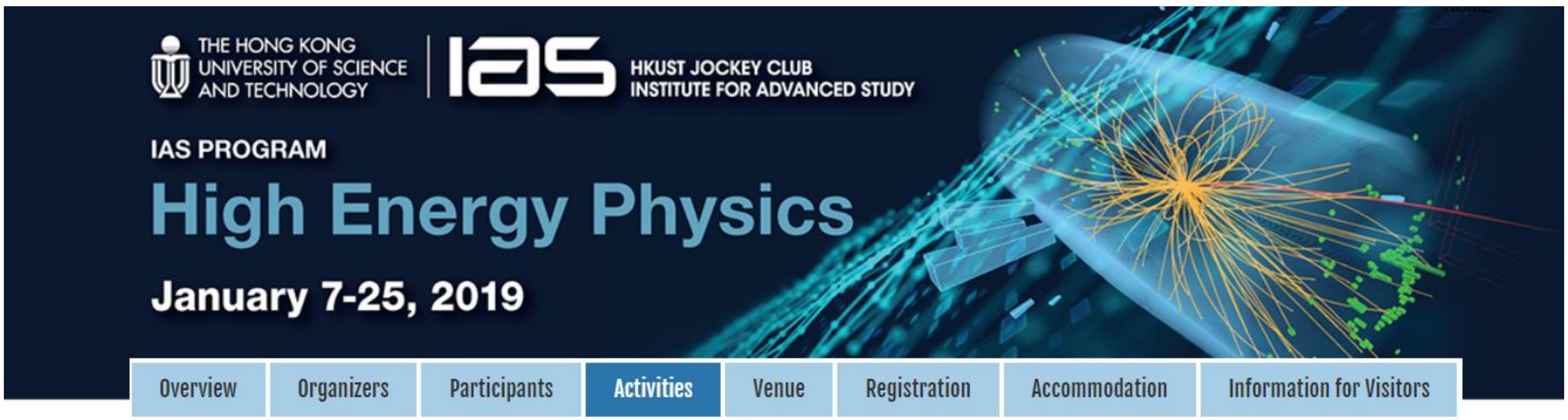
Report from the Hong Kong IAS 2019 conference

M. Koratzinos

25/2/2019

Contents

- An incomplete and biased report of the HKUST AIS conference on high energy physics



Jan 17-18 (Thu-Fri) — Mini-Workshop: Accelerator - Beam Polarization in Future Colliders
Venue: IAS4042, 4/F, Lo Ka Chung Building, Lee Shau Kee Campus, HKUST

Program Weeks (Completed) | Conference (Completed) | White Papers

Period: Jan 21-24, 2019

Venue: Lo Ka Chung Building, Lee Shau Kee Campus, HKUST

Polarization workshop

- Talks from our collaborators: Ivan Koop, Nikolai Muchnoi, Eliana Gianfelice-Wendt
- My impression was that the participants are more interested about polarization *per-ce* and not resonant depolarization as a tool to measure the energy. So, the discussion was very theoretical and things like systematic errors of energy determination were not touched.
- Longitudinal polarization was discussed in equal footing with transverse polarization

Conference proper

- Format: four days, morning plenaries afternoon parallel
- Three plenaries from FCC:
  - MK: FCC status
  - Mogens Dam: FCC-ee status
  - Michelangelo Mangano: FCC-hh and HE-LHC

Conference schedule

IAS Program on High Energy Physics 2019

1/23/2019

Conference Schedule (Jan 21-24, 2019)

	Monday		Tuesday		Wednesday		Thursday
	21-Jan		22-Jan		23-Jan		24-Jan
8:30	Conference Registration						
8:50	Welcome Remarks (Henry Tye)						
	Session M1 **Venue: IAS Lecture Theater (LT)** **[Chair: Tao Liu]**		**Session Tu 1** **Venue: IAS Lecture Theater (LT)** **[Chair: Joao Guimaraes da Costa]**		**Session W1** **Venue: IAS Lecture Theater (LT)** **[Chair: Joao Guimaraes da Costa]**		**Session Th 1** **Venue: IAS Lecture Theater (LT)** **[Chair: Tao Liu]**
9:00	Plenary #01 Opening Talk (Geoffrey Taylor) (09:00 - 09:45)		Plenary #05 CEPC Status (Jie Gao) (09:00 - 09:45)		Plenary #10 SppC Status (Jie Gao) (09:00 - 09:45)		Plenary #11 US HEP Planning and Strategy (Andrew Lankford) (09:00 - 09:45)
9:30							
9:45	Plenary #02 Physics Beyond the SM: Past, Today and Future (Carlos Wagner) (09:45 - 10:30)		Plenary #06 FCC Status (Michael Koratzinos) (09:45 - 10:15)		Summary (Theory) (Liantao Wang) (09:45 - 10:30)		Plenary #12 China HEP Strategy (Yifang Wang) (09:45 - 10:30)
10:00			Plenary #07 FCC-ee Status (Mogens Dam) (10:15 - 10:45)				Plenary #13 Road to European HEP Strategy (Jorgen D'Hondt)(10:30 - 11:15)
10:30	**Coffee Break (10:30 - 11:00)**		**Coffee Break (10:45 - 11:15)**		**Coffee Break (10:30 - 11:00)**		**Coffee Break (11:15 - 11:45)**
11:00	Plenary #03 ILC Status (Shinichiro Michizono) (11:00 - 11:45)		Plenary #08 HL-LHC Status (Sarah Eno) (11:15 - 12:00)		Summary (Experiment/ Detector) (Massimo Caccia) (11:00 - 11:45)		Forum Discussion: Jorgen D'Hondt, John Ellis, Andrew Lankford, Yifang Wang, Hitoshi Yamamoto. (11:45 - 12:45)
11:15							
11:45	Plenary #04 CLIC Status (Andrea Latina) (11:45 - 12:30)		Plenary #09 HE-LHC + FCC-hh Status (Michelangelo Mangano) (12:00 - 12:45)		Summary (Accelerator Physics) (Yuhong Zhang) (11:45 - 12:30)		
12:30	**Program Lunch** **for Registered Participants only (12:30 - 14:00)**		**Self-arranged Lunch (12:45 - 14:00)**		**Self-arranged Lunch (12:30 - 14:00)**		
12:45							
12:55							Closing Remarks (Tao Liu) (12:45 - 12:55)
	Parallel Sessions **(Accelerator Physics)** **Venue: IAS LT** **[Chair: Francois Meot]**	**Parallel Sessions** **(Theory)** **Venue: IAS 4042** **[Chair: Takeo Moroi]**	**Parallel Sessions** **(Accelerator Physics)** **Venue: IAS LT** **[Chair: Makoto Tobiyama]**	**Parallel Sessions** **(Experiment/Detector)** **Venue: IAS 4042** **[Chair: Paul Colas]**	**Parallel Sessions** **(Theory)** **Venue: IAS LT** **[Chair: Ian Low]**	**Parallel Sessions** **(Experiment/Detector)** **Venue: IAS 4042** **[Chair: Roberto Ferrari]**	
14:00	Yuhong Zhang (14:00 - 14:20)	Ian Low (14:00 - 14:25)	Sha Bai (14:00 - 14:20)	Xin Shi (14:00 - 14:25)	Takeo Moroi (14:00 - 14:25)	Zongtai Xie (14:00 - 14:25)	
14:20	Yiwei Wang (14:20 - 14:40)	Mihoko Nojiri (14:25 - 14:50)	Yingshun Zhu (14:20 - 14:40)	Yang Zhou (14:25 - 14:50)	John Ellis (14:25 - 14:50)	Mingyi Dong (14:25 - 14:50)	
14:40	Dou Wang (14:40 - 15:00)	Cen Zhang (14:50 - 15:15)	Jiyuan Zhai (14:40 - 15:00)	Serguei Ganjour (14:50 - 15:15)	Antonio Delgado (14:50 - 15:15)	Boxiang Yu (14:50 - 15:15)	
15:00	Yuanyuan Wei (15:00 - 15:20)	Hao Zhang (15:15 - 15:40)	Robert Rimmer (15:00 - 15:20)	Weiming Yao (15:15 - 15:40)	Tevong You (15:15 - 15:40)	Gabriella Gaudio (15:15 - 15:40)	
15:20	Xiaohao Cui (15:20 - 15:40)		Dijuan Gong (15:20 - 15:40)				
15:40	**Coffee Break** **(15:40 - 16:10)**		**Coffee Break** **(15:40 - 16:10)**		**Coffee Break** **(15:40 - 16:10)**		
	Parallel Sessions **(Accelerator Technology)** **Venue: IAS LT** **[Chair: Jie Gao]**	**Parallel Sessions** **(Experiment/Detector)** **Venue: IAS 4042** **[Chair: Paolo Giacomelli]**	**IAS Distinguished Lecture** **Venue: IAS LT** **[Moderator: Henry Tye]**		**Parallel Sessions** **(Accelerator Technology)** **Venue: IAS LT** **[Chair: Francois Meot]**	**Parallel Sessions** **(Experiment/Detector)** **Venue: IAS 4042** **[Chair: Shan Jin]**	
16:10	Makoto Tobiyama (16:10 - 16:35)	Rafael Coelho Lopes de Sá (16:10 - 16:30)	Prof HAN Tao (16:10 - 17:40) IAS Distinguished Lecture: "Quest for Nature: Fifty Years of Discoveries in High Energy Physics"		Bin Chen (16:10 - 16:30)	Yuanning Gao (16:10 - 16:30)	
16:30	Francois Meot (16:35 - 17:00)	Manqi Ruan (16:30 - 16:50)			Song Jin (16:30 - 16:50)	Yanping Huang (16:30 - 16:50)	
16:50	Yuhong Zhang (17:00 - 17:25)	Xin Shi (16:50 - 17:10)			Yu Xiao (16:50 - 17:10)	Xuai Zhuang (16:50 - 17:10)	
17:10	Michael Koratzinos (17:25 - 17:50)	Zhijun Liang (17:10 - 17:30)			Ke Huang (17:10 - 17:30)	Shih-Chieh Hsu (17:10 - 17:30)	
17:30		Roman Pöschl (17:30 - 17:50)			Yunlong Chi (17:30 - 17:50)	Jennifer Thomas (17:30 - 17:50)	
17:40			Short Break (17:40 - 18:00)				
17:50 onwards							
18:15 onwards			**Program Banquet** **(Depart from HKUST at 18:00)**				

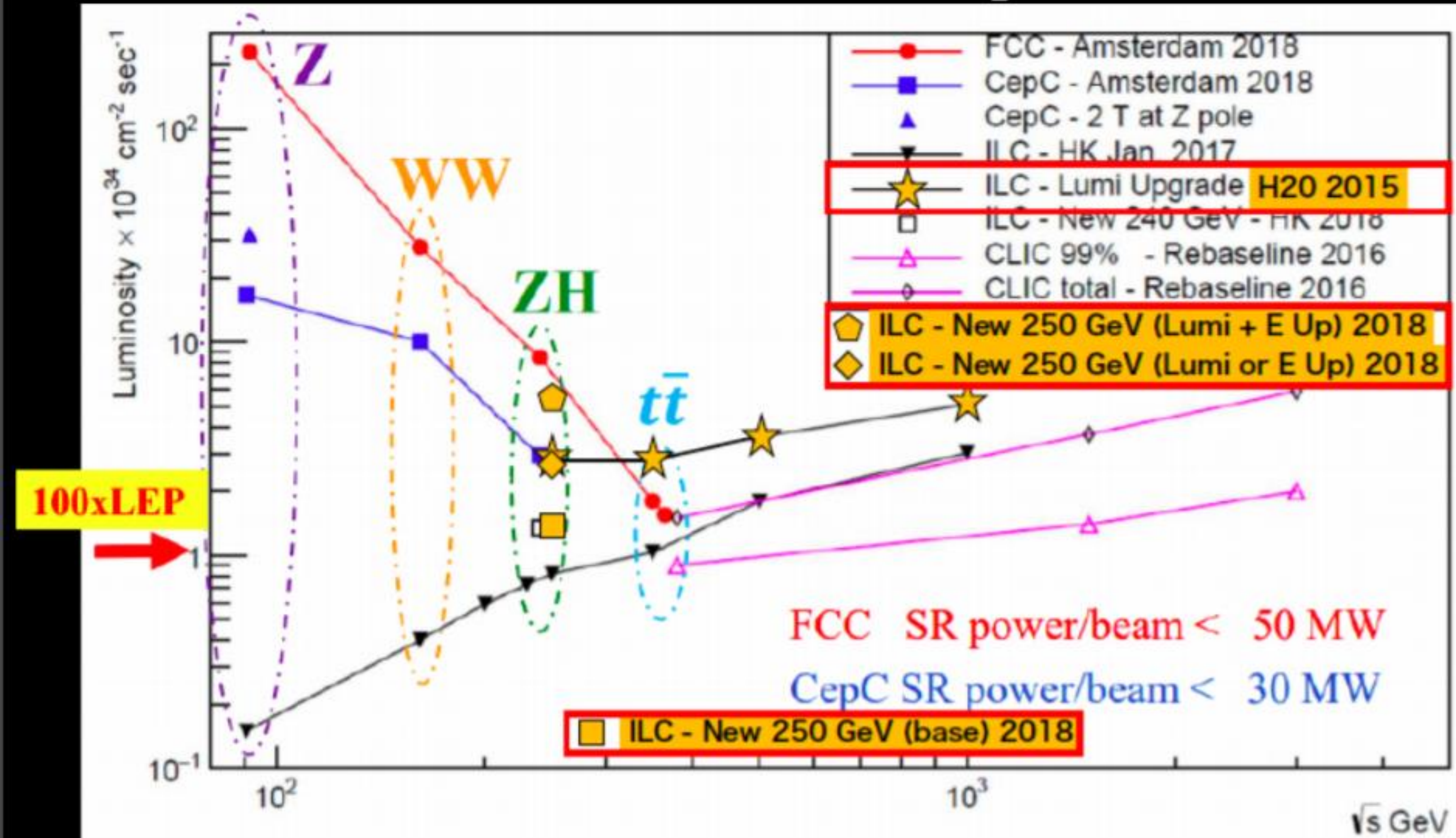
Chairman of ICFA

09:00 - 09:45

Opening Talk [Slides]
Geoffrey TAYLOR
The University of Melbourne

- He presented a luminosity plot comparing different e+e- collider options
- ILC appears with many different options to have luminosities at 250GeV ranging from 1.3 to 5E34 .
- FCC-ee appears with a luminosity of 8.5E34 at 240GeV
- It is not mentioned if the luminosities presented are per IP

e+e- Lumi Comparison

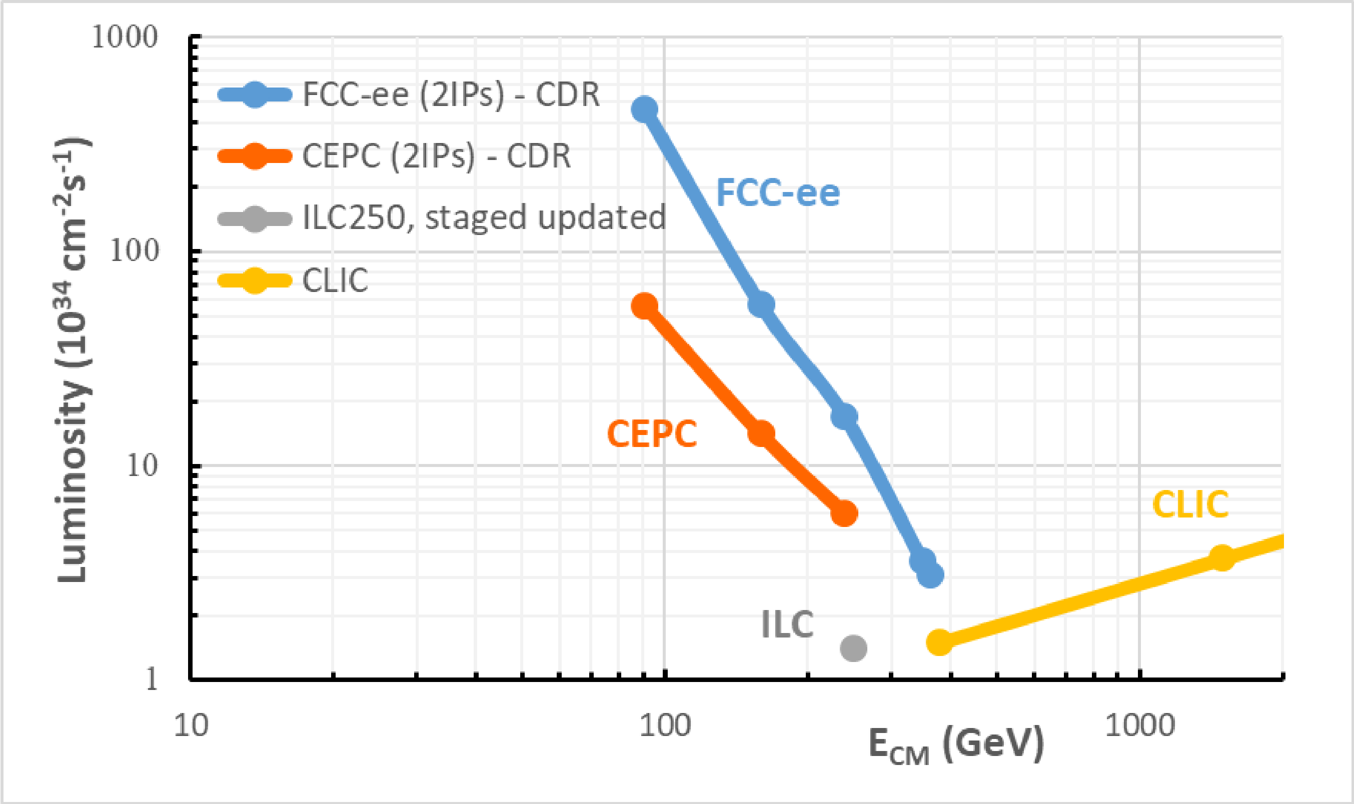


- Original Plot, F. Bedeschi , CEPC Workshop, Rome, May 2018
- Updates Private communication, Keisuke Fujii, IPNS, KEK

Fast forward to the FCC-ee presentation…

- FCC-ee luminosity at 240GeV with 2IPs is 17E34

Lepton collider luminosities



M. Koratzinos IAS 2019

Private communication with G. Taylor

- Naturally after the morning session we discussed the discrepancies between the luminosities in the two presentations.
- Geoff seemed unaware about the difference of a factor 10 in luminosity between the ILC and the FCC-ee at the HZ
- Emails and clarifications were exchanged with Keisuke Fujii. The higher lumi numbers of ILC have never been published, I encouraged them to do so.

2018/10/21

Design Luminosity

Lumi-Up = # bunches x 2
E-Up = E-Up to 500 GeV

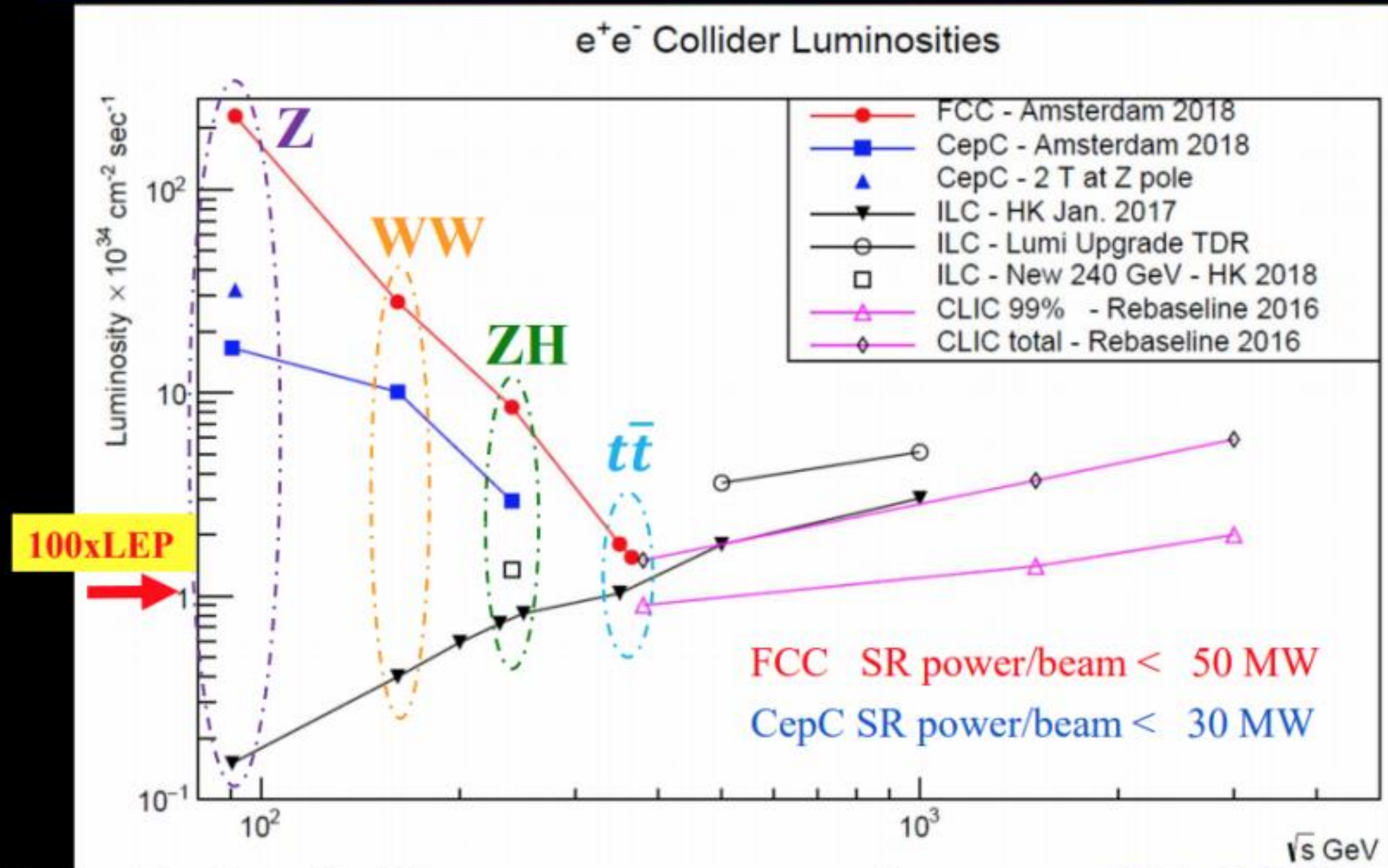
	Base Line 1312 bunches (5 Hz)	Lumi-Up 2625 bunches (5 Hz)	(Lumi+E-Up) 2625 bunches (High Rep)
250 GeV (H20)	0.82×10^{34} (5 Hz)	1.64×10^{34} (5 Hz)	3.28×10^{34} (10 Hz)
350 GeV (H20)	1.0×10^{34} (5 Hz)	2.0×10^{34} (5 Hz)	2.8×10^{34} (7 Hz)
500 GeV (H20)	1.8×10^{34} (5 Hz)	3.6×10^{34} (5 Hz)	–
250 GeV (New)	1.35×10^{34} (5 Hz)	2.7×10^{34} (5 Hz)	5.4×10^{34} (10 Hz)

H20 numbers from arXiv: 1506.07830 with revision according to Change Request 5 (approved by Change Control Board in 2015)

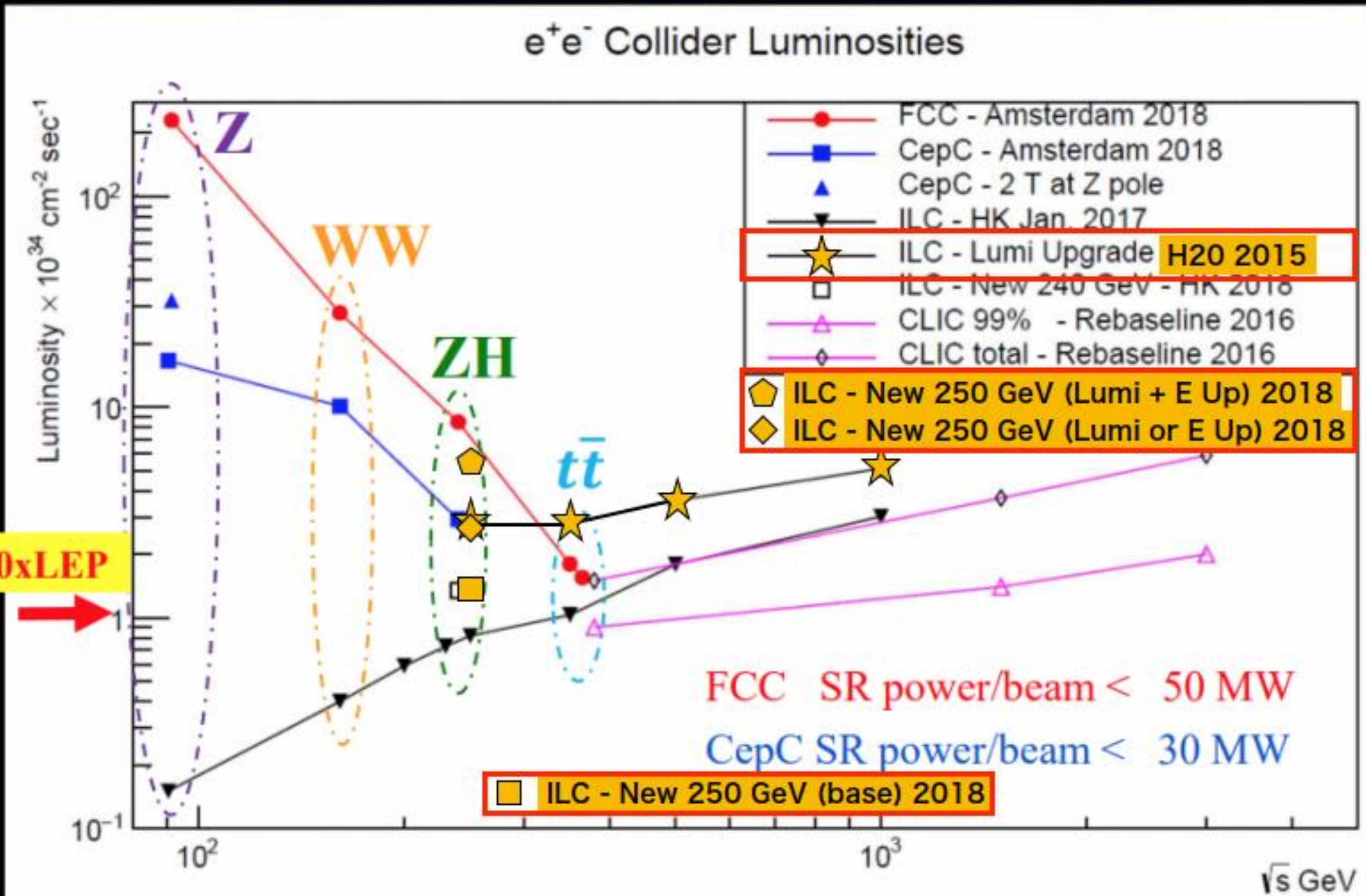
250 GeV (New) numbers based on arXiv: 1711.00568

Only the possibility of a luminosity upgrade is mentioned in this document, no numbers are given

CepC, FCC, ILC, CLIC luminosity comparison



CepC, FCC, ILC, CLIC
luminosity comparison



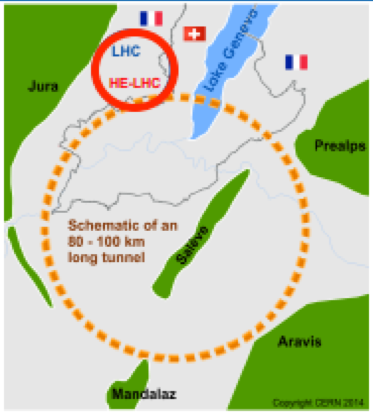
FCC talks

- First time that the “integrated project” has been presented outside CERN (to my knowledge)
- It immediately prompted a question from Qing Qin (why have we changed our minds)

Future Circular Collider (FCC)

Conceptual Design Report released today!

	√s	L /IP (cm^{-2} s^{-1})	Int. L /IP(ab^{-1})	Comments
e^+e^- FCC-ee	~90 GeV Z 160 WW 240 H ~365 top	230 x10^{34} 28 8.5 1.5	75 ab^{-1} 5 2.5 0.8	2 experiments Total ~ 15 years of operation
pp FCC-hh	100 TeV	5 x 10^{34} 30	2.5 ab^{-1} 15	2+2 experiments Total ~ 25 years of operation
PbPb FCC-hh	$\sqrt{s_{NN}}$ = 39TeV	3 x 10^{29}	100 nb^{-1}/run	1 run = 1 month operation
ep Fcc-eh	3.5 TeV	1.5 10^{34}	2 ab^{-1}	60 GeV e- from ERL Concurrent operation with pp for ~ 20 years
e-Pb Fcc-eh	$\sqrt{s_{eN}}$ = 2.2 TeV	0.5 10^{34}	1 fb^{-1}	60 GeV e- from ERL Concurrent operation with PbPb



Also studied: HE-LHC: √s=27 TeV using FCC-hh 16 T magnets in LHC tunnel; L~1.6x10^{35} → 15 ab^{-1} for 20 years operation

Sequential implementation, FCC-ee followed by FCC-hh, would enable:

- ❑ variety of collisions (ee, pp, PbPb, eh) → impressive breadth of programme, 6++ experiments
- ❑ exploiting synergies by combining complementary physics reach and information of different colliders → maximise indirect and direct discovery potential for new physics
- ❑ starting with technologically ready machine (FCC-ee); developing in parallel best technology (e.g. HTS magnets) for highest pp energy (100++ TeV!)
- ❑ building stepwise at each stage on existing accelerator complex and technical infrastructure

Purely technical schedule, assuming green light to preparation work in 2020.
A 70 years programme

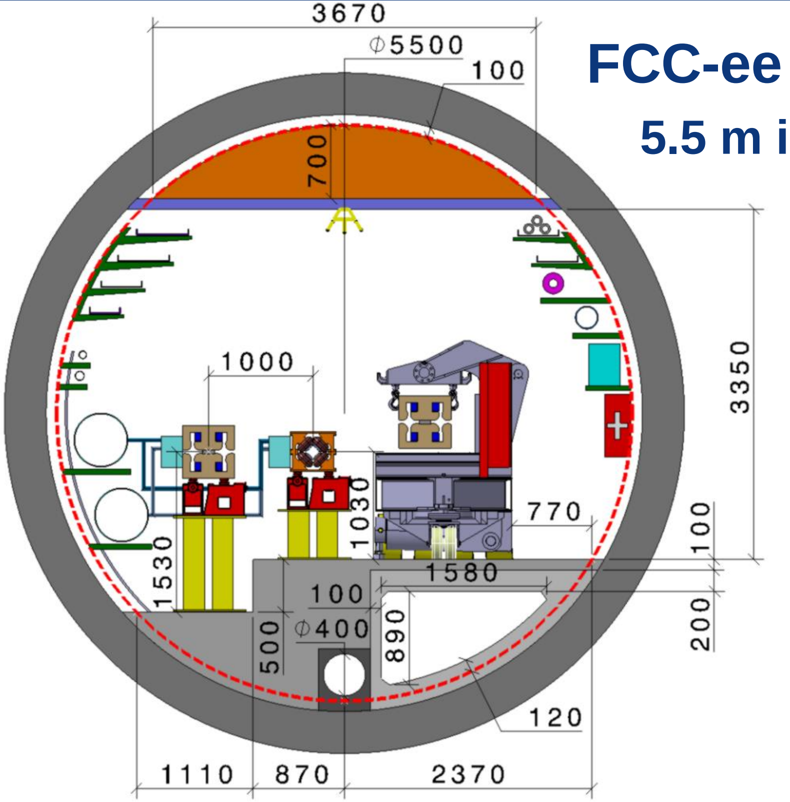
8 years preparation	10 years tunnel and FCC-ee construction	15 years FCC-ee operation	11 years FCC-hh preparation and installation	25 years FCC-hh operation pp/PbPb/eh
2020-2028		2038-2053		2064-2090

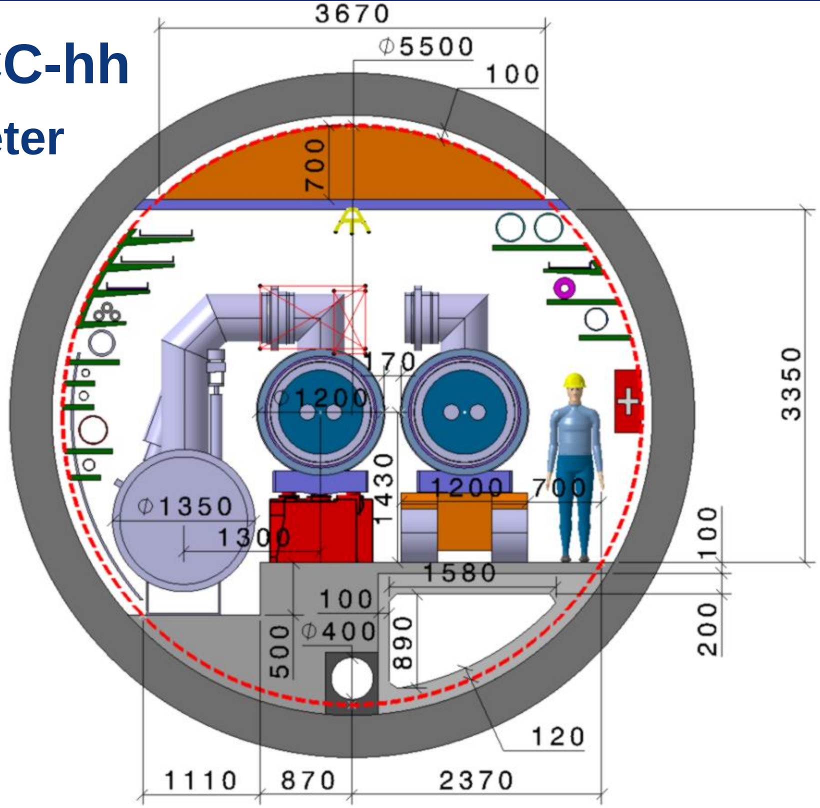
F. Gianotti 15/1/2019

FCC – tunnel integration in arcs

FCC-ee **FCC-hh**

5.5 m inner diameter





Cost comparison of CEPC, FCC-ee

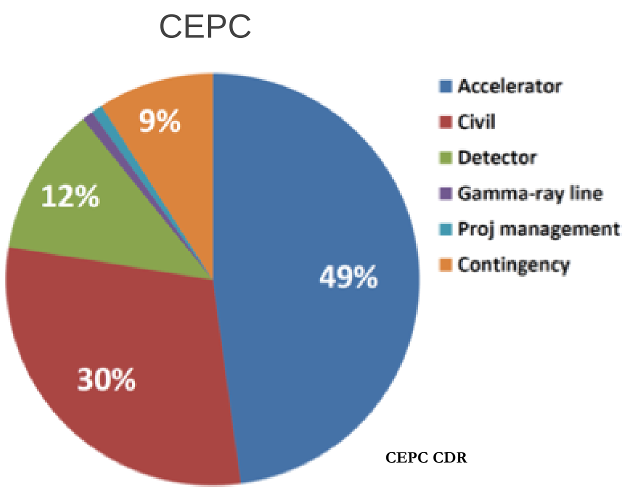
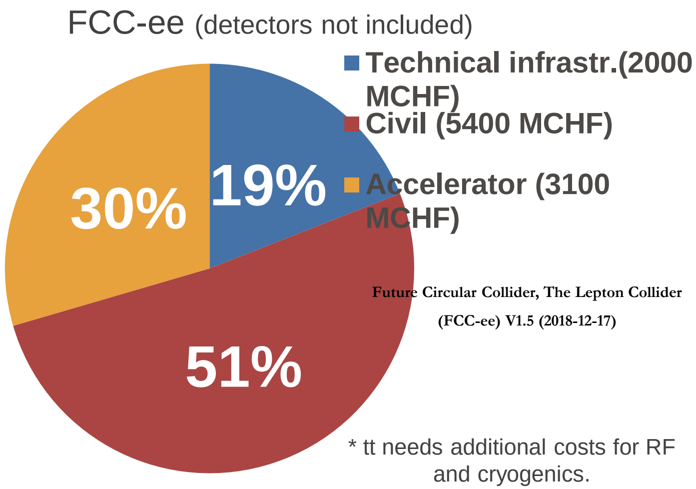


Figure 12.1: Relative cost of the CEPC project constituents.



- Note that the relative portion for civil engineering and technical infrastructure is much smaller in CEPC than FCC-ee.
- The cost for FCC-ee roughly agrees with scaling from LEP (1/3.5) including ~150% inflation adjustment of CHF since 1985.

K.Oide

Mogens: slide on theory effort needed

Precision of theory predictions

- Improving the precision of EW and QCD calculations for the FCC
  - Is a great challenge (exponentially growing number of diagrams with # loops)
  - Has discovery potential (see previous slide)
  - Is therefore recognized as strategic
    - *Included in the FCC-ee CDR volume as a target for "Strategic R&D"*
- First workshop on "Methods and tools" in January 2018
  - 33 participants
  - Produced a 250+ pages proceedings !
  - Conclusion of the workshop
    - ***We cannot promise, but yes, we can do it !***
    - Requires ~500 person-year over the next 20 years

Standard Model theory for the FCC-ee (2018)
J. Gluza et al., https://arxiv.org/abs/1809.01830

- Workshop series continued in January 2019
  - Topics cover the whole FCC-ee programme, 106 registered participants
    - Z, W, Higgs, top, b, c, QED, Monte Carlo, software, and detector technologies

Michelangelo: Higgs couplings

Higgs couplings after FCC-ee / hh

	HL-LHC	FCC-ee	FCC-hh
$\delta\Gamma_H / \Gamma_H$ (%)	SM	1.3	tbd
$\delta g_{HZZ} / g_{HZZ}$ (%)	1.5	0.17	tbd
$\delta g_{HWW} / g_{HWW}$ (%)	1.7	0.43	tbd
$\delta g_{Hbb} / g_{Hbb}$ (%)	3.7	0.61	tbd
$\delta g_{Hcc} / g_{Hcc}$ (%)	~70	1.21	tbd
$\delta g_{Hgg} / g_{Hgg}$ (%)	2.5 (gg->H)	1.01	tbd
$\delta g_{H\tau\tau} / g_{H\tau\tau}$ (%)	1.9	0.74	tbd
$\delta g_{H\mu\mu} / g_{H\mu\mu}$ (%)	4.3	9.0	0.65 (*)
$\delta g_{H\gamma\gamma} / g_{H\gamma\gamma}$ (%)	1.8	3.9	0.4 (*)
$\delta g_{Htt} / g_{Htt}$ (%)	3.4	–	0.95 (**)
$\delta g_{HZ\gamma} / g_{HZ\gamma}$ (%)	9.8	–	0.9 (*)
$\delta g_{HHH} / g_{HHH}$ (%)	50	~30 (indirect)	6.5
BR_{exo} (95%CL)	$BR_{inv} < 2.5\%$	< 1%	$BR_{inv} < 0.025\%$

* From BR ratios wrt B(H→4lept) @ FCC-ee

** From pp→ttH / pp→ttZ, using B(H→bb) and ttZ EW coupling @ FCC-ee

Jie Gao: CEPC status

CEPC Collider and Booster Ring Conventional Magnets

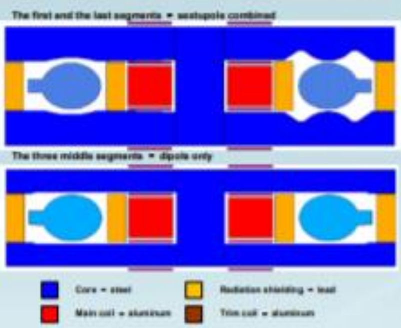
China Astronotics Department 508 Institute participates CEPC magnets mechanical designs

CEPC collider ring magnets

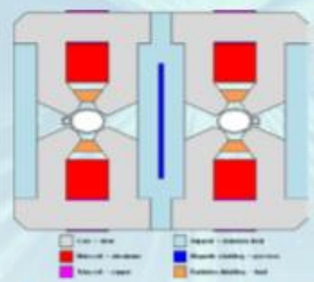
	Dipole	Quad.	Sext.	Corrector	Total
Dual aperture	2384	2392	-	-	13742
Single aperture	80*2+2	480*2+172	932*2	2904*2	
Total length [km]	71.5	5.9	1.0	2.5	80.8
Power [MW]	7.0	20.2	4.6	2.2	34

Length

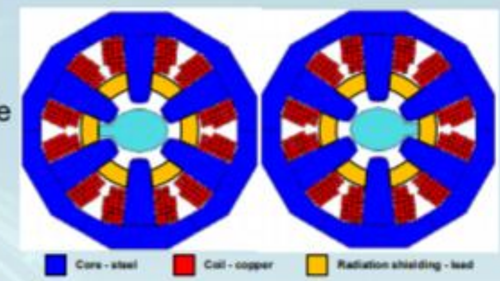
Quads: 2m
Sext: 1m
Corr: 1m



Dipole



Quadrupole

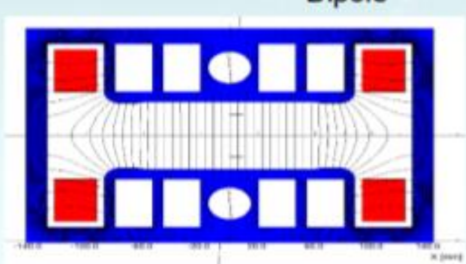


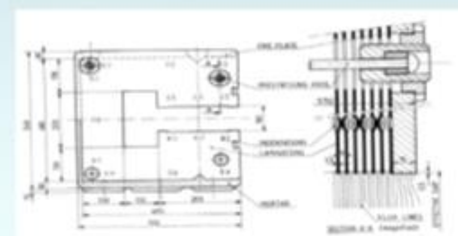
Sextupole

Booster ring low field magnets

Quantity	16320
Magnetic length(m)	4.711
Max. strength(Gs)	338
Min. strength(Gs)	28
Gap height(mm)	63
GFR(mm)	55
Field uniformity	5E-4

Dipole



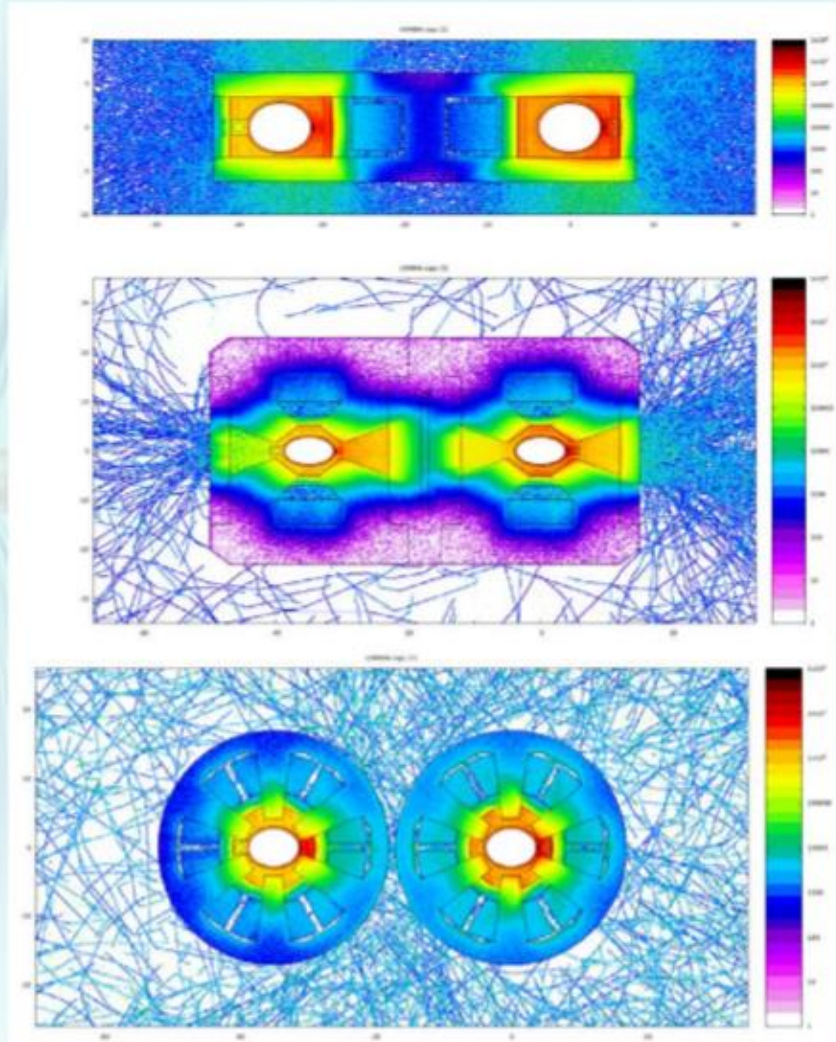


Comparison of arc magnets

- FCC-ee quadrupole: 3.1m magnetic length
- CEPC quadrupole: 2m
- FCC-ee sextupole: 1.4m magnetic length
- CEPC sextupole: 1m
- CEPC will have increased power compared to FCC-ee

Magnets R&D:-SR Analysis

Total power 870 W/m			
Beam direction: left W/m		Beam direction: right W/m	
Al chamber	199	Al chamber	186
Cu chamber	308	Cu chamber	332
Dipole	186	Dipole	182
Lead A	60.6	Lead A	29.2
Lead B	33.5	Lead B	80.0
Lead C	46.8	Lead C	18.8
Lead D	14.3	Lead D	20.4
Quadrupole	279	Quadrupole	268
Lead A	37.8	Lead A	36.4
Lead B	18.1	Lead B	21.7
Sextupole	179	Sextupole	174
Lead A	95.1	Lead A	107
Lead B	60.3	Lead B	43.1

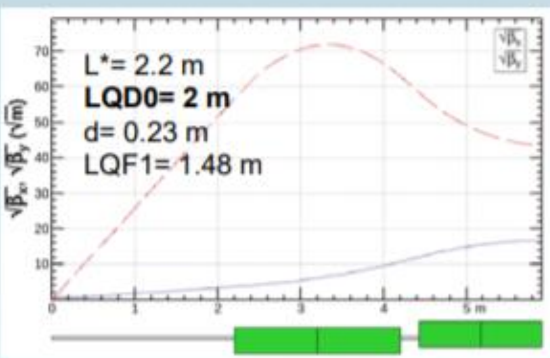


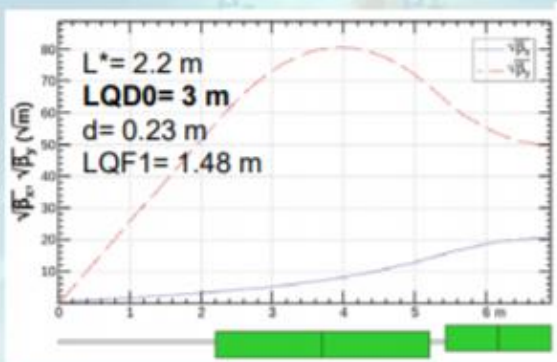
Optimization of the radiation effect due to QD0

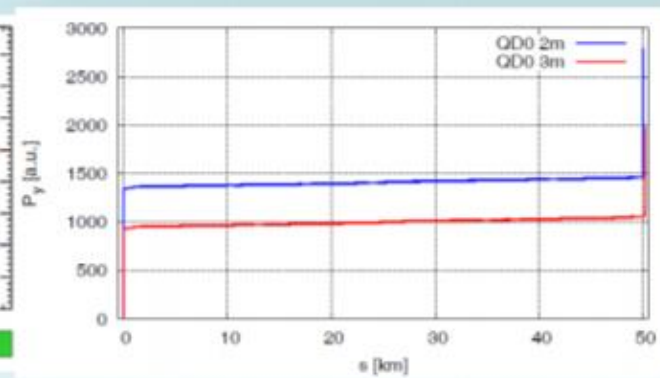
- The dynamic aperture reduction due to the damping and fluctuation is significant on the vertical plane.

$$P \propto \int B^2 ds \propto \int {K_1}^2 \beta ds \cong \sum (K_1 l)^2 \beta / l$$

- Radiation power due to quadrupoles:
  - contribution of QD0 dominant
  - longer QD0 will significantly decreased the power on vertical plane and thus help to increase the dynamic aperture





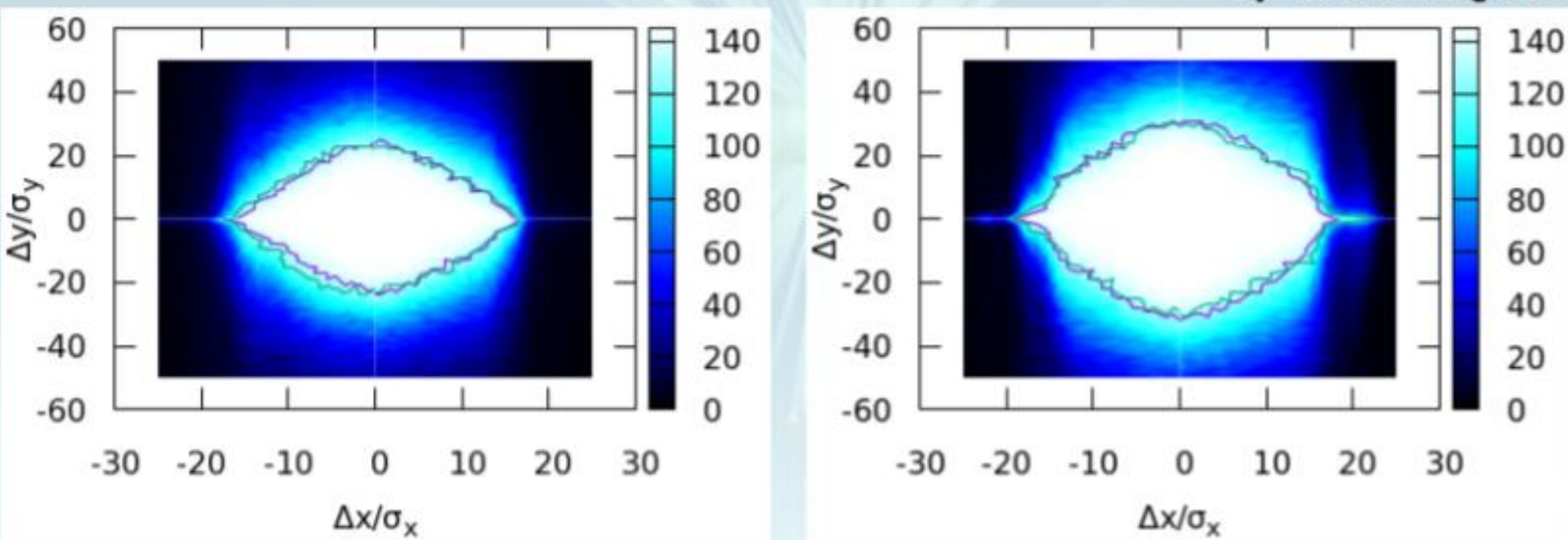


CEPC had to increase the size of FF quads from 2m to 3m (FCC-ee: 3.2m)

Optimization of the radiation effect due to QD0 (cont.)

- **With longer QD0, the vertical dynamic aperture increased from 23 σy to 30 σy.**
- **Further optimization of the horizontal dynamic aperture and momentum acceptance is under going.**

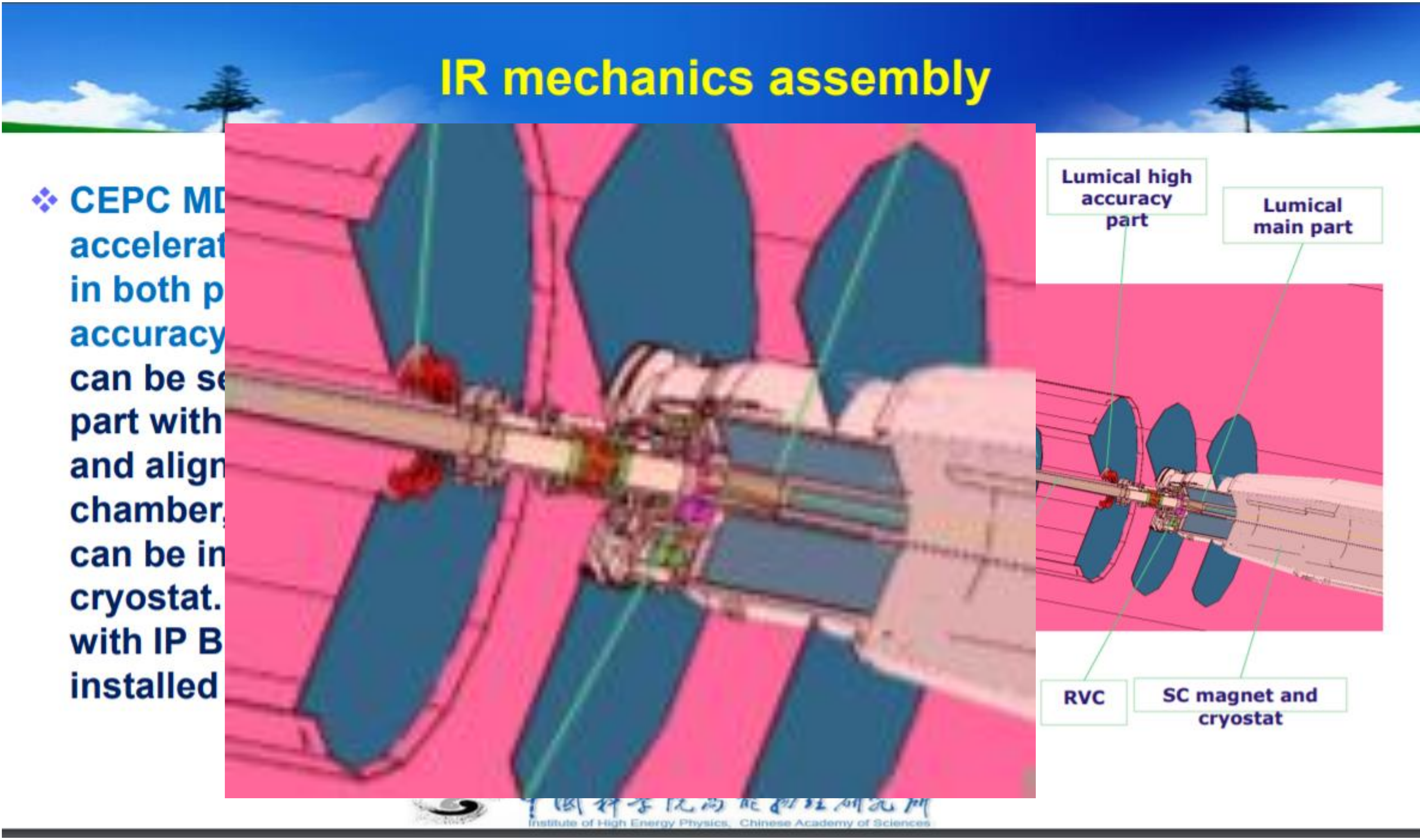
by Yuan Zhang, Jin Wu



CEPC movies

- Jie Gao showed us a very sleek, very professional, very impressive 4min20 film of how CEPC would look like.
- Done by the civil engineering company for free using BIM

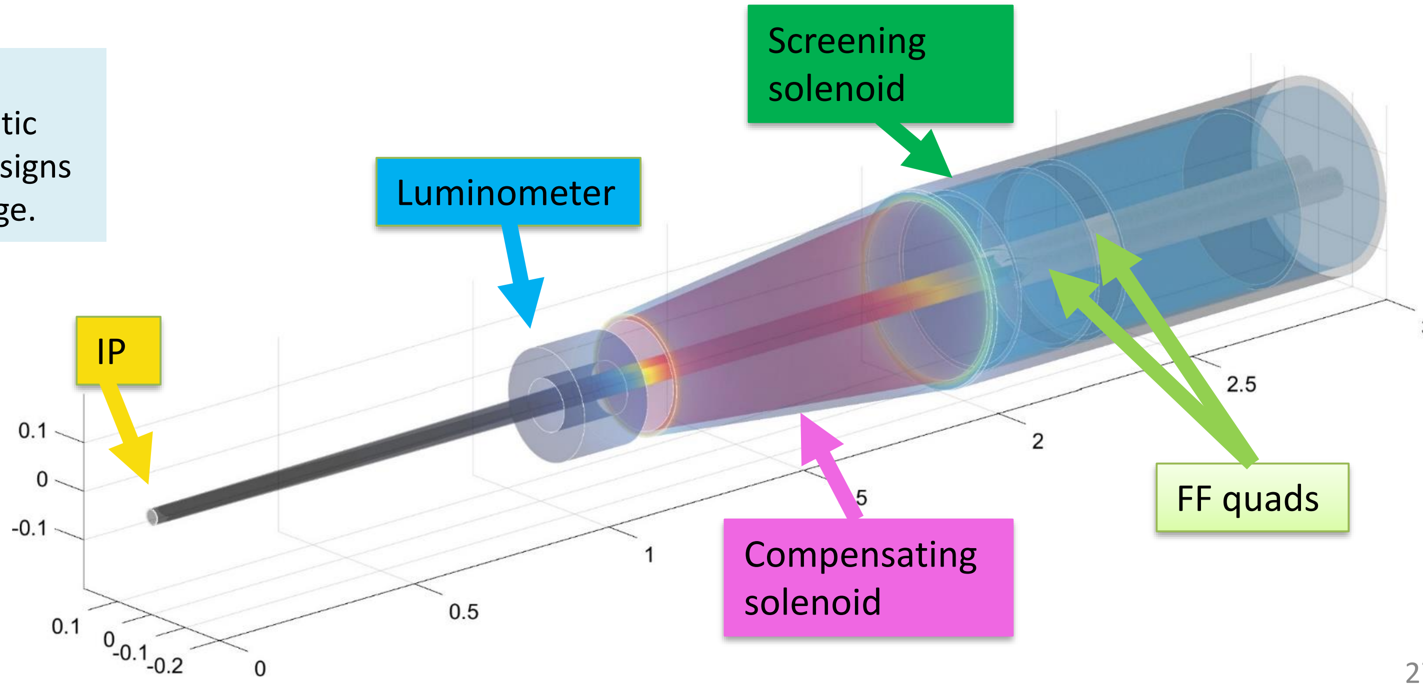
CEPC MDI


IR mechanics assembly
Lumical high accuracy part
Lumical main part
RVC
SC magnet and cryostat
Institute of High Energy Physics, Chinese Academy of Sciences

The FCC-ee baseline solution

- L* = 2.2m; 30mrad opening angle between beamlines – elegant solution satisfying all requirements
- Luminometer needs to fit in front of magnetic elements and as far back as possible to have a decent rate
- FF quads sit in a zero longitudinal field region (integral of solenoid field <50mTm) encompassed by a screening solenoid which needs to extend to L* of 2.0m
- A compensating solenoid must sit between the screening solenoid and luminometer to ensure an integral field of zero

This is the design with the minimum number of magnetic elements. More complex designs were disfavoured at this stage.



Unlike linear colliders, we are facing the challenge of FF quads inside the detector!

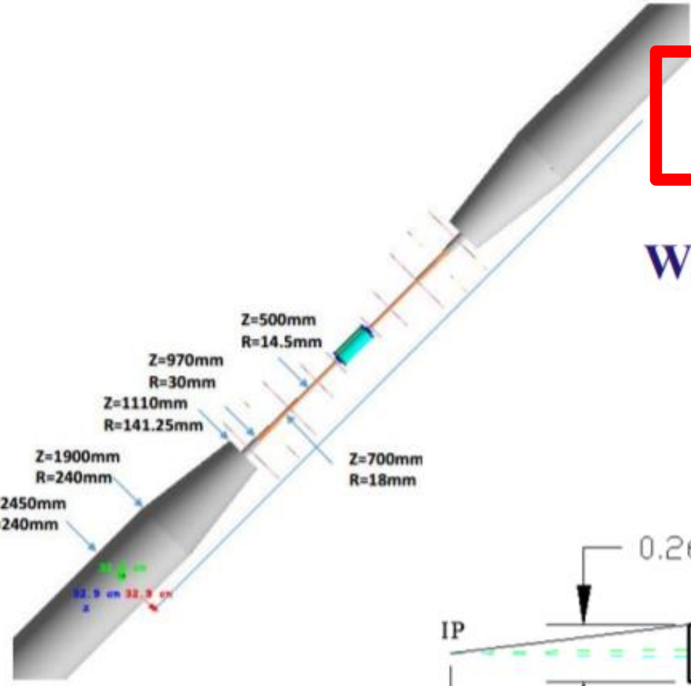
Lumical

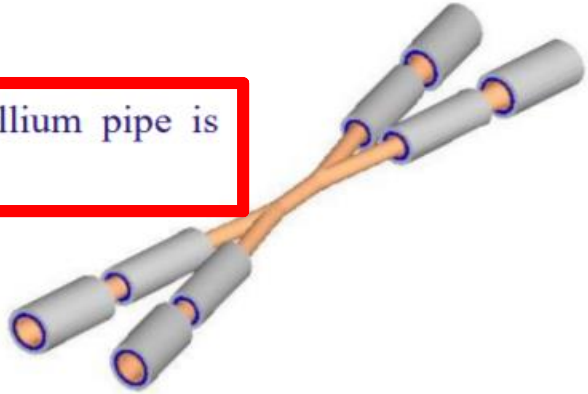
- CEPC has chosen a lumical design split in two parts: a “pre-shower-tracker” sitting at 0.65m and a “calorimeter” sitting behind a lot of material (mechanical gears, flanges, etc) at 0.95m from the IP.

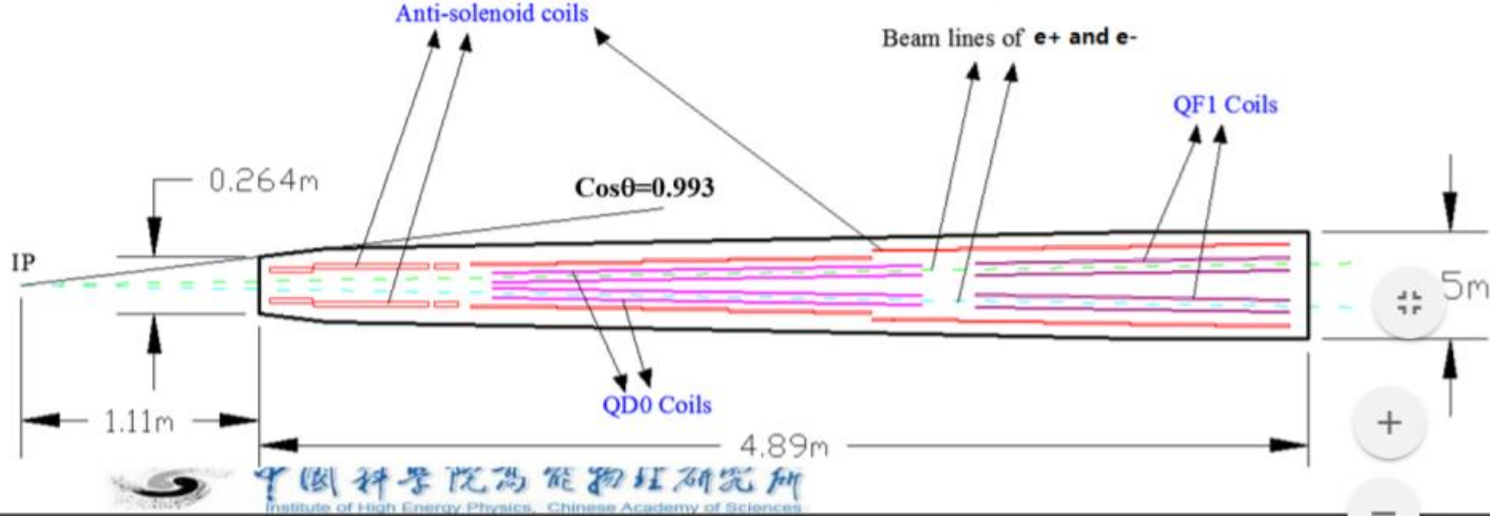
The design of interaction region

The inner diameter of the beryllium pipe is 28mm with the length of ±7cm.

Without tungsten shield.



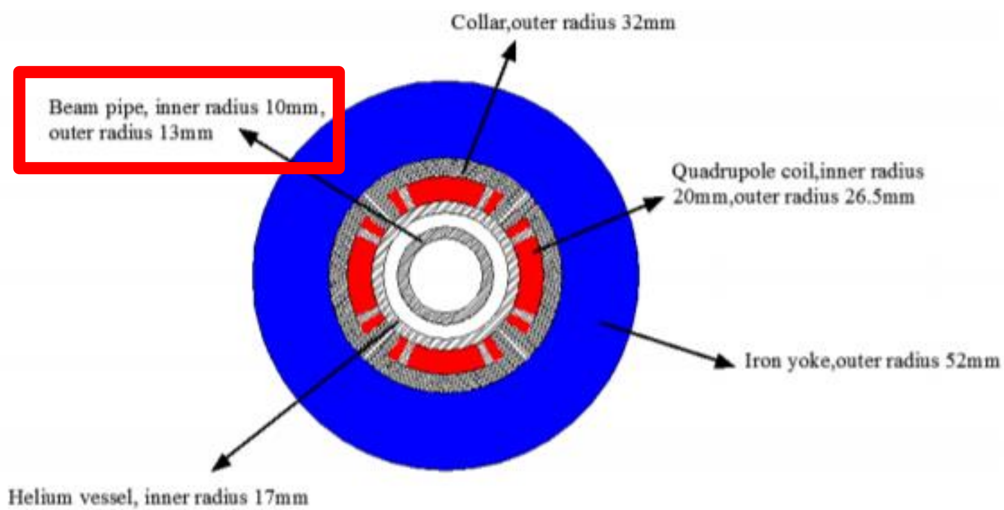


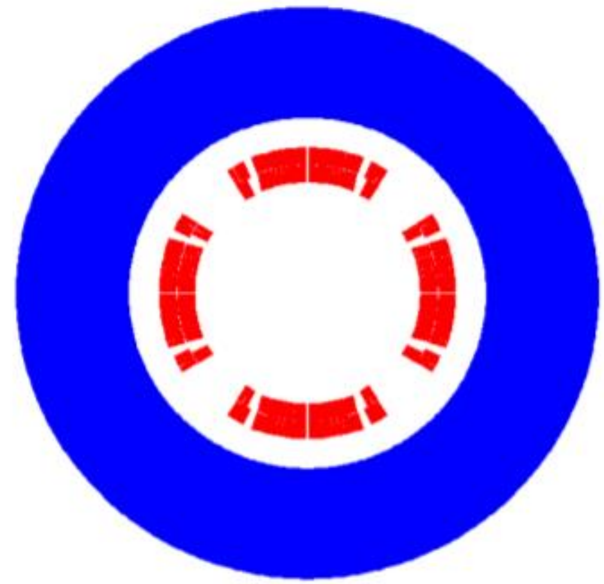


Sha Bai

- 3D field simulation result shows that, iron yoke can well shield the leakage field of each aperture, so field cross talk is not a problem.
- Each integrated multipole field as a result of field crosstalk between the two apertures is smaller than 1×10^{-4}.

◆ QD0 single aperture cross section.





◆ The beam pipe at room temperature is held inside the helium vessel with a clearance gap of 4 mm.

- In 2D case where the distance between the two aperture is the smallest and the field crosstalk is the most serious, iron yoke can well shield the leakage field of each aperture, and the field harmonics as a result of field crosstalk between the two apertures is smaller than 0.6×10^{-4}.
- In other cases where the distance between the two apertures becomes larger, the field harmonics as a result of field crosstalk will be smaller.

✓ Using the iron yoke, the field harmonics as a result of the field crosstalk is not a problem.

✓ In addition, compared with the iron-free design of QD0, the excitation current can be reduced.

✓ The main disadvantage of the iron option is that the diameter of QD0 will be larger, and there will be not enough space for multipole corrector coils.

Comparison between CEPC and FCC-ee MDI region

	CEPC	FCC_ee
Collision angle	33mrad	30 mrad
MDI cone	118 mrad	100 mrad
Screening solenoid L*	2.07 m	2.0 m
Compensating solenoid L*	1.15 m	1.23 m
Lumical L*	0.97 m + 0.65 m (tracker)	1.074 m
Beam pipe central	28mm (ID) X 14cm	30mm(ID) X 25cm
Beam pipe @ QD0	20mm (inner diameter)	30mm (inner diameter)

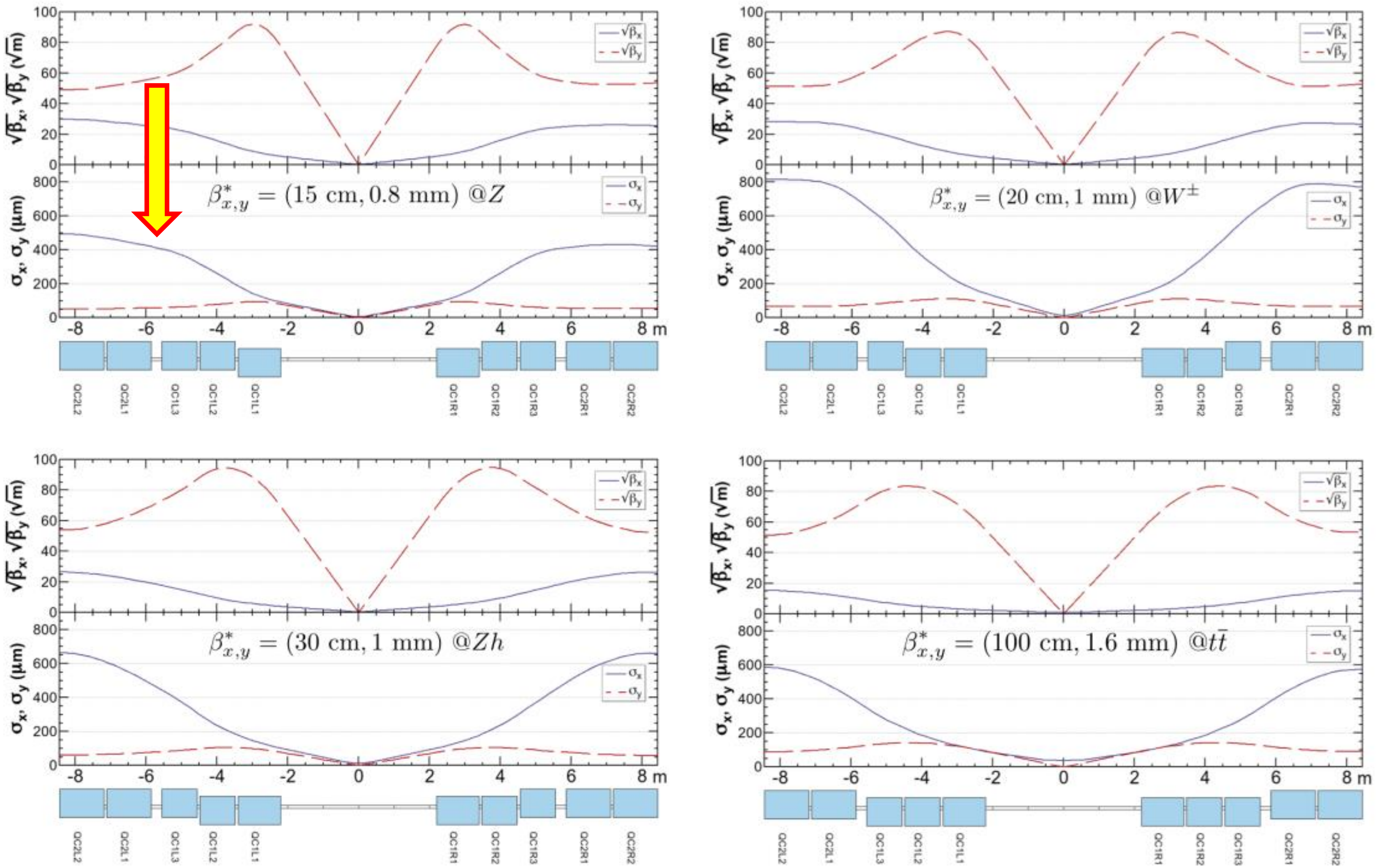
CEPC values approximate

Beam pipe considerations

There were interesting discussions regarding the beam pipe which we need to think about:

- Can we have the central beam pipe with only conductive cooling, to reduce the amount of material?
- Can we have a smaller beam pipe? (at least for some of the physics)
- A smaller beam pipe would have
  - Smaller physical aperture
  - More difficult masking from SR
  - Higher resistive heating (power loss is inversely proportional to radius – het dissipation per square cm of beam pipe is inversely proportional to the square of the radius)

Beam size around the IP



Aperture

Table 2.4: On-momentum transverse dynamic and physical apertures at each energy. The narrowest physical aperture is given by the beam pipe of the final quadrupole with 15 mm inner radius as shown in Fig. 2.7. All effects in Table 2.3 were included for the DA.

Energy	Dynamic		Physical		Going from 30 to 20mm
	$\Delta x/\sigma_x$	$\Delta y/\sigma_y$	$\Delta x/\sigma_x$	$\Delta y/\sigma_y$	
Z	±35	±58	±37	±170	+-25
WW	±22	±55	±23	±133	+-15
ZH	±18	±67	±34	±144	+-23
$t\bar{t}$	±19	±70	±43	±107	+-29

Physical aperture limitation at the end of QC1L3 – the beam pipe increases in diameter for QC2

CEPC Power consumption

16.5MW

CEPC Power for Higgs and Z

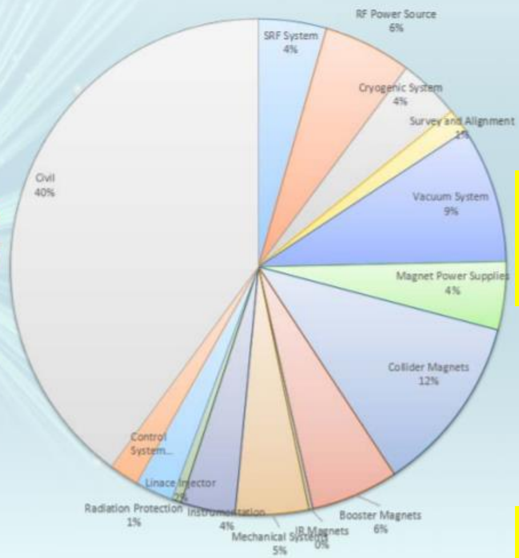
	System for Higgs (30MW)	Location and electrical demand(MW)						Total (MW)
		Ring	Booster	LINAC	BTL	IR	Surface building	
1	RF Power Source	103.8	0.15	5.8				109.75
2	Cryogenic System	11.62	0.68			1.72		14.02
3	Vacuum System	9.784	3.792	0.646				14.222
4	Magnet Power Supplies	47.21	11.62	1.75	1.06	0.26		61.9
5	Instrumentation	0.9	0.6	0.2				1.7
6	Radiation Protection	0.25		0.1				0.35
7	Control System	1	0.6	0.2	0.005	0.005		1.81
8	Experimental devices					4		4
9	Utilities	31.79	3.53	1.38	0.63	1.2		38.53
10	General services	7.2		0.2	0.15	0.2	12	19.75
	Total	213.554	20.972	10.276	1.845	7.385	12	266.032

266MW

	System for Z	Location and electrical demand(MW)						Total (MW)
		Ring	Booster	LINAC	BTL	IR	Surface building	
1	RF Power Source	57.1	0.15	5.8				63.05
2	Cryogenic System	2.91	0.31			1.72		4.94
3	Vacuum System	9.784	3.792	0.646				14.222
4	Magnet Power Supplies	9.52	2.14	1.75	0.19	0.05		13.65
5	Instrumentation	0.9	0.6	0.2				1.7
6	Radiation Protection	0.25		0.1				0.35
7	Control System	1	0.6	0.2	0.005	0.005		1.81
8	Experimental devices					4		4
9	Utilities	19.95	2.22	1.38	0.55	1.2		25.3
10	General services	7.2		0.2	0.15	0.2	12	19.75
	Total	108.614	9.812	10.276	0.895	7.175	12	148.772

149MW

CEPC Cost Breakdwon (no detector)



94% of FCC-ee for 60% SR

57% of FCC-ee for 16% SR

FCC-ee power comsumption

Table 9.1: Power requirements of accelerator subsystems and comparison with the LEP collider. Indicated power consumption values are upper level estimates with further improvement potential for the non accelerator systems.

	Electrical needs (approx. MW)					
Subsystem	**LEP2**	**Z**	**WW**	**ZH**	**$t\bar{t}$**	**$t\bar{t}$ optimised**
Collider cryogenics	18	1	9	14	46	ca. 35 (−25%)
Booster RF and cryogenics	n/a	3	4	6	8	ca. 6 (−25%)
Radiofrequency	42	163	163	145	145	145
Magnets	16	4	12	26	60	59
Cooling and ventilation	16	30	31	33	37	37
General services	9	36	36	36	36	36
Two experiments	9	8	8	8	8	8
Two data centres	?	4	4	4	4	4
Injector complex	10	10	10	10	10	10
Total	**120**	**259**	**277**	**282**	**354**	**340**

ILC talk

ILC status

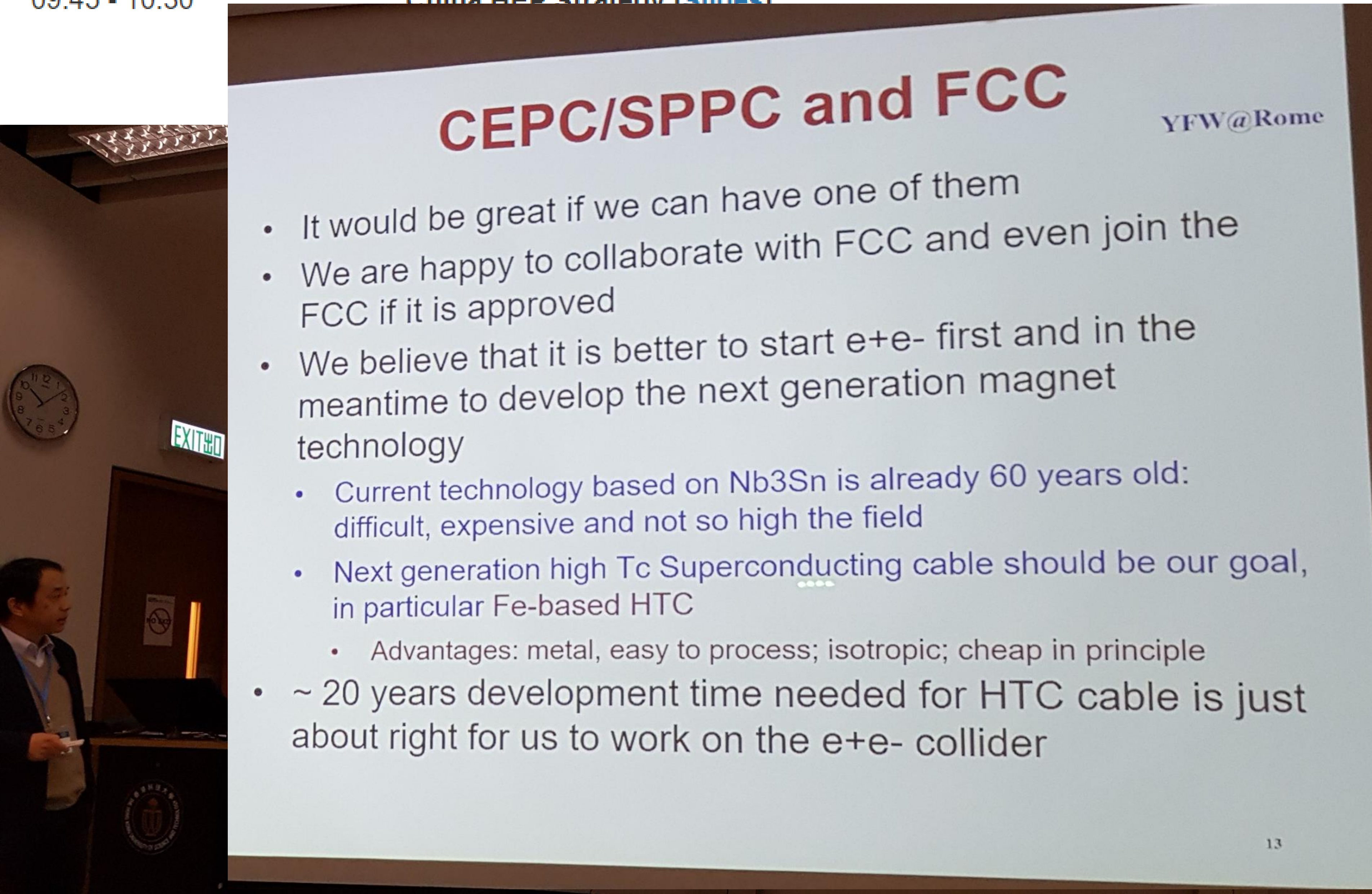
Shin MICHIZONO
KEK/Linear Collider Collaboration (LCC)

- *250 GeV ILC*
- *SRF R&D*
  - *Cost reduction R&Ds*
  - *SRF accelerators (European XFEL)*
- *Nano-beam R&D*
- *Beam dump, positron*
- *ILC preparation*
- *Recent status*
- *Summary*

No mention of performance or comparison with other projects

Yifang Wang statement

09:45 - 10:30 China HEP Strategy [Slides]



Round table

11:15 - 11:45	Coffee Break (Venue: IAS Lobby, G/F)
11:45 - 12:45	**Forum** **- Jorgen D'HONDT (Vrije Universiteit Brussel)** **- John ELLIS (CERN and King's College London; IAS Senior Visiting Fellow)** **- Andrew LANKFORD (University of California, Irvine)** **- Yifang WANG (Institute of High Energy Physics, Chinese Academy of Sciences)** **- Hitoshi YAMAMOTO (Tohoku University) [Slides]**
12:45 - 12:55	**Closing Remarks [Slides]** **Tao LIU** *HKUST*

Only written remarks by Hitoshi Yamamoto

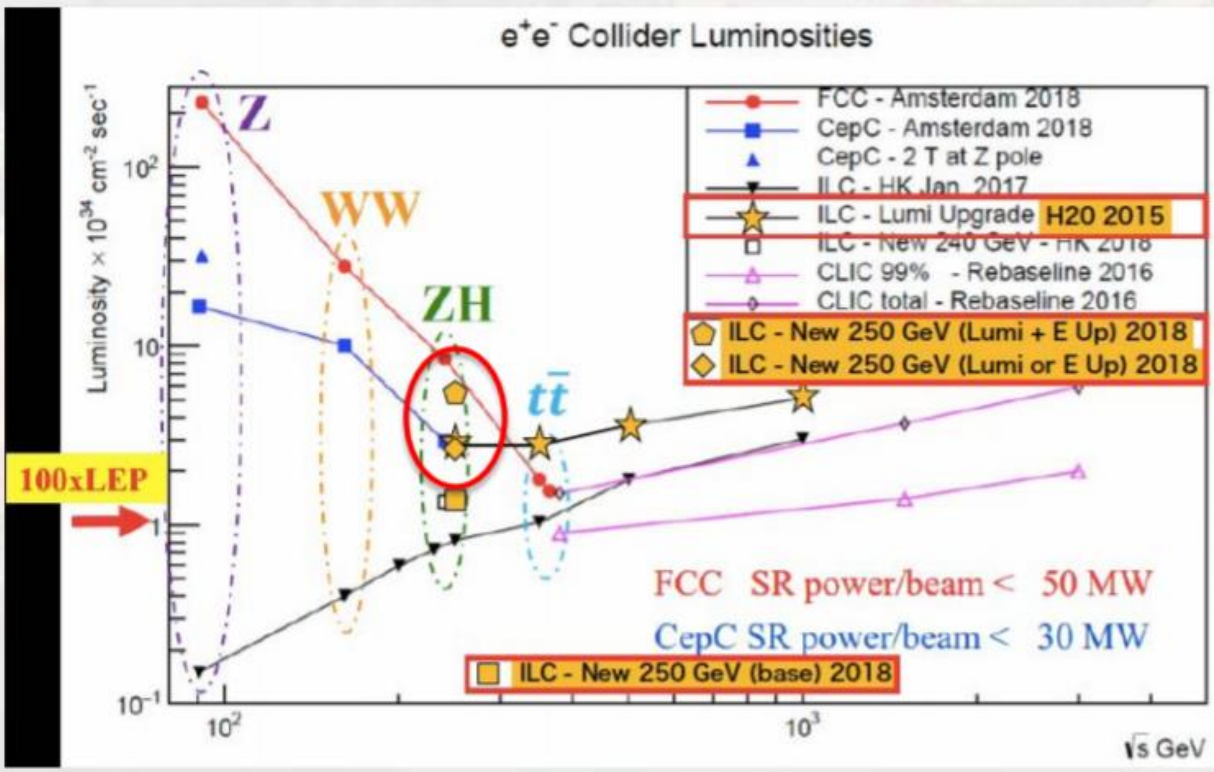
ILC statement at the round table: Hitoshi YAMAMOTO

Luminosity Upgrades

Options:

a) x2 by doubling the number of bunches

b) x2 by doubling the rep rate (5 Hz → 10 Hz, requires 500 GeV ILC at 5 Hz)



Shown by Geoff Taylor

Polarization

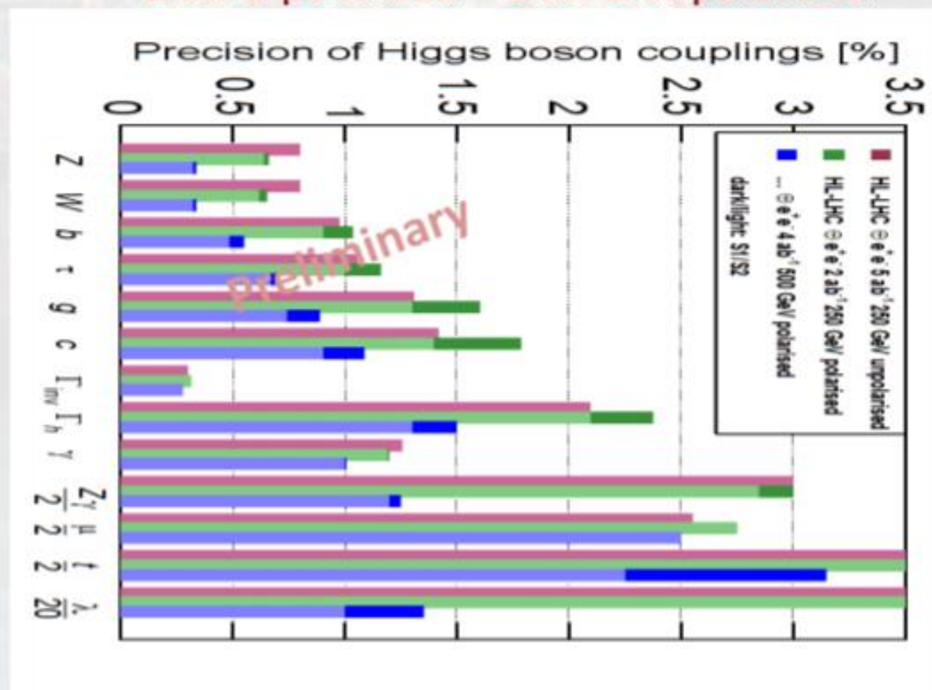
Beam polarization is a powerful tool:

When measuring Higgs couplings by EFT fit, polarization effectively increases integrated luminosity not just by the increased rates but also by its power to separate different EFT operators.

If ILC observes new phenomena, polarization will play an essential role in determining their chiral properties.

Polarization will also allow systematic uncertainties on many measurements to be significantly reduced.

2 ab-1 polarized ~ 5 ab-1 unpolarized



ILC performance

- Yamamoto-san stated:
  - Factor of 2.5 from polarization
  - Factor of 2 from no. of bunches
  - Factor of 2 from repetition rate
- Total lumi factor: 10 – so equivalent to FCC-ee with 2IPs at the Higgs

On Announcement by Japanese Government

Chair's Summary from the LCB phone meeting that took place on 5 December 2018 concerning the status of the ILC discussion in Japan

In order to adhere to the plan, it would be crucial to have a statement from the Japanese government in time for the March 2018 LCB/ICFA meeting, expressing its strong interest to host the ILC in Japan and intention to initiate international discussion, together with an indication of possible Japanese contribution along the line suggested in the LCB conclusion endorsed by the ICFA in Ottawa in November 2017.

→ Effective deadline: March 7/8, 2019 LCB/ICFA meeting in Tokyo
(to be properly included in the European Strategy Update discussion)

(LCB, Nov 2017)

...A natural expectation would be that the cost for the civil construction and other infrastructure is the responsibility of the host country, while the accelerator construction should be shared appropriately. ...

7 March

- Yamamoto-san was asked what would the answer of the Japanese government be on the 7 March
- He said that in his opinion the Japanese government will say yes to the project, provided international (financial) support can be obtained
- He thought that this process (high-level talks with other governments) will take a further two years
- Michelangelo made a comment saying that to his mind the negotiations will take considerably longer, five years, and such a long period of uncertainty will not be good for the field.

My comments regarding the ILC

I find it very good that the discussion with our ILC colleagues has shifted from purely political arguments (readiness of project, timescales) to a more technical discussion where the relative merits of the projects and their performance is taken into account.

End