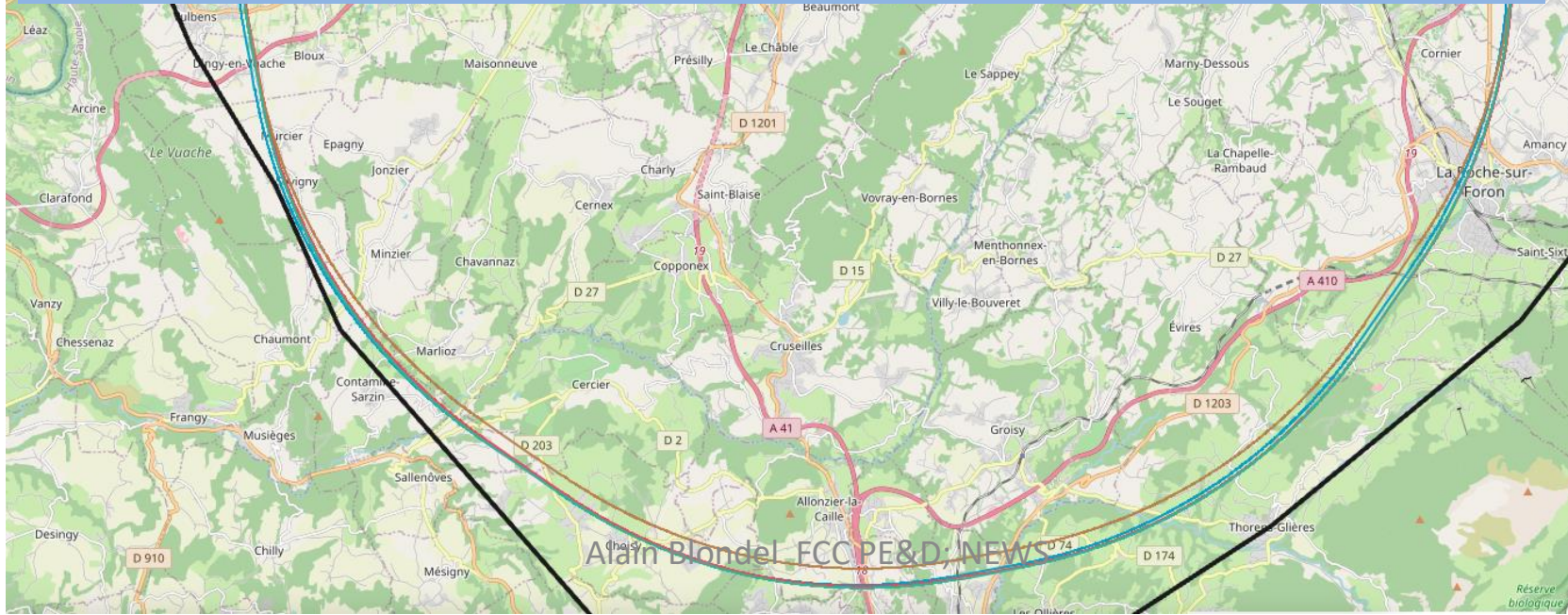


FCC feasibility study -- NEWS



29.11.2021



PLENARY ECFA meeting 19 November 2021

<https://indico.cern.ch/event/1085137/>

see very nice presentations on FCC project:

FCC project , (Michael Benedikt)

FCC PED project, (Patrick Janot)

ECFA Higgs and EW factory working group activities:

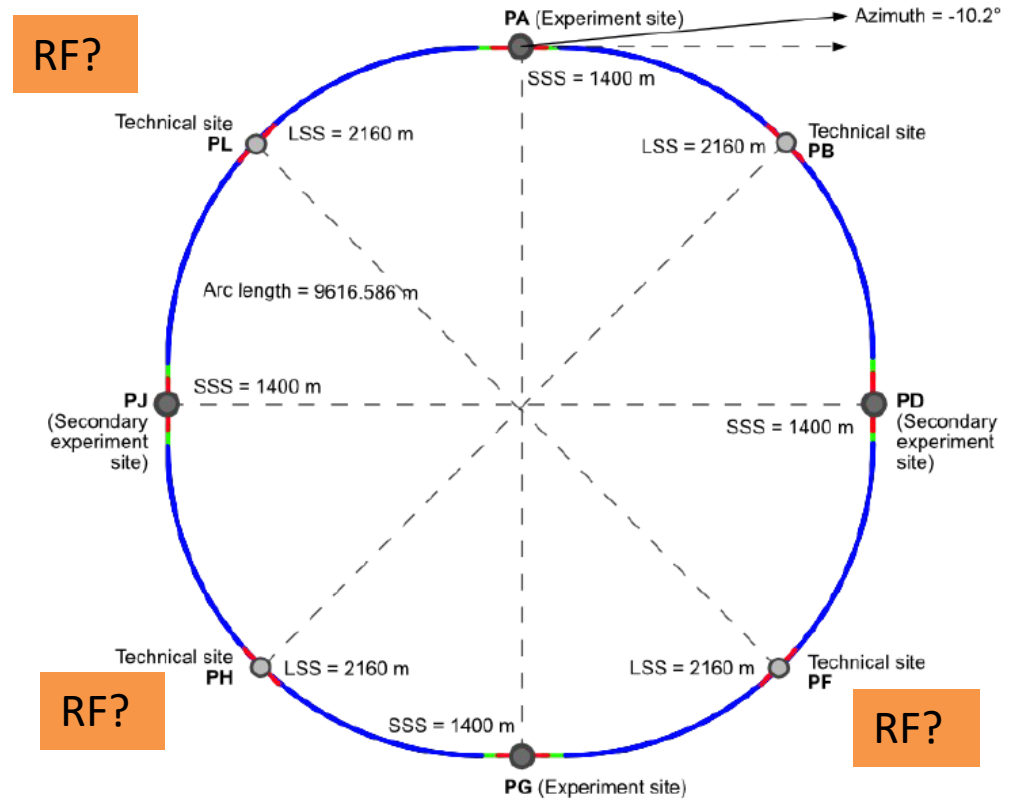
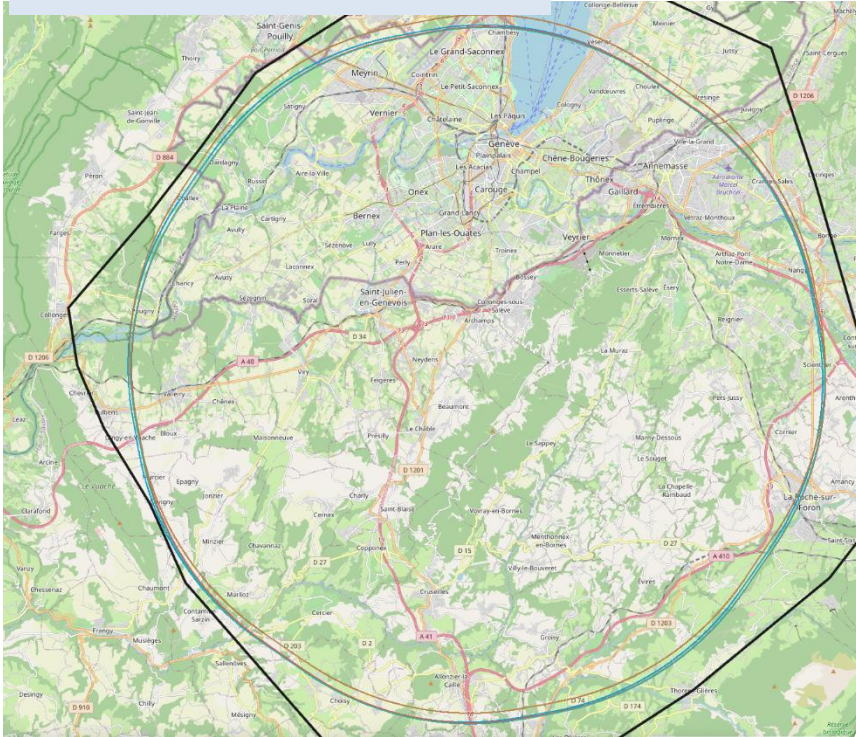
(Juan Alcaraz and Patrizia Azzi)

Detector and Accelerator R&D roadmaps

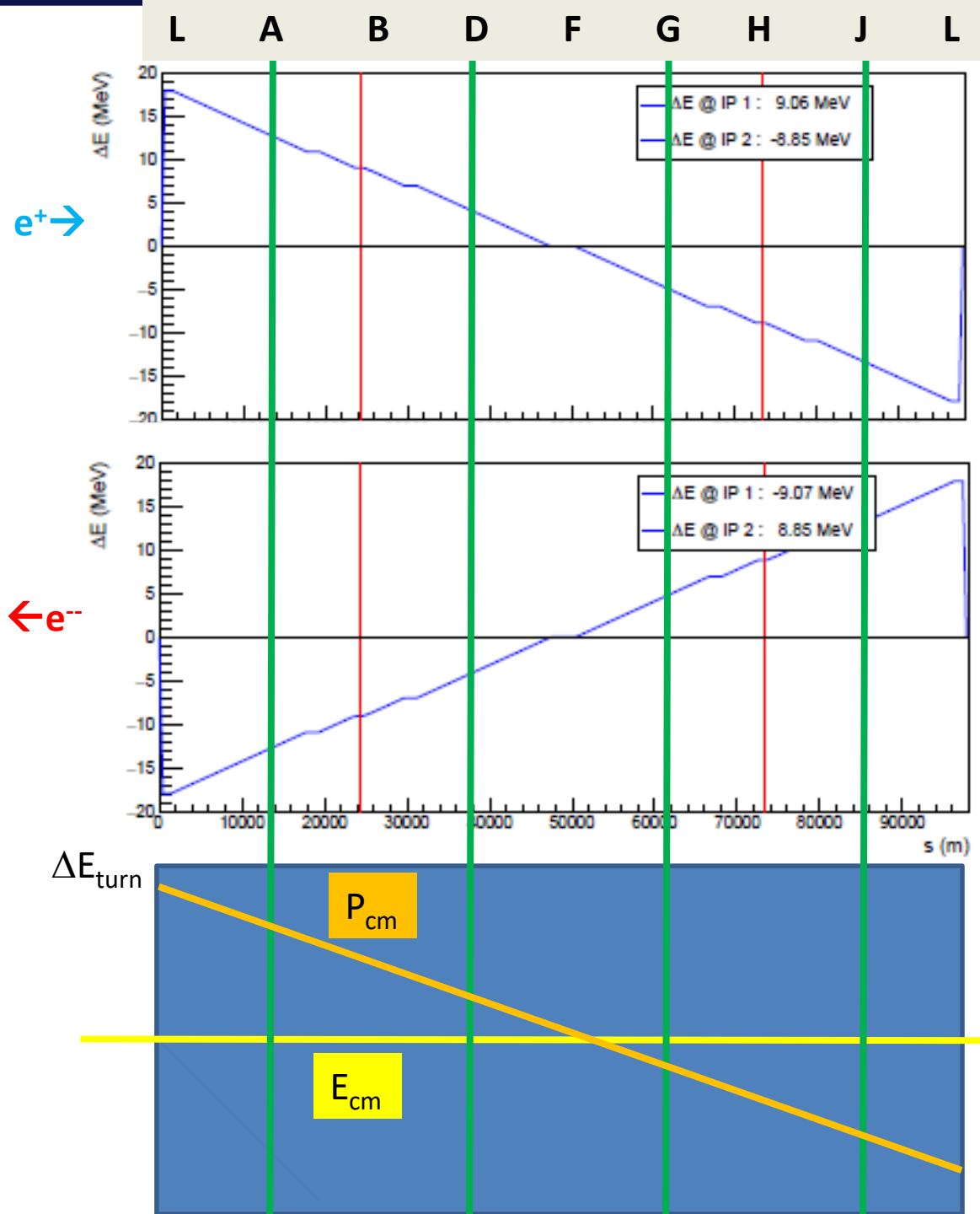
(Phil Allport and Dave Newbold)



New FCC Layout



- Study has converged on **1 baseline layout** (and 2 fallback solutions)
- 8 pits (was 12) total circumference of 91.173km (was 97km in CDR) → cost savings. Luminosity smaller by ~10%
- Consistent with ee (2 or 4IP), hh; flexibility. Optimization of 4IP parameters under study for realistic machines.
- **Placement of RF stations has made considerable progress** (point B unpractical, L,H preferred, F possible)
 - 1 RF point for Z, WW, HZ, (eeH) acceleration of e+ and e- in separate RF cavities (low gradient, high current) eliminate uncertainties on E_{cm} due to beam energy losses (synchrotron radiation, beamstrahlung)
 - 2 RF points (HZ), tt ($E_{cm} = 340-365$) e+ and e- acceleration in the same RF cavities (low current, high gradient) → centre of mass boosts!



1 single RF point for e^- and e^+
 good for Z, eeH , WW and even ZH if wanted

Approximate energy loss per turn (91.3km machine)

| E_{cm} | E_{beam} | ΔE_{turn} (GeV) | maximal boost P_{cm} |
|----------|------------|-------------------------|------------------------|
| 91 | 45 | 0.039 | 0.030 |
| 125 | 62.5 | 0.140 | 0.105 |
| 160 | 80 | 0.374 | 0.280 |
| 240 | 120 | 1.89 | 1.420 |
| 350 | 175 | 7.98 | |
| 365 | 182.5 | 10.0 | |

UPGRADE

scaling law: E^4/ρ : increase of 6% with new 91.3km layout

$$\Delta E_{cm} = \Delta E_{e^+} + \Delta E_{e^-} = \{0, 0, 0, 0\}$$

$$P_{cm} = \Delta E_{e^+} - \Delta E_{e^-} = \{ \frac{3}{4} \Delta E_{turn}, \frac{1}{4} \Delta E_{turn}, -\frac{1}{4} \Delta E_{turn}, \frac{3}{4} \Delta E_{turn} \}$$

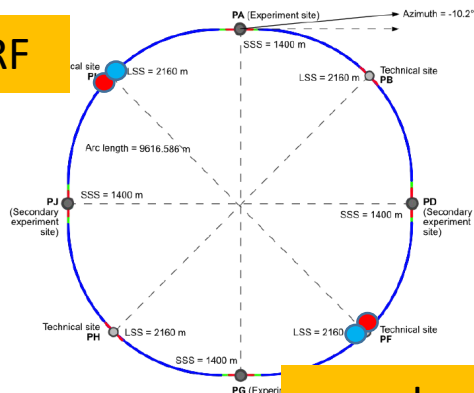
with a single RF location and two or four experiments
 all IP have the same energy (within small corrections)
different c.m. boost OK
Boosts will be very well measured at all energies with $\mu+\mu$ -events and serve as a measure of the beam energy loss!



C

For the high energies (possibly ZH, then top energies)

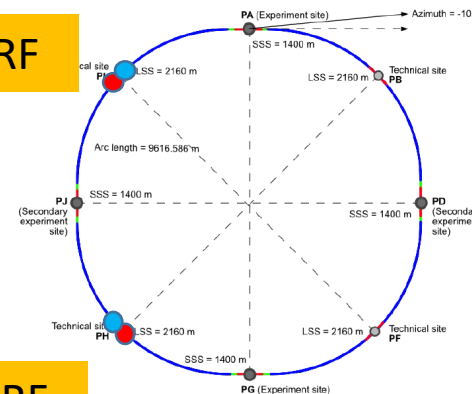
e- and e+ RF



e- and e+ RF

D

e- and e+ RF



e- and e+ RF

After an upgrade, the FCC-ee will have two RF stations with RF shared between e+ and e-
→ same energy gain for e+ and e- at two different places.

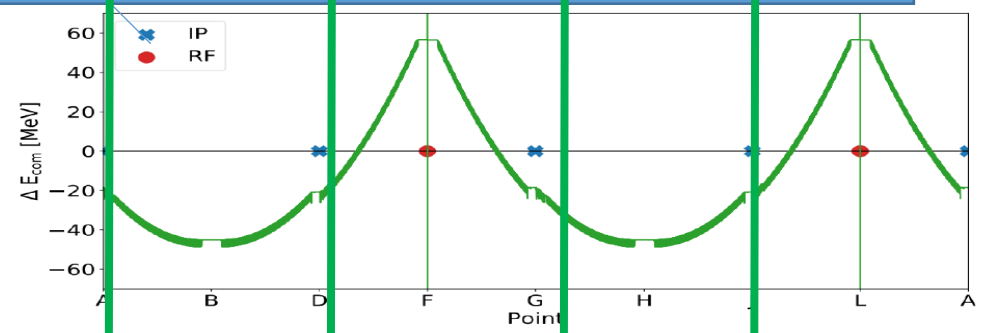
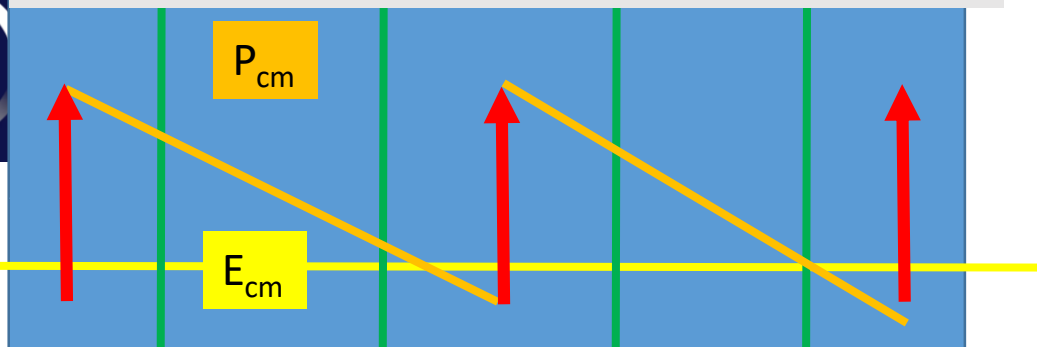
Question from Klaus Hanke: (for local practicality)

Do we need the scenario C or can we live with scenario D (easier for logistics)?

Answer next pages



L A B D F G H J L



J. Keintzel

scenario C 2 RF stations for both e+ and e- for top energies (shared RF) here points F and L

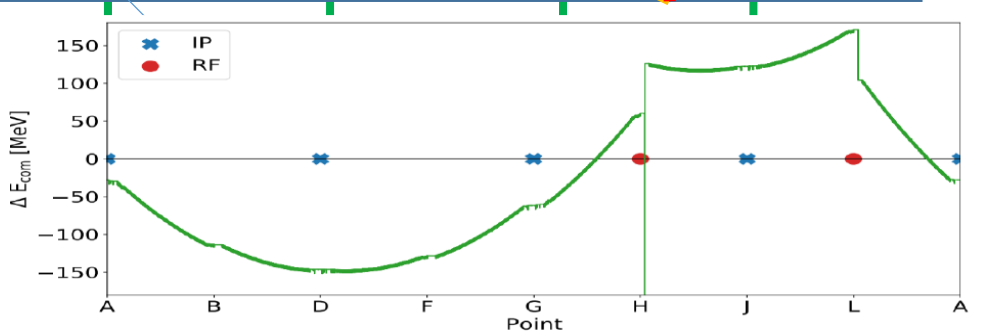
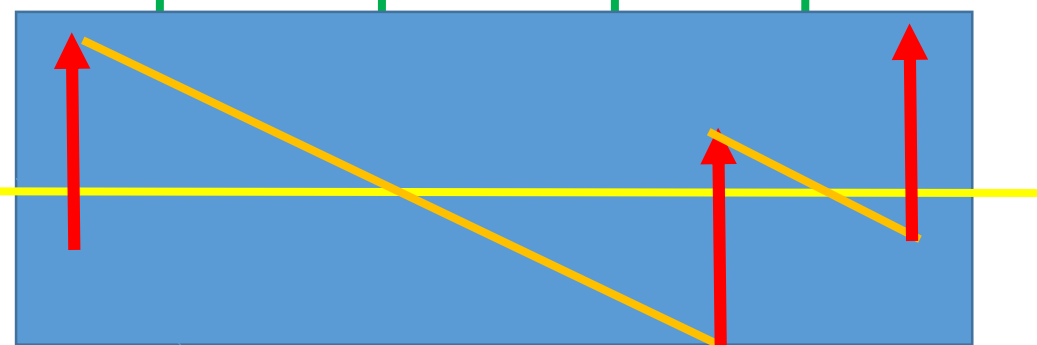
Energy loss per turn (91.3km machine)

| E_{cm} | E_{beam} | ΔE_{turn} (GeV) | maximal boost | P_{cm} |
|----------|------------|-------------------------|---------------|----------|
| 91 | 45 | 0.039 | 0.030 MeV | |
| 350 | 175 | 7.98 | C: 2.0 GeV | D: 4 GeV |
| 365 | 182.5 | 10.0 | D: 2.5 GeV | D: 5 GeV |

scaling law: E^4/ρ : increase of 6% with new 91.3km layout

$$\Delta E_{cm} = \Delta E_{e+} + \Delta E_{e-} = \{-19, -21, -19, -21\} \text{ MeV}$$

$$P_{cm} = \Delta E_{e+} - \Delta E_{e-} = \{\frac{1}{4} \Delta E_{turn}, -\frac{1}{4} \Delta E_{turn}, \frac{1}{4} \Delta E_{turn}, -\frac{1}{4} \Delta E_{turn}\}$$



scenario D: 2 RF stations for both e+ and e- for top energies (shared RF) here points H and L

$$\Delta E_{cm} = \Delta E_{e+} + \Delta E_{e-} = \{-28, -146, -61, +123\} \text{ MeV}$$

$$P_{cm} = \Delta E_{e+} - \Delta E_{e-} = \{\frac{1}{2} \Delta E_{turn}, 0, -\frac{1}{2} \Delta E_{turn}, 0\}$$

all IPs have the same energy (C: +/- 2MeV D: +/- 135 MeV)
but D leads to different (large) c.m. boost
C is a bit nicer but both C and DOK!



Important Events (I)

- **Snowmass 21** <https://indico.fnal.gov/category/1098/>
regular meetings of interest in the Energy Frontier, Rare processes and precision Frontier
Sarah Eno (Maryland) and Dmitri Denisov (BNL) will be overseeing the US contributions
- **Next FCC France workshop (Annecy): 30 Nov – 2 Dec**
LAPP Annecy <https://indico.in2p3.fr/event/22887/>
- **Lepton-Photon Symposium Manchester**
 - early registration extended till 10 December
 - we have been attributed 2 talks and 3 posters red: **(speaker to be found)**
 - talks: eeH **ZH and H ν**
 - posters: **Precision EW,**
 - Flavors esp. B_c → tau nu,**
 - HNL searches**

Volunteer!



Important Events (II)

[FCC Accelerators and Beam Physics Day](https://indico.cern.ch/event/1090005/) 2 December <https://indico.cern.ch/event/1090005/>

FCC-IS WP2 workshop today → 10 December <https://indico.cern.ch/event/1085318/>

(includes Energy calibration and polarization meeting on 9 december <https://indico.cern.ch/event/1099047/>)

- **FCC Physics, Experiments & Detectors workshop** in Liverpool 7-11 Feb 2022
see next slides <https://cern.ch/FCCPhysics2022>
- **FCC Week 2022, Paris, 30/5-3/6 2022 (note the date)**



Feb 7 – 11, 2022
Europe/London timezone

Welcome to the 5th FCC Physics workshop in Liverpool!

For sanitary reasons, the event will be held in hybrid mode, with a limited number of participants allowed on site. All plenary and parallel sessions will be accessible for remote participants by a zoom link.

Following the recommendations from the European Strategy for Particle Physics, CERN has now launched the FCC technical and financial Feasibility study (FCC-FS), of the FCC colliders (ee and hh) as a global project with its international partners[1]. The study goals include optimization of the placement and layout of the ring and related infrastructure, and demonstration of the geological, technical, environmental and administrative feasibility of the tunnel and surface areas, as well as the preparatory administrative processes required for a potential project approval, together with the Host States. The study will deepen the design of FCC-ee and FCC-hh and their injectors, supported by R&D on key technologies. The financial feasibility study will focus on the first stage (tunnel and FCC-ee)[2]. One of the pillars of the FCC-FS organization is the Physics Experiments and Detectors (PED) study, in which the physics case and detector concepts will be consolidated for both colliders (FCC-ee and FCC-hh, with its heavy ion programme and with the e-p option)[2].



- Overview
- Call for Abstracts
- Participant List
- Scientific Programme Committee
- Venues
 - The University of Liverpool
 - How to get there
 - ACC Liverpool
 - How to get there
 - Hotels near ACC
- Things to see and do in Liverpool
- Reception and formal Dinner
- Excursion options - Wednesday afternoon
- Online Payment



Important points for the 5th Physics workshop

1. The workshop registration is open

- number of in-person participants is limited to ~150 (first come -- first served)
- registration fee is 300€
- all sessions will be broadcast in zoom, and all slides on indico but of course not:
the poster session, collaboration dinner, excursion and private discussions, coffees/tea breaks etc.

REGISTER!

2. Preliminary workshop agenda is posted

- There will be parallel sessions corresponding to the PED main work-packages
- There will be a poster session

3. Abstract submission:

- single abstract for parallel/poster session.
- **submitter or one of the authors must be in person at the meeting to present it.**
- it is highly desirable that parallel session presentations also have a poster so that everyone can benefit from it.

Submit ABSTRACTS!

FCC Week 2022

Save the date!

- **From 30 May to 3 June in Paris**
 - ◆ Two conference sites visited
 - Decision mid-November

Palais des Congrès d'Issy



- In the South West of Paris
- Entirely privatized event
- Accommodation not included

Hotel Pullman Montparnasse



- More central Paris intra-muros
- Hotel 4* included

- **Gala dinner in Musée des Arts Forains**
 - ◆ Rental costs paid by IN2P3