5th Forward Physics Facility Meeting
CERN, 15-16 November 2022

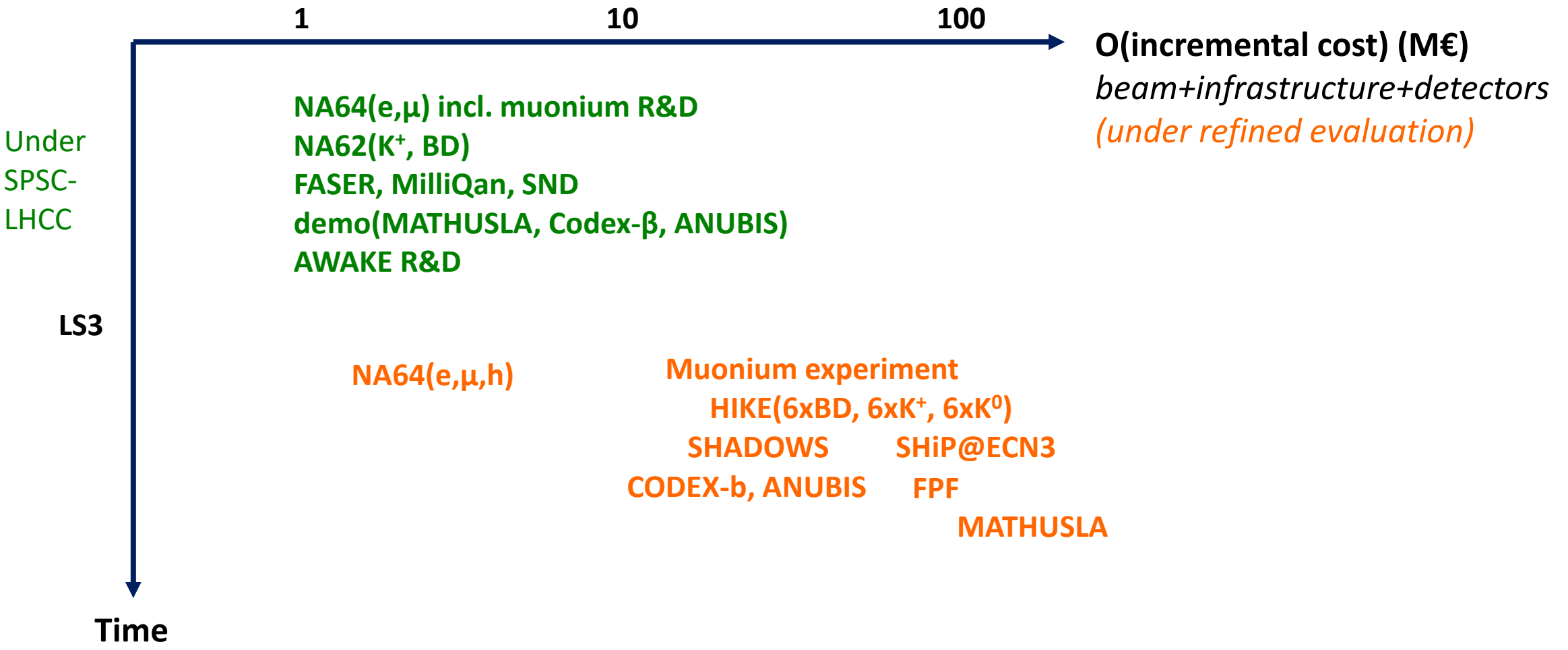
PBC LANDSCAPE and CERN CONTEXT

Claude Vallée

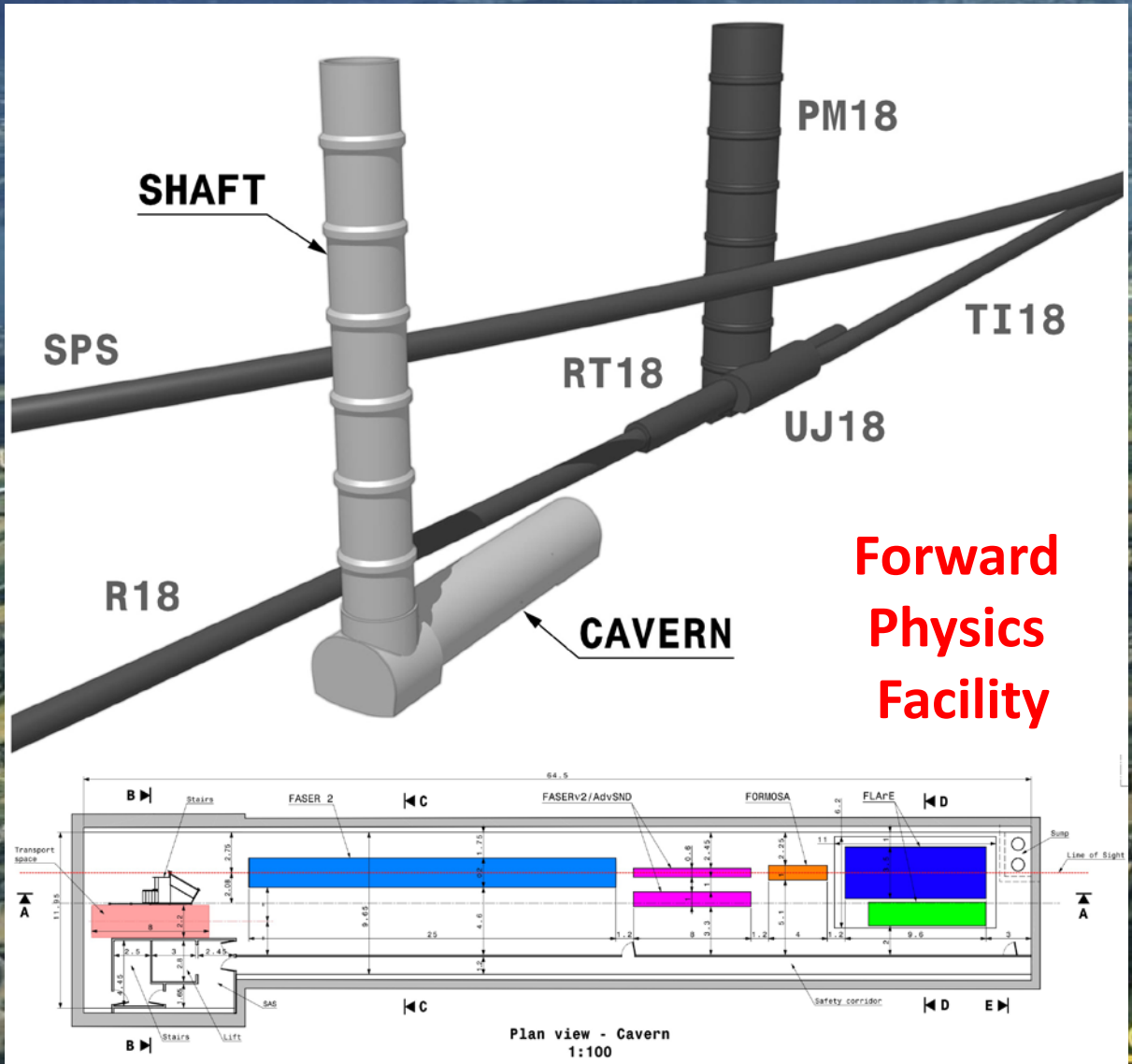
NB: Latest status of all PBC projects available from last week PBC Annual Workshop (indico)

Will focus here on projects with physics overlap with FPF

PBC BSM-ORIENTED MAIN PROJECTS



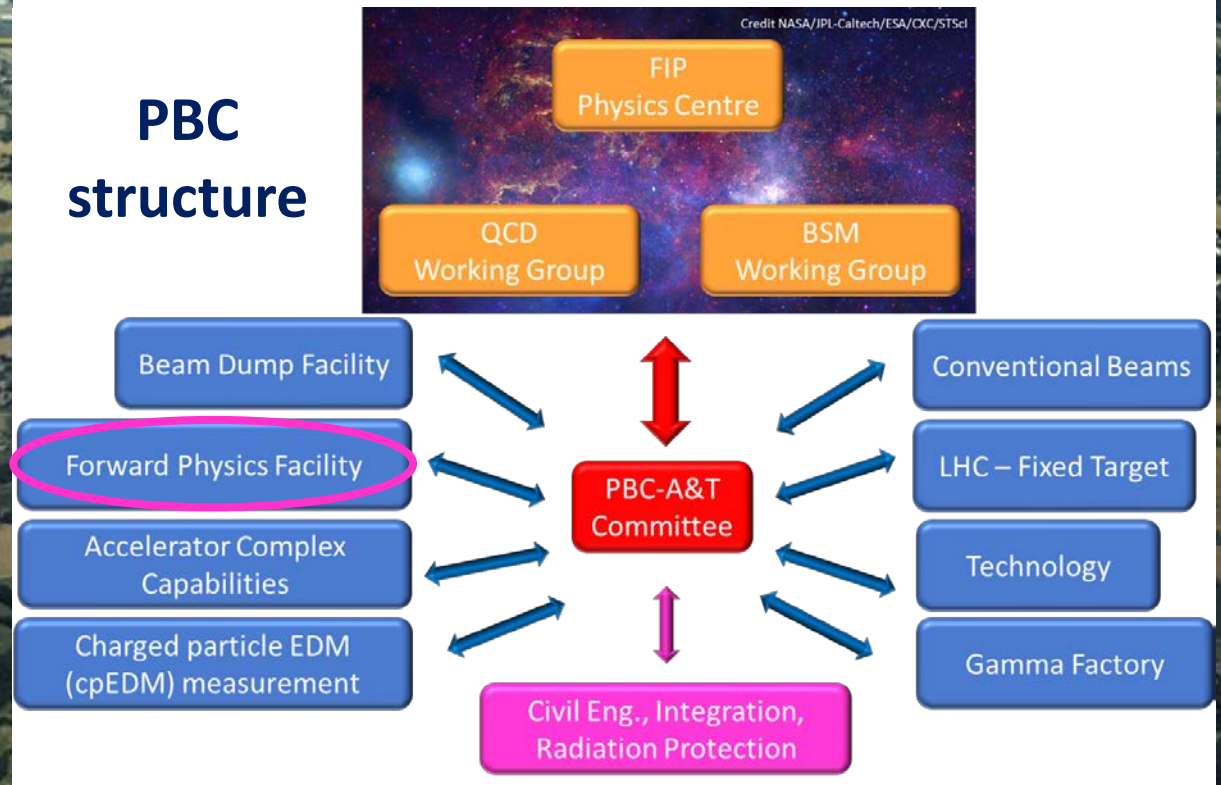
The FORWARD PHYSICS FACILITY within PBC



Following successful study and implementation of FASER in PBC Phase I,

FPF is one of the major new projects benefiting from strong support of PBC

PBC structure



POSSIBLE DIRECT COMPETITOR @LHC: FACET@CMS

https://doi.org/10.1007/JHEP06(2022)110

FACET: A new long-lived particle detector in the very forward region of the CMS experiment

S. Cerci†, D. Sunar Cerci† (Adiyaman Univ.), D. Lazic (Boston Univ.), G. Landsberg* (Brown Univ.), F. Cerutti, M. Sabaté-Gilarte (CERN), M.G. Albrow*, J. Berryhill, D.R. Green, J. Hirschauer (Fermilab), S. Kulkarni (Univ. Graz), J.E. Brücken (Helsinki Inst. Phys.), L. Emediato, A. Mestvirishvili, J. Nachtman, Y. Onel, A. Penzo (Univ. Iowa), O. Aydilek, B. Hacisahinoglu, S. Ozkorucuklu*, H. Sert, C. Simsek, C. Zorbilmez (Istanbul Univ.), I. Hos† (Istanbul Univ.-Cerrahpasa), N. Hadley, A. Skuja (Univ. Maryland), M. Du, R. Fang, Z. Liu (Univ. Nanjing), B. Isildak† (Ozyegin Univ.), V.Q. Tran (Tsung-Dao Lee Inst., Shanghai)

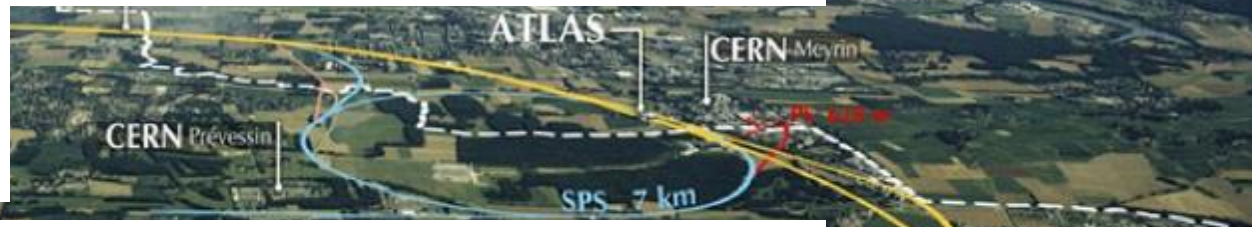
†Also at Istanbul Univ.

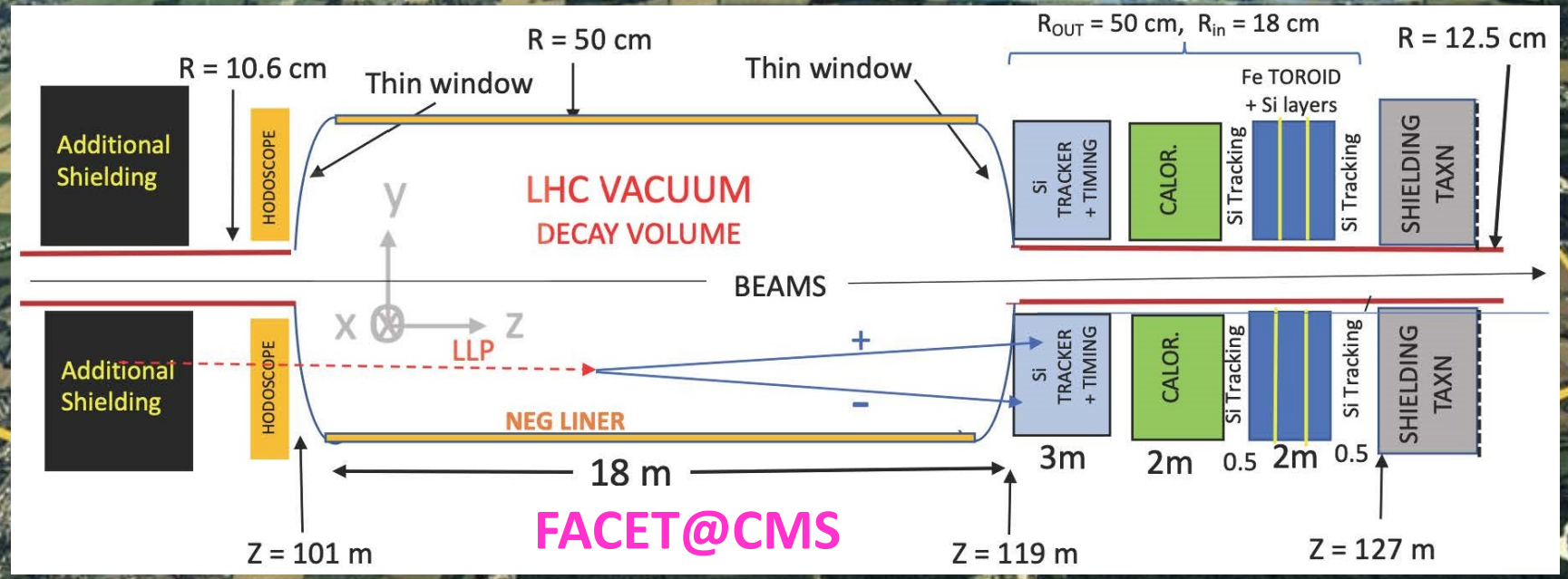
*Contacts: albrow@fnal.gov, greg.landsberg@cern.ch, suat.ozkorucuklu@cern.ch

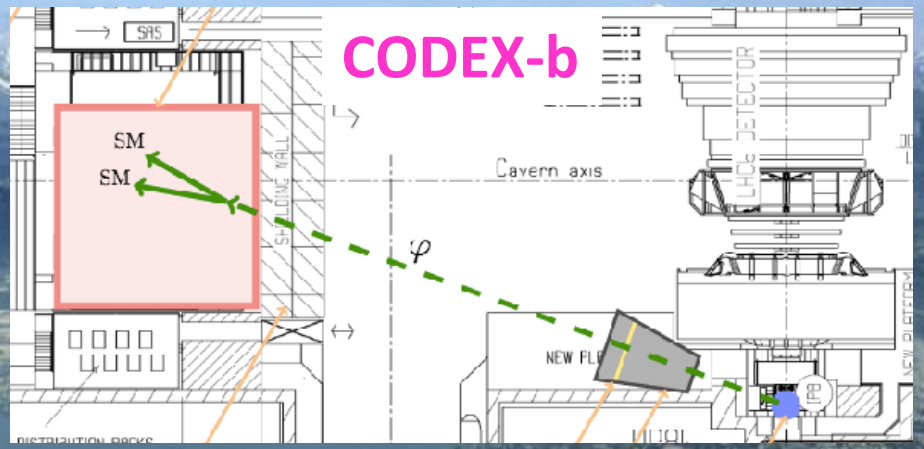
May 16, 2022

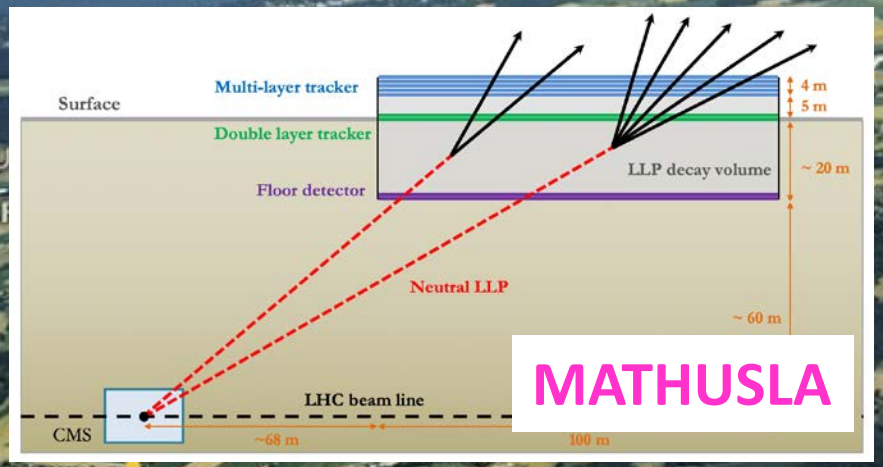
Project being developed within CMS

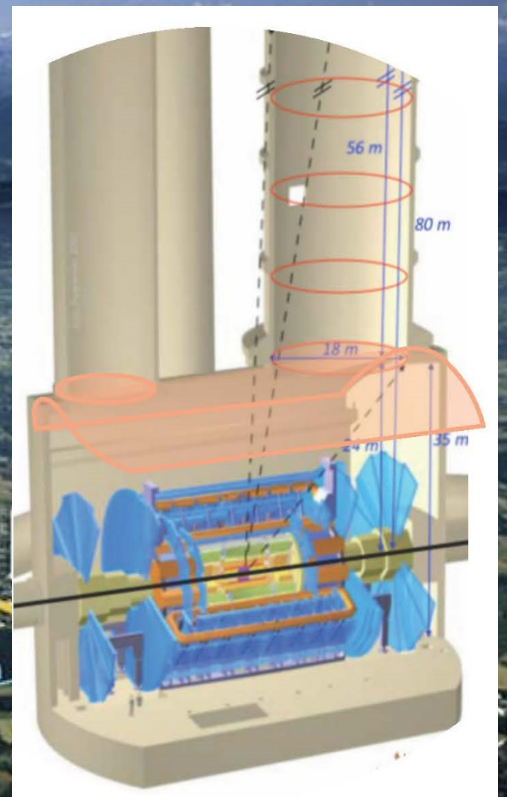
(did not apply to PBC)











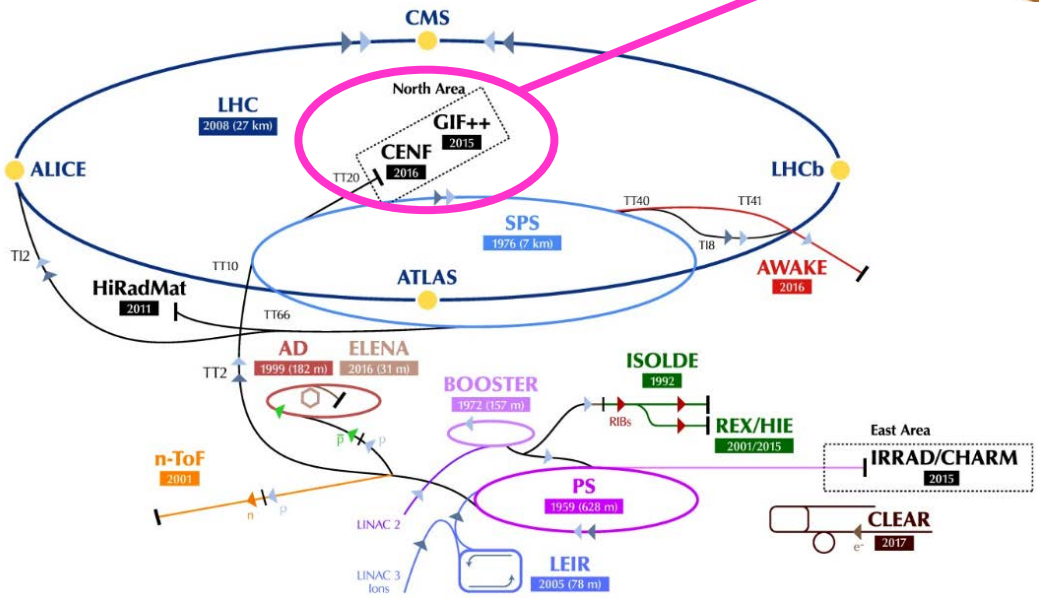
Further demonstrators and detailed simulations planned during run 3

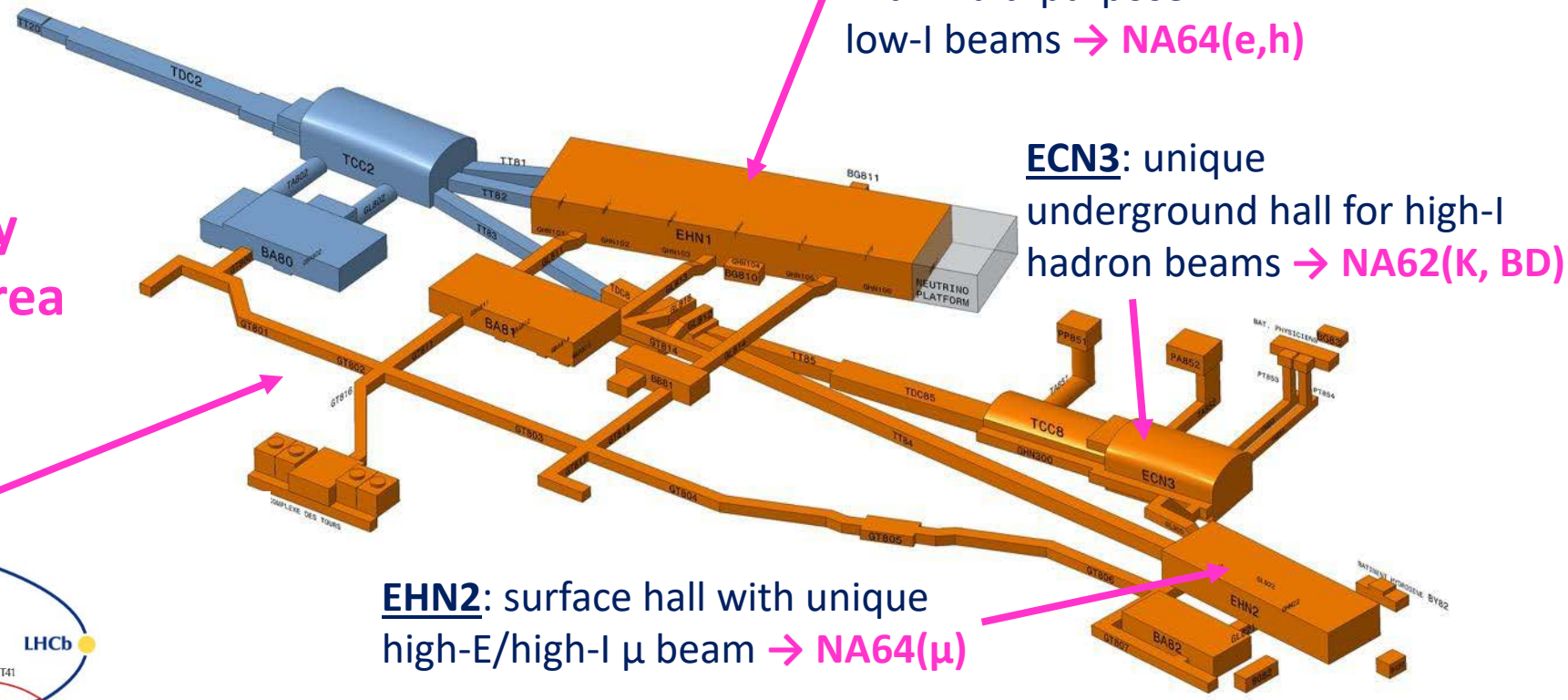
ANUBIS: similar concept as MATHUSLA but in ATLAS access shaft

OTHER LLP PROJECTS @LHC: "LARGE ANGLE" DETECTORS

Non-LHC BSM PROJECTS: THE SPS NORTH AREA

Non-LHC BSM-oriented beam experiments mostly located in the SPS North Area





EHN1: large surface hall with multi-purpose low-I beams → **NA64(e,h)**

ECN3: unique underground hall for high-I hadron beams → **NA62(K, BD)**

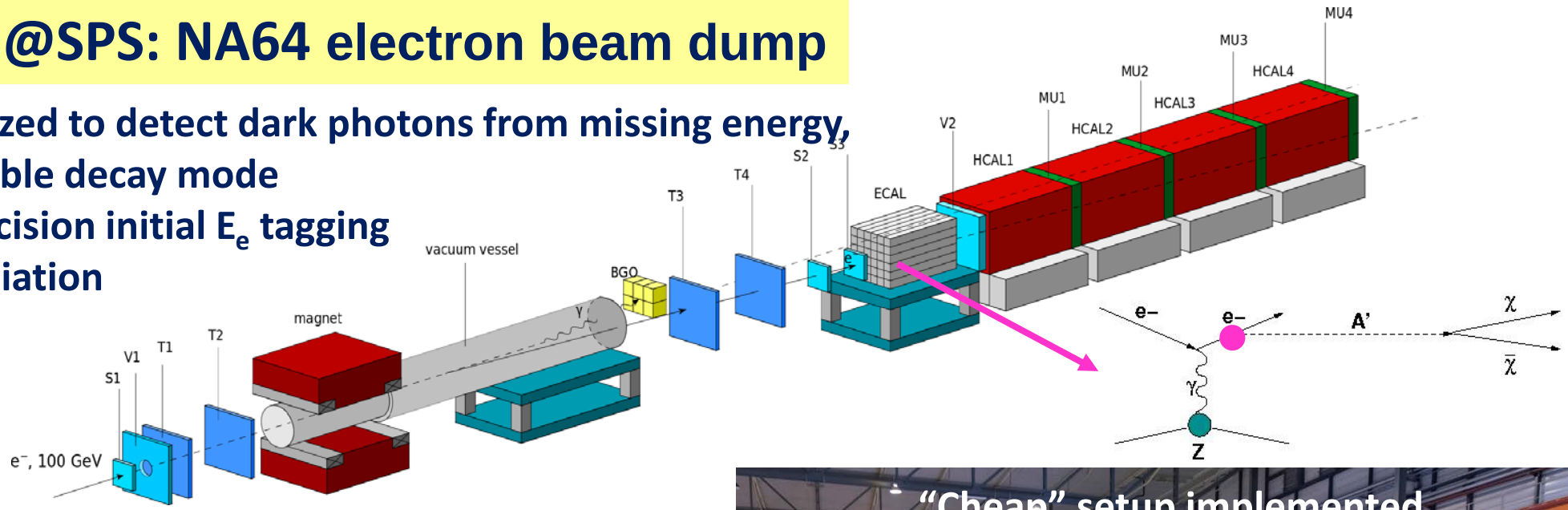
EHN2: surface hall with unique high-E/high-I μ beam → **NA64(μ)**

A consolidation of the North Area is now necessary and being prepared for the coming years

→ an opportunity of beam upgrades for new experimental projects

LLP PROJECTS @SPS: NA64 electron beam dump

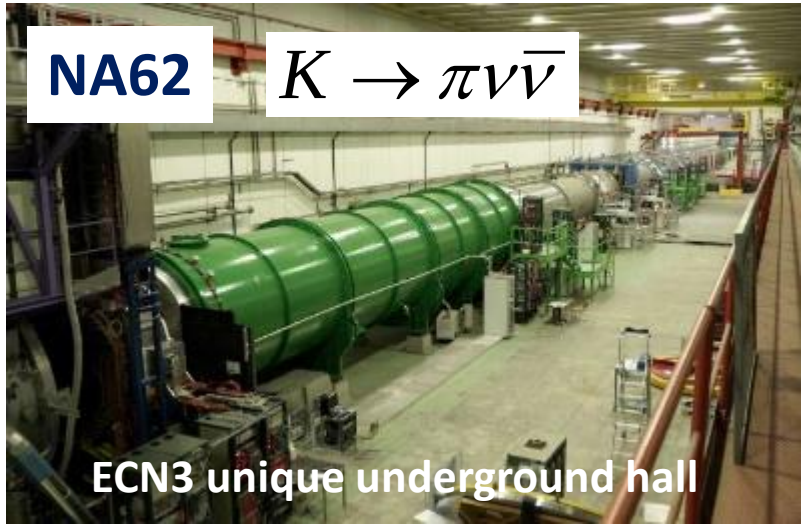
Configuration optimized to detect dark photons from missing energy, adaptable to e^+e^- visible decay mode
One key feature: precision initial E_e tagging with synchrotron radiation



Permanent setup implemented on H4 for higher intensities in run 3

Similar searches in preparation with muon and hadron beams

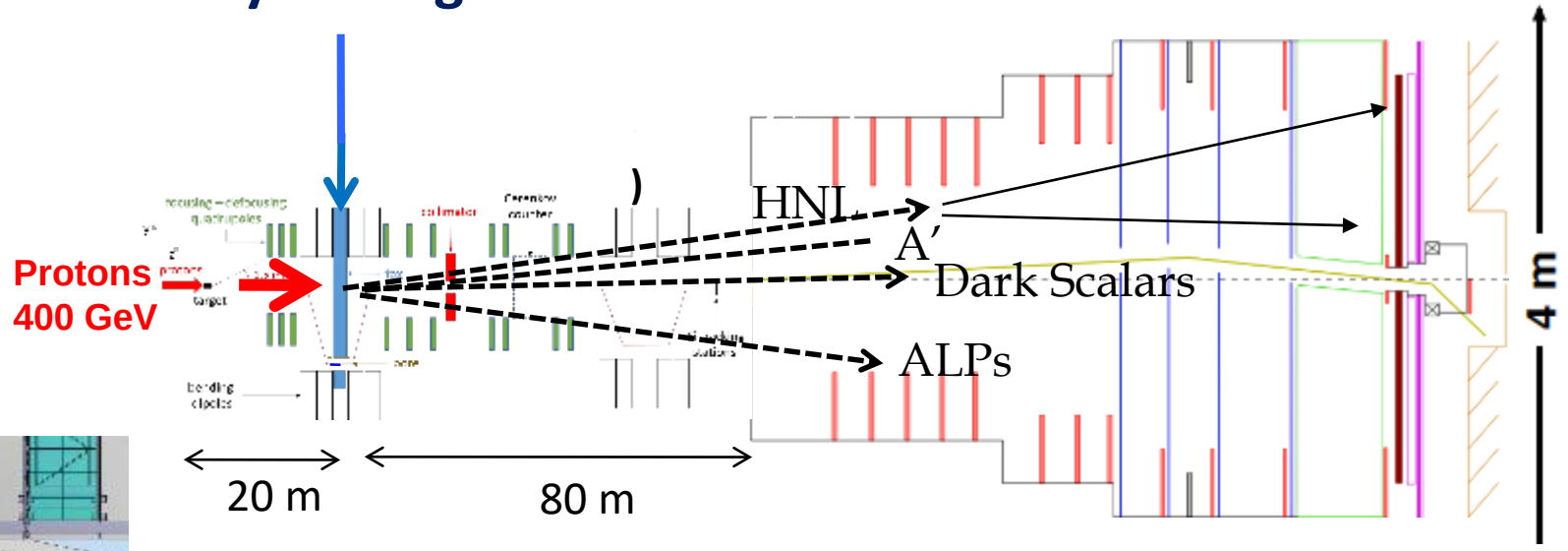
Currently leading the field of dark photons!



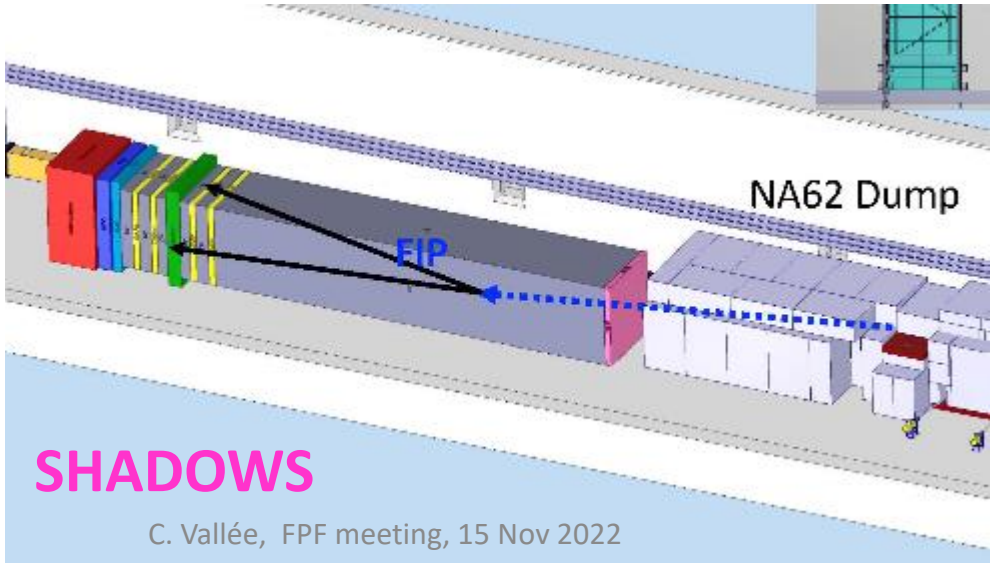
LLP PROJECTS @SPS:
SPS proton beam dump with HIKE&SHADOWS

Part of NA62 data in beam dump mode during run 3

Achieved by closing the TAX collimator ~10^{18} PoT in few months



Instrumentation of NA62 decay vessel well adapted to searches in visible decay mode

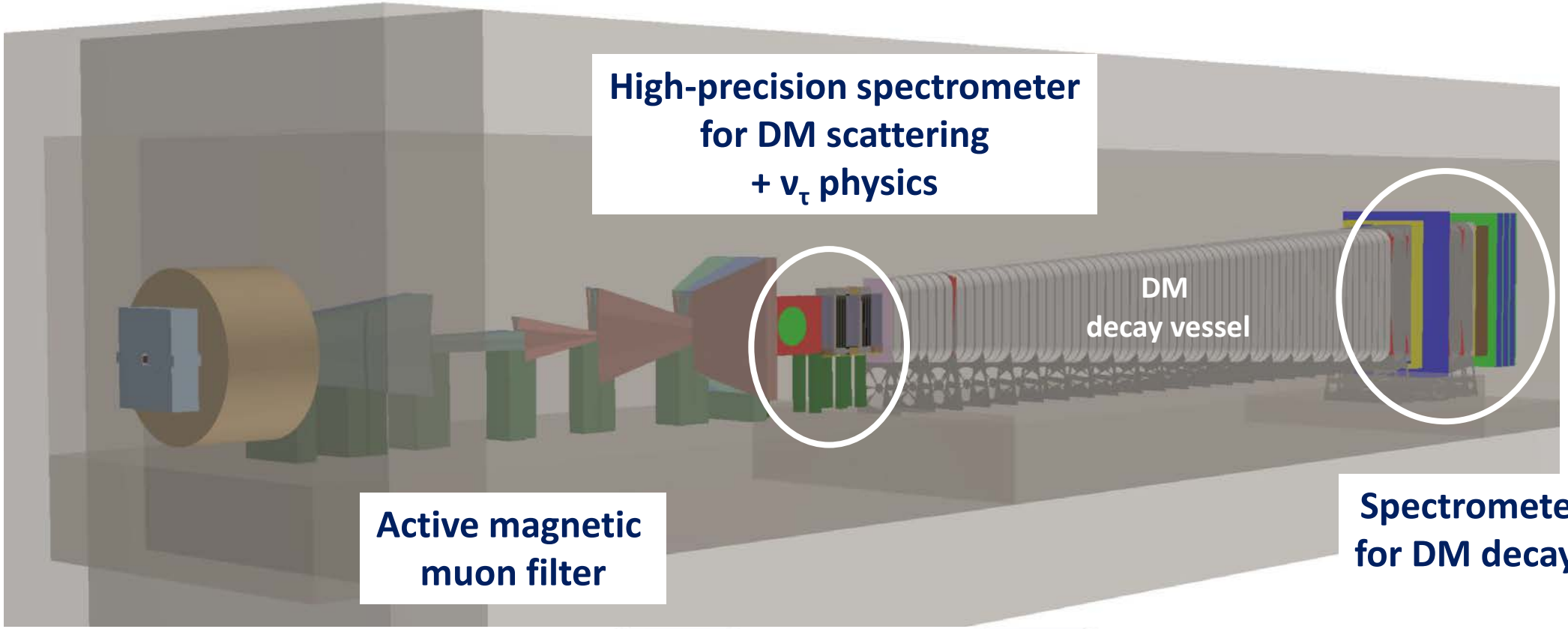


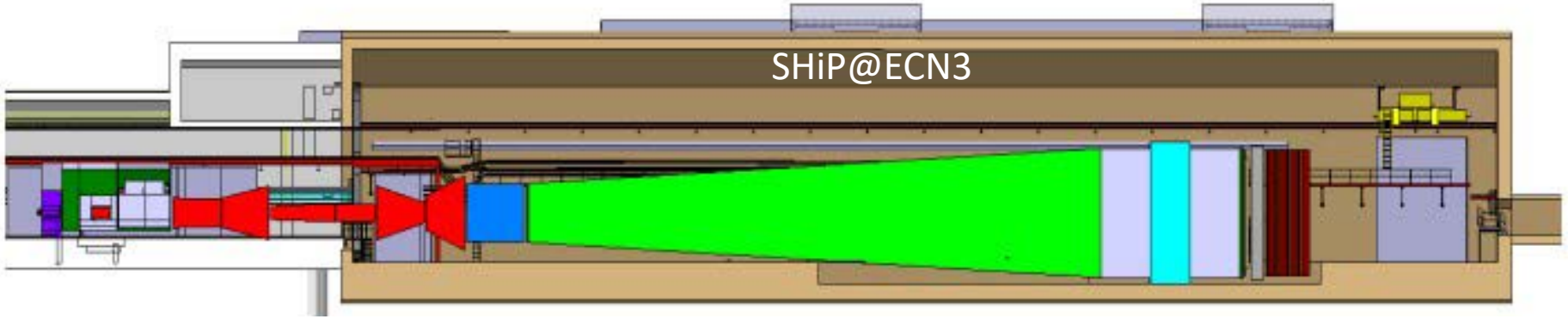
Higher-intensity (x6) proton beam proposed for post-LS3 in ECN3 for both K physics and BD searches

New SHADOWS "low cost" detector slightly off axis proposed to increase BD acceptance at high mass

LLP PROJECTS @SPS: SHiP@ECN3

State-of-the-Art Dual Spectrometer for hidden particle searches

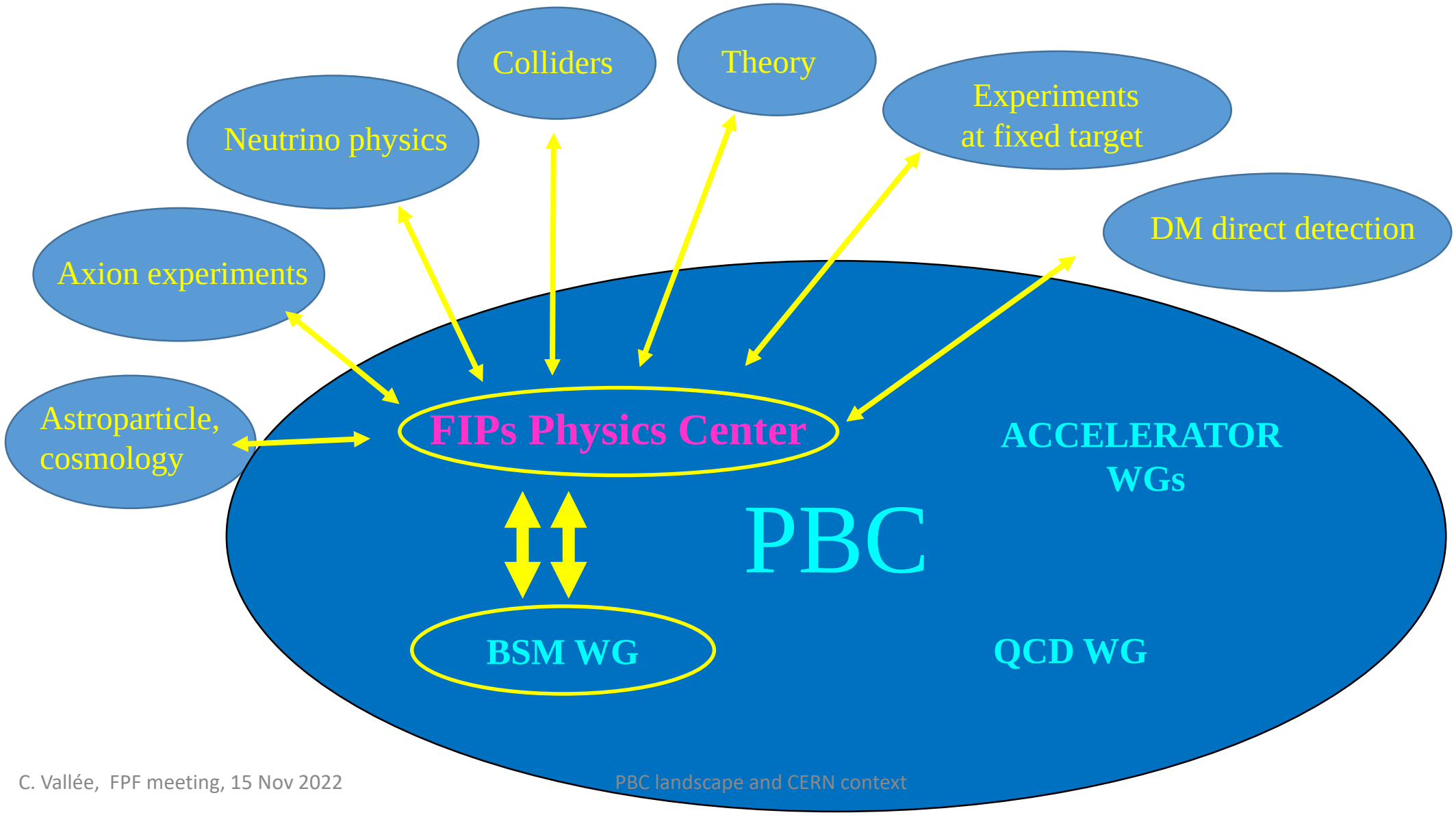




Relocation in ECN3 and re-optimization under study to reduce the overall cost

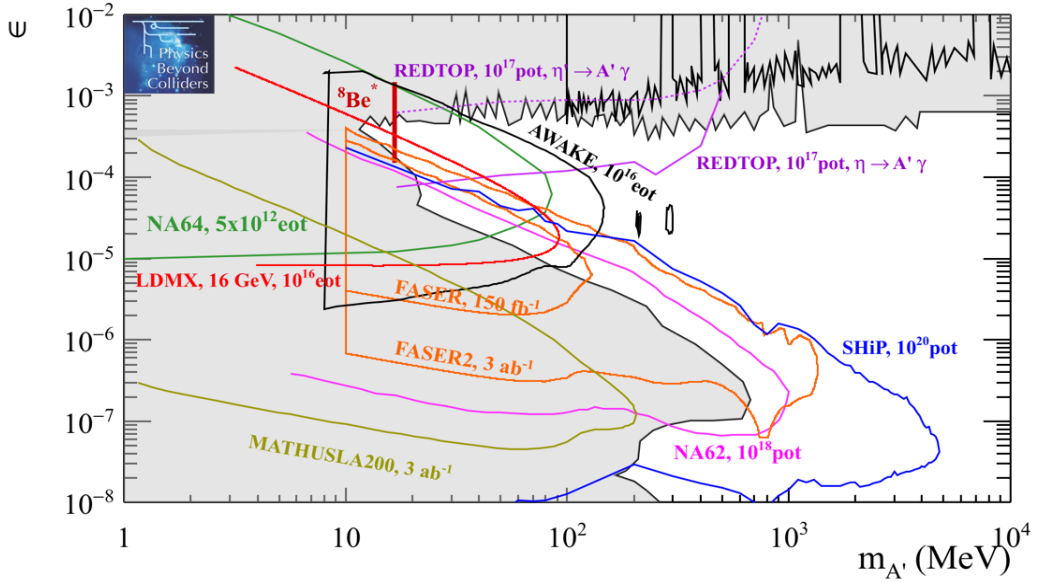
THE FIPs PHYSICS CENTRE

Now embedded within PBC
to compare the reach of PBC LLP projects
within the worldwide context

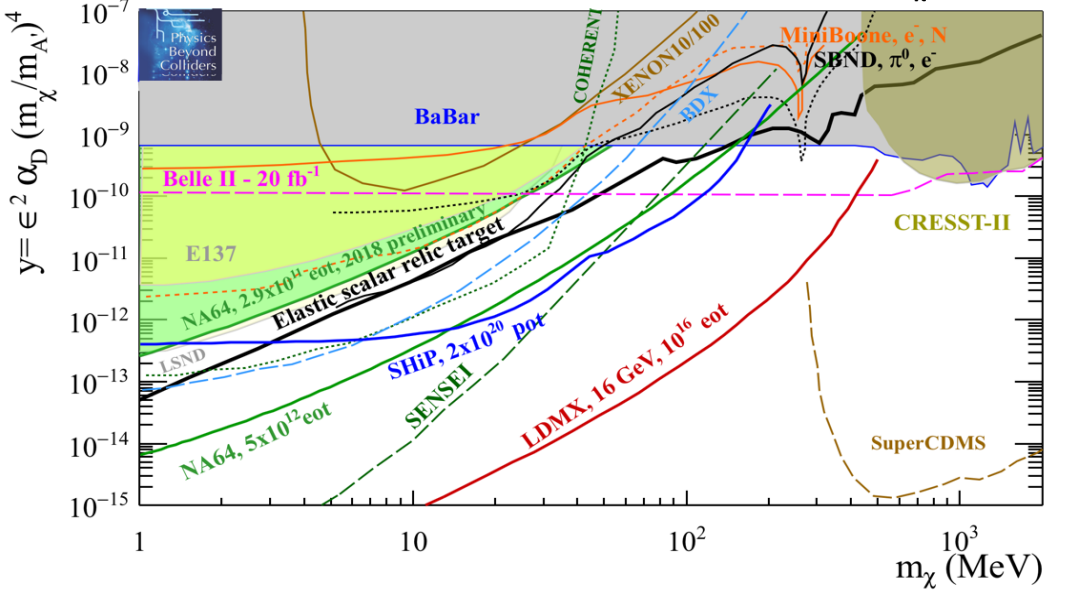


EXCERPTS OF COMPARISONS DONE FOR EPPSU

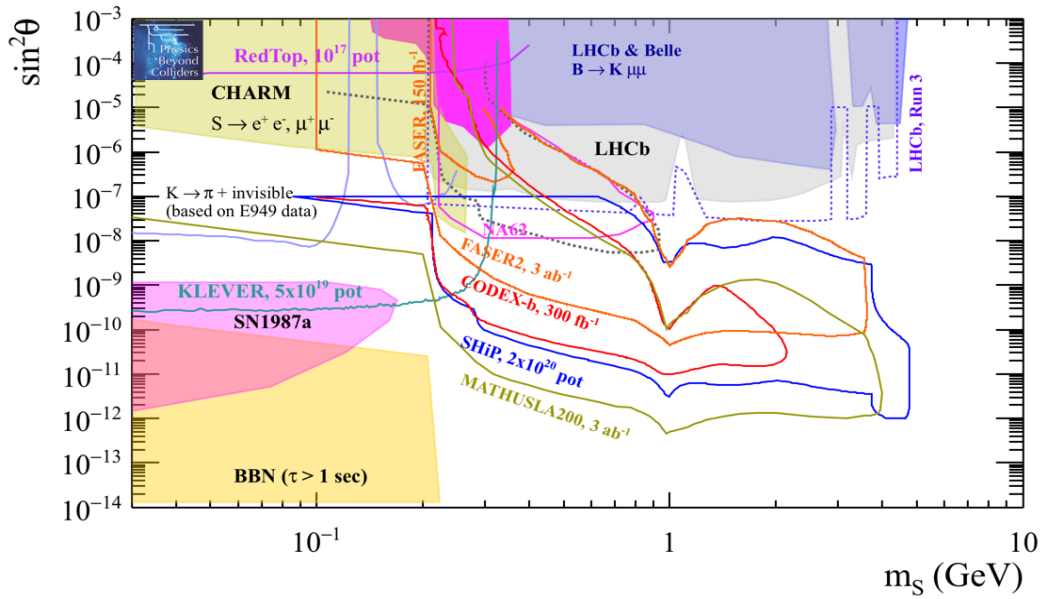
BC1: Dark photon visible decay to SM



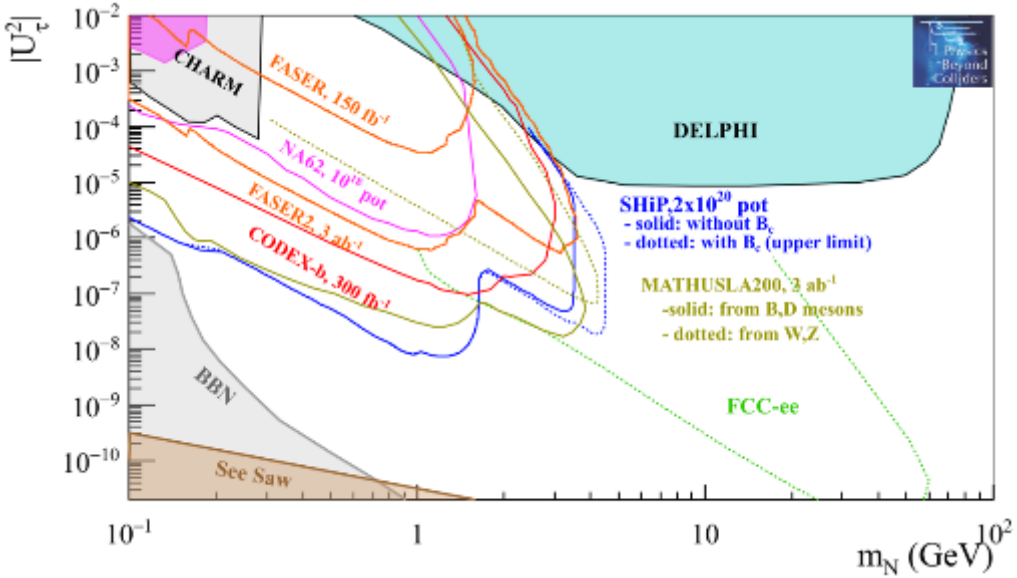
BC2: Dark photon decay to scalar DM $\alpha_D = 0.1$, $m_\chi = 1/3\ m_{A'}$



BC4: Dark scalar mixing with Higgs



BC8: dark HNL coupling to τ



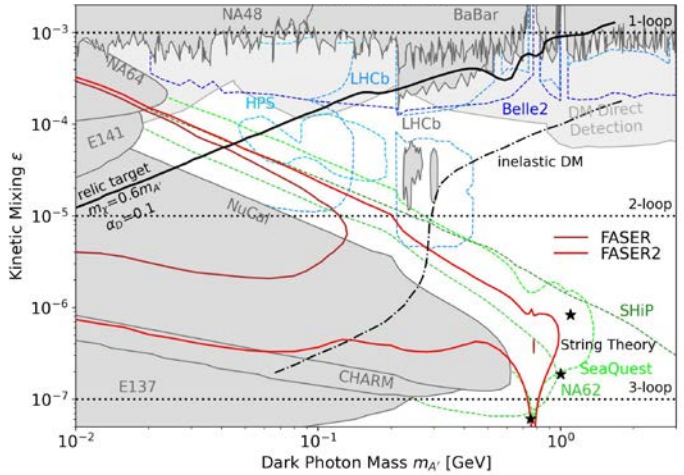
cape and CER

SOME UPDATED PLOTS FROM PROJECTS

NB: not PBC official plots!

BC1: Dark photon visible decay to SM

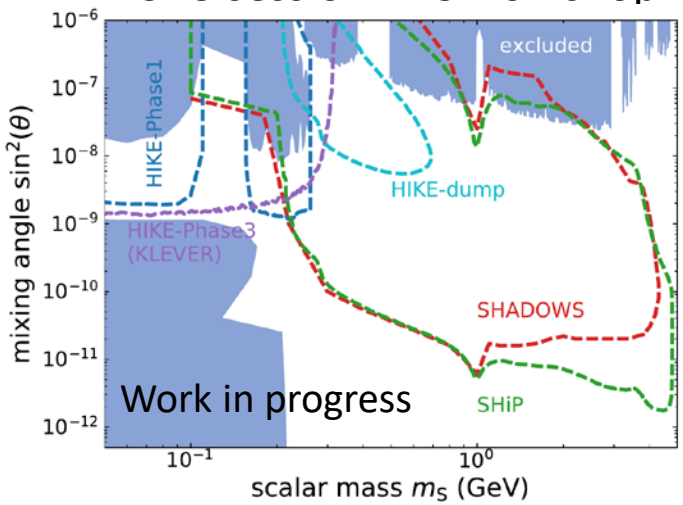
FPF white paper

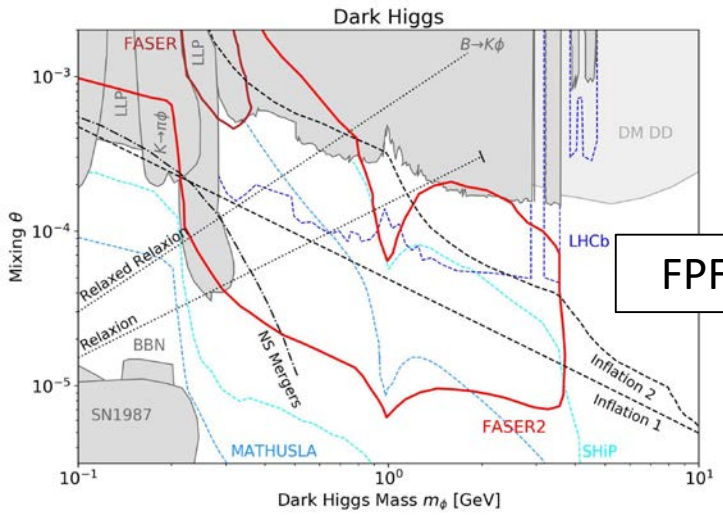


- **Expected sensitivities to FIPs from all projects will be compiled by FIPs Physics Centre under well defined conditions**
  → *Please provide all required info to FPC when available*
- **Physics reach of precision Kaon physics being evaluated in parallel by PBC BSM WG**
- **Neutrino measurements (SHiP, SHADOWS, FPF) being addressed by PBC QCD WG**

BC4: Dark scalar mixing with Higgs

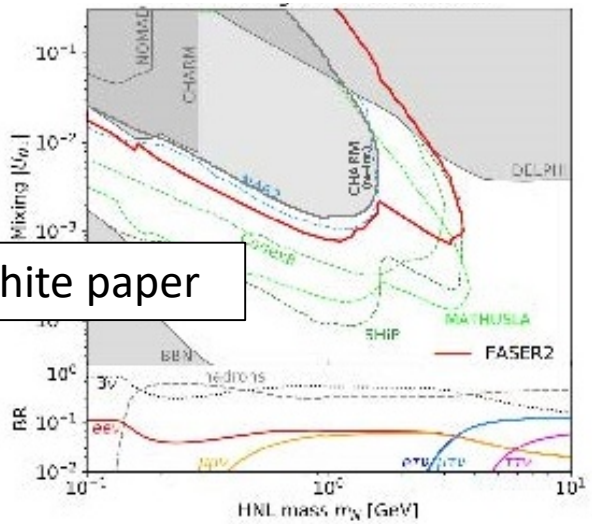
ECN3 session PBC workshop





BC8: dark HNL coupling to τ

FPF white paper



CERN DECISION PROCESS AND TIMELINE

ECN3 FUTURE

2-step procedure agreed with SPSC and Management:

Physics-agnostic High Intensity facility in ECN3:

- **SPSC recommendation February 2023**
- **Management decision and inclusion in MTP Spring 2023**

Choice of experimental programme:

- **SPSC recommendation November 2023**
- **Management decision end 2023**

FPF

LHCC statement September 2022

Given the scope of the proposed facility and the scientific overlap with projects that fall into the responsibility of other committees, **the LHCC proposes** to discuss the FPF together with other proposals, in an appropriate forum such as the Physics Beyond Colliders study group, prior to moving towards reviews by the scientific committees to ensure a comprehensive and aligned view of the strategy for CERN moving forward. Considering the implications for the long-term scientific strategy and the future development of the CERN infrastructure, a discussion in the SPC may be appropriate to help define priorities prior to further steps.

Personal remarks

ECN3-HI and FPF are not exclusive from each other
Motivation to have both projects will strongly depend on the complementarity of physics reach
Their preparation within PBC should proceed timely and independently

Implementation decisions and schedules will depend on a mix of:

- **Physics reach** ***(→ unique features of FPF to be highlighted)***
- **Technically driven constraints (e.g. North Area consolidation, LHC Long Shutdowns, etc…)**
- **CERN available resources**
- **External community support** ***(→ FPF detectors design and Collaborations structures to be strengthened)***