Update from CERN PBC

Gianluigi Arduini, Joerg Jaeckel, Claude Vallée

6th Forward Physics Facility Meeting - 8th June 2023

ESPP & PBC

…..A diverse programme that is complementary to the energy frontier is an essential part of the European particle physics Strategy.* *Experiments in such diverse areas that offer potential high-impact particle physics programmes at laboratories in Europe should be supported, as well as participation in such experiments in other regions of the world…..

International panorama

Very active community studying feebly interacting/long-lived particles to provide possible answers to some of the presently open questions in particle physics

World-wide interest

Extremely valuable input to assess physics reach in the international context

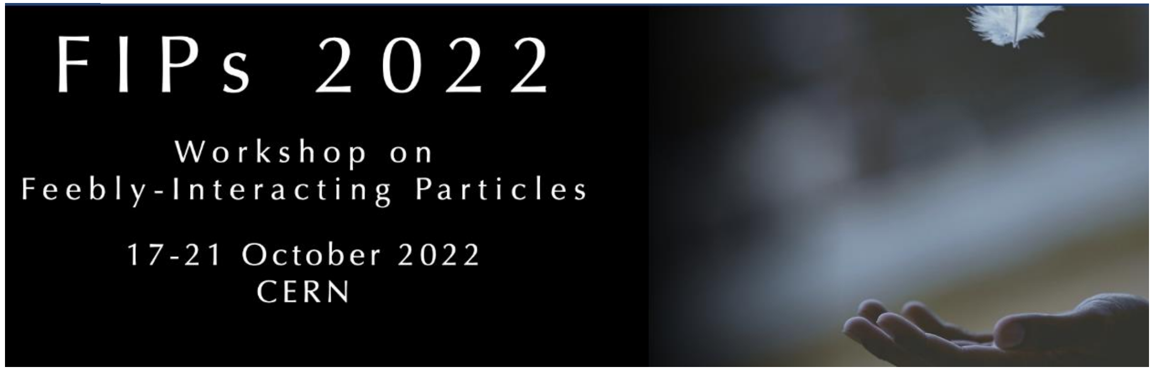
Physics Beyond Colliders

2022 Snowmass Energy Frontier Summary

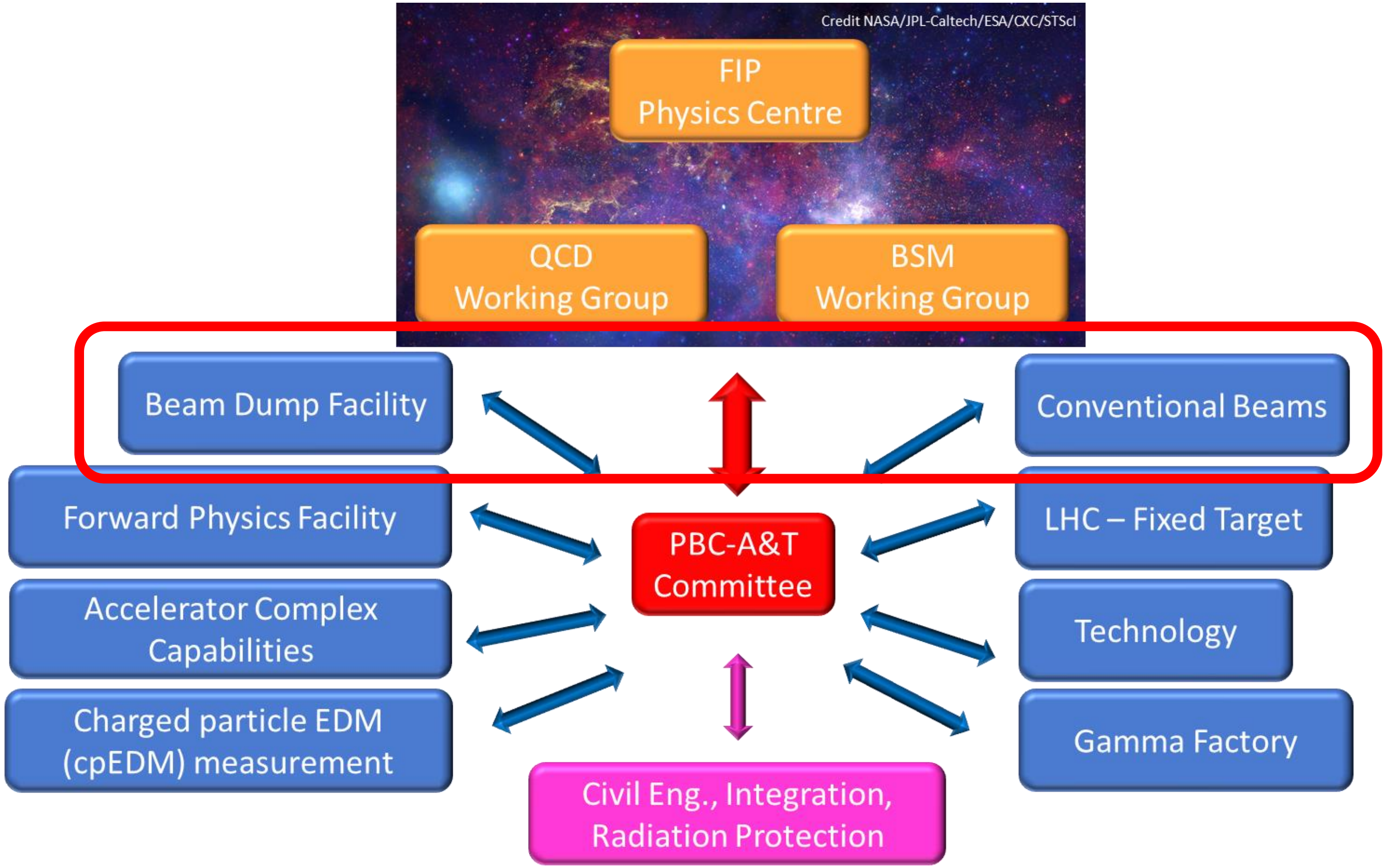
Our highest immediate priority accelerator and project is the HL-LHC, the successful completion of the detector upgrades, operations of the detectors at the HL-LHC, data taking and analysis, including the construction of auxiliary experiments that extend the reach of HL-LHC in kinematic regions uncovered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

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

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



A number of complementary proposals



North Area High Intensity Beams ECN3

SPS North Area is at the very heart of many present and proposed explorations for BSM Physics

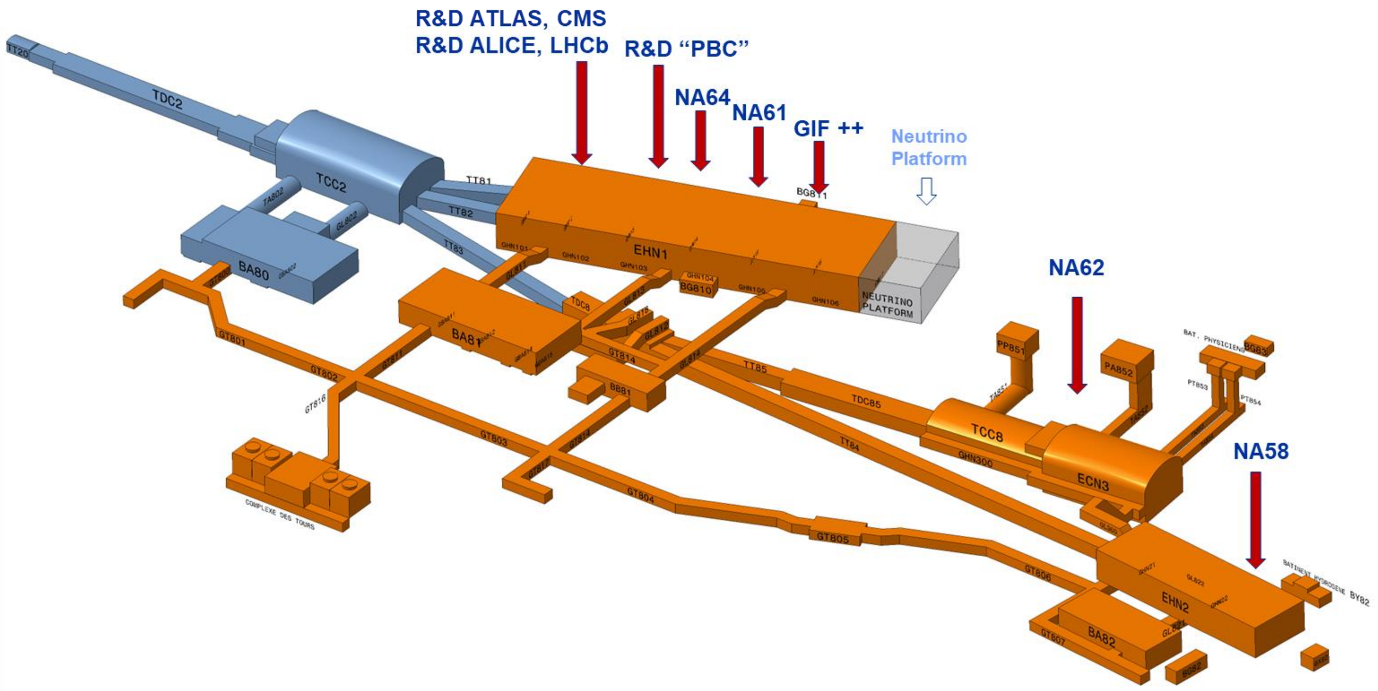
Consolidation programme ongoing

A number of proposals requiring higher intensities in the ECN3 underground cavern post-LS3.

Beam loss/radiation control, beam quality (reproducibility, spill structure etc.) are challenging future requirements

Phase 1: 2019 - 2028 => priority to TT20 & NA transfer tunnels

Phase 2: 2029 - 2034 => H2, H4, H6, H8, M2 and K12 beam lines



Important to identify synergies and implications of a future ECN3 High Intensity programme on North Area Consolidation

ECN3 High Intensity Beams

A number of proposals requiring higher intensities (factor 6 to 12 in p/spill – factor 6 to >20 in p.o.t./year) in the ECN3 underground cavern post-LS3:

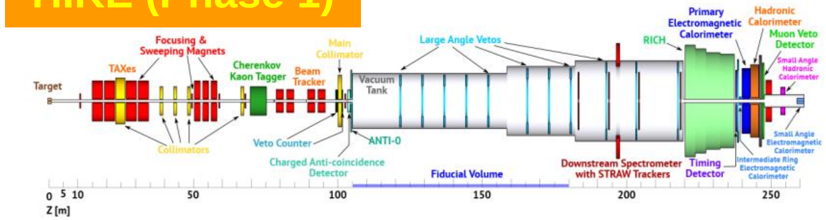
- High intensity Kaon Experiment (HIKE) with a programme to study Ultra Rare Kaon decays (e.g. $K \rightarrow \pi \nu \bar{\nu}$ - BR~10^{-10}) complemented by the search for visible decays of Feebly-Interacting Particles (FIP) in Beam Dump mode on-axis

- SHADOWS (Search for Hidden And Dark Objects With the SPS) to search for FIP visible decays in Beam Dump (BD) mode off-axis. Running in parallel to HIKE when operated in BD mode

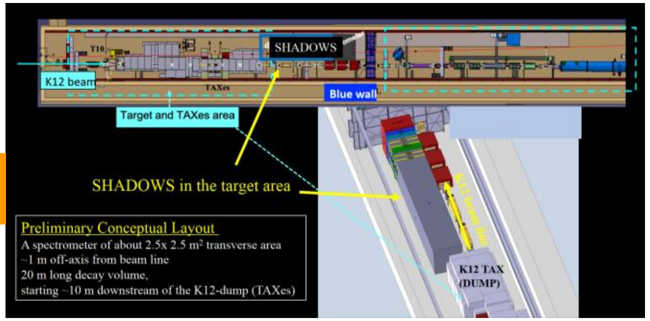
- SHiP (Search for Hidden Particle) proposing a comprehensive investigation of the Hidden Sector in the O(GeV) domain

- A programme going **beyond HL-LHC (~15 years of operation)**

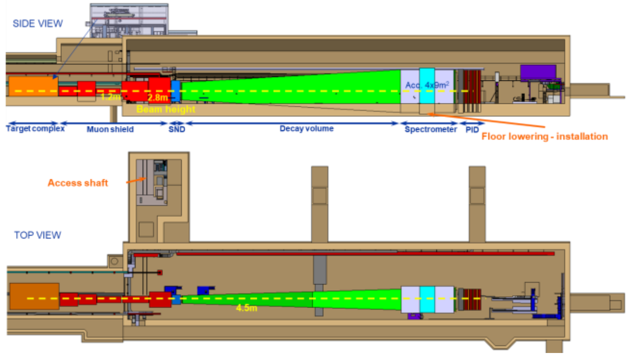
HIKE (Phase 1)



SHADOWS



SHiP@ECN3



ECN3 Timeline

Nov. 2022: Letters of intent submitted to SPSC

Feb. 2023: PBC ECN3 Beam Delivery Task Force delivered document on ‘physics agnostic’ feasibility for high intensity facility in ECN3. Estimated cost: ~65 MCHF from 2023 to 2031

- 14 MCHF for beam delivery
- ~50 MCHF for TCC8/ECN3

Feb. 2023: Strong support from SPSC for the High Intensity Upgrade of ECN3*…..The SPSC recognizes that the intensity upgrade of ECN3 opens up unique opportunities for potential high-impact particle physics programs at CERN. Therefore, the SPSC strongly recommends, in an experiment-agnostic way, the intensity upgrade of ECN3....*

Mar. 2023: Research Board endorsed launch of preparatory studies for beam delivery upgrade

Mar-May 2023: ECN3 HI well received by SPC

ECN3 Timeline

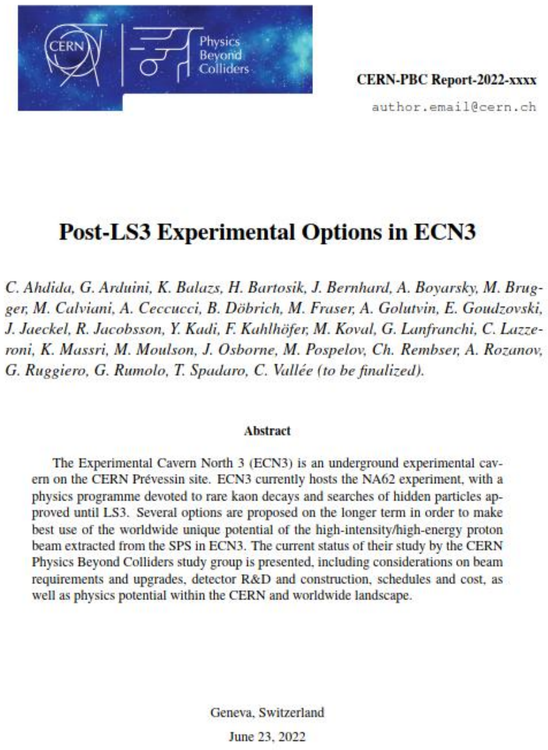
Draft MTP23 (May 2023):

- Includes funding for 2023-24 to allow the continuation of the engineering preparation studies in view of possible upgrade starting in LS3
- Additional allocation for **NA-CONS phase 1**, and allocation for **phase 2** ➔ commitment to North Area exploitation in the longer term

PBC document on ECN3 options post-LS3 to SPSC and Management in preparation of SPSC Sep 2023. FPF representatives involved to assess complementarity ECN3/FPF on FIPs and neutrino physics.

Final recommendation/decision on which experiment to host (SPSC & RB November/December 2023)

Possible start of the TDR phase in 2024


CERN-PBC Report-2022-xxxx

author.email@cern.ch

Post-LS3 Experimental Options in ECN3

C. Ahdida, G. Arduini, K. Balazs, H. Bartosik, J. Bernhard, A. Boyarsky, M. Brugger, M. Calviani, A. Ceccucci, B. Döbrich, M. Fraser, A. Golutvin, E. Goudzovski, J. Jaeckel, R. Jacobsson, Y. Kadi, F. Kahlhöfer, M. Koval, G. Lanfranchi, C. Lazzeroni, K. Massri, M. Moulson, J. Osborne, M. Pospelov, Ch. Rembser, A. Rozanov, G. Ruggiero, G. Rumolo, T. Spadaro, C. Vallée (to be finalized).

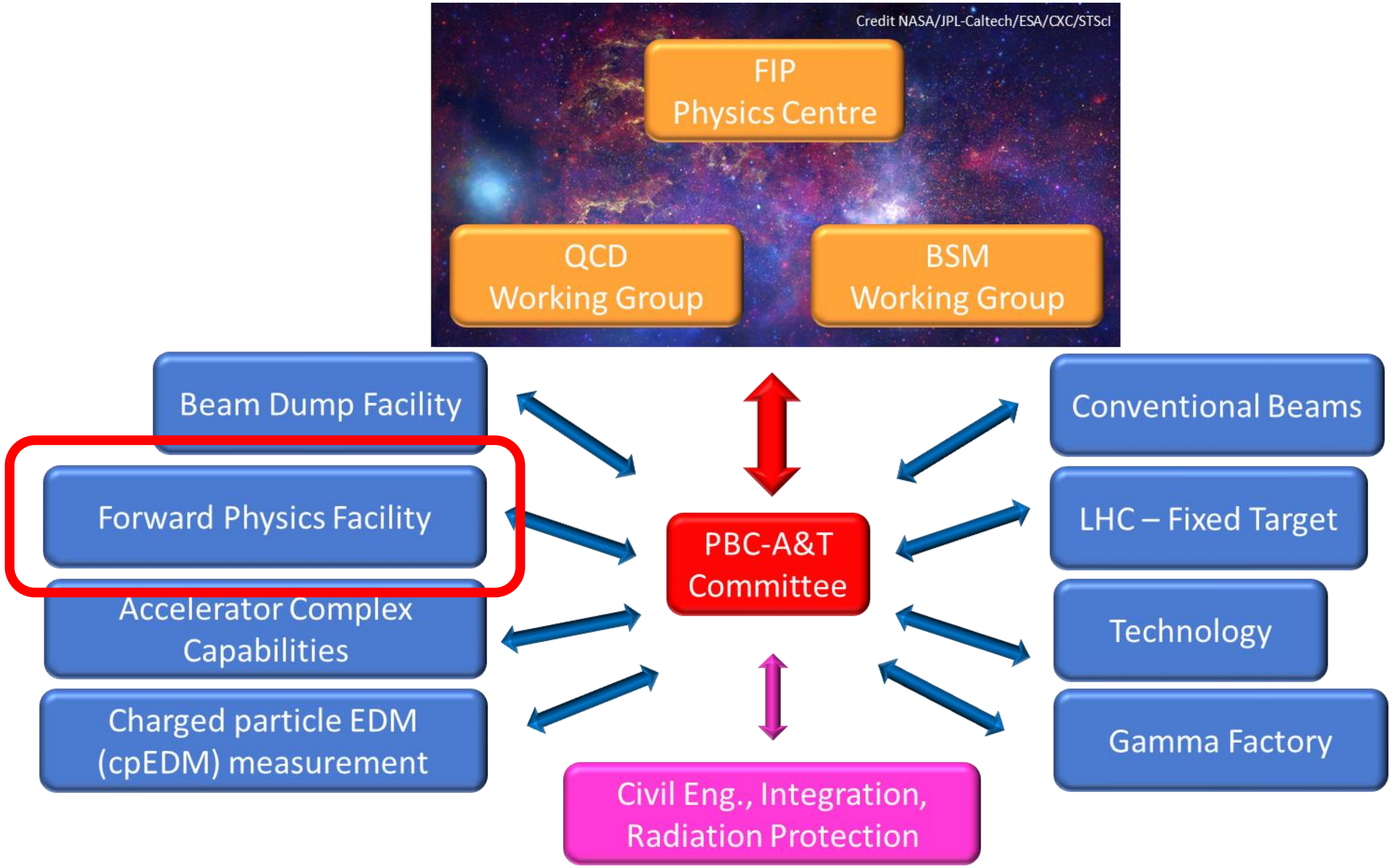
Abstract

The Experimental Cavern North 3 (ECN3) is an underground experimental cavern on the CERN Prévessin site. ECN3 currently hosts the NA62 experiment, with a physics programme devoted to rare kaon decays and searches of hidden particles approved until LS3. Several options are proposed on the longer term in order to make best use of the worldwide unique potential of the high-intensity/high-energy proton beam extracted from the SPS in ECN3. The current status of their study by the CERN Physics Beyond Colliders study group is presented, including considerations on beam requirements and upgrades, detector R&D and construction, schedules and cost, as well as physics potential within the CERN and worldwide landscape.

Geneva, Switzerland

June 23, 2022

A number of complementary proposals



The precursors…..

CERN Courier – May/June Issue

CERNCOURIER.COM

NEWS ANALYSIS

NEUTRINOS

First collider neutrinos detected

Since their discovery 67 years ago, neutrinos from a range of sources – solar, atmospheric, reactor, geological, accelerator and astrophysical – have provided ever more powerful probes of nature. Although neutrinos are also produced abundantly in colliders, until now no neutrinos produced in such a way had been detected, their presence inferred instead via missing energy and momentum.

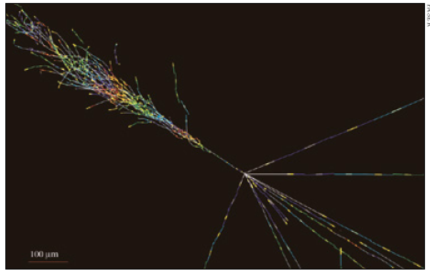
A new LHC experiment called FASER, which entered operations at the start of Run 3 last year, has changed this picture with the first observation of collider neutrinos. Announcing the result on 19 March at the Rencontres de Moriond, and in a paper submitted to *Physical Review Letters* on 24 March, the FASER collaboration reconstructed 153 candidate muon neutrino and antineutrino interactions in its spectrometer with a significance of 16 standard deviations above the background-only hypothesis. Being consistent with the characteristics expected from neutrino interactions in terms of secondary-particle production and spatial distribution, the results imply the observation of both neutrinos and antineutrinos with an incident neutrino energy significantly above 200 GeV. In addition, an ongoing analysis of data from an emulsion/tungsten subdetector called FASERν revealed a first electron–neutrino interaction candidate (see image above).

"FASER has directly observed the interactions of neutrinos produced at a collider for the first time," explains co-spokesperson Jamie Boyd of CERN. "This result shows the detector worked perfectly in 2022 and opens the door for many important future studies with high-energy neutrinos at the LHC."

The extreme luminosity of proton–proton collisions at the LHC produces a large neutrino flux in the forward direction, with energies leading to cross-sections high enough for neutrinos to be detected using a compact apparatus. FASER is one of two new forward experiments situated at either side of LHC Point 1 to detect neutrinos produced in proton–proton collisions in ATLAS. The other, SND@LHC, also reported its first results at Moriond. The team found eight muon–neutrino candidate events against an expected background of 0.2, with an evaluation of systematic uncertainties ongoing.

Covering energies between a few hundred GeV and several TeV, FASER and SND@LHC narrow the gap between fixed-target and astrophysical neutrinos. One of the unexplored physics topics to which they will contribute is the study of high-energy neutrinos from astrophysical sources. Since the production mechanism and energy of neutrinos at the LHC is similar to that of very-high-energy neutrinos from cosmic-ray collisions with the atmosphere, FASER and SND@LHC can be used to precisely estimate this background. Another application is to measure and compare the production rate of all three types of neutrinos, providing an important test of the Standard Model.

Beyond neutrinos, the two experiments open new searches for feebly interacting particles and other new physics. In a separate analysis, FASER presented first results from a search for dark photons decaying to an electron–positron pair. No events were seen in an almost background-free analysis, yielding new constraints on dark photons with couplings of 10^{-5} to 10^{-4} and masses of between 10 and 100 MeV, in a region of parameter space motivated by dark matter.



New source *A candidate high-energy electron neutrino charged-current interaction recorded by FASERν, with the electron shower (left of the image) balanced by several charged particle tracks (right).*

Further reading

FASER Collab. 2023 arXiv:2303.14185.

FASER Collab. 2023 CERN-FASER-CONF-2023-001.

CERN-EP-2023-056

First Direct Observation of Collider Neutrinos with FASER at the LHC

FASER Collaboration

Henso Abreu,[1] John Anders,[2] Claire Antel,[3] Akitaka Ariga,[4,5] Tomoko Ariga,[6] Jeremy Atkinson,[4] Florian U. Bernlochner,[7] Tobias Blesgen,[7] Tobias Boeckh,[7] Jamie Boyd,[2] Lydia Brenner,[8] Franck Cadoux,[3] David W. Casper,[9] Charlotte Cavanagh,[10] Xin Chen,[11] Andrea Coccaro,[12] Ansh Desai,[13] Sergey Dmitrievsky,[14] Monica D'Onofrio,[10] Yannick Favre,[3] Deion Fellers,[13] Jonathan L. Feng,[9] Carlo Alberto Fenoglio,[3] Didier Ferrere,[3] Stephen Gibson,[15] Sergio Gonzalez-Sevilla,[3] Yuri Gornushkin,[14] Carl Gwilliam,[10] Daiki Hayakawa,[5] Shih-Chieh Hsu,[16] Zhen Hu,[11] Giuseppe Iacobucci,[3] Tomohiro Inada,[11] Sune Jakobsen,[2] Hans Joos,[2,17] Enrique Kajomovitz,[1] Hiroaki Kawahara,[6] Alex Keyken,[15] Felix Kling,[18] Daniela Köck,[13] Umut Kose,[2] Rafaella Kotitsa,[2] Susanne Kuehn,[2] Helena Lefebvre,[15] Lorne Levinson,[19] Ke Li,[16] Jinfeng Liu,[11] Jack MacDonald,[20] Chiara Magliocca,[3] Fulvio Martinelli,[3] Josh McFayden,[21] Matteo Milanesio,[3] Dimitar Mladenov,[2] Théo Moretti,[3] Magdalena Munker,[3] Mitsuhiro Nakamura,[22] Toshiyuki Nakano,[22] Marzio Nessi,[3,2] Friedemann Neuhaus,[20] Laurie Nevay,[2,15] Hidetoshi Otono,[6] Hao Pang,[11] Lorenzo Paolozzi,[3,2] Brian Petersen,[2] Francesco Pietropaolo,[2] Markus Prim,[7] Michaela Queitsch-Maitland,[23] Filippo Resnati,[2] Hiroki Rokujo,[22] Elisa Ruiz-Choliz,[20] Jorge Sabater-Iglesias,[3] Osamu Sato,[22] Paola Scampoli,[4,24] Kristof Schmieden,[20] Matthias Schott,[20] Anna Sfyrla,[3] Savannah Shively,[9] Yosuke Takubo,[25] Noshin Tarannum,[3] Ondrej Theiner,[3] Eric Torrence,[13] Serhan Tufanli,[2] Svetlana Vasina,[14] Benedikt Vormwald,[2] Di Wang,[11] Eli Welch,[9] and Stefano Zambito[3]

[1] *Department of Physics and Astronomy, Technion—Israel Institute of Technology, Haifa 32000, Israel*
[2] *CERN, CH-1211 Geneva 23, Switzerland*
[3] *Département de Physique Nucléaire et Corpusculaire, University of Geneva, CH-1211 Geneva 4, Switzerland*
[4] *Albert Einstein Center for Fundamental Physics, Laboratory for High Energy Physics, University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland*
[5] *Department of Physics, Chiba University, 1-33 Yayoi-cho Inage-ku, 263-8522 Chiba, Japan*
[6] *Kyushu University, Nishi-ku, 819-0395 Fukuoka, Japan*
[7] *Universität Bonn, Regina-Pacis-Weg 3, D-53113 Bonn, Germany*
[8] *Nikhef National Institute for Subatomic Physics, Science Park 105, 1098 XG Amsterdam, Netherlands*
[9] *Department of Physics and Astronomy, University of California, Irvine, CA 92697-4575, USA*
[10] *University of Liverpool, Liverpool L69 3BX, United Kingdom*
[11] *Department of Physics, Tsinghua University, Beijing, China*
[12] *INFN Sezione di Genova, Via Dodecaneso, 33–16146, Genova, Italy*
[13] *University of Oregon, Eugene, OR 97403, USA*
[14] *Affiliated with an international laboratory covered by a cooperation agreement with CERN.*
[15] *Royal Holloway, University of London, Egham, TW20 0EX, United Kingdom*
[16] *Department of Physics, University of Washington, PO Box 351560, Seattle, WA 98195-1460, USA*
[17] *II. Physikalisches Institut, Universität Göttingen, Göttingen, Germany*
[18] *Deutsches Elektronen-Synchrotron DESY, Notkestr. 85, 22607 Hamburg, Germany*
[19] *Department of Particle Physics and Astrophysics, Weizmann Institute of Science, Rehovot 76100, Israel*
[20] *Institut für Physik, Universität Mainz, Mainz, Germany*
[21] *Department of Physics & Astronomy, University of Sussex, Sussex House, Falmer, Brighton, BN1 9RH, United Kingdom*
[22] *Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8602, Japan*
[23] *University of Manchester, School of Physics and Astronomy, Schuster Building, Oxford Rd, Manchester M13 9PL, United Kingdom*
[24] *Dipartimento di Fisica "Ettore Pancini", Università di Napoli Federico II, Complesso Universitario di Monte S. Angelo, I-80126 Napoli, Italy*
[25] *Institute of Particle and Nuclear Studies, KEK, Oho 1-1, Tsukuba, Ibaraki 305-0801, Japan*

(Dated: March 24, 2023)

We report the first direct observation of neutrino interactions at a particle collider experiment. Neutrino candidate events are identified in a 13.6 TeV center-of-mass energy *pp* collision data set of 35.4 fb^{-1} using the active electronic components of the FASER detector at the Large Hadron Collider. The candidates are required to have a track propagating through the entire length of the FASER detector and be consistent with a muon neutrino charged-current interaction. We infer 153^{+12}_{-13} neutrino interactions with a significance of 16 standard deviations above the background-only hypothesis. These events are consistent with the characteristics expected from neutrino interactions

arXiv:2303.14185v1 [hep-ex] 24 Mar 2023

CERN Physics Beyond Colliders

Observation of collider muon neutrinos with the SND@LHC experiment

R. Albanese,[1,2] A. Alexandrov,[1] F. Alicante,[1,2] A. Anokhina,[3] T. Asada,[1,2] C. Battilana,[4,5] A. Bay,[6] C. Betancourt,[7] A. Blanco Castro,[8] M. Bogomilov,[9] D. Bonacorsi,[4,5] W.M. Bonivento,[10] P. Bordalo,[8] A. Boyarsky,[11,12] S. Buontempo,[1] M. Campanelli,[13] T. Camporesi,[14] V. Canale,[1,2] A. Castro,[4,5] D. Centanni,[1,15] F. Cerutti,[14] M. Chernyavskiy,[3] K.-Y. Choi,[16] S. Cholak,[6] F. Cindolo,[4] M. Climescu,[17] A.P. Conaboy,[18] G.M. Dallavalle,[4] D. Davino,[1,19] P.T. de Bryas,[6] G. De Lellis,[1,2] M. De Magistris,[1,15] A. De Roeck,[14] A. De Rújula,[14] M. De Serio,[20,21] D. De Simone,[7] A. Di Crescenzo,[1,2] R. Donà,[4,5] O. Durhan,[22] F. Fabbri,[4] F. Fedotovs,[13] M. Ferrillo,[7] M. Ferro-Luzzi,[14] R.A. Fini,[20] A. Fiorillo,[1,2] R. Fresa,[1,23] W. Funk,[14] A. Golovatiuk,[1,2] A. Golutvin,[24] E. Graverini,[6] A.M. Guler,[22] V. Guliaeva,[3] G.J. Haefeli,[6] J.C. Helo Herrera,[25,26] E. van Herwijnen,[24] P. Iengo,[1] S. Ilieva,[1,2,9] A. Infantino,[14] A. Iuliano,[1,2] R. Jacobsson,[14] C. Kamiscioglu,[22,27] A.M. Kauniskangas,[6] E. Khalikov,[3] S.H. Kim,[28] Y.G. Kim,[29] G. Klioutchnikov,[14] M. Komatsu,[30] N. Konovalova,[3] S. Kovalenko,[25,31] S. Kuleshov,[25,31] H.M. Lacker,[18] O. Lantwin,[3] F. Lasagni Manghi,[4] A. Lauria,[1,2] K.Y. Lee,[28] K.S. Lee,[32] S. Lo Meo,[4] V.P. Loschiavo,[1,19] S. Marcellini,[4] A. Margiotta,[4,5] A. Mascellani,[6] A. Miano,[1,2] A. Mikulenko,[11] M.C. Montesi,[1,2] F.L. Navarria,[4,5] S. Ogawa,[33] N. Okateva,[3] M. Ovchynnikov,[11] G. Paggi,[4,5] B.D. Park,[28] A. Pastore,[20] A. Perrotta,[4] D. Podgrudkov,[3] N. Polukhina,[3] A. Prota,[1,2] A. Quercia,[1,2] S. Ramos,[8] A. Reghunath,[18] T. Roganova,[3] F. Ronchetti,[6] T. Rovelli,[4,5] O. Ruchayskiy,[34] T. Ruf,[14] M. Sabate Gilarte,[14] M. Samoilov,[3] V. Scalera,[1,15] O. Schneider,[6] G. Sekhniaidze,[1] N. Serra,[7] M. Shaposhnikov,[6] V. Shevchenko,[3] T. Shchedrina,[3] L. Shchutska,[6] H. Shibuya,[33,35] S. Simone,[20,21] G.P. Siroli,[4,5] G. Sirri,[4] G. Soares,[8] O.J. Soto Sandoval,[25,26] M. Spurio,[4,5] N. Starkov,[3] I. Timiryasov,[34] V. Tioukov,[1] C. Trippl,[6] E. Ursov,[3] A. Ustyuzhanin,[1,36] G. Vankova-Kirilova,[9] V. Verguilov,[9] N. Viegas Guerreiro Leonardo,[8] C. Vilela,[8,*] C. Visone,[1,2] R. Wanke,[17] E. Yaman,[22] C. Yazici,[22] C.S. Yoon,[28] E. Zaffaroni,[6] and J. Zamora Saa[25,26]

(SND@LHC Collaboration)

[1] *Sezione INFN di Napoli, Napoli, Italy*
[2] *Università di Napoli "Federico II", Napoli, Italy*
[3] *Affiliated with an institute covered by a cooperation agreement with CERN*
[4] *Sezione INFN di Bologna, Bologna, Italy*
[5] *Università di Bologna, Bologna, Italy*
[6] *Institute of Physics, École Polytechnique Fédérale de Lausanne (EPFL), Lausanne, Switzerland*
[7] *Physik-Institut, Universität Zürich, Zürich, Switzerland*
[8] *Laboratory of Instrumentation and Experimental Particle Physics (LIP), Lisbon, Portugal*
[9] *Faculty of Physics, Sofia University, Sofia, Bulgaria*
[10] *Università degli Studi di Cagliari, Cagliari, Italy*
[11] *University of Leiden, Leiden, The Netherlands*
[12] *Taras Shevchenko National University of Kyiv, Kyiv, Ukraine*
[13] *University College London, London, United Kingdom*
[14] *European Organization for Nuclear Research (CERN), Geneva, Switzerland*
[15] *Università di Napoli Parthenope, Napoli, Italy*
[16] *Sungkyunkwan University, Suwon-si, Gyeong Gi-do, Korea*
[17] *Institut für Physik and PRISMA Cluster of Excellence, Johannes Gutenberg Universität Mainz, Mainz, Germany*
[18] *Humboldt-Universität zu Berlin, Berlin, Germany*
[19] *Università del Sannio, Benevento, Italy*
[20] *Sezione INFN di Bari, Bari, Italy*
[21] *Università di Bari, Bari, Italy*
[22] *Middle East Technical University (METU), Ankara, Turkey*
[23] *Università della Basilicata, Potenza, Italy*
[24] *Imperial College London, London, United Kingdom*
[25] *Millennium Institute for Subatomic physics at high energy frontier-SAPHIR, Fernandez Concha 700, Santiago, Chile*
[26] *Departamento de Física, Facultad de Ciencias, Universidad de La Serena, Avenida Cisternas 1200, La Serena, Chile*
[27] *Ankara University, Ankara, Turkey*
[28] *Department of Physics Education and RINS, Gyeongsang National University, Jinju, Korea*
[29] *Gwangju National University of Education, Gwangju, Korea*
[30] *Nagoya University, Nagoya, Japan*

arXiv:2305.09383v1 [hep-ex] 16 May 2023

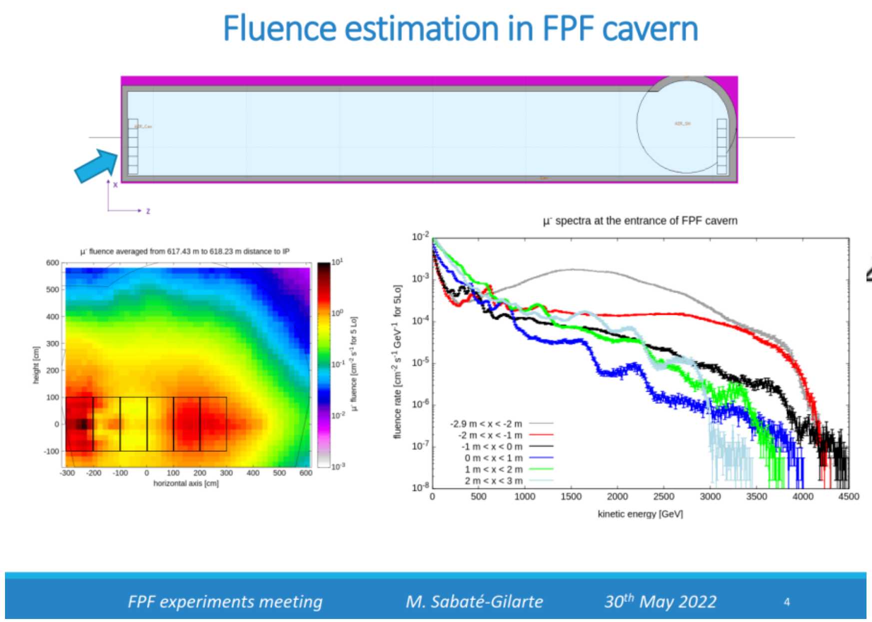
Forward Physics Facility

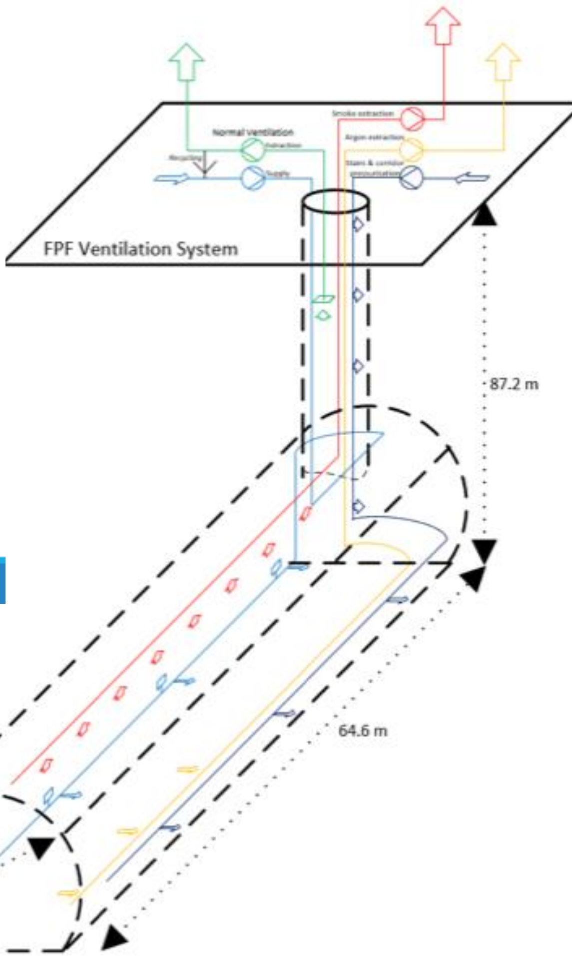
Quite some progress in the conceptual design of the infrastructure:

- No more connection gallery with LHC
- Study of vibrations due to civil engineering ➔ encouraging. Need to evaluate long term movement of SPS and LHC tunnels
- Estimates of muon fluence
- RP assessment showing that access should be possible during HL-LHC Operation for radiation workers

➔ construction decoupled from LHC schedule

➔ optimization led to estimated cost reduction





Forward Physics Facility

Updated technical report ➔ J. Boyd

- Technical system requirements and costs refined

CERN-PBC-NOTE 2023-002

7 March 2023

Jamie.Boyd@cern.ch

Update on the FPF Facility technical studies

FPF PBC Working Group:
M. Andreini, G. Arduini, K. Balazs, J. Boyd, R. Bozzi, F. Cerutti, F. Corsanego, J-P. Corso, L. Elie, A. Infantino, A. Navascues Cornago, J. Osborne, G. Peon, M. Sabaté Gilarte
CERN, CH-1211 Geneva, Switzerland

Keywords: FPF

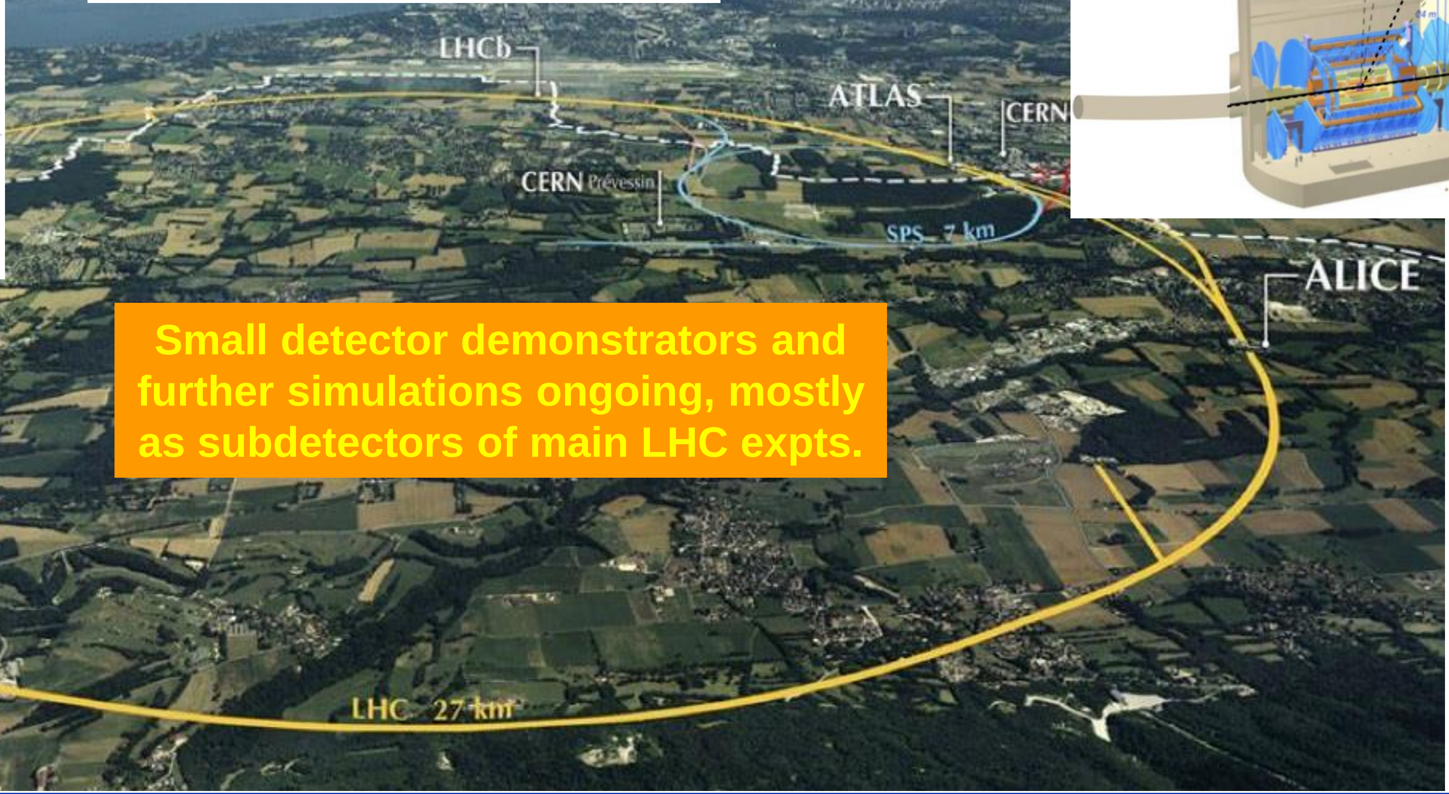
Summary

The Forward Physics Facility (FPF) is a proposed new facility to house several new experiments at the CERN High Luminosity LHC (HL-LHC). The FPF is located such that the experiments can be aligned with the collision axis line of sight (LOS), a location which allows many interesting physics measurements and searches for new physics to be carried out. The status of technical studies related to the FPF, as well as the physics potential were documented in Ref. [1] which was released in March 2022. This note documents updates to the FPF technical studies completed since that time.

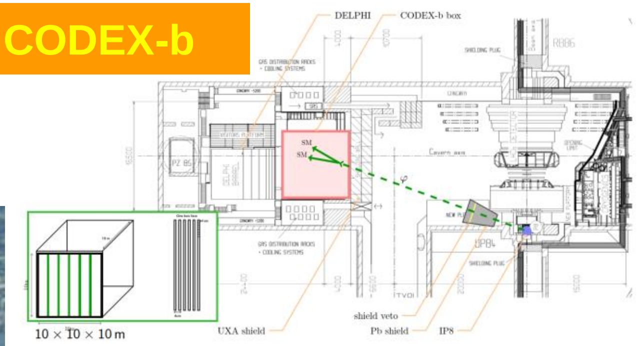
1

Site investigations completed ➔ K. Balazs

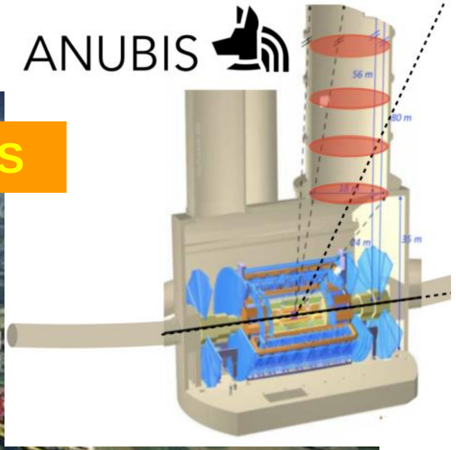
Long-Lived Particles @ LHC

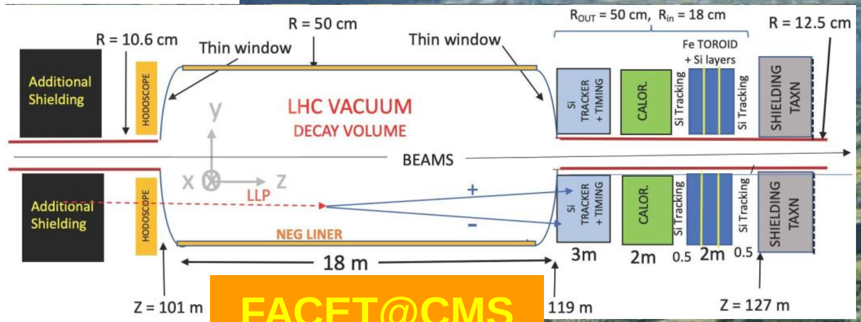


CODEX-b



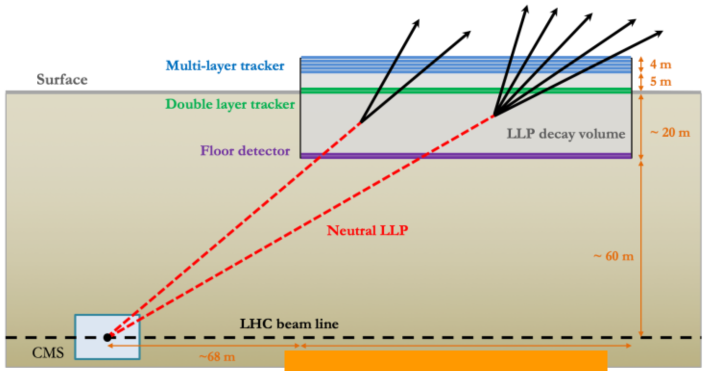
ANUBIS





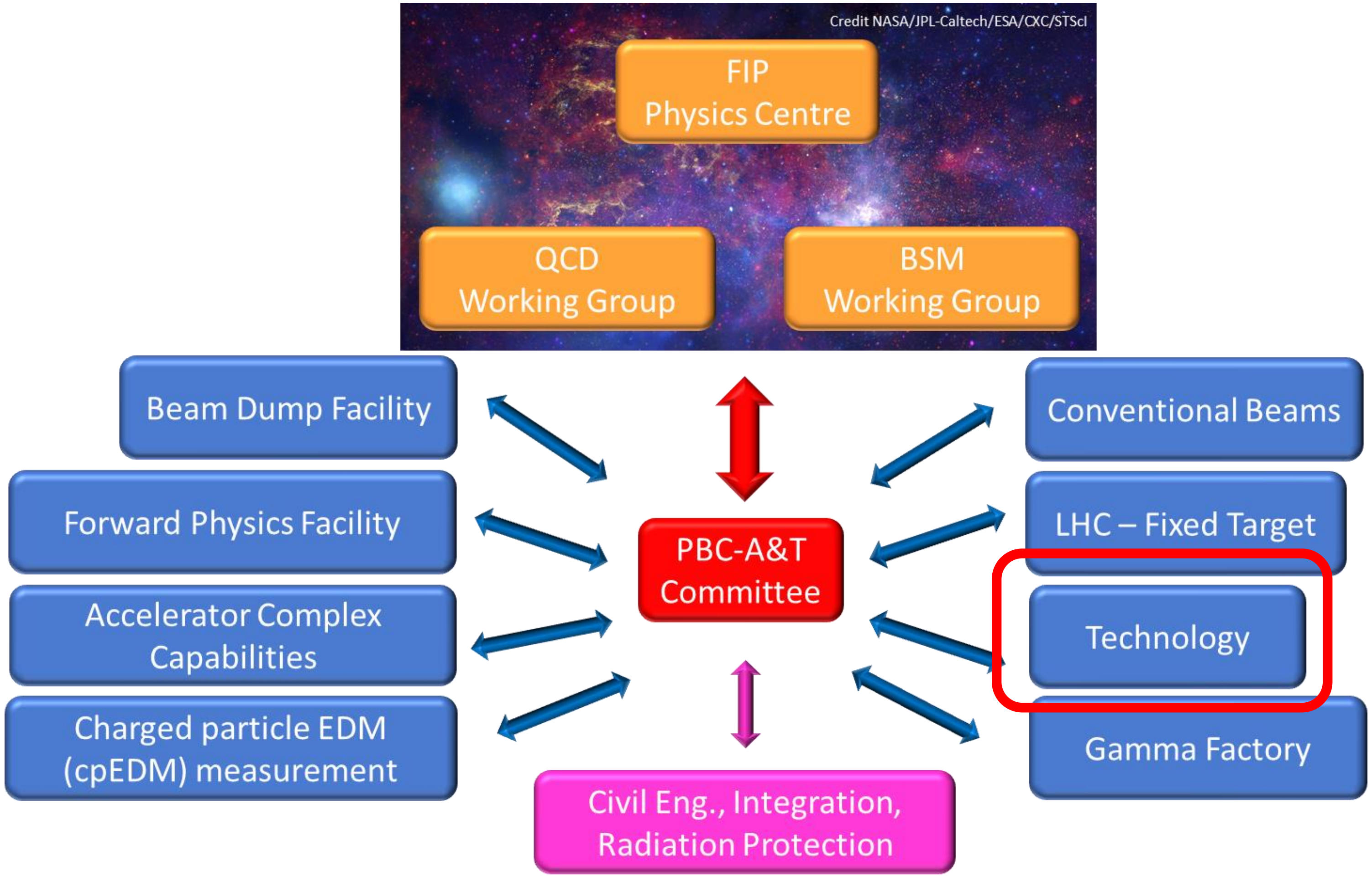
FACET@CMS

Small detector demonstrators and further simulations ongoing, mostly as subdetectors of main LHC expts.



MATHUSLA

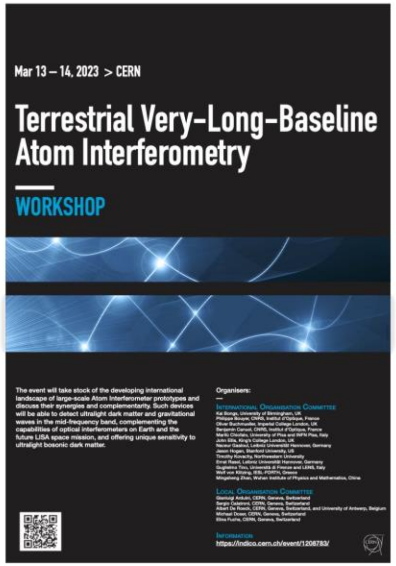
A number of complementary proposals

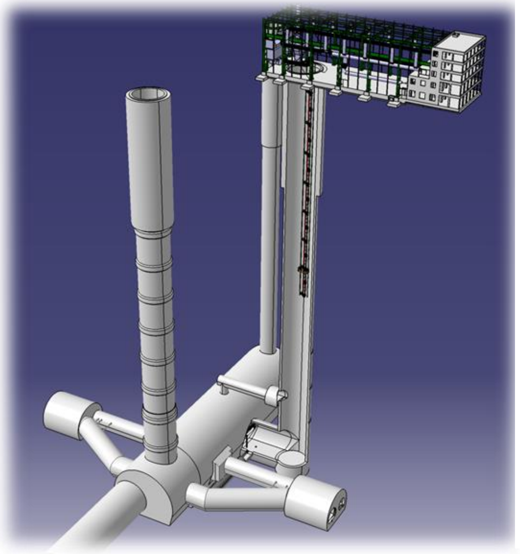


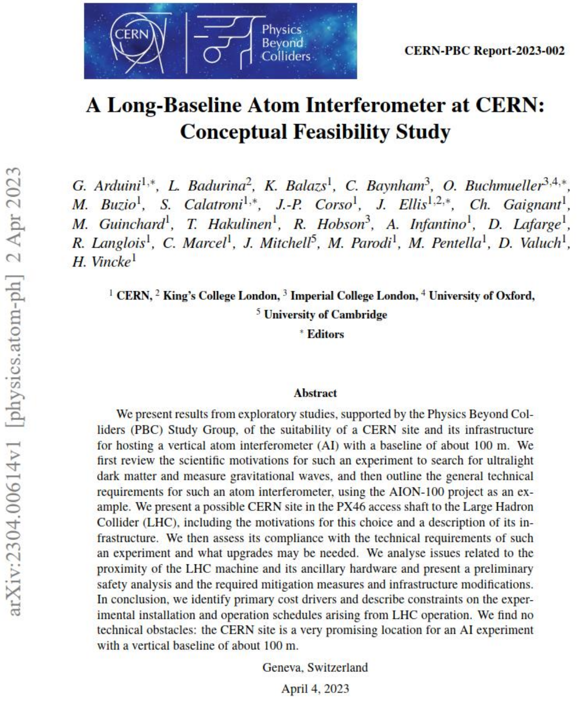
Long-Baseline Atom Interferometer@CERN

For mid-frequency gravitational waves and ultra light Dark Matter detection

- Proof-of-Principle (10m) being built in UK
- Siting of a 100m setup in an LHC shaft (PX46) investigated in PBC (Integration, RP & general safety, evaluation of EM interference -RF zone- and seismic noise /vibrations).
- Timeline:
  - Feasibility study for CERN implementation completed
  - Proto-collaboration being set-up
  - Possible LoI submission to CERN by beginning 2024 if CERN is retained as preferred site
  - Preparations (access, shielding, safety…) could occur during LS3






CERN-PBC Report-2023-002

A Long-Baseline Atom Interferometer at CERN: Conceptual Feasibility Study

G. Arduini[1,*], L. Badurina[2], K. Balazs[1], C. Baynham[3], O. Buchmueller[3,4,*], M. Buzio[1], S. Calatroni[1,*], J.-P. Corso[1], J. Ellis[1,2,*], Ch. Gaignant[1], M. Guinchard[1], T. Hakulinen[1], R. Hobson[3], A. Infantino[1], D. Lafarge[1], R. Langlois[1], C. Marcel[1], J. Mitchell[5], M. Parodi[1], M. Pentella[1], D. Valuch[1], H. Vincke[1]

[1] CERN, [2] King's College London, [3] Imperial College London, [4] University of Oxford, [5] University of Cambridge
[*] Editors

arXiv:2304.00614v1 [physics.atom-ph] 2 Apr 2023

Abstract

We present results from exploratory studies, supported by the Physics Beyond Colliders (PBC) Study Group, of the suitability of a CERN site and its infrastructure for hosting a vertical atom interferometer (AI) with a baseline of about 100 m. We first review the scientific motivations for such an experiment to search for ultralight dark matter and measure gravitational waves, and then outline the general technical requirements for such an atom interferometer, using the AION-100 project as an example. We present a possible CERN site in the PX46 access shaft to the Large Hadron Collider (LHC), including the motivations for this choice and a description of its infrastructure. We then assess its compliance with the technical requirements of such an experiment and what upgrades may be needed. We analyse issues related to the proximity of the LHC machine and its ancillary hardware and present a preliminary safety analysis and the required mitigation measures and infrastructure modifications. In conclusion, we identify primary cost drivers and describe constraints on the experimental installation and operation schedules arising from LHC operation. We find no technical obstacles: the CERN site is a very promising location for an AI experiment with a vertical baseline of about 100 m.

Geneva, Switzerland

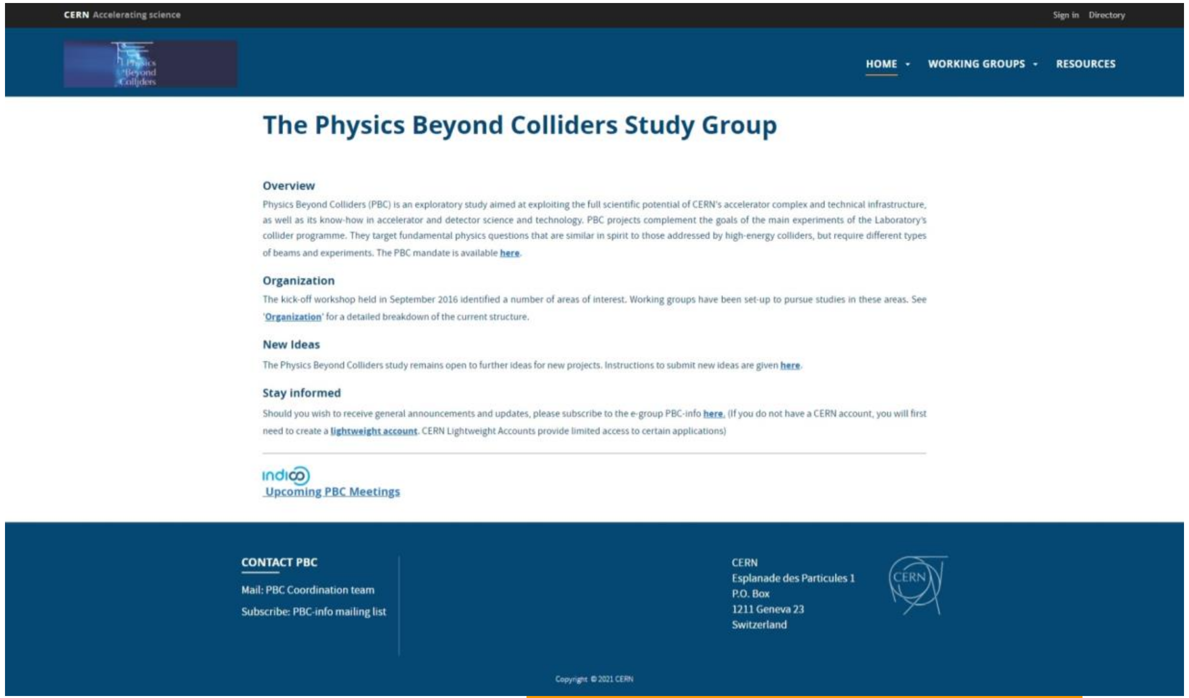
April 4, 2023

Summary

- PBC is supporting projects, benefitting from CERN competence and expertise, in view of the submission of proposals to the relevant CERN Scientific Committees

- Those with a potential implementation at CERN and related to Long Lived Particles and Dark Matter searches have been presented and their progress outlined

- **The Forward Physics Facility would allow to further extend the LHC physics reach** enhancing and expanding the potential of its precursors: FASER and SND@LHC



CERN Accelerating science
Sign in Directory
HOME WORKING GROUPS RESOURCES

The Physics Beyond Colliders Study Group

Overview

Physics Beyond Colliders (PBC) is an exploratory study aimed at exploiting the full scientific potential of CERN's accelerator complex and technical infrastructure, as well as its know-how in accelerator and detector science and technology. PBC projects complement the goals of the main experiments of the Laboratory's collider programme. They target fundamental physics questions that are similar in spirit to those addressed by high-energy colliders, but require different types of beams and experiments. The PBC mandate is available here.

Organization

The kick-off workshop held in September 2016 identified a number of areas of interest. Working groups have been set-up to pursue studies in these areas. See 'Organization' for a detailed breakdown of the current structure.

New Ideas

The Physics Beyond Colliders study remains open to further ideas for new projects. Instructions to submit new ideas are given here.

Stay informed

Should you wish to receive general announcements and updates, please subscribe to the e-group PBC-info here. (If you do not have a CERN account, you will first need to create a lightweight account. CERN Lightweight Accounts provide limited access to certain applications)

indico
Upcoming PBC Meetings

CONTACT PBC
Mail: PBC Coordination team
Subscribe: PBC-info mailing list

CERN
Esplanade des Particules 1
P.O. Box
1211 Geneva 23
Switzerland

Copyright © 2021 CERN

https://pbc.web.cern.ch/

beams.cern