



Summary of the 1st US FCC Workshop: Accelerators

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FCC Workshop, BNL, April 26, 2023

Accelerators at this Workshop: Plenaries

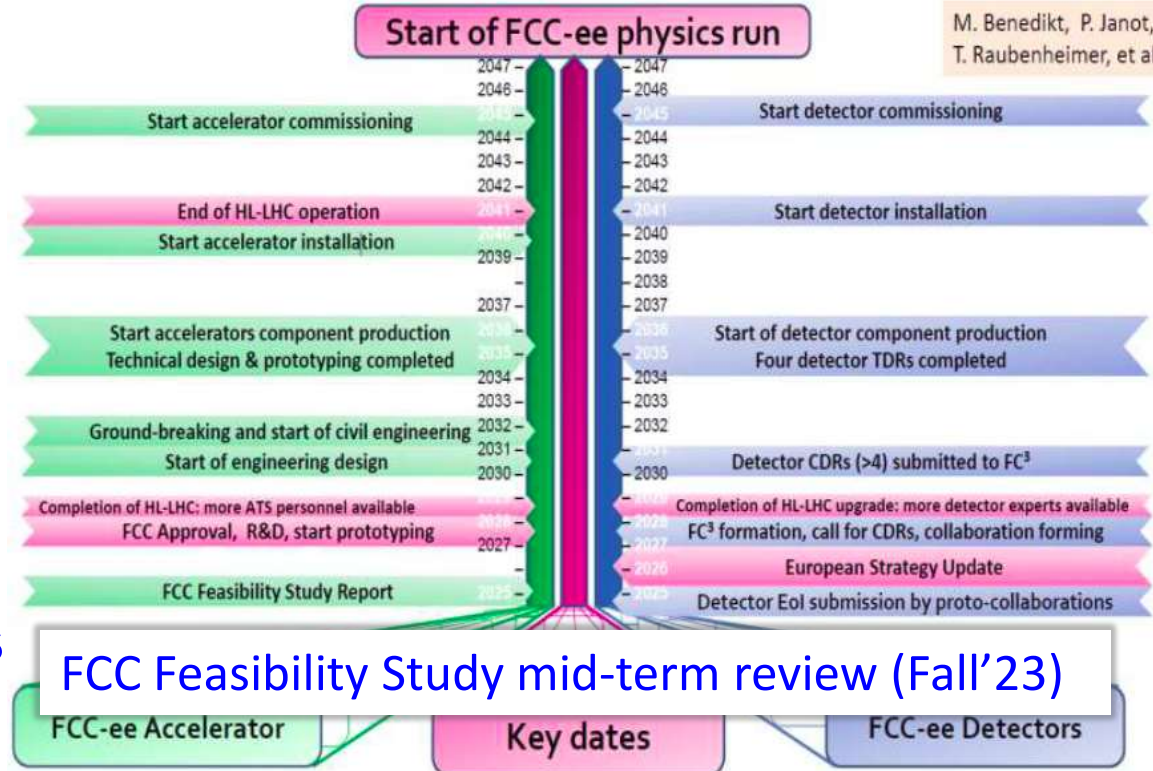
Michael Benedikt

Tor Raubenheimer

Vladimir Shiltsev

Thomas Roser

- FCC Project
- Accelerator
- Synergies across HFs
- ITF report

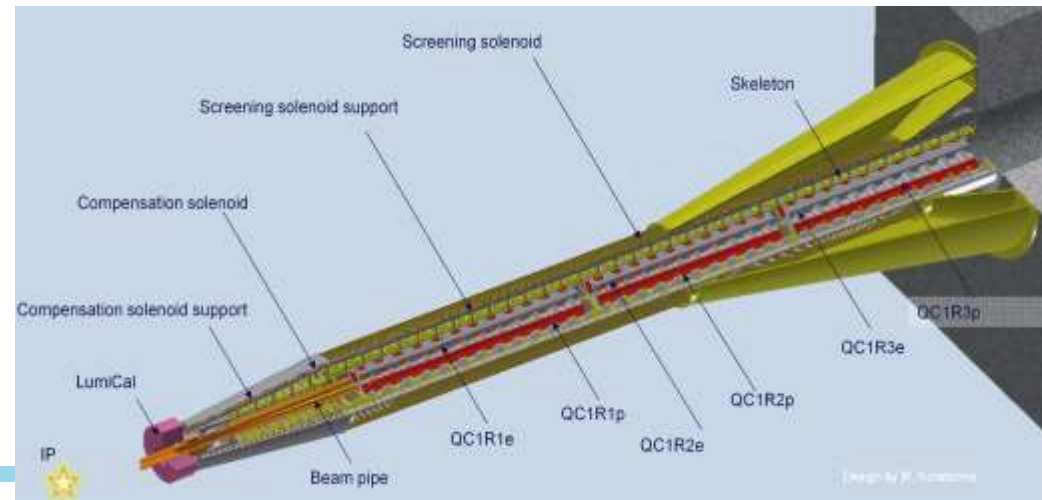
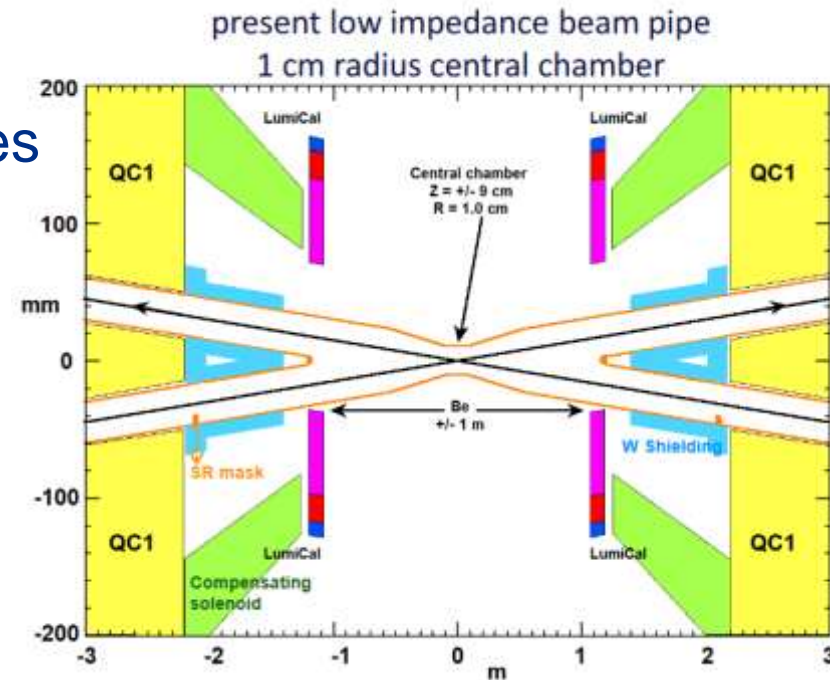


M. Benedikt, P. Janot,
T. Raubenheimer, et al.

Proposal Name	CM energy nom. (range) [TeV]	Lum./IP @ nom. CME [$10^{34} \text{ cm}^{-2} \text{ s}^{-1}$]	Years of pre-project R&D	Years to first physics	Construction cost range [2021 B\$]	Est. operating electric power [MW]
FCC-ee ^{1,2}	0.24 (0.09-0.37)	7.7 (28.9)	0-2	13-18	12-18	290

Topic 1: Accelerator MDI and IR Magnets

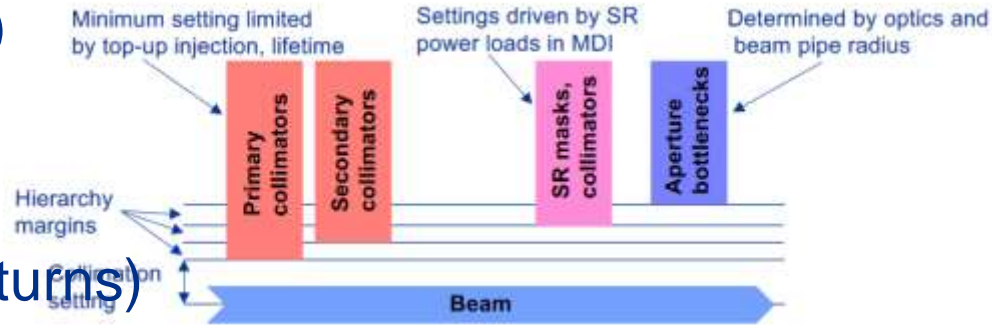
- Manuela Boscolo – FCCee IRs:
 - 4 hi-lumi IPs/CrabWaist, challenges
 - Now 2 cm dia central chamber
 - Control/dump ~400kW s.radiation
 - Full IR mock up in Frascati
- Brett Parker
 - Complex set of magnets
 - 30 tons of pull on anti-solenoid
- John Seeman
- Angelika Drees
 - Tons of relevant experience from PEP-II (199-2008) and EIC (now)



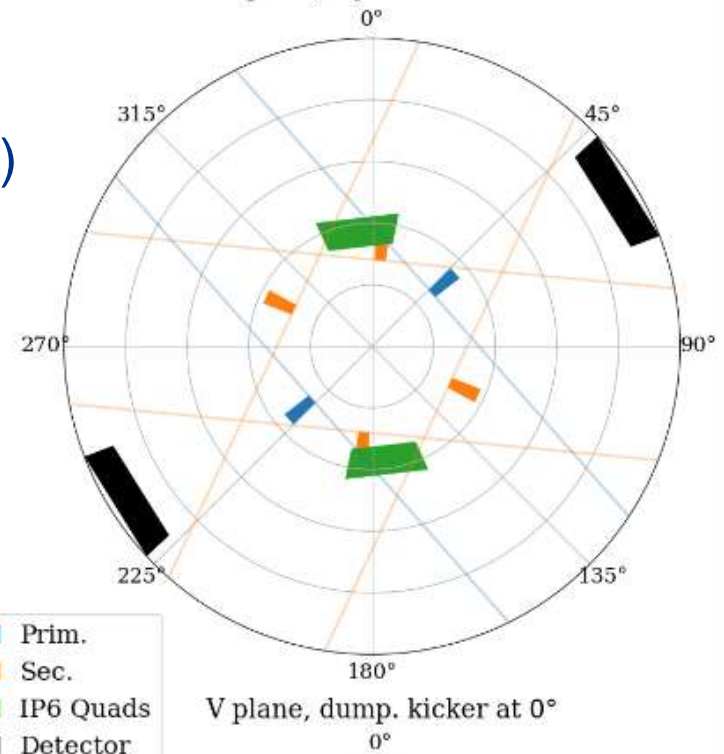
Topic 2: Collimation and Protection

- Andrey Abramov – current FCCee scheme:

- 18 MJ at 45 GeV (LHC ions)
- IRs and arcs
- Source of instabilities
- S-KEKB damage (80% in 2 turns)
- Alternatives:
 - hollow laser Compton (J.Byrd)
 - hollow e-beam (as in Tevatron, RHIC)



H plane, inj. kicker at 0°



- Matthew Valette – EIC collimation

- 18 GeV e-
- 18 cm long collimators
- Conceptually similar to FCCee

Topic 3: Polarization and E-calibration

- Jacqueline Keintzel – overview:

- 4keV at 45GeV
- 250 keV at 80 GeV
- 160 m of wigglers to polarize
- 5-10% P and polarimeters
- Monochromatization (DAFNE)
- Polarized $e^+ e^-$ sources:
 - Save ~2-3 hr lumi time /day

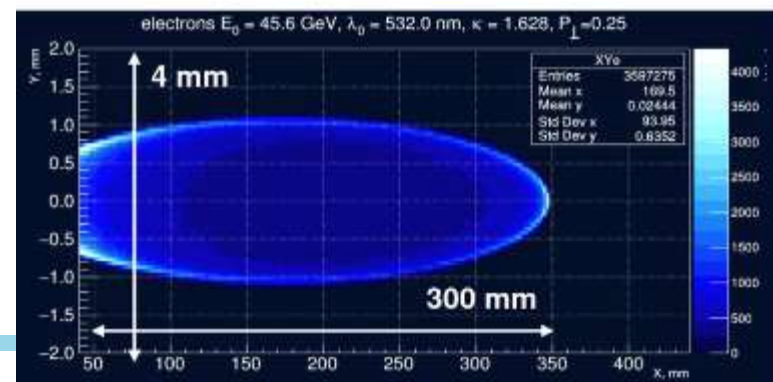
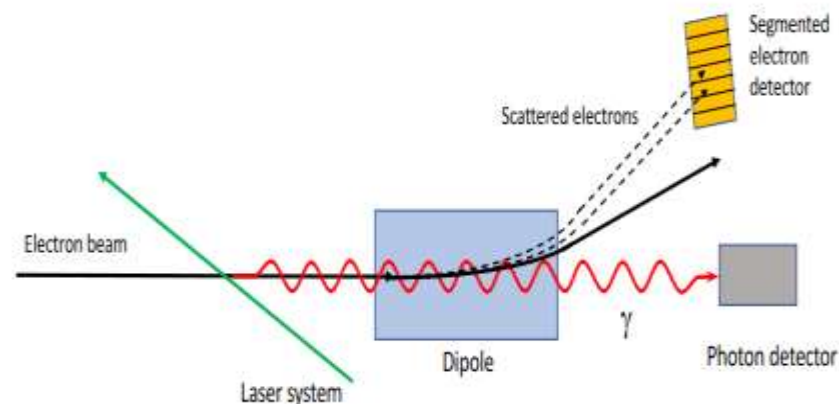
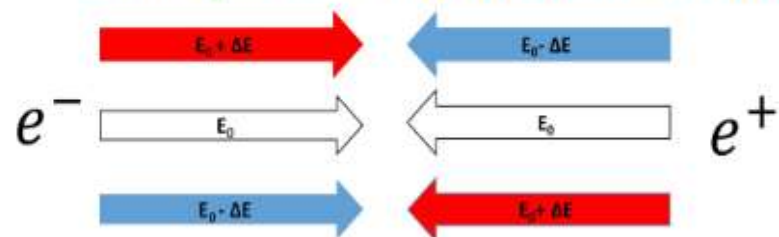
- Eliana Gianfelice-Wendt

- Simulations for EIC and FCCee
- Control beam orbit ~20 μm

- Dave Gaskell

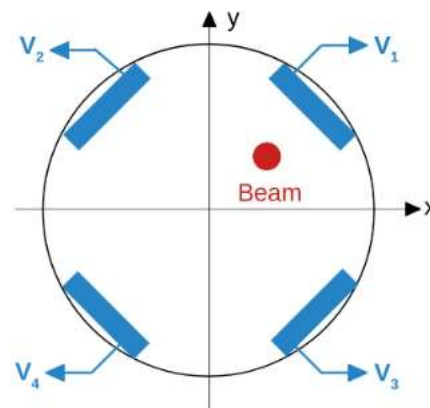
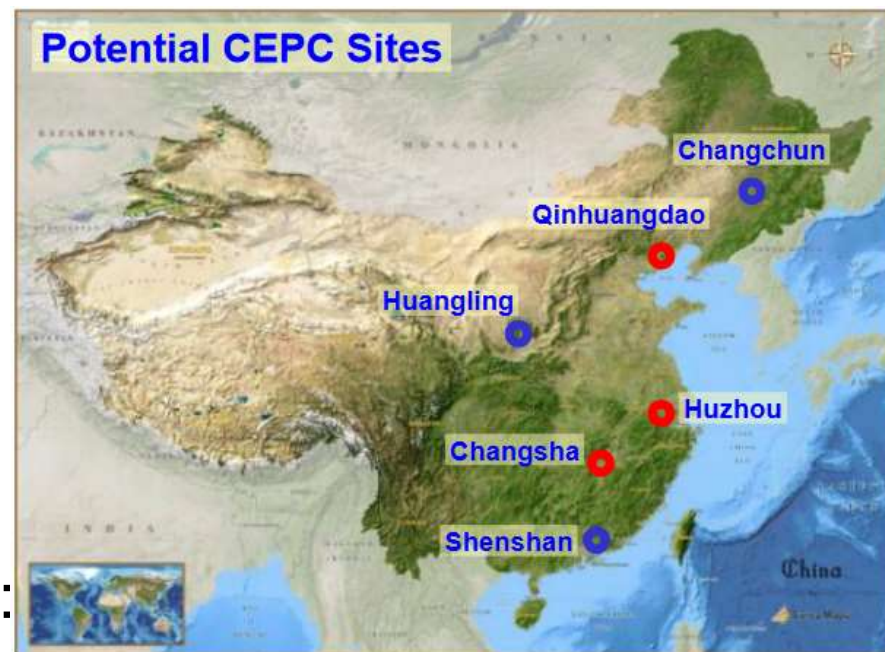
- 2 Compton polarimeters (1%)
- Quite similar for EIC and FCCee

Opposite sign dispersion helps reducing ECM spread → **Monochromatization**



Topic 4: Joint with Detectors

- Jianchung Wang– CEPC:
 - Raised $P=30 \rightarrow 50\text{MW}$
 - TDR later this yr, 36B RMB
 - A lot of progress
 - **If** in the 15th 5-yr plan – civil '26
 - 1st beam 2036
- Jacqueline Keintzel – IR diagn.:
 - 1 μm BPMs
 - Polarimeters
 - SR dumps
 - Wigglers
 - How do we support central part of the detector, etc



Thinking Ahead

Our Message to P5 (on the US FCCee):

Higgs Factory is slated to be the next high priority Energy Frontier project following the completion of HL-LHC.

FCCee is one of the most feasible HF options

We are considering a plan for R&D that could lead to fabrication of several critical components for the FCCee..... for example:

RF Systems - R&D, Design and Fabrication

1.800 MHz SRF cavities with $Q_0 = (3 \rightarrow 6)e10$ at 25 MV/m; then 4-cavity **Cryomodules**

- **28 RF cryomodules** are needed for the Higgs operation,
- Follow up possibility - another 244 CMs (later) for Booster/Collider Rung at $t\bar{t}$

2. High efficiency power sources for 800 MHz with $\eta > 80\%$

3. High gradient 70 MV/m 150 MOhm/m copper RF for injector (eg C³ type):

- **6-20 GeV RF** high gradient inj. Linac

Magnets/MDI - R&D, Design and Fabrication

1. IR magnets, cryostats, masks (fabr. for 4 IPs)
2. FCCee collider ring magnets (low field, DC)
3. Booster ring magnets (low field, ~ 1 s ramp)
4. Polarization wigglers (0.1-0.7 T, EM)
5. FCChh collider ring magnets (~ 14 -20T, DC)
 - Already part of the GARD magnets (MDP)

“Dynamics” - R&D, Design and Fabrication

1. Interaction region design, and integrated machine design

- Modeling/simulations: crab waist and beam-beam/beamstrahlung, DA, chromatic compensation and optics correction schemes

2. Losses, collimation and background

- Modeling/simul: codes on halo formation, background in detectors, efficient collimation system(elens/NLO/CS), detector background masking, TMCI, build collimation system for 4 IRs and rings

3. Polarization (esp. at 45 GeV and 80 GeV beam energies):

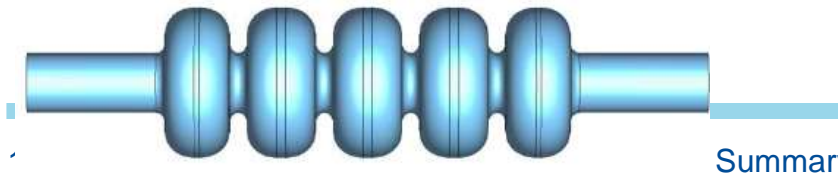
- Modeling/simulations: 45-80 GeV energy calibration, error analysis, design and build wigglers, polarimeters, polarized sources

4. Instrumentation:

- Design and prototyping, then build, IR BPMs and lumi monitors, TMCI feedback systems, emittance and halo monitors, Low Level RF

Possible Additional Scope for Later Considerations:

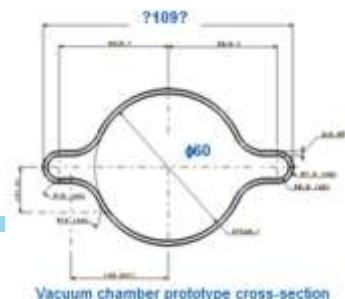
- 1) 18.4 GV of SRF for $t\bar{t}$ collider operations
 - By 2055; after the Higgs-Phase ramps down
- 2) Magnets for the collider and booster rings
- 3) 270 km of beam pipes (collider, booster)
- 4) RF bypass beamline for optimal switch ZH, $t\bar{t}$
- 5) Infrastructure contributions
 - Alignment | Radiation protection | Safety systems | Power converters
 - The need, scope, cost and timeline ?



Summar



04/24/2023



That was a very productive Workshop!

**Thanks to all speakers and attendees
– on Zoom and in-person – for
participation and contributions!**

**(after P5) See you all at the FCC
Week in London and at the next US-
FCC Workshop!**