On CEPC-SppC Accelerator international Collaboration Issues

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On behalf of CEPC+SPPC

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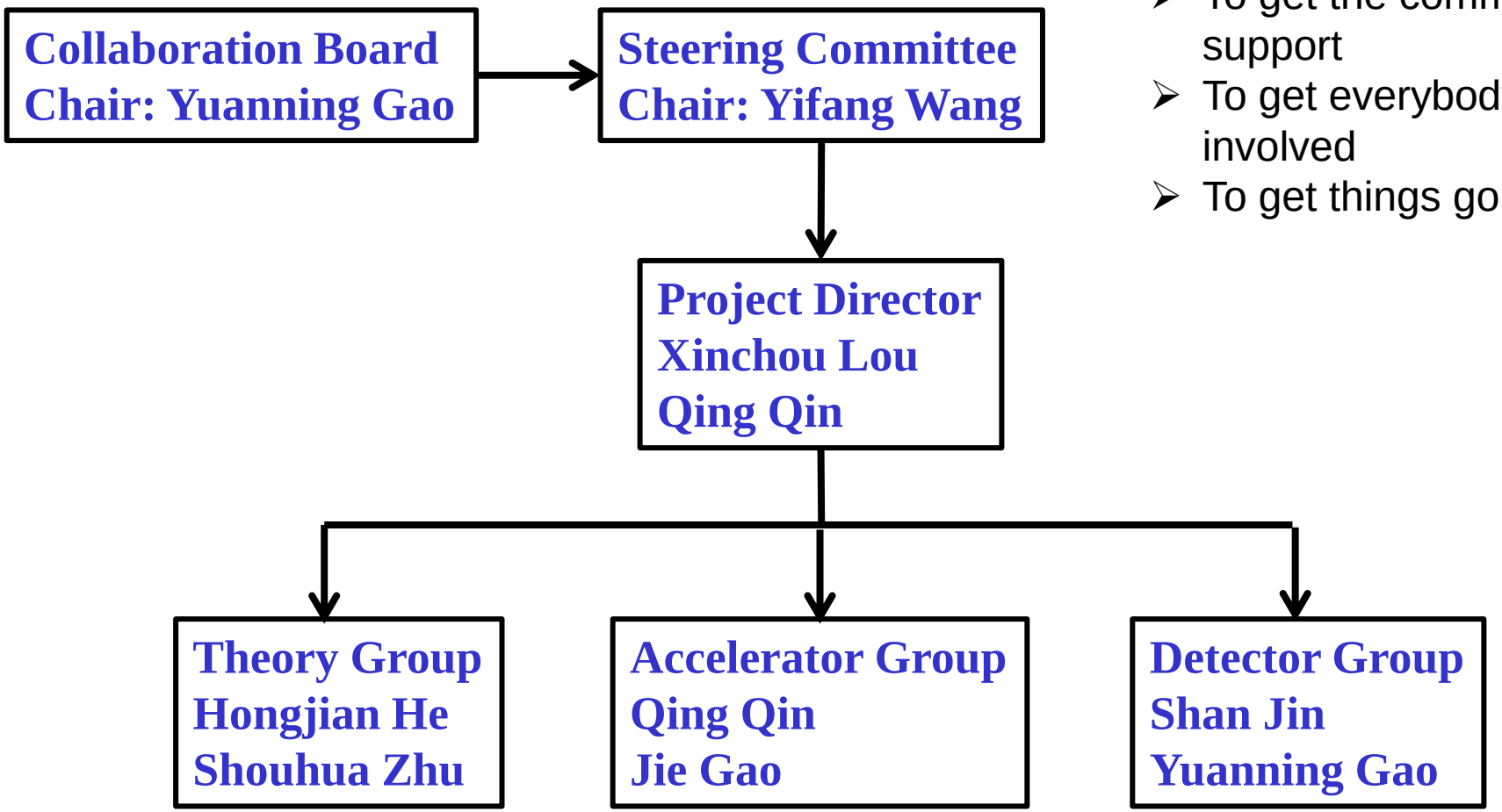
Feb. 14, 2014， Geneva

Current organization for pre-study



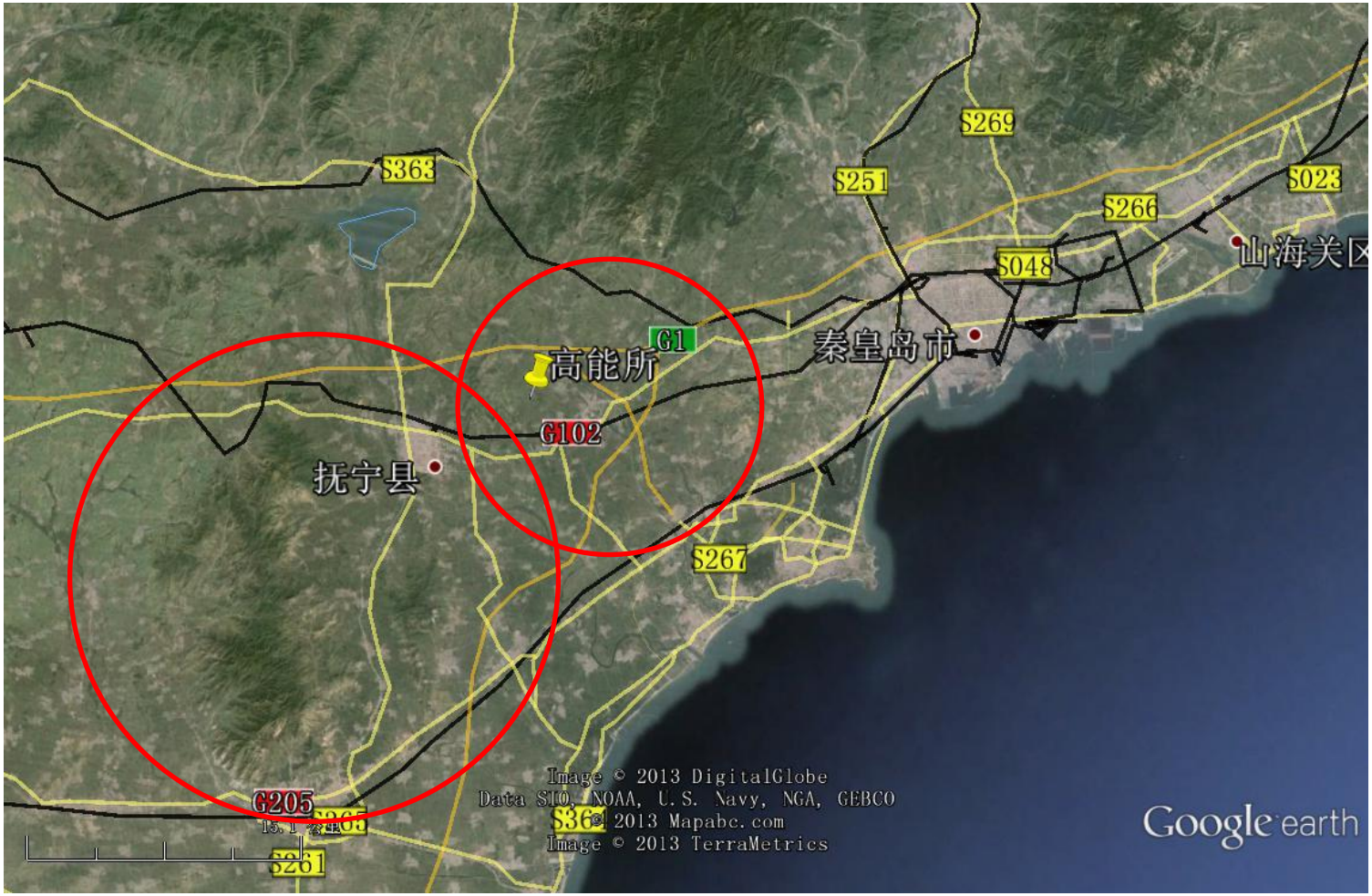
- To get the community support
- To get everybody involved
- To get things going

Internationalization

- This is a machine for the world and by the world
- As the first step, a "Center for Future High Energy Physics (CFHEP)" is established
  - 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.
  - More are welcome ➔ need support from the related management
  - Current work:
    - Workshops, seminars, public lectures, working sessions, …
    - Pre-CDR
  - Future works
    - CDR & TDR
    - Engineer design and construction
  - A seed for an international lab ➔ Organized and managed by the community
- We hope to closely collaborate with FCC@CERN

Site

- Preliminary selected Qinhuangdao (秦皇岛）
- Strong support by the local government



Easy Access

- 300 km from Beijing
- 3 h by car
- 1 h by train

Good geological condition

- Base rock type: granite
- Base rock depth: 0.5 - 2 m
- Earth quake: no more than 7 , 0.10g
- Earth vibration(RMS, nm):

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

Building the tunnel in granite will have lowest cost

Current design

CEPC basic parameters:

- Beam energy ~120 GeV.
- Synchrotron radiation power ~50 MW.
- 50/70 km in circumference.

SppC basic parameters:

- Beam energy ~50-70 TeV.
- 50/70 km in circumference.
- Needs B_{max} ~20T.

The circumference of CEPC will be determined later based on cost estimate. A total budget cap is preliminarily set to be about 20B RMB.

Accelerator design: CEPC

- **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:**
  - 6GeV–Linac will be adopted

Main parameters of CEPC at 50km

Parameter	Unit	Value	Parameter	Unit	Value
Bean Energy	GeV	120	Circumference	km	50
Number of IP		2	L_0 /IP (10^{34})	$cm^{-2}s^{-1}$	2.62
No. of Higgs/year/IP		1E+05	Power(wall)	MW	200
e+ polarization		0	e- polarization		0
Bending radius	km	6.2	N_e/bunch	1E10	35.2
N_b/beam		50	Beam current	mA	16.9
SR loss	(GeV/turn)	2.96	SR power/beam	MW	50
Critical energy of SR	MeV	0.6	ε_x,n	mm-mrad	1.57E+06
ε_y,n	mm-mrad	7.75E+03	β_{IP} (x/y)	mm	200/1
Trans. size (x/y)	μm	36.6/0.18	Bunch length	mm	3
Energy spread SR	%	0.13	Full crossing angle	mrad	0
Lifetime due to Bhabha	sec	930	Damping part. No. (x/y/z)		1/1/2
b-b tune shift x/y		0.1/0.1	Syn. Osci. tune		0.13
RF voltage V_{rf}	GV	4.2	Mom. compaction	1E-4	0.4
Long. Damping time	turns	40.5	Ave. No. of photons		0.59
dB beam-beam	%	0.014			

Main Parameters of SppC

Parameter	SppC-1	SppC-2
Beam energy (TeV)	25	45
Circumference (km)	49.78	69.88
Number of IPs	2	2
SR loss/turn (keV)	440	4090
N_p/bunch (10^{11})	1.3	0.98
Bunch number	3000	6000
Beam current (mA)	0.5	0.405
SR power /ring (MW)	0.22	1.66
B_0 (T)	12	19.24
Bending radius (km)	6.9	7.8
Momentum compaction (10^{-4})	3.5	2.5
β_{IP} x/y (m)	0.1/0.1	0.1/0.1
Norm. trans. emit. x/y (μm·rad)	4	3
ξ_y/IP	0.004	0.004
Geo. luminosity reduction factor F	0.8	0.9
Luminosity /IP ($10^{35}cm^{-2}s^{-1}$)	2.15	2.85

Schedule

- CPEC
  - Pre-study, R&D and preparation work
    - Pre-study: 2013-15 ➔ Pre-CDR by 2014
    - CDR in 2015
    - TDR(R&D): 2016-2020
    - Engineering Design: 2015-2020
  - Construction: 2021-2027
  - Data taking: 2028-2035
- SPPC
  - Pre-study, R&D and preparation work
    - Pre-study: 2013-2020
    - R&D: 2020-2030
    - Engineering Design: 2030-2035
  - Construction: 2035-2042
  - Data taking: 2042 -

Action items(partially)

- Pre-CDR by 2014
- Approaching the Chinese government in 2015 for R&D funding (next 5-year planning: 2016-2020)
- Get community support in China: ready for some kind of review
- Get international support
  - Workshops, joint efforts, statement(?), …
- Develop documents to address scientific, economical and industrial benefit to China and to the world
- Education: public lectures, books, schools, mumti-media, …
- Media: news release, event coverage, interview, …
- ……

Pre-CDR of CEPC+SppC

Table of Contents (Draft, February 10, 2014)

Pre-CDR of CEPC+SppC

5. CEPC – technical systems

1) Superconducting RF system
2) Cryogenic system
3) Magnets
4) Vacuum
5) Power supplies
6) Instrumentation
7) Control system
8) Radiation shielding
9) Survey and alignment

6. CEPC – injectors

1) e+ and e- sources
2) Linac
3) Booster ring

Pre-CDR of CEPC+SppC

7. Upgrade to SppC

1) Key accelerator physics issues

i. Main parameters

ii. Synchrotron radiation

iii. Beam-beam effects

iv. Electron cloud effect

2) Key technical systems

i. High field superconducting magnet

ii. Vacuum and beam screen

3）Reconfiguration of the accelerator complex

8. Other possible upgrades

1) ep

2) $\gamma\gamma$

9. Civil construction

10. Environment, safety and health considerations

11. R&D programs

12. Project plan and cost estimate

Timeline

- **ICFA Advanced Beam Dynamics Workshop on High Luminosity Circular e+e- Colliders - Higgs Factory**, October 8-11, 2014, Beijing. (pending ICFA's approval on Feb. 21, 2014, DESY)

- Pre-CDR review: November 2014

- Pre-CDR v1.0: by the end of the year 2014

Collaboration Issues (1)

- FCC is similar to CEPC+SppC.
- However, there are two main differences:

(1) CERN is focusing on pp, CEPC+SppC is focusing on e+e-

(2) FCC's CDR is due in 2018, and CEPC+SppC 's CDR is due in 2015

(3) CERN is running LHC (pp) and IHEP is running BEPCII (e+e-)

Collaboration Issues (2)

The mode of collaboration between FCC and CEPC+SPPC:

1) Exchange visitors
2) Visitors working on both projects (with comparisons , cross-checks, new ideas, training students, etc., design works in the first phase)
3) Joint meetings (with web-meetings), workshops, and schools, etc…
4) Help each other by taking into account of differences in time and particle type priorities…
5) Key technical parameter be better same such as rf frequency
6) Common design of key components, such as SCRF system…

Summary

- FCC and CEPC+SppC are very exciting and important in parallel to ILC
- High energy physics committee is booming with these projects and proposals, especially for young generations
- Circular colliders' beam dynamics and technologies are arrived at a good time to boom together with linear colliders
- Future large collider projects are all of the nature international collaboration and are all belong to our community
- Collaborations between institutions and projects are vital for all projects, especially FCC+CEPC+SppC
- China HEP is open to the world for participation and joint development