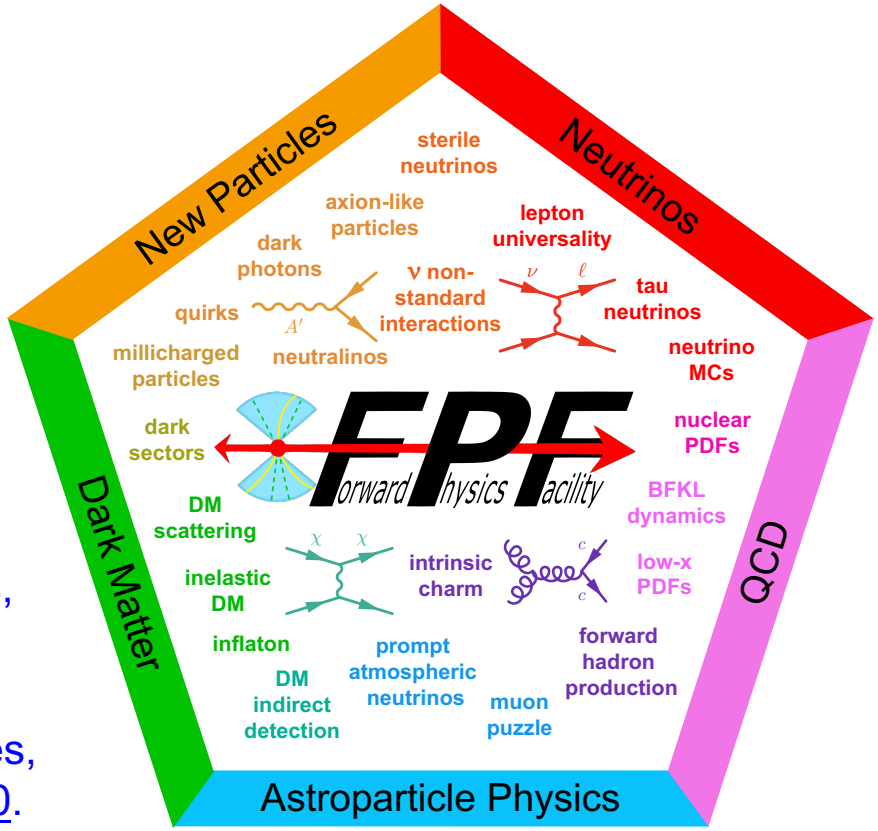
WELCOME AND INTRODUCTION

6th Forward Physics Facility Meeting, CERN

Jonathan Feng, UC Irvine, 8 June 2023

WELCOME

- This is the 6th in a series of meetings held every ~6 months since 2020.
- These meetings bring together the large, rapidly growing FPF community, including multiple CERN technical teams, ~300 experimentalists on pathfinder experiments, and ~200 theorists with important contributions.
- FPF Meetings
  - FPF Kickoff Meeting, 9-10 Nov 2020
  - FPF2 Meeting, 27-28 May 2021
  - FPF3 Meeting, 25-26 Oct 2021
  - FPF4 Meeting, 31 Jan-1 Feb 2022
  - FPF5 Meeting, 15-16 Nov 2022
  - FPF6 Meeting, 8-9 June 2023
- FPF Papers
  - FPF "Short" Paper: 75 pages, 80 authors, Phys. Rept. 968, 1 (2022), 2109.10905.
  - FPF White Paper: 429 pp, 392 authors + endorsers representing over 200 institutes, J. Phys. G 3, 030501 (2023), 2203.05090.



WELCOME

- Many opportunities for new participants, new ideas. The meeting is organized to catalyze discussion and interaction; please ask questions, reach out.
- See https://pbc.web.cern.ch/fpf-mandate for documents, Slack, meetings, etc.

Steering Committee: Jamie Boyd, Albert De Roeck, Milind Diwan, Jonathan Feng, Felix Kling

WG0 Facility: Jamie Boyd

Physics WGs

WG1 Neutrino Interactions: Juan Rojo

WG2 Charm Production: Hallsie Reno, Anna Stasto

WG3 Light Hadron Prod: Luis Anchordoqui, Dennis Soldin

WG4 BSM: Brian Batell, Sebastian Trojanowski

Detector WGs

WG5 FASER2: Alan Barr, Josh McFayden, Hide Otono

WG6 FASERnu2: Aki Ariga, Tomoko Ariga

WG7 FLArE: Jianming Bian, Milind Diwan

WG8 AdvSND: Giovanni De Lellis

WG9 FORMOSA: Matthew Citron, Chris Hill

WG Liaisons	WG5 FASER2	WG6 FASERnu2	WG7 FLArE	WG8 AdvSND	WG9 FORMOSA
WG1	Josh McFayden	Aki Ariga, Tomoko Ariga	Steve Linden, Wenjie Wu	Antonia Di Crescenzo	Matthew Citron
WG2	Josh McFayden	Aki Ariga, Tomoko Ariga	Steve Linden, Wenjie Wu	Antonia Di Crescenzo	Matthew Citron
WG3	Josh McFayden	Aki Ariga, Tomoko Ariga	Steve Linden, Wenjie Wu	Antonia Di Crescenzo	Matthew Citron
WG4	Josh McFayden	Aki Ariga, Tomoko Ariga	Steve Linden, Wenjie Wu	Cristovao Vilela	Matthew Citron

CONCLUSIONS CIRCA 2022

- The FPF will greatly enhance the HL-LHC physics program.
  - Neutrinos: Neutrino blind → Neutrino factory, insights into neutrinos, QCD, astroparticle physics.
  - BSM: Modest extension of weak-scale searches → New sensitivity to MeV-GeV FIPs, LLPs, milli-charged particles, quirks, light dark matter, and many other groundbreaking discoveries.
- Much of this physics program relies essentially on the LHC's high center-of-mass energy, is inaccessible at fixed target experiments and unique to the FPF, and will disappear for decades (or forever) if not explored at the HL-LHC.
- The FPF could not be better aligned with the highest priority EPPSU and Snowmass recommendations.

2020 EPPSU 1st Recommendation

The successful completion of the high-luminosity upgrade of the machine and detectors should remain the focal point of European particle physics, together with continued innovation in experimental techniques. The full physics potential of the LHC and the HL-LHC, including the study of flavour physics and the quark-gluon plasma, should be exploited.

2022 Snowmass Energy Frontier Summary

Our highest immediate priority accelerator and project is the HL-LHC, the successful completion of the detector upgrades, operations of the detectors at the HL-LHC, data taking and analysis, including the construction of auxiliary experiments that extend the reach of HL-LHC in kinematic regions uncovered by the detector upgrades.

Resource needs and plan for the 5-year period starting 2025:

1. Prioritize HL-LHC physics program, including auxiliary experiments.

NEW DEVELOPMENTS

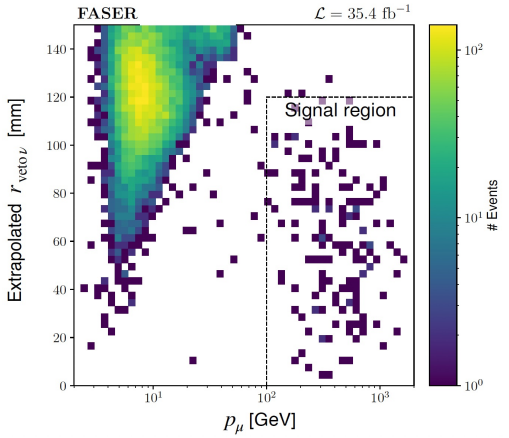
Since FPF5 in November 2022, there has been great progress on all fronts

- First physics results from FASER and SND@LHC
- The facility
- Physics studies
- Experiments
- Budgets and timelines

SINCE FPF5: FIRST PHYSICS RESULTS

- Pathfinder experiments (FASER, SND@LHC) have demonstrated the ability of small far-forward experiments to do groundbreaking physics.

- With 2022 data (only ~30 fb^{-1}):
  - First direct observation of collider neutrinos at the highest energies ever from a human source: 153 events (FASER) + 8 events (SND@LHC), ~0 background.
  - World-leading bounds on dark photons, first new probe of dark photon thermal target parameter space from low coupling in 30 years.



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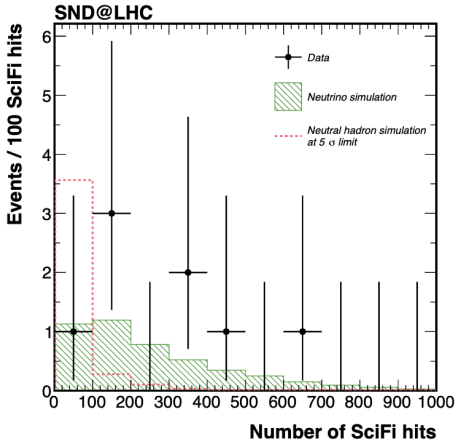

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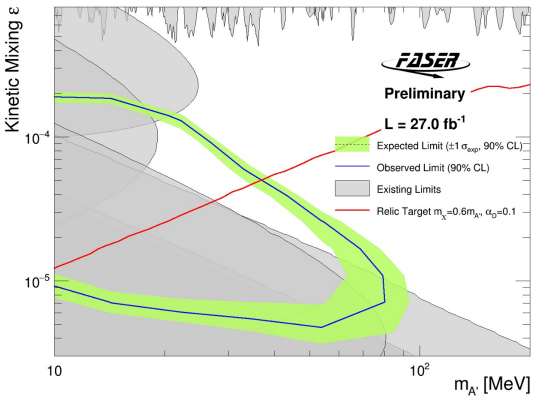
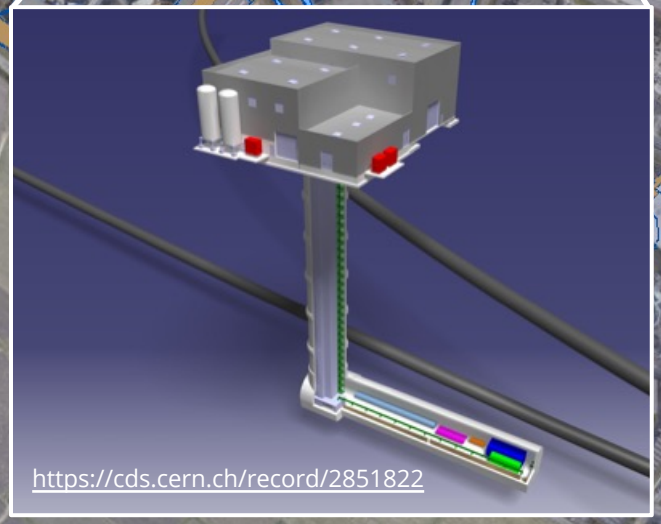


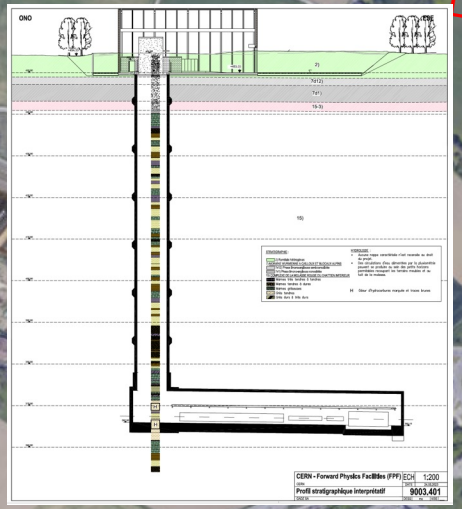
CERN-FASER-CONF-2023-001

SINCE FPF5: THE FACILITY

- Continued strong support from Physics Beyond Colliders at CERN
  - New results on civil engineering, ventilation, background particle rate, radiation protection studies, vibration studies
  - 100 m-deep core sample taken to study geology at the site

CERN-PBC-Notes-2023- 002

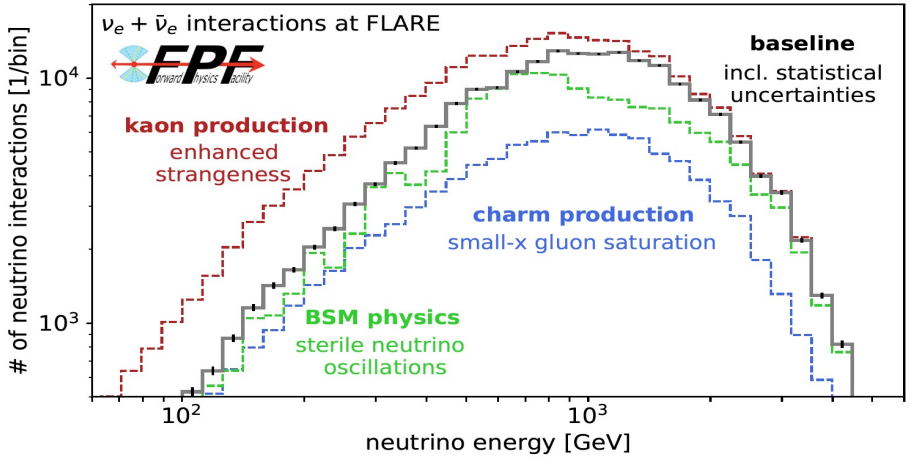


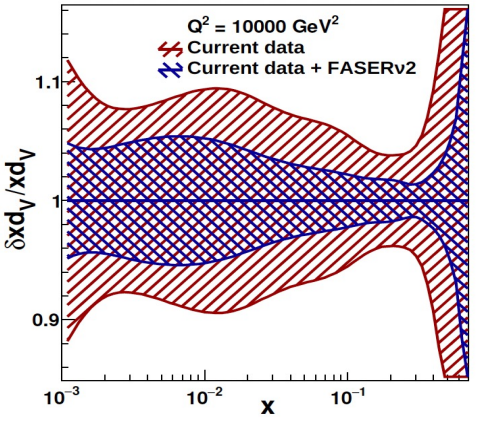


CERN GIS

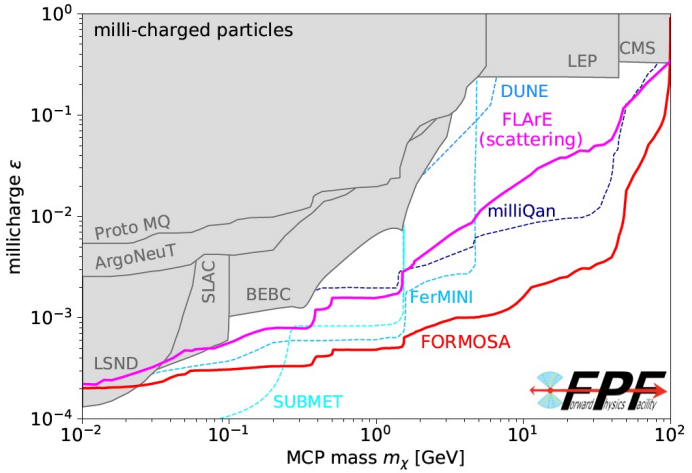
SINCE FPF5: PHYSICS STUDIES

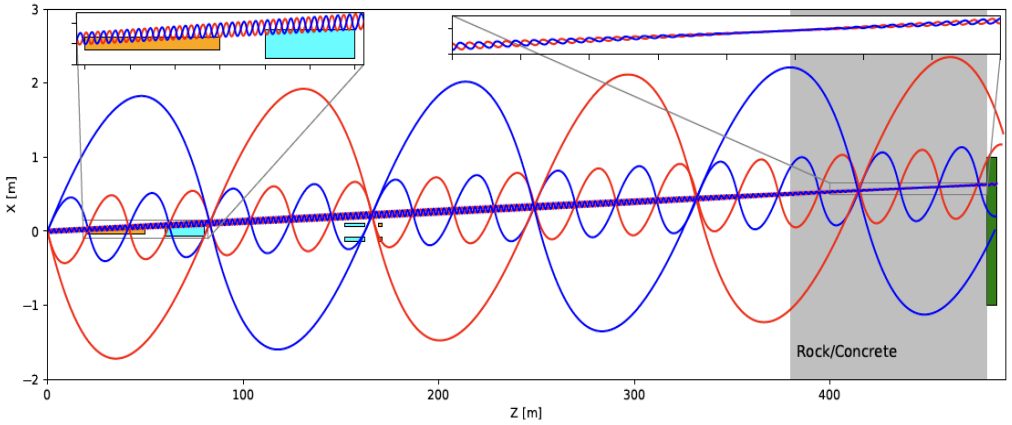
- New quantitative results from SM studies, guaranteed interesting physics





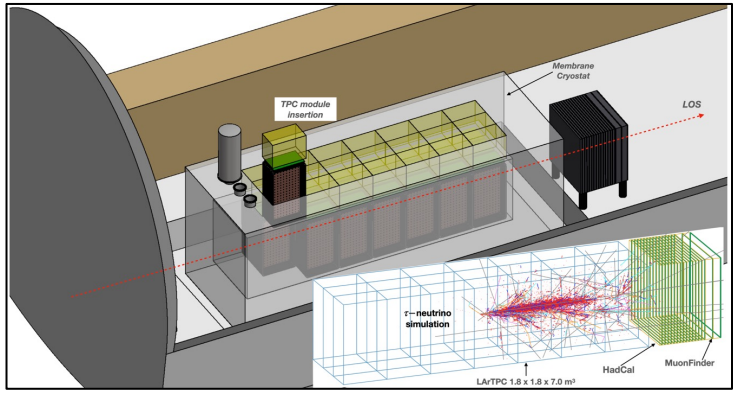
- New BSM studies, including models where the FPF is uniquely sensitive

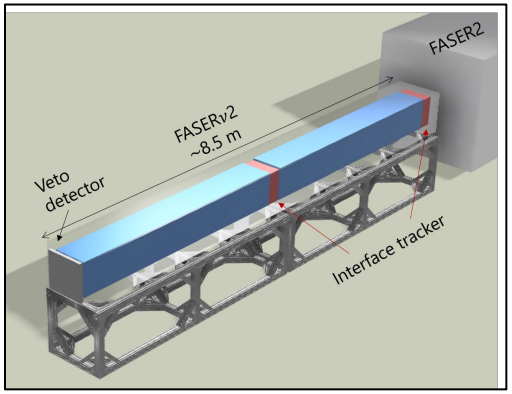


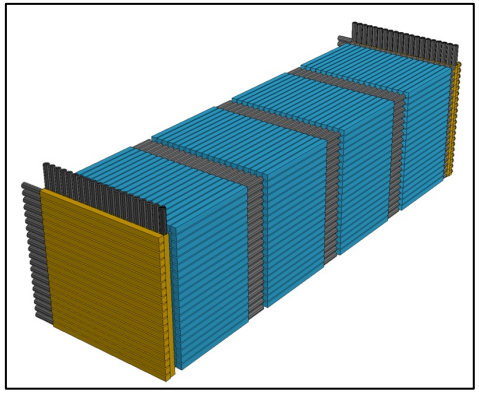


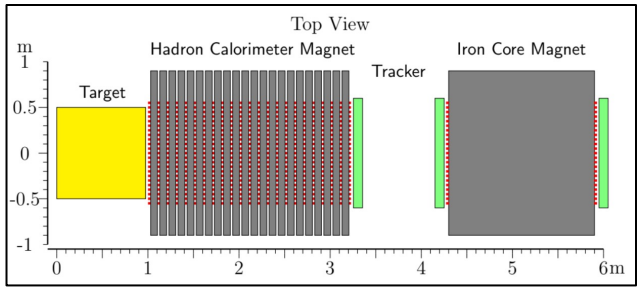
SINCE FPF5: EXPERIMENTS

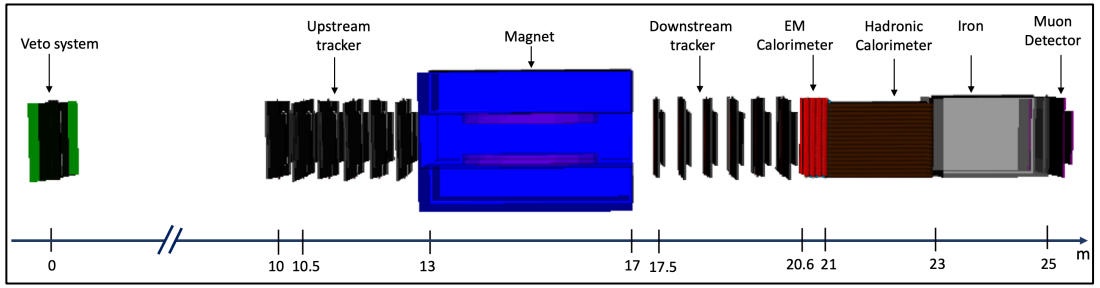
- Continued progress in defining the design of 5 proposed FPF experiments, diverse detectors for a broad physics program











SINCE FPF5: BUDGETS AND TIMELINES

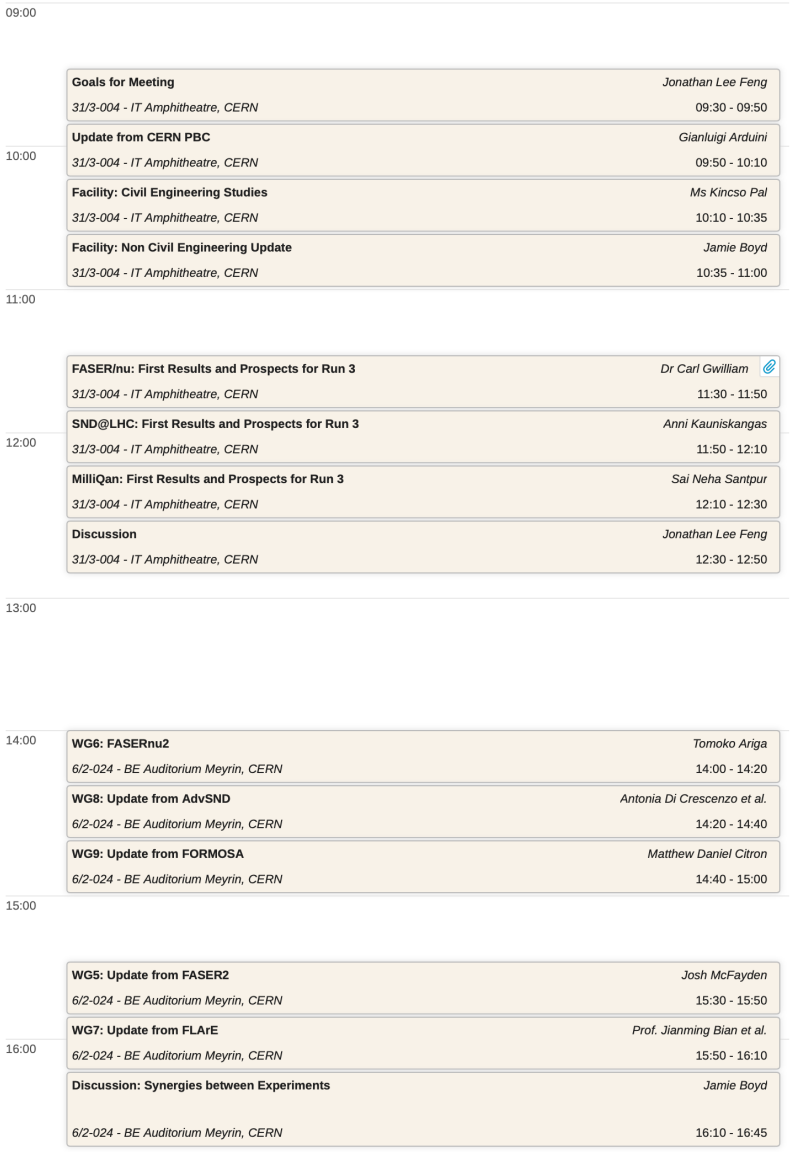
- To fully realize the LHC's potential, the FPF and its experiments should be ready for physics in the HL-LHC era as early as possible in Run 4 (2029-32).

- Preliminary budget profile and timeline have been developed and presented to P5:
  - Build FPF during Long Shutdown 3 from 2026-28.
  - Install support services and experiments starting in 2029.
  - Experiments begin taking data not long after the beginning of Run 4.

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033-34
(HL)-LHC nominal schedule	Run3	Run3	Run3	Run3	LS3	LS3	LS3	Run4	Run4	Run4	Run4	LS4
FPF/FLARE milestones		Pre-CDR and physics proposal	R&D and detetor prototypes	CDR- long lead item magnet	Start of civil constr. TDR for detectors	Detector construction start	Long lead items for detector	End of civil constr. Install services	Detector install	Detector Commissioning and physics start	Physics running with full complement of detectors	

FPF6 THURSDAY

- All sessions are hybrid
  - Same Zoom link; not recorded, use microphones so online people can hear questions
  - Different rooms
- Morning IT Amph: 31/3-004
  - Update from CERN PBC
  - News from WG0: Facilities, Core Study
  - First physics results from FASER, SND@LHC, MilliQan
  - Discussion
- Afternoon BE Aud: 6/2-024
  - Updates from Expt WGs 5-9
  - Discussion: synergies between experiments



FPF6 FRIDAY

- Morning Salle Dirac: 40/S2-D01
  - Reports from Physics WGs 1-4
  - Discussion: Planned studies for pre-CDR, publications, theory day
- Afternoon Salle Dirac: 40/S2-D01
  - 14:15: Group photo by the blue magnet outside Restaurant 1
  - Discussions
    - Budget profile, timeline
    - Funding sources, project management
    - Proto-collaboration structure
    - New ideas, next steps