The CEPC-SppC Study Group

Status Report

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On Behalf of the CEPC-SppC Study Group

May 16, 2014

Outline

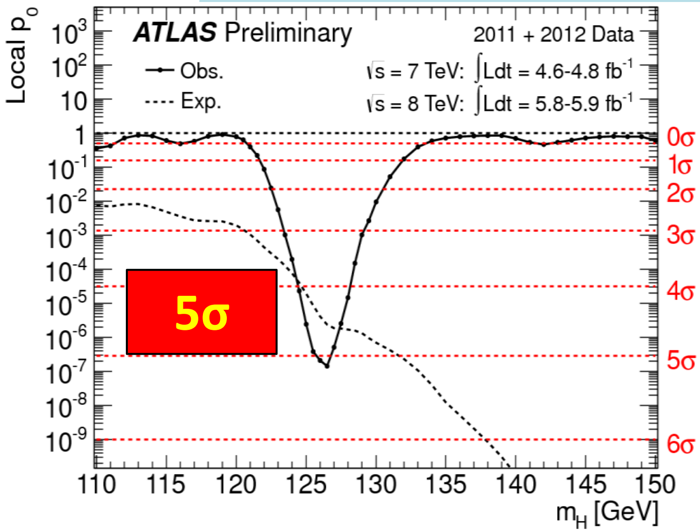
- CEPC+SppC a Higgs factory and a high energy pp collider
- Organization
- PRE-CDR physics, feasibility, technology, design, schedule, cost estimate
- Current status
  theory, accelerator, detector,
  site consideration, civil engineering,
  worldwide effort, etc.
- Prospects

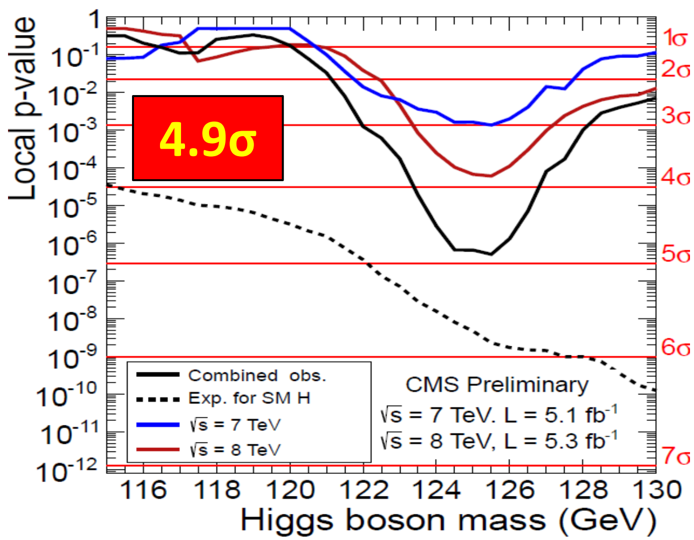
CEPC Study Group

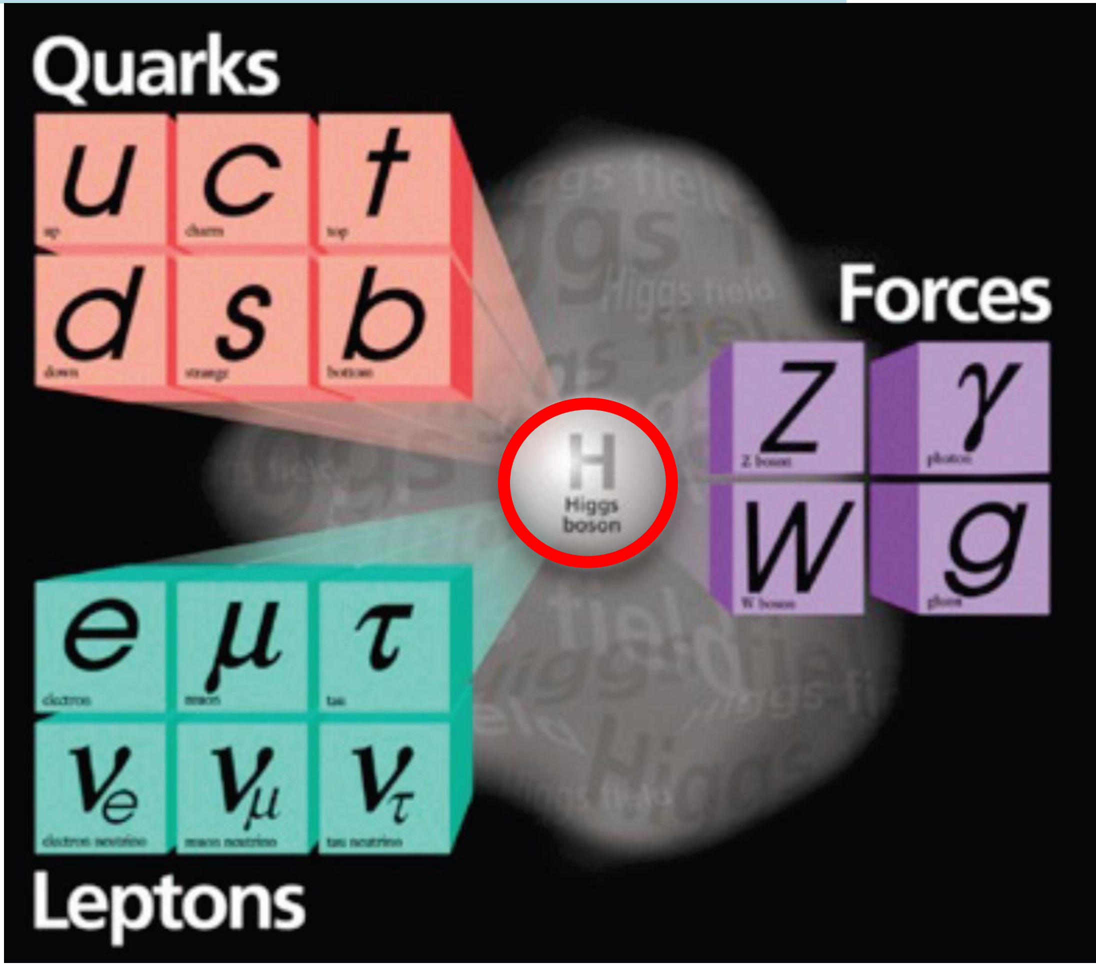
CEPC

"low Higgs mass makes the circular e^+e^- collider as a viable option"

a new fundamental particle: light, weakly coupling H:
M_h=125-126 GeV, Γ<1 GeV, spin 0 (first) July 4, 2012







What is it? How does it behave? New physics?

CEPC-SppC

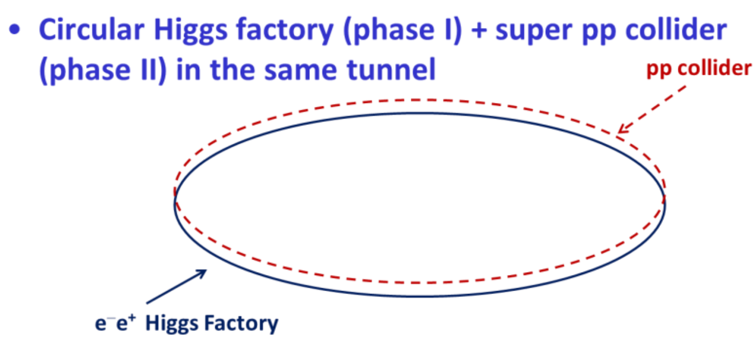
Phase 1: e^+e^- Higgs (Z) factory

$E_{cm}\approx 240$GeV, luminosity $\sim 2\times10^{34}$ $cm^{-2}s^{-1}$, can also run at the Z-pole

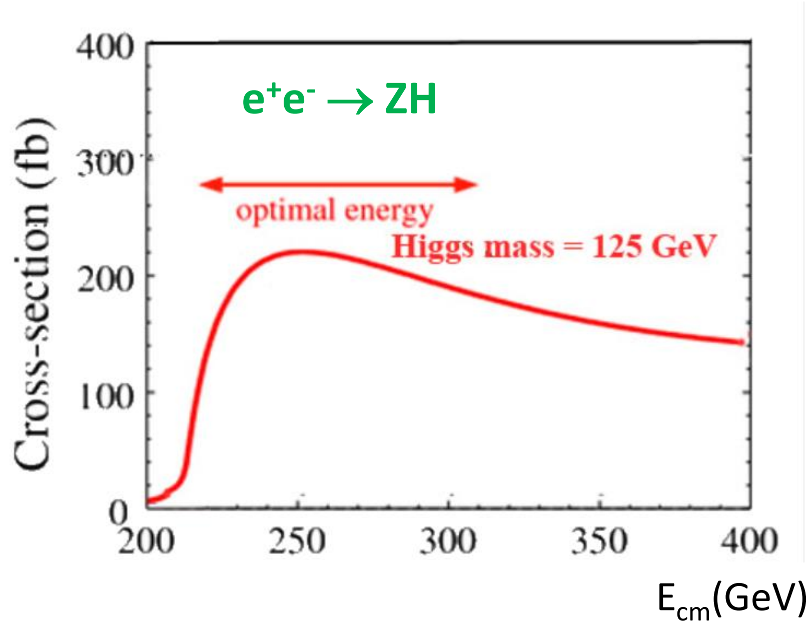
精确测量希格斯玻色子性质， Z玻色子精确测量

Phase 2: a discovery machine; pp collision with $E_{cm}\approx$ 50-100 TeV; ep option

物理目标是发现BSM新物理



Q. Qin



BEPCII后中国粒子物理加速器候选项之一

CEPC Organization

CEPC Kick-off Meeting

- The Chinese CEPC+SppC Study Group kick-off meeting took place Sept. 13-14,2013
- Participation by over 120 physicists
- Domestic accelerator, theoretical and experimental physicists were organized

CEPC组织结构

CEPC Organization –

- **Institutional Board:**

  chairman: **GAO Yuanning** (Tsinghua U); 1 rep. per institution

  deputy chairman: **GAO Jie** (IHEP)

- **Steering Committee:**

  chairman **WANG Yifang** (IHEP);

- Project directors: **LOU Xinchou** (IHEP), **QIN Qing** (IHEP)

- Working groups:
  - Theory (Conveners: **HE Hong-jian, ZHU Shouhua**)
  - Accelerator (Conveners: **QIN Qing, GAO Jie**)
  - Detector (Conveners: **JIN Shan**, **GAO Yuanning**)

- Monthly Steering Committee + Conveners meetings
- 2-3 workshops per year

PRE-CDR 初步概念设计

- getting preliminary answers to critical questions
- document ready for 13th 5 Year Plan (2015)

PRE-CDR

Pre-CDR (by end of 2014)

- main physics topics and motivations;
- initial collider design(s);
- detector technologies and conceptual configuration
- core physics sensitivity (initial)
- site requirement, reality check on civil engineering
- crude cost estimates
- etc.

Established persons in charge of the Pre-CDR writing

Theory – Hong-jian He（Tsinghua）, Shouhua ZHU（PKU） and Nima Arkani-Hamed （Princeton）

Accelerator – Weiren Chou（Fermi Lab）

Detector & Simulation – Yuanning GAO（Tsinghua）

Civil Engineering & Support – Zhao Jingwei (IHEP)

PRE-CDR 初步概念设计

THEORY

Center for Future High Energy Physics

- Aiming at "world class particle physics"
- "CFHEP" is established at IHEP
  - Prof. Nima Arkani-Hamed is now the director
  - Many theorists (coordinated by Nima and Tao Han) and accelerator physicists(coordinated by Weiren Chou) from all the world have signed to work here from weeks to months.
  - Current work:
    - Workshops, seminars, public lectures, working sessions, …
    - Pre-CDR
  - Future works (with the expansion of CFHEP to include Exp. & more Acc.)
    - CDR & TDR
    - Engineer design and construction
  - A seed for an international lab ➔ For the world's HEP community

First Charge:

Physics Cases for PRE-CDR

Center for Future High Energy Physics

- 高能物理前沿研究中心协助清华大学召开了“希格斯粒子之后，基础物理学向何处去”的论坛，600多人参加。
- 到目前为止的两个月的时间内，已经有29人次在中心访问。每个礼拜都会去清华、北大或者理论所访问。
- 每周至少两次seminar，一天去国内其它研究所或者大学访问，例如：4月2号，李田军和杨金民在理论所组织了SUSY的讨论会。

C. D. Lv

THEORY Preliminary Conceptual Design Report

Higgs Physics

- Introduction
- Theoretical Overview
- Prospects for Higgs Measurements at the LHC
- Higgs Physics at the CEPC
- High Energy Upgrades: the SppC

SM Physics

Beyond Standard Model: Supersymmetry

Beyond Standard Model: Alternatives

Flavor physics

TeV Cosmology

- Dark matter
- Electroweak baryognesis

Heavy Ion Physics

Monte Carlo Tools

PRE-CDR 初步概念设计

ACCELERATOR

CEPC Preliminary Conceptual Design Report

Introduction

CEPC - machine layout and performance

CEPC – technical systems

CEPC – injectors

Upgrade to SppC

- Key accelerator physics issues
- Key technical systems
- Reconfiguration of the accelerator complex

Alternative designs

- Limited scale Higgs factory
- ep
- $\gamma\gamma$

Civil construction

Environment, safety and health considerations

R&D programs

Project plan and cost estimates

CEPC – current accelerator status

Weiren Chou (Fermi Lab) is spending a year at IHEP

- **Is in charge of the CEPC-SppC PRE-CDR writing**
- **Arranges world's accelerator experts to come to Beijing to contribute**
- **Bring staff and students on board doing real work**
- **Train IHEP staff in proton accelerator technology**
- **Organize ICFA workshop on circular collider workshop (October 2014)**
- **Facilitates communications with others**

April Visitor's Schedule

Name	Institution	Specialty	Dates
Dmitry Shatilov	BINP (Russia)	Beam-beam	April 1-16
Dick Talman	Cornell U. (USA)	General	April 13 - May 15
Yoshihiro Funakoshi	KEK (Japan)	Parameters, injection, background	April 1-15
Kazuhito Ohmi	KEK (Japan)	Beam-beam, e-cloud	April 13-25
Armen Apyan	Northwestern U. (USA)	CAIN/Guinea-Pig, polarized e+, beam dump	March 31 - April 30
Yunhai Cai	SLAC (USA)	Lattice, interaction region	April 15-30
Yuhong Zhang	Jlab (USA)	ep collider	April 13 - May 10

CEPC – current accelerator status

e+e- collider as a Higgs factory

- Beam energy ~ 120 GeV
- Synchrotron radiation power ~50 MW
- **50** in circumference (two options)

base line

Proton-proton collider

- Beam energy ~50-100 TeV
- 50 or 70 km in circumference
- Superconducting, high-field magnets (~20T)

CEPC – current accelerator status

Main ring:

- A FODO lattice in arcs with 60 degree phase advances
- 16-folder symmetry
- RF sections distribute around the ring

  f_{rf} = 700MHz is chosen
- Pretzel scheme is adopted for multi-bunch collision
- Double ring option is under-investigation
- ATF2 type and ILC type FFS designs are currently under study

Booster:

- In the same tunnel of the collider (6 – 120 GeV)

Linac:

- 6 GeV–Linac will be adopted

CEPC – current accelerator status

preliminary parameters

Accelerator Parameters		
Beam energy [E]	GeV	120
Circumference [C]	km	53.6
Luminosity [L]	$cm^{-2}s^{-1}$	1.82E+34
SR power/beam [P]	MW	50
Bending radius [ρ]	m	6094
N_{IP}		2
n_B		50
filling factor [κ]		0.71
Lorentz factor [γ]		234834.66
Revolution period [T_0]	s	1.79E-04
Revolution frequency [f_0]	Hz	5591.66
Magnetic rigidity [$B\rho$]	T·m	400.27
momentum compaction factor [α_p]		4.15E-05
Energy acceptance Ring[η]		0.02
cross-section for radiative Bhabha scattering [σ_{ee}]	cm^2	1.53E-25
lifetime due to radiative Bhabha scattering [τ_L]	min	55.42
build-up time of polarization [τ_p]	min	21

input

calculated

simulation results

PRE-CDR 初步概念设计

Detector & Simulation

CEPC – Detector Considerations

- **baseline detector configuration & conceptual choice for detector components**
- **sensitivities of Higgs measurement relative to LHC and ILC**
- **design and optimization considerations**

Benefit greatly from the work done with the ILC

Start with the ILD

✓ Adopt the detector technologies and basic layout

- detector operates without the power pulsing
- vary detector geometries
- implement simulation to evaluate the detector performance
  at the CEPC and do the cost estimates

CEPC – Detector Considerations

CEPC Detector: Institutes

Theory

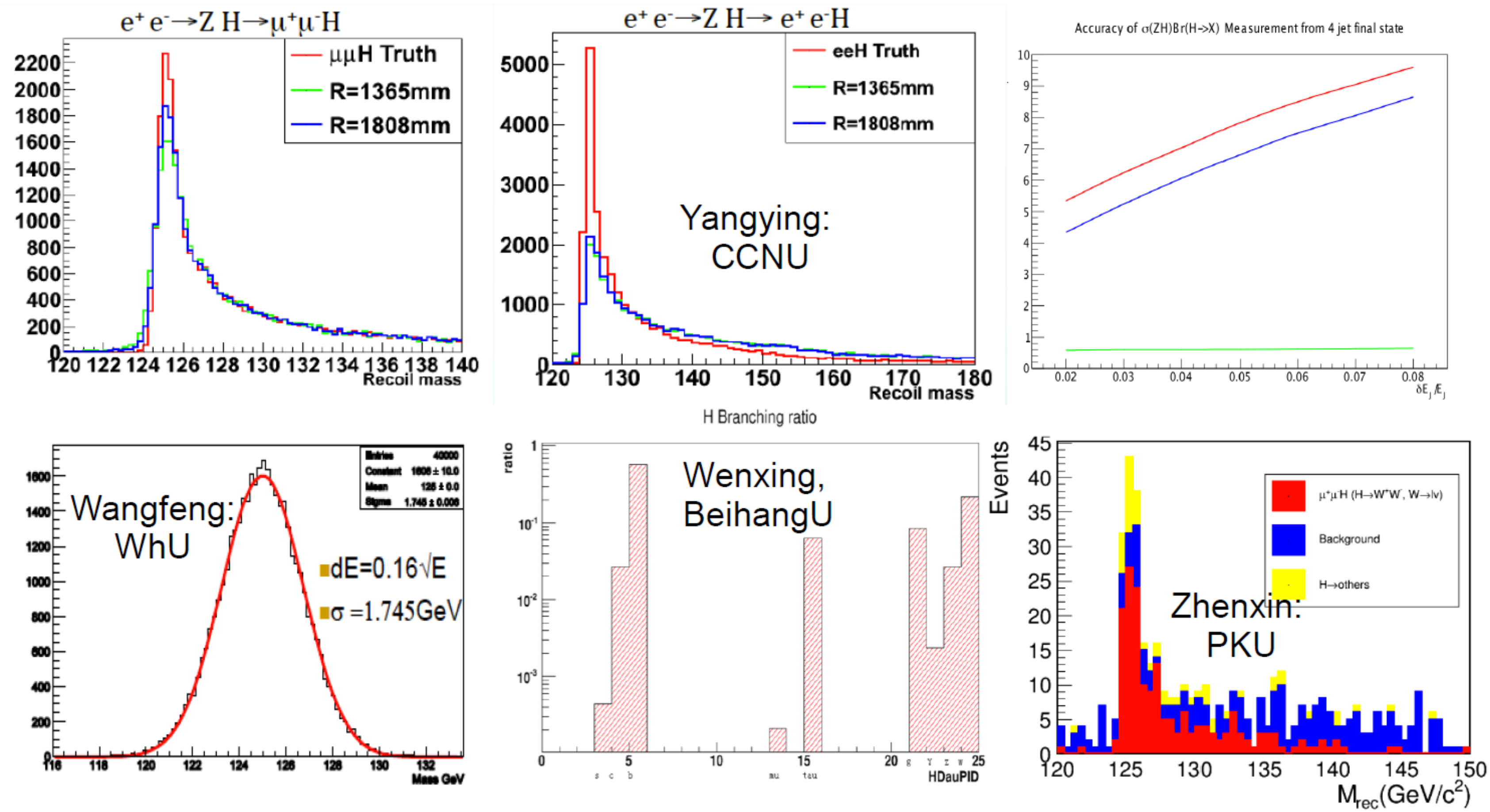
VTX	TPC	Calo	Physics Requirement
ShanDong University (SDU) IHEP ...	Tsinghua University (THU), University of Chinese Academic of Science (UCAS), IHEP ...	University of Science and Technology of China (USTC), Shanghai Jiaotong University (SJTU), Wuhan University (WhU), Nanjing University IHEP ...	Nankai University, Pekin University (PKU), Beihang University, Center China Normal University (CCNU), IHEP ...

Machine

M. Q. Ruan

CEPC – Detector Considerations

Ongoing Physics Analysis



Duchun(IHEP): generator development/comparison

M. Q. Ruan

CEPC-SppC Detector & Technology Considerations

critical technologies: activities and plan

- High field superconducting magnets for SppC
- Silicon pixel-strip detectors and ASIC electronics
- High performance calorimeters: ECAL and HCAL
- Trigger, data flow and computing

Also need sustained, advanced ATF facility and staff

M. Q. Ruan

PRE-CDR 初步概念设计

Site Consideration & Civil Engineering

实验场地考虑

- 高能所玉泉路 园区有限，不满足未来大设施 需要
- 华北是否有合适建造地下大型加速器的场地？
- 场地是否满足建立大型国际化实验中心的条件？
- 地方政府的支持力度？

高能所组织考察了14 场地（河北，河南），调查地下结构。

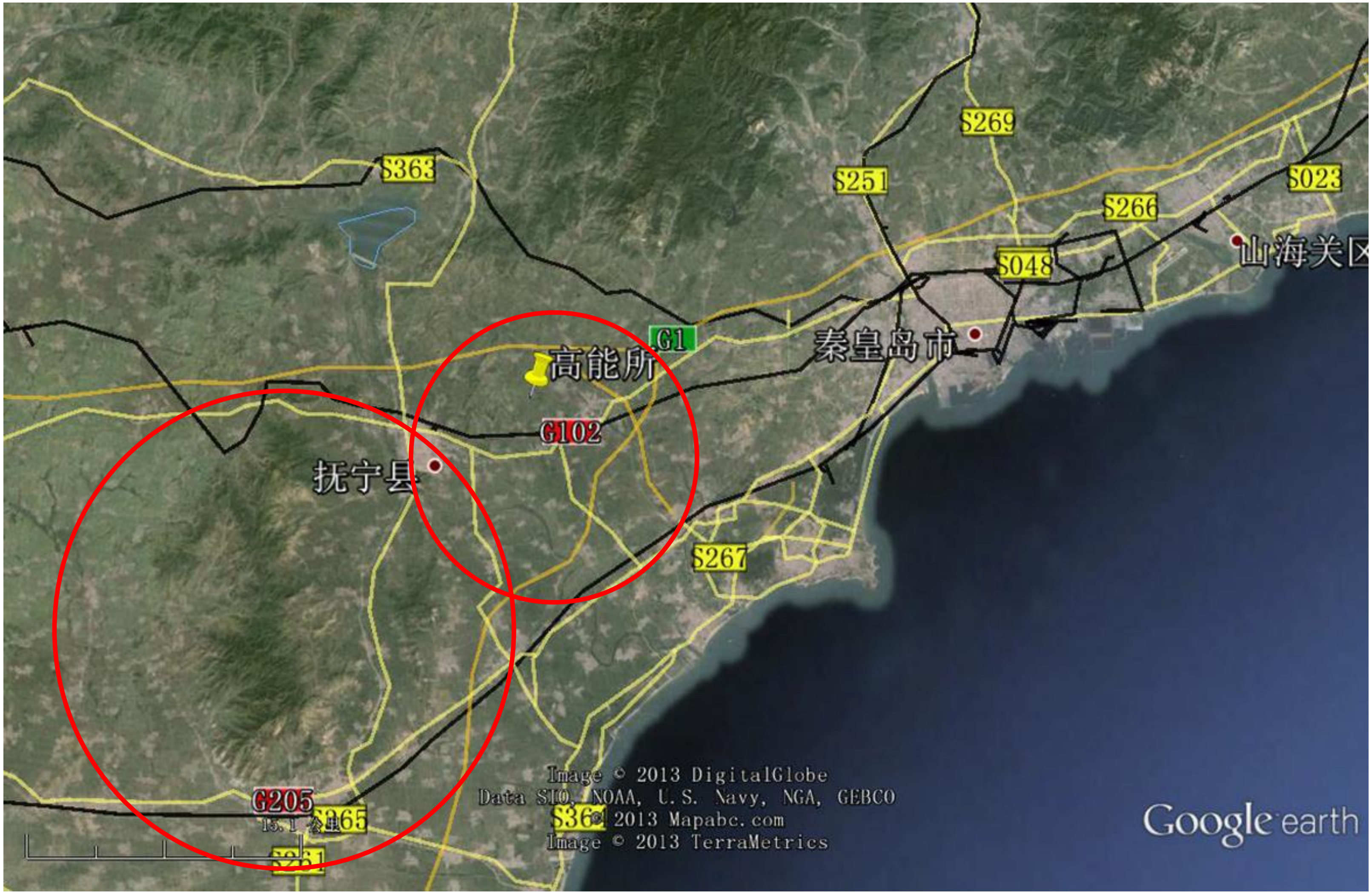
以河北秦皇岛为例 --

CEPC – Site Investigation

A good example is 秦皇岛:

300 km from Beijing

3 hours by car; 1 hours by high speed train



Y. F. Wang

PRE-CDR Civil Engineering

IHEP Engineering & Support Group

地下隧道建设 –施工方法，防、排水，通风，辐射防护，电子仪器厅，....

地面设施 – 实验厅，供电，制冷，消防，交通，竖井，access points,

其他 – 节能减排，工期，整体造价

Baseline Consideration:

黄河勘测规划设计有限公司 –

- 秦皇岛抚宁地区为概念设计地点
- C=50km圆环形隧道，截面直径R~6.5m，地下50-100m
- 倾斜度控制在4‰以内（便于排水）
- 节能减排：为节约能源，减少浪费，设法进行二次利用
- 在环形隧道地面设有5000亩办公园区
- 隧道供电负荷、区域变电站，园区需要若干小变电站
- 使用硬岩TBM或盾构机的比较造价清单

高能所 –

- 估算与制冷机配套的冷却塔占地面积
- 安排黄河公司对CERN LHC现场考察活动
- 提供给黄河公司有关的资料

双方确定交流会，保持及时沟通

PRE-CDR 初步概念设计

Timelines

CEPC Timeline (dream)

Pre-study, R&D and preparatory work

- **Pre-CDR** (by end of 2014) to be ready by China 13th 5-year plan
- Pre-study 2013-2015
- R&D 2016-2020
- Engineering Design 2015-2020

Construction: 2021-2027

Data taking: 2028-2035

SppC Timeline (dream)

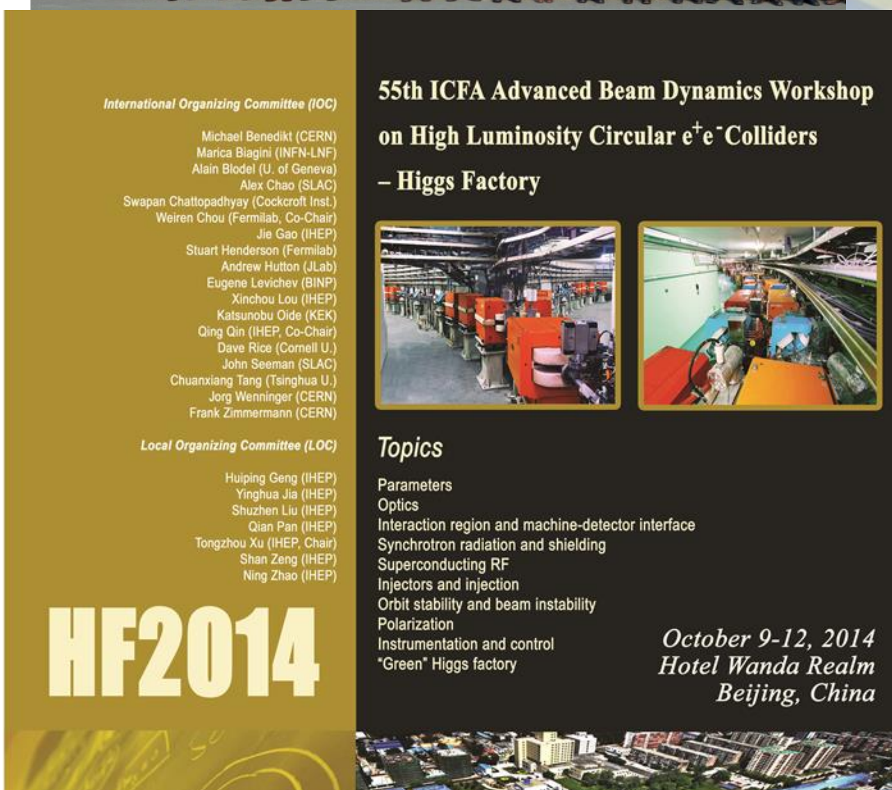
Pre-study, R&D and preparatory work

- Pre-study 2013-2020
- R&D 2020-2030
- Engineering Design 2030-2035

Construction: 2035-2042

Data taking: 2042 –

World Wide Effort



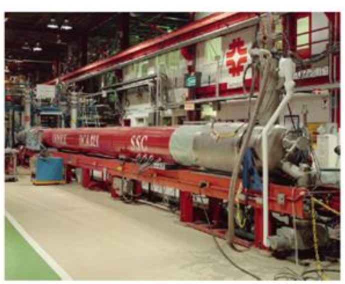
CEPC-SppC Detector & Technology Considerations

Accelerator Magnets

Then . . .

The Tevatron (Fermilab) 1983

4.4 T , NbTi, 4.2K



HERA, SSC, UNK, RHIC

And now . . .

LHC 2007

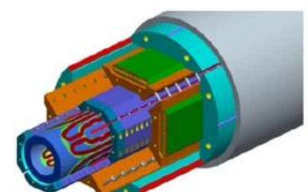
8.3 T, NbTi, 1.9K

Limit of NbTi

US LHC Upgrade

Nb_3Sn quadrupoles

Operating until about 2030

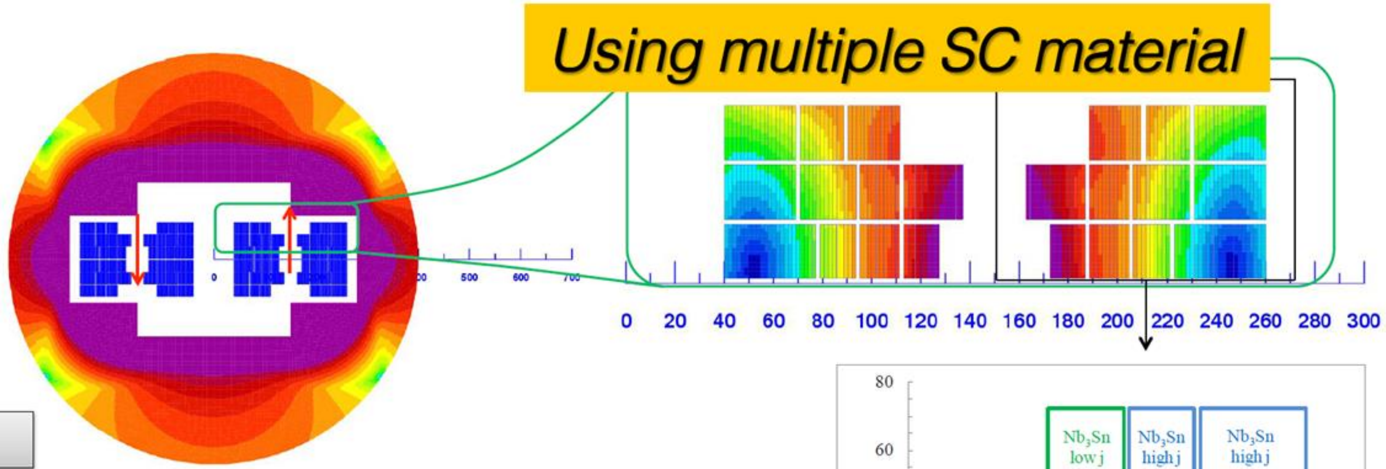


Steve Gourlay

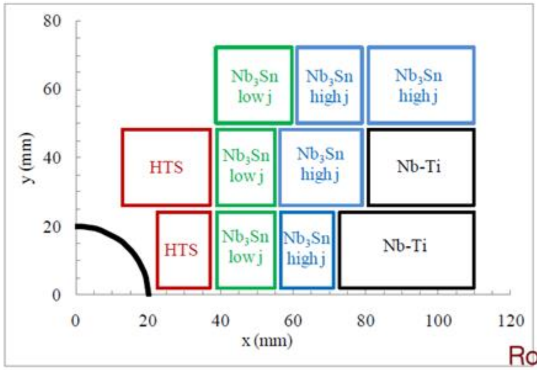
CEPC-SppC Detector & Technology Considerations

Go for 20 T

First consistent conceptual design



L.Rossi



Material	N. turns	Coil fraction	Peak field	$J_{overall}$ (A/mm^2)
Nb-Ti	41	27%	8	380
Nb3Sn (high Jc)	55	37%	13	380
Nb3Sn (Low Jc)	30	20%	15	190
HTS	24	16%	20.5	380

20 T field!

Roy Aleksan
CERN
Feb. 22, 2013

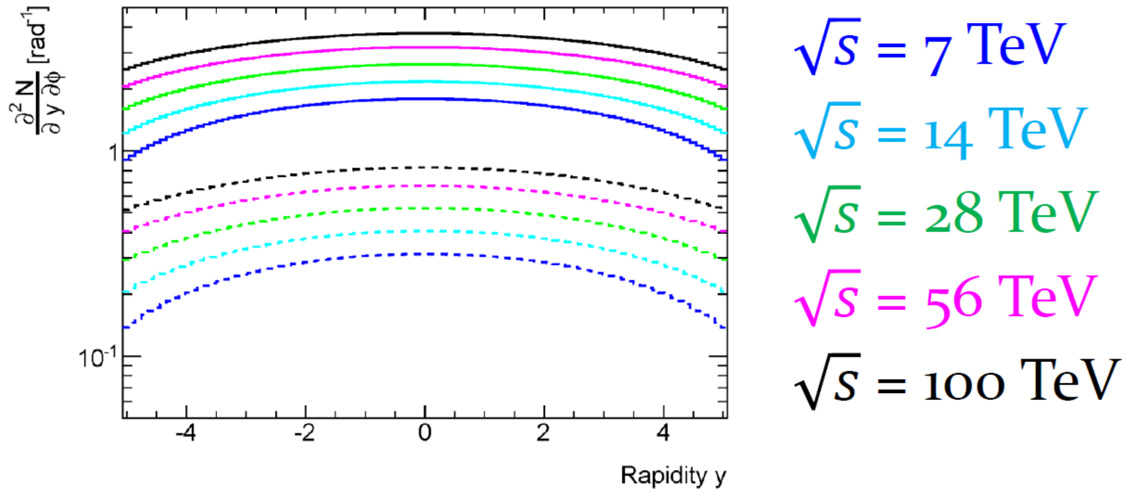
Magnet design: 40 mm bore (depends on injection energy: > 1 Tev)
Approximately 2.5 times more SC than LHC: 3000 tonnes! (~4000 long magnets)
Multiple powering in the same magnet for FQ (and more sectioning for energy)
Only a first attempt: cosϑ and other shapes needs to be also investigated

Cost of Nb_3Sn: 4 times Nb-Ti
Cost of HTS: 4 times Nb_3Sn

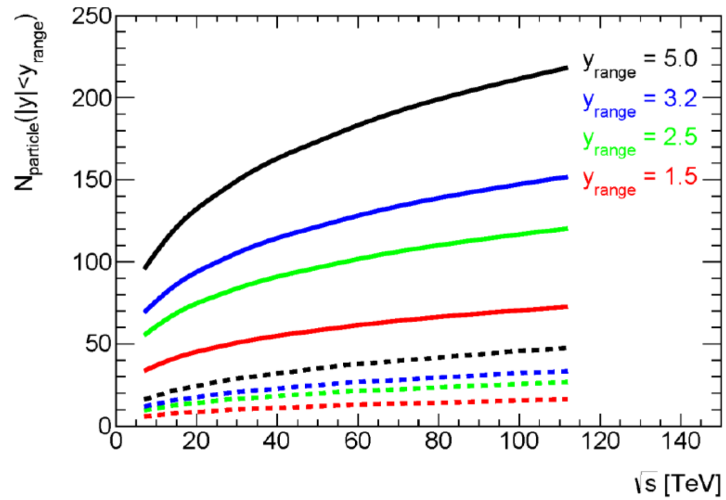
The last 2 - 3T is expensive!

CEPC-SppC Detector & Technology Considerations

Multiplicities at 100 TeV

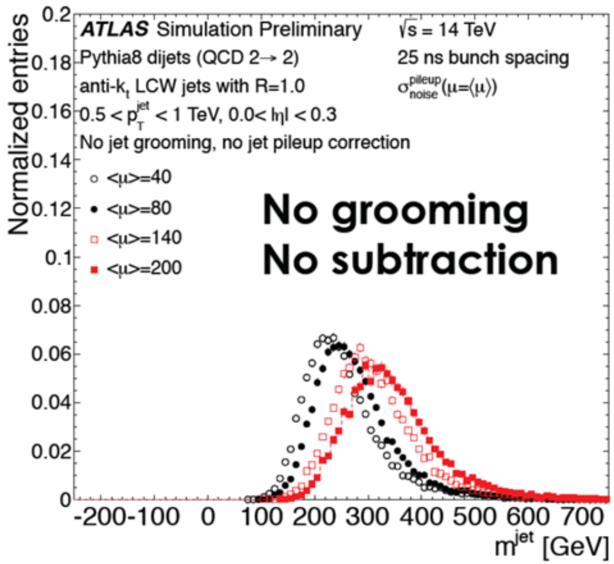


single MB interactions, charged particles with $p_T > 500$ MeV

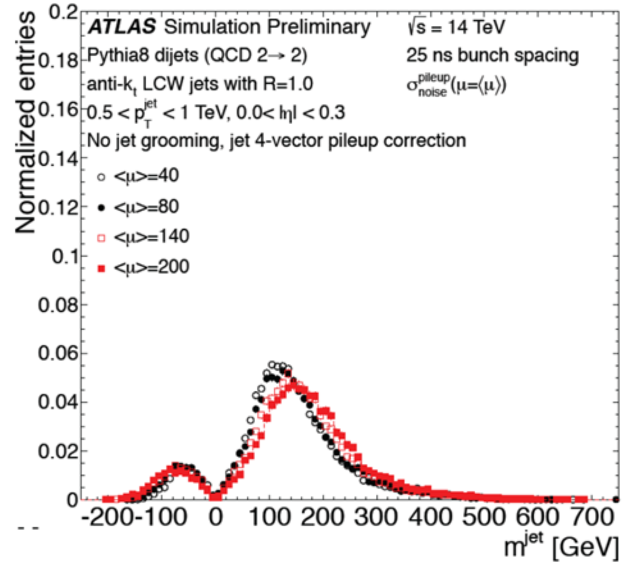


P. Loch

CEPC-SppC Detector & Technology Considerations



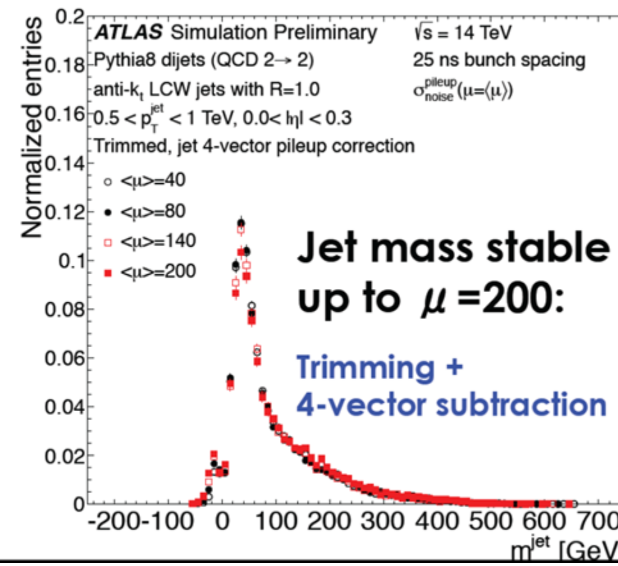
jet 4-vector area based pile-up subtraction



trimming

Higher energy and intensities

- Detailed studies with a well-known detector useful for preparation for even higher energy scenarios
  - Understand effectiveness of signal definitions and jet grooming techniques



P. Loch

CEPC-SppC Detector & Technology Considerations

See Sanjay Padhi's Talk at Beijing

Fermilab UIC University at Chicago

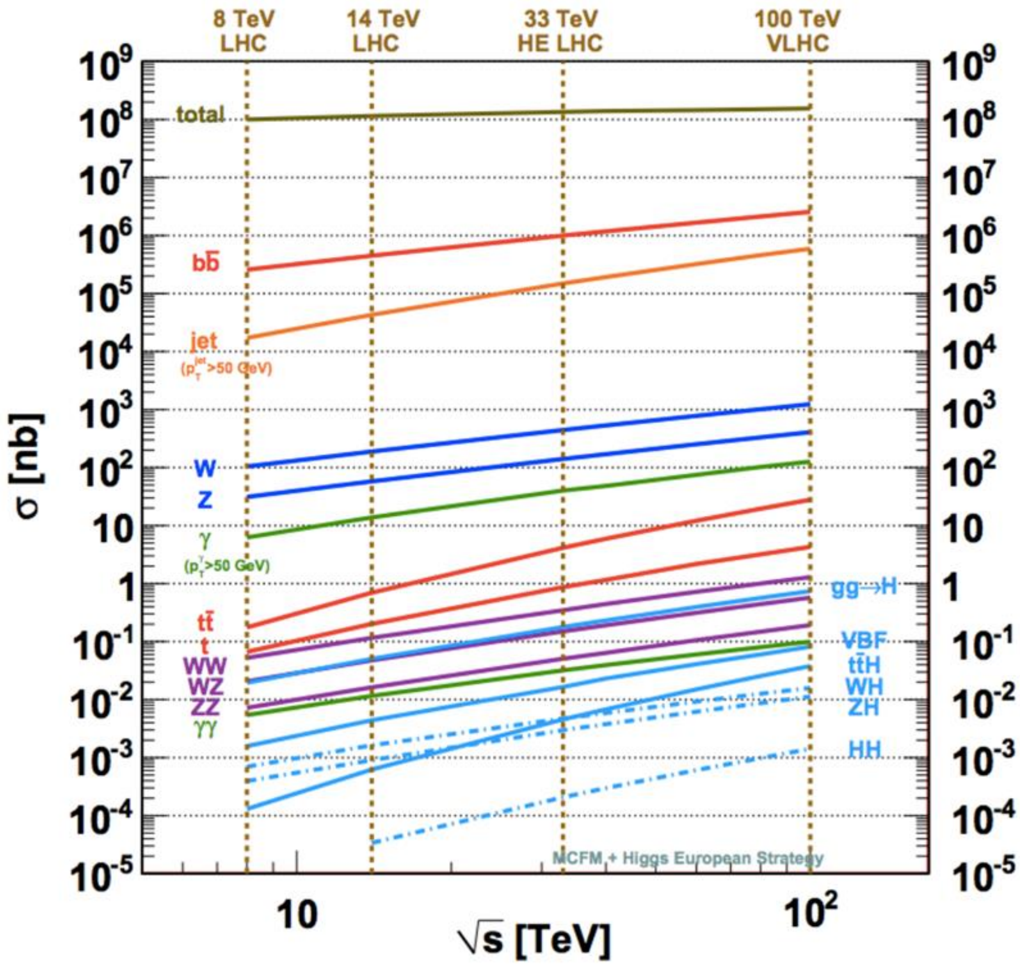
R. Cavanaugh   100 TeV Workshop, SLAC   23-26 August, 2014

Parametrized detector for 100 TeV proton collider (baseline)

1. Large Solenoid + return yoke: Magnetic Field: 5T, 24m long and 5m radius
2. Central Tracker (including pixel detector)
   - Acceptance within $|\eta| < 4$
   - Momentum resolution $\sigma / p_T \approx 1.5 \times 10^{-4} \oplus 0.005$
   - Efficiencies similar (not same) to CMS Phase-II ECFA studies
3. EM Calorimeter (PbWO4) $\sigma / E = 2.0\% / \sqrt{E} \oplus 0.5\%$
4. Hadronic Calorimeter $\sigma / E = 50\% / \sqrt{E} \oplus 3\%$
5. Forward Calorimeter (needed for VBF and other studies) up to $|\eta| \sim 6$ $\sigma / E = 100\% / \sqrt{E} \oplus 5\%$
6. Muon detector
   - Acceptance within $|\eta| < 4$
   - Momentum resolution $\sigma / p_T \approx 1\%@100\ GeV - 10\%@10s\ TeV$
   - Efficiencies similar (not same) as CMS Phase-II ECFA studies

Trigger

The Landscape



Minbias ~140 mb
~170 per crossing

Trigger Backgrounds
$b\bar{b}$ 150 MHz
~6 per crossing
~1 per crossing w/ lepton

Jets p_T > 50 GeV 25 MHz
~1 per crossing

Electroweak Physics
W+Z = 70 KHz!

Top ~30 mb
~1500 Hz

Moore's Law easily accommodates saving all the electroweak

Elliot Lipeles

CEPC – Prospects

Theory

➔ fully explore physics with the Higgs boson & in the energy frontier

Detector: benefits from ILC, FCC, LHC experiments + own effort

➔ excellent design, cost effective, fully functional

Accelerator

➔ cost effective, expandability

International cooperation: LHC, ILC, FCC and CEPC and others

This is part of a global effort to make sure HEP's future is very bright

BACKUP

CEPC – Web & Documentation 中文版准备中

Contents http://cepc.ihep.ac.cn

- **Internal**： link to the internal Twiki
- **Events**：record of past events and announcements of future events

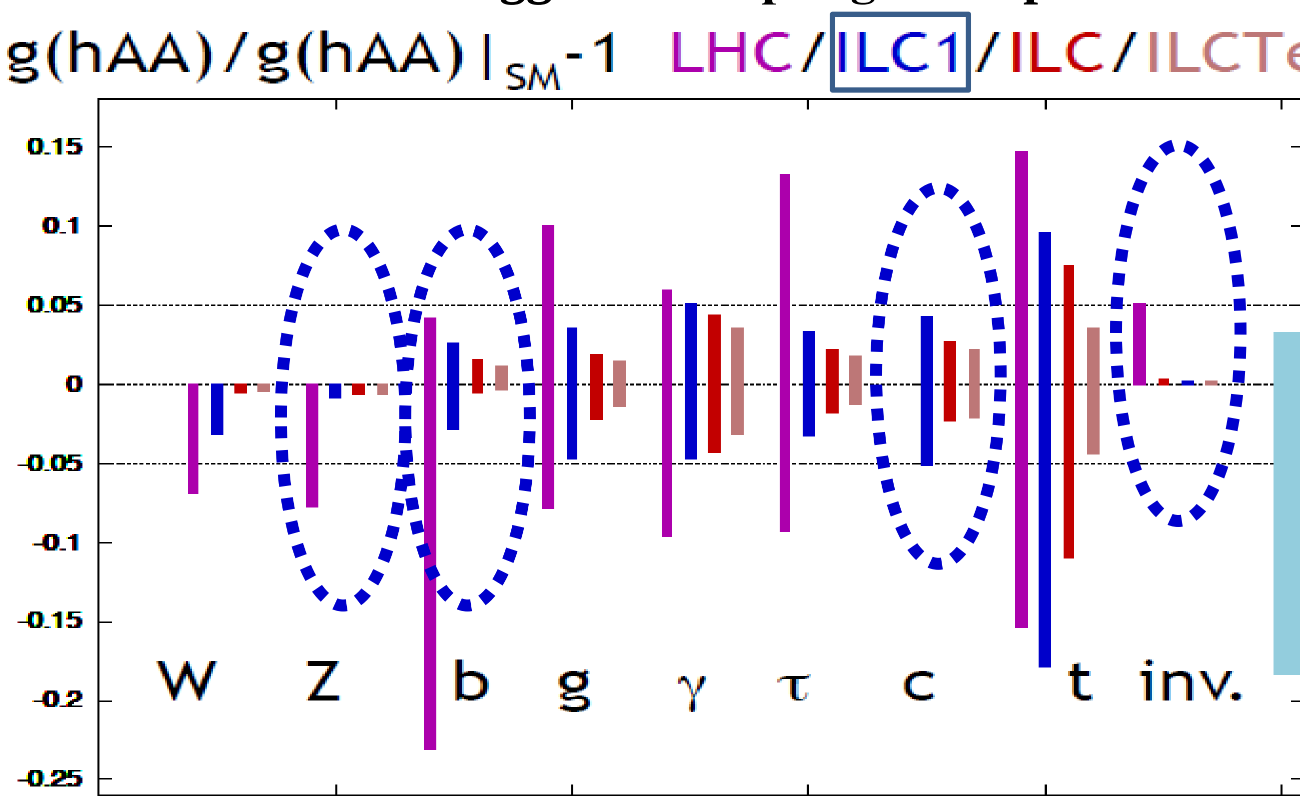
- **HOME**：general introduction
- **ABOUT CEPC**：introduction to CEPC
- **ORGANISATION**：organisational structure and WG activities
- **RESULTS**：publications and more
- **WHY SCIENCE**：motivations to pursue basic scientific researches
- **JOIN US**：subscribe to express interests

- **Not displayed**: job opportunities, external links, etc.

CEPC Logo your creative idea to: cepc-admin@ihep.ac.cn

Circular e^+e^- : Precision Higgs Machine

- **e^+e^- Higgs Factory (240GeV) can more precisely measure Higgs properties than LHC: Mass, J^{PC}, Couplings, especially h-ZZ, h-bb, h-ττ, couplings, and invisible decays . It can also measure h-cc Coupling, which cannot be carried out at LHC.**
- **Most of important Precision-Higgs-Tests can be already done at HF(240GeV) , without ILC500. Higgs self-couplings'll be probed at Super pp(50-100TeV).**



M. E. Peskin, arXiv:1207.2516

CEPC comparable to ILC1(250GeV)

Need verifications (CDR,TDR)

关于CEPC-SppC 的一些考虑

- A circular Higgs factory fits our strategic needs in terms of
  - Science (great & definite physics)
  - Timing (after BEPCII)
  - Technological feasibility (experience at BEPC/BEPCII and other machines in the world),
  - Manpower reality (our hands are free after ~2020)
  - Economical scale (although slightly too high)
- The risk of no-new-physics is complement by a pp collider in the same tunnel
  - A definite path to the future
- A unique position for China to contribute at this moment:
  - Economical growth ➔ new funding to the community
  - Large & young population ➔ new blood to the community
  - Affordable tunnel & infrastructure
  - If no new project, no new resources ➔ It is a pity if we miss it

Y. F. Wang

CEPC –SppC “（多样化的）高能环形对撞机”

“**C**ircular **E**lectron **P**ositron **C**ollider”

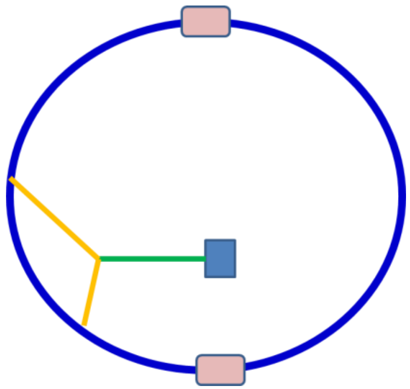
环形正负电子对撞机

“**C**ircular **E**lectron **P**roton **C**ollider”

环形电子质子对撞机

“**C**ircular **P**roton-**P**roton **C**ollider

环形质子质子对撞机



- BEPCII后中国粒子物理加速器候选项之一

PRE-CDR & Feasibility Study

- ✓ Kick-off meeting – September 12-13, 2013 (Beijing)
- ✓ Organization
- ✓ Working group meetings **regular and numerous**
- ✓ Documentations and collaboration web site
- ✓ Recruitment and training
- ✓ Regular Steering Committee meetings (monthly)
- ✓ Regular CEPC-SppC group workshops & meetings

  2-3 times per year
- ✓ CFHEP – get theoretical guidance
- ✓ Schedule established for Pre-CDR **by end of 2014**
- ✓ Initial considerations for TDR, construction, commission & operation

International Workshop Held in Beijing Dec. 16-17, 2013

The workshop will bring together people interested in circular high energy e^+e^- colliders as a Higgs factory as well as a future circular high energy pp collider beyond the Higgs factory, and will discuss critical issues in accelerator technology, detector design and in theory on the precision measurement of the Higgs and the physics with pp collision at 50-100 TeV.

- **First International CEPC Workshop**
- **CERN FCC participation**
- **Jump start the international coordination**

Monday, December 16, 2013

09:00 - 10:35 Session I
Convener: Prof. Xinchou Lou (IHEP, Beijing)
09:00 Welcome and Introduction 15' Speaker: Prof. Yifang Wang (IHEP)
09:15 Physics Opportunities 40'
Speaker: Prof. Nima Arkani-Hamed (Princeton)
09:55 The HL-LHC Physics Program 40'
Speaker: Dr. Takanori Kono (KEK/Ochanomizu)

10:55 - 12:05 Session II
Convener: Dr. Frank Zimmermann (CERN)
10:55 First Look at the Physics Case of TLEP 35'
Speaker: Prof. Alain Blondel (DPNC UNiversity og Geneva)

11:30 CEPC Machine Optimization and Final Focus Design 35'
Speaker: Dr. Dou Wang (IHEP)

14:00 - 15:45 Session III
Convener: Prof. Qing QIN (Institute of High Energy Physics)
14:00 Beam-beam Study of TLEP and Super-KEKB 35'
Speaker: Dr. Demin Zhou (KEK)

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Theory: Physics Cases for CEPC (E_{cm}≈240GeV, luminosity ~2×10^{34} $cm^{-2}s^{-1}$)

Light, weakly coupling H: M_h=125-126 GeV, Γ<1 GeV, spin ~0 (first)

- Verification the 125 GeV boson is the SM Higgs
- Precision measurement of the Higgs Boson

  mass, width, couplings to final states;

  look for deviations from the SM

- Does the Higgs decay into something unexpected?
- Are there more than 1 Higgs boson?
- Use the Higgs boson to look for new physics
- ……

Higgs(~125 GeV) physics topics being identified and developed by the Theory Group and CFHEP

Theory: Physics Cases for SppC (50-100 TeV pp collider $L \approx 2 \times 10^{35} cm^{-2}s^{-1}$)

By then, all all Higgs study and search for SUSY and Dark Matter has been conducted at the HL-LHC

- **It is a discovery machine**
- MSSM Higgs
- Look out for new physics beyond the Standard Model
- Search for WIMP and dark matter
- Search for SUSY

……

See talks by Nima and Gordon

Borrowing from Tao Han Slides

What It tells us

$$V = -\mu^2|\phi|^2 + \lambda|\phi|^4$$

the only dimensional parameter allowed by SM symmetry.

The "large hierarchy":

$$\mathrm{m}_h^2 - m_{h^0}^2 \sim -\frac{3}{8\pi^2} y_t^2 \Lambda^2$$

10^{-3} fine-tune

Michael Dine's cancelation at Planck scale:

$$\mathrm{m_H}^2 = 36{,}127{,}890{,}984{,}789{,}307{,}394{,}520{,}932{,}878{,}928{,}933{,}023$$
$$-36{,}127{,}890{,}984{,}789{,}307{,}394{,}520{,}932{,}878{,}928{,}917{,}398$$
$$= (125\ \mathrm{GeV})^2\ !\ ?$$

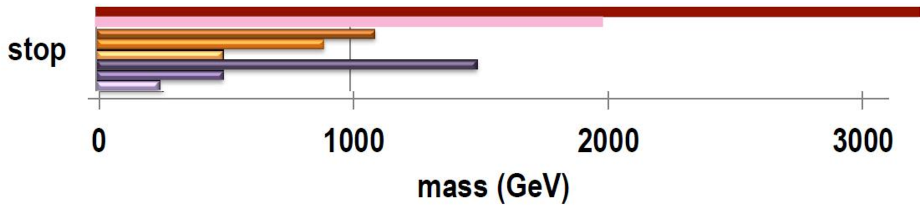
T. Han

"Naturalness" → TeV scale new physics.

Physics Cases for SppC

Naturalness

$$\epsilon \sim (125\ \mathrm{GeV}/M_{\mathrm{NP}})^2$$



- LHC: TeV scale for top partner, ε~1%
- HL-LHC:

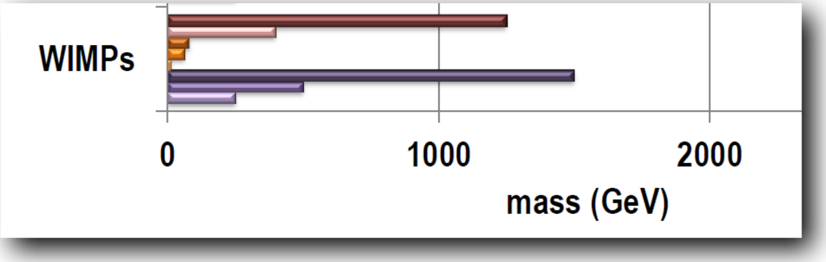
  increase the reach by 10-20%, measure top partner property
- 100 TeV VLHC: 10 TeV level, $\varepsilon \sim 10^{-4}$
- ILC: $E_{cm}/2$, 1 TeV machine, ε~1%

  Precision measurements, multi TeV level

S. Su

Dark Matter

$$m_{\mathrm{WIMP}} \leq 2\ \mathrm{TeV}\left(\frac{g_{\mathrm{eff}}^2}{0.3}\right)$$



- Dark matter at TeV scale (Wino or Higgsino LSP)
  - ➡ can not be explored at LHC 14 with 300 fb^{-1}
  - ➡ enhanced reach at VLHC 33 or 100 TeV
- Smaller dark matter mass
  - ➡ low mass loopholes of suppressed coupling or compressed spectrum, small MET
  - ➡ e+e- collider, reach $E_{cm}/2$.

S. Su

CEPC – theory effort

- Great effort by Chinese theorists, (**Hong-jian He** & **Shouhua Zhu**)
  - Sub-groups formed
  - Meetings
  - Document " Higgs Physics at CEPC-SPPC " in progress

Higgs Physics at the CEPC-SPPC

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ABSTRACT: In this report, we survey Higgs physics in the SM and beyond, review the current measurements of Higgs physics at the LHC, and present the potential studies of Higgs physics at the CEPC-SPPC.

CEPC – current accelerator status

input

calculated

simulation results

preliminary parameters

Beam Parameters		
Beam current [I]	mA	16.60
Bunch population [N_e]		3.71E+11
emittance-horizontal [ε_x]	m·rad	6.79E-09
emittance-vertical [ε_y]	m·rad	2.04E-11
coupling factor [κ]		0.003
Beam length SR [$\sigma_{s.SR}$]	m	0.00226
Beam length total [$\sigma_{s.tot}$]	m	0.00258
Interation Point Parameters		
Betatron function at IP-vertical [β_y]	m	0.0012
Betatron function at IP-horizontal [β_x]	m	0.8
Transverse size [σx]	μm	73.70
Transverse size [σy]	μm	0.16
Beam-beam parameter [ξ_x]		0.104
Beam-beam parameter [ξ_y]		0.074
Hourglass factor	Fh	0.687
Lifetime due to Beamstrahlung-Telnov [τ_{BS}]	min	2028
Lifetime due to Beamstrahlung [simulation]	min	80

RF Parameters		
RF voltage [Vrf]	GV	6.87
RF frequency [frf]	GHz	0.7
Harmonic number [h]		125208
Synchrotron oscillation tune [ν_s]		0.206
Energy acceptance RF [η]	%	5.36
Synchrotron Radiation		
SR loss/turn [U0]	GeV	3.01
Damping partition number [Jx]		1
Damping partition number [Jy]		1
Damping partition number [$J\varepsilon$]		2
Energy spread SR [$\sigma_{\delta.SR}$]	%	0.13
Energy spread BS [$\sigma_{\delta.BS}$]	%	0.07
Energy spread total [$\sigma_{\delta.tot}$]	%	0.15
Average number of photons emited per electron during the collision [$n\gamma$]		0.22
Transverse damping time [n_x]	turns	79.70
Longitudinal damping time [n_ε]	turns	39.85
ARC Parameters		
largest horizontal Betatron function [β_{xmax}]	m	83
largest vertical Betatron function [β_{ymax}]	m	83
largest horizontal size [σx]	mm	0.7507
largest vertical size [σy]	mm	0.0411

Perspective of CEPC Higgs measurement

	ILC @ 250 fb^{-1} (-0.8, 0.3)	CEPC @ 500 fb^{-1} (0, 0)	Status
mH (MI)	29 MeV	25 MeV	FS Validated
σ(ZH)	2.6%	2.2%	
Δ(σ*Br)/(σ*Br)			
ZH, H→bb	1.2%	1.0%	FS Estimated
H→cc	8.3%	6.6%	
H→gg	7.0%	5.6%	
H→WW*	6.4%	**4.0%**	PKU, SJTU L. Yuan
H→ττ	4.2%	3.7%	USTC
H→ZZ*	19%	16%	SDU
H→γγ	29-38%	25%	IHEP, WhU
H→μμ	-	?	L. Yuan
H→Inv.	0.95%	0.8%	
ννH, H→bb	10.5%	**12%**	PKU

In communication/cooperation with ILC efforts

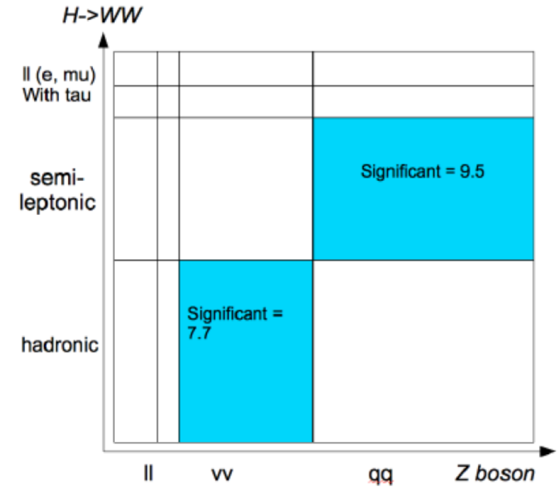
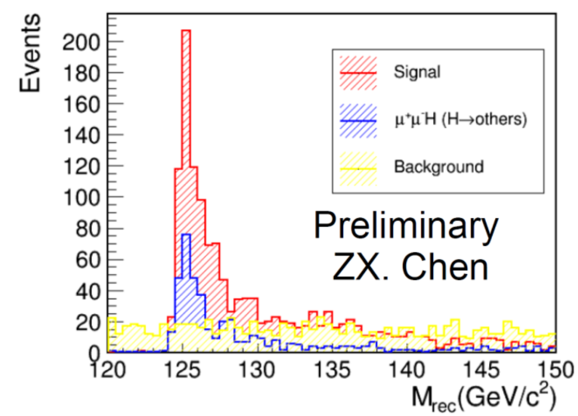


Figure 8. Result of ILC Analysis on $Br(H \to WW^*)$

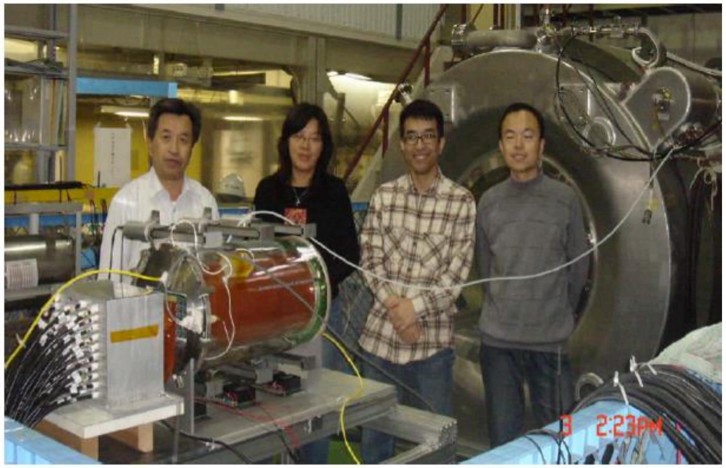


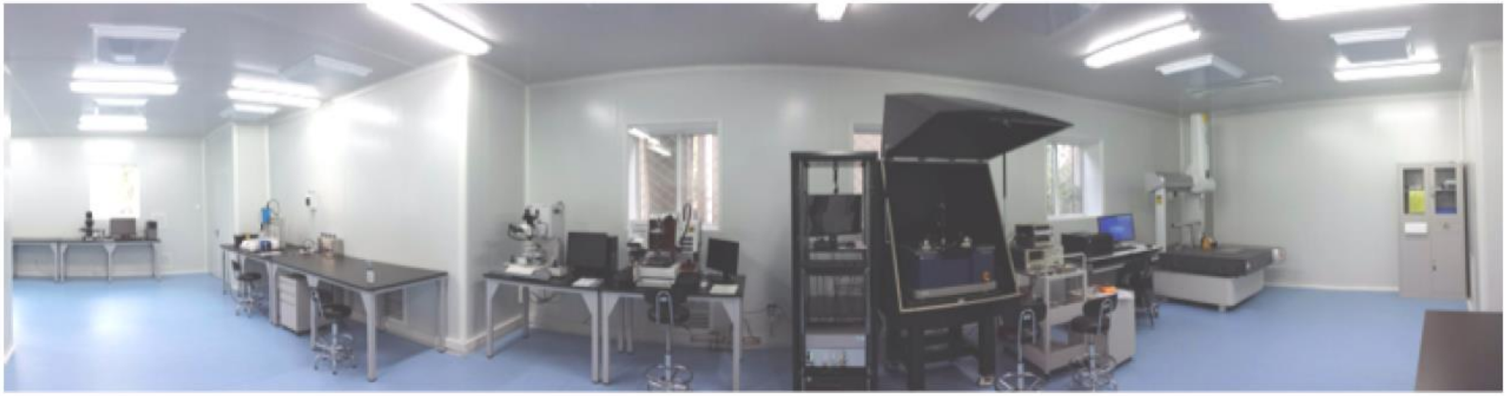
M. Q. Ruan

CEPC – Detector Considerations

Detector R&D

- Status:
  - TPC: Tsinghua & IHEP have participated in LCTPC
  - VTX: Investigating into the technology Market, lots of related projects
  - Calorimeter: cooperation with CALICE collaboration
- *Long termly: prototype design, construction, test, integration...*





M. Q. Ruan

CEPC – Site Investigation Qinghungdao (秦皇岛)

Good geological condition

- Base rock type: granite
- Base rock depth: 0.5 - 2 m
- Seismic intensity: no more than the level 7 (some damage to houses), 0.10g
- Earth vibration(RMS, nm):

	Zhangjiakou	Huailai	Qinhuangdao	Tianjing	Huairou
1~100hz	~12	~40	~1.9	~470	~60
4~100hz	~7	~14	~0.8	~24	

Building the tunnel in granite will have the lowest cost

Y. F. Wang

CEPC – Site Investigation Qinghungdao (秦皇岛)

Best beach & cleanest air
Summer capital of China

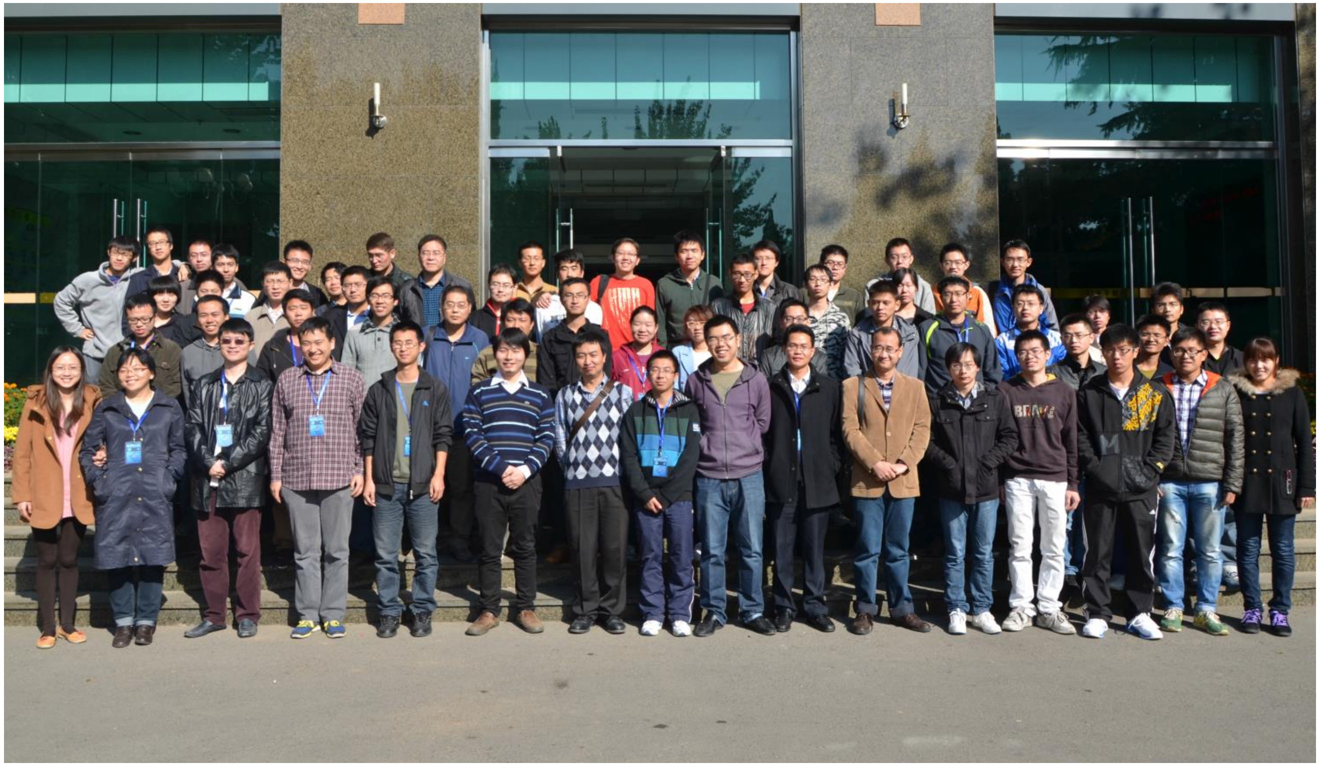
Starting point of the Great Wall

Wine yard

Y. F. Wang

CEPC – Manpower Considerations

- Training young people to address manpower shortage



- Recruitment: postdocs and staff at IHEP

高能所卓越中心成立，着重提高博士后待遇