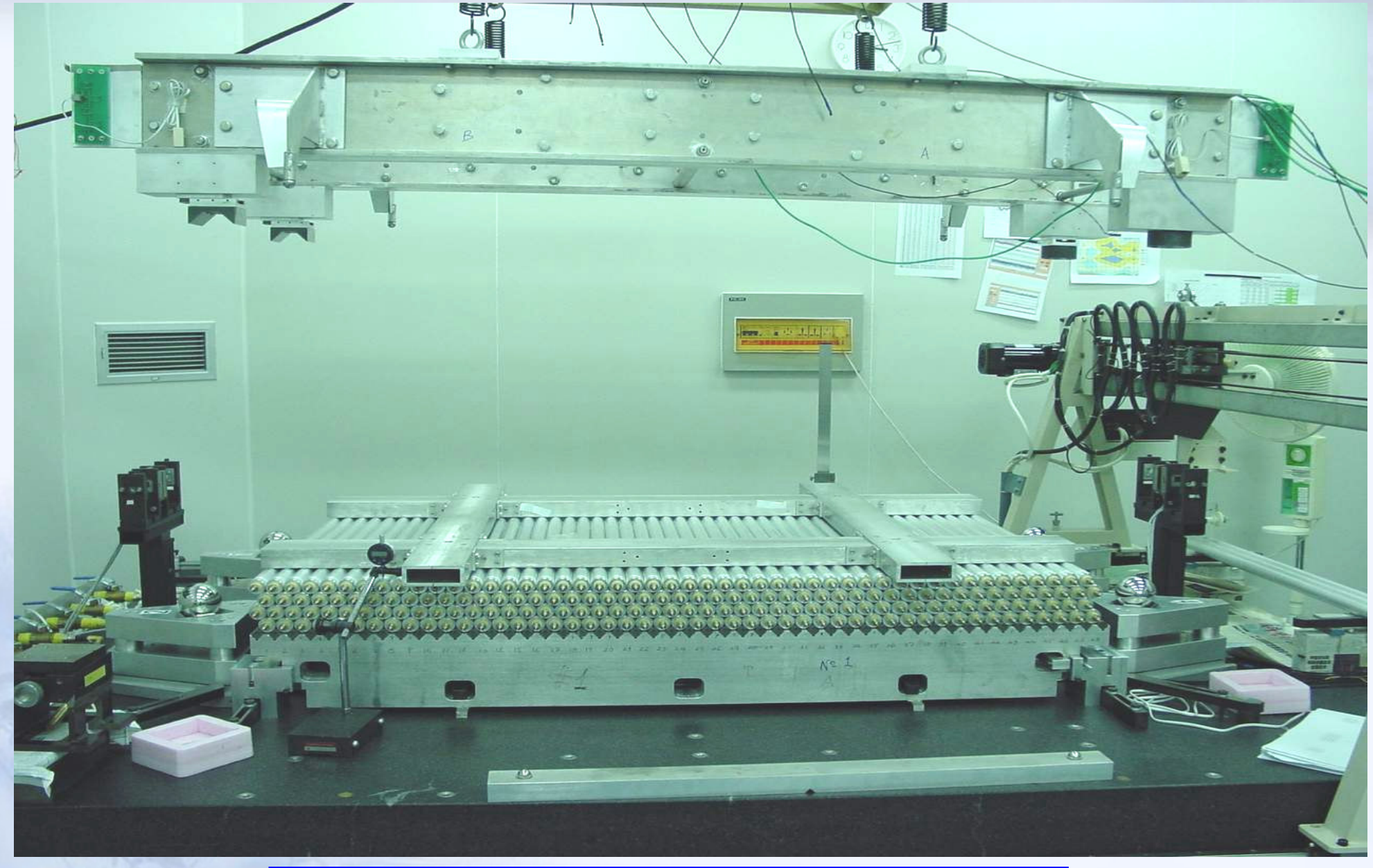
Assembling table &
Wire tension
measurement

Leakage rate
measurement



Dark current
measurement





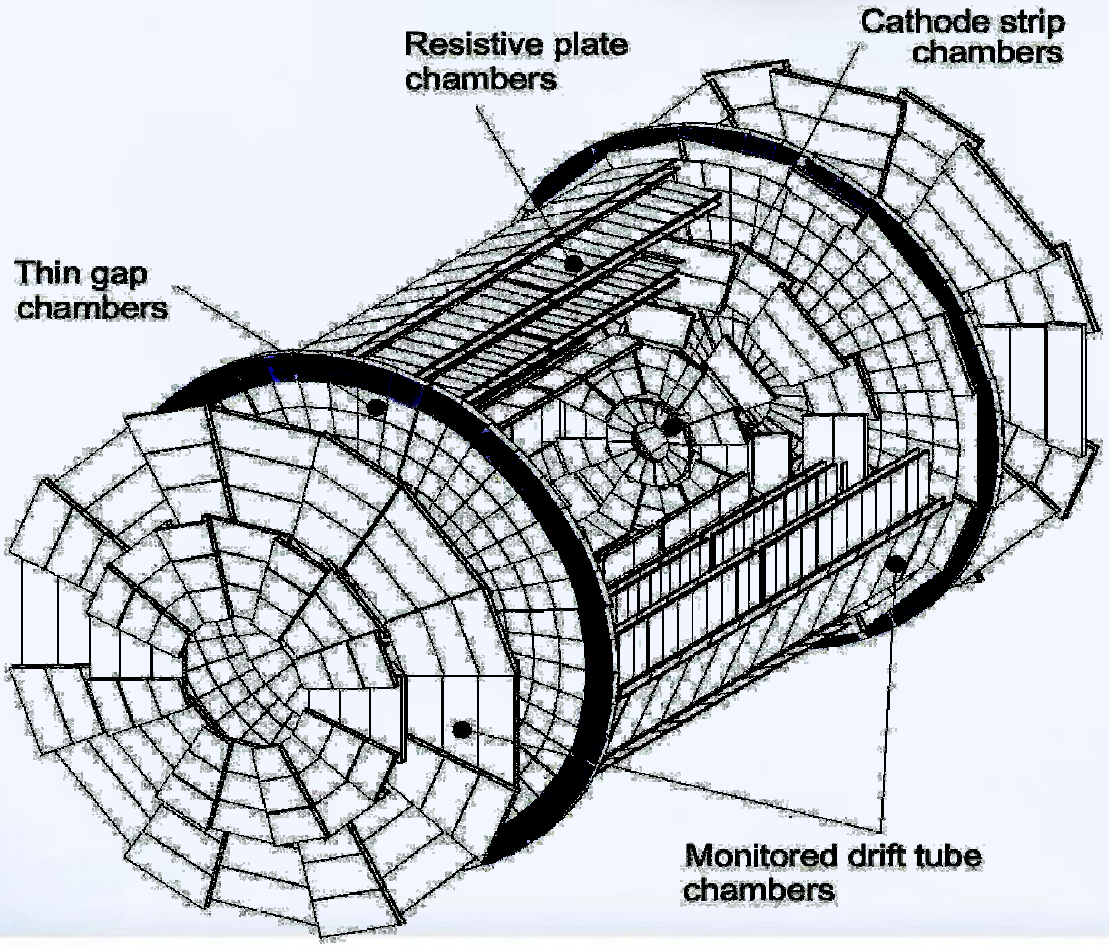
MDT Chamber and the assembling granite table

4.2.2 TGC Production(Shandong Univ.)

400 TGCs (the LVL1 trigger chambers)

400 TGCs Will be produced at Shandong University.

Their location in ATLAS detector is shown in the picture (the black ring).

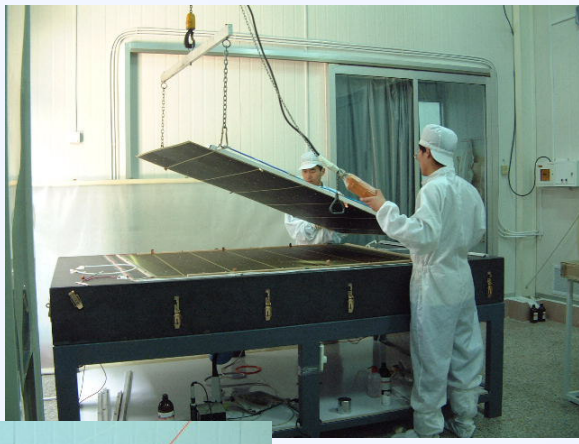


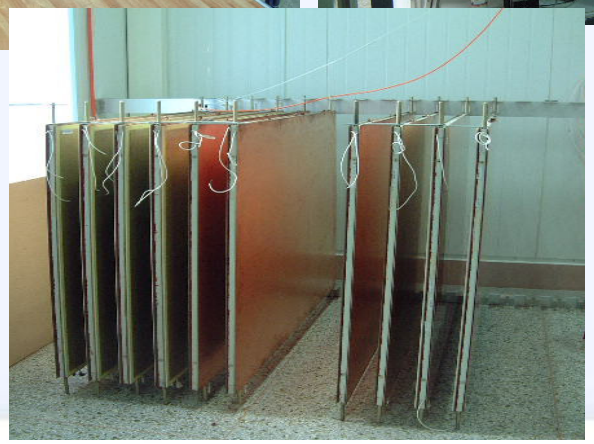
TGC construction site and Prototypes

A special TGC Lab was established by the end of 2001.

Special tools and instruments for TGC production were prepared.

With the help of Weizmann people, we produced the first chamber in the beginning of 2002 and assembled the first unit in June 2002.

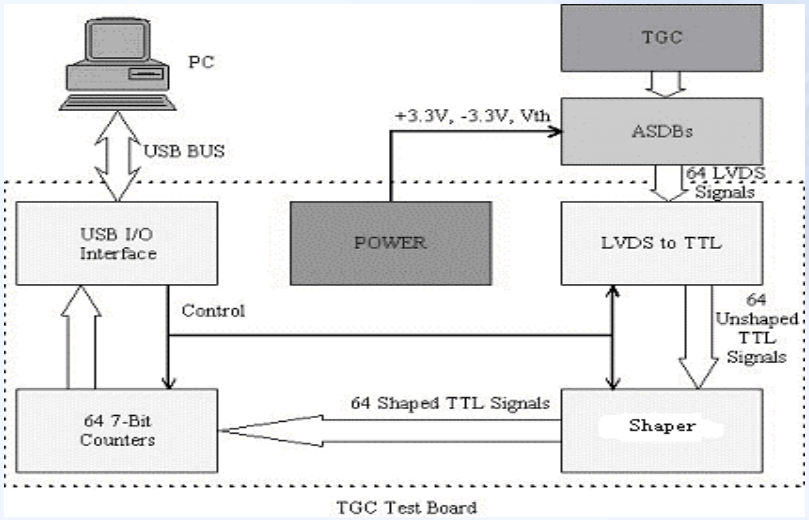




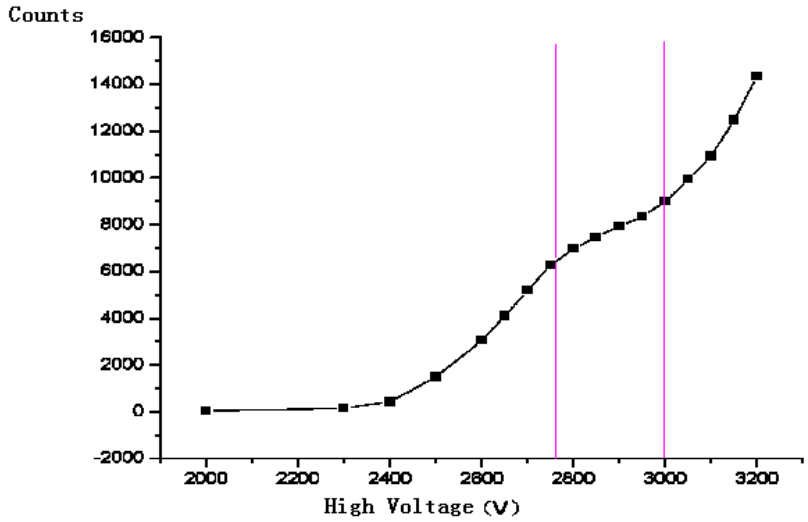
TGC Inspection System (USTC)

Status

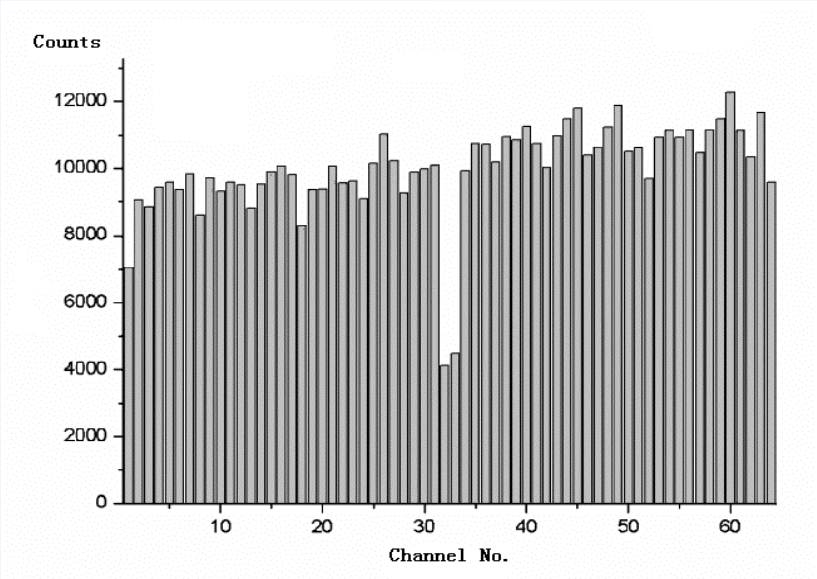
- The System has been installed at the TGC production site in Shandong University
- It's working normally
- Spending about 30 minutes to test one T9 TGC unit
- 48 units of T9 TGC tested using this system



Block Diagram of the System



Sample of Plateau Curve



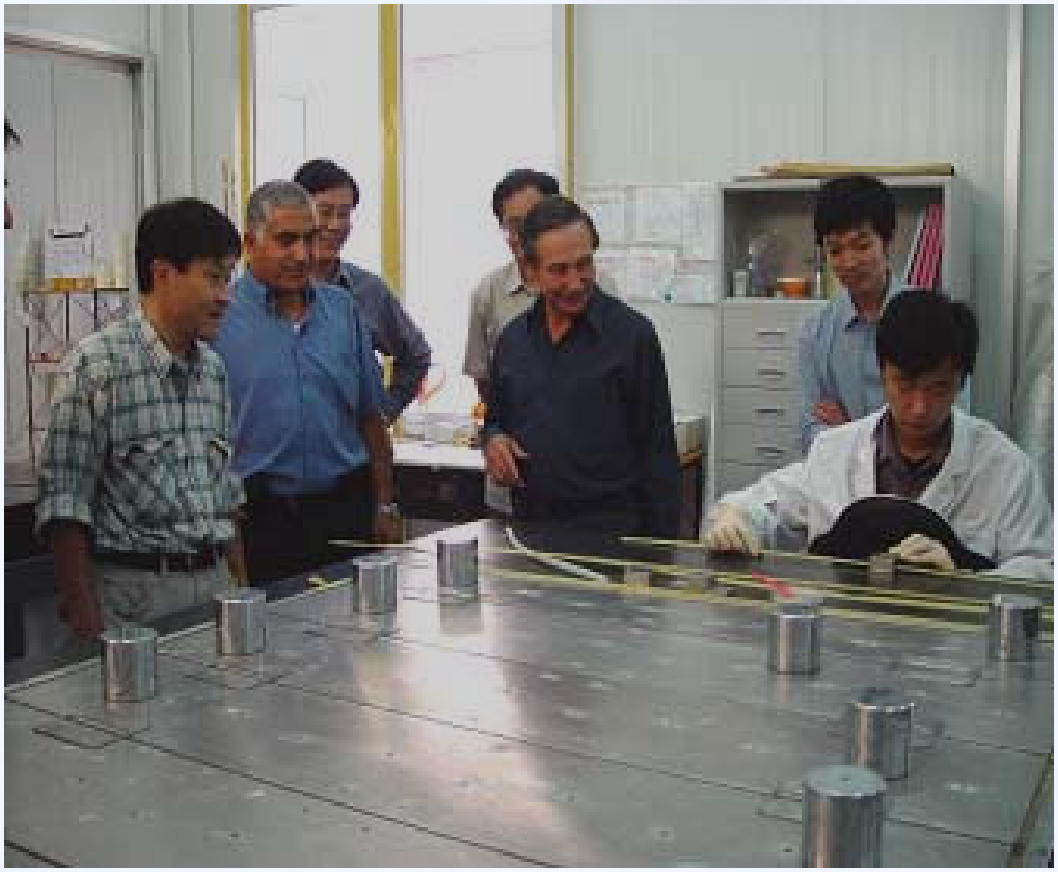
Sample of uniform inspection between channels in a unit (channel 32 and 33 at the edge of chamber, the area is half of normal channel)

Site Review by ATLAS

A group of TGC experts from ATLAS Muon group had a site review of Shandong TGC Lab in September 2002.

- According to the production rate: 6 chambers per week, all 400 chambers will be completed around June 2004.

  Including the time of detector reparation, testing and transportation, the task is foreseen to be completed before the end of 2004.



4.3 Computing and Software preparation in China

3.1 - participation in DC1(Data Challenge 1)

IHEP, Beijing

70GB pile-up output files have been transferred to CERN.

The ATLAS software release version 6.0.4 has been installed in Beijing which include packages of PythiaB, AtlsimMain, Atlfast, Atrecon, ...

Nanjing Univ.

- Produced 10GB minimum bias events in 2002.

60GB pile-up events in March 2003

These data have been sent over to CERN

Installed LCG1

3.2 - LCG in China

- NSFC supports to build a Grid testbed.
  - Funds about 1.5million CNY (about 180k USD).
  - IHEP and PKU, SDU will build the testbed.

- LCG testbed at IHEP:
  - LCG-2 installed and running
  - 10 PCs with 2TB of RAID
  - 20 new CPUs are being added
  - another 3TB are being installed

Tier-1 at IHEP

- Tier-1 supposed to be built
  - ~1PB of Tape library
  - 400TB of disks
  - ~500 CPUs
  - ~2.5Gbps link to CERN and US (possibly via Gloriad)

Grid for Other Experiments

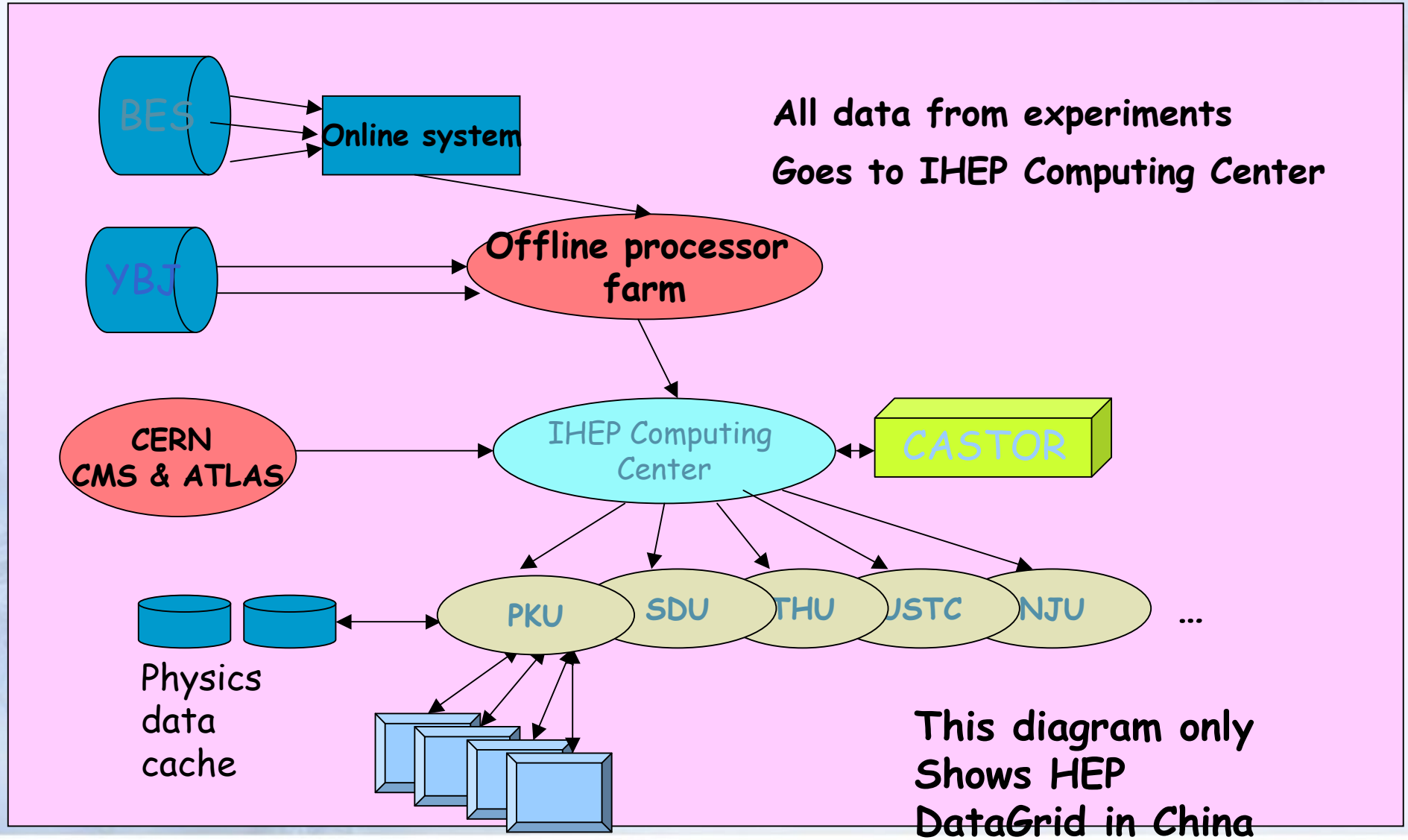
- Grid resources supposed to be shared by other experiments:
  - BEPC-II/BES-III
  - YBJ-ARGO
  - AMS
  - Synchrotron Radiation experiments
  - ……

Difficulty

- Network
  CAS (CSTNET) to US/Europe: 2.5Gbps deployed.
  But IHEP to CAS: only 100Mbps!

  Negotiation undergoing—seeking support from CAS and IHEP.

China HEP DataGrid in the Future



Physics Interests

- Most People busy for detector construction or other urgent work, there are no serious proposal so far for the physics topics to be studied.

- IHEP: We are somewhat late,

  but: we have experts who are experienced on Higgs search at LEP, but people are busy for BEPC issue.

  Dr. Feng LU is considering on Higgs/SUSY search, but just at beginning.

  Someone is interested in Triple Gauge Couplings WWγ, WWZ measurement

5. Summary

BES has produced many interesting results, a good place to study light hadron spectroscopy, excited baryons, etc.

BEPCII/BESIII project will provide data with hundreds more statistics, with a better detector, should play an important roll in understanding the mesons and baryons.

BEPC II is most important project and activities in recent years at IHEP

ATLAS collaboration is important project in China

Project for detector construction moving well ahead!

MDT,TGC Mass Production Smoothly on Schedule

Software,computing and Physics move on the front stage for the collaboration and relevant preparation (manpower,budget and schedule) should be planned and started.

Merci!