

SHADOWS-LNF: 2022 Status Report

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1 Status of the SHADOWS project

The year 2022 has been a crucial year for SHADOWS for the following reasons:

- 1. January 2022:** the Expression of Interest (EoI) has been prepared and submitted to the SPS Committee (CERN-SPSC-2022-006 ; SPSC-EOI-022). About 32 people signed the EoI, coming from the following Institutions:
INFN, Sezione di Ferrara; INFN, Laboratori Nazionali di Frascati; INFN, Sezione di Bologna; University of Lancaster, Lancaster (UK); University of Mainz (D); Royal Holloway, University of London (UK); CERN.
- 2. November 2022:** the Letter of Intent (LoI) has been prepared and submitted to the SPS Committee (CERN-SPSC-2022-030 ; SPSC-I-256). The LoI has been signed by 60 people, belonging to the following Institutions: INFN, Sezione di Napoli; Heidelberg University; INFN, Sezione di Ferrara; INFN, Laboratori Nazionali di Frascati; INFN, Sezione di Bologna; CERN ; Karlsruhe Institute of Technology, KIT, Germany; INFN, Sezione di Roma III; University of Freiburg; Charles University, Prague; University of Mainz, Germany; Royal Holloway, University of London; PARTREC and University of Groningen, Groningen, The Netherland; University of Bologna, Bologna, Italy
To be noted: the number of signatories has doubled with respect to the EoI, including renowned persons as Prof. Karl Jacobs (Freiburg), Prof. U. Uwer and Prof. S. Hanzmann-menzemer (Heidelberg), Prof. M. Klute and T. Ferber (Karlsruhe), Prof. M. Schott (Mainz U.), B. Schmidt (CERN), A. Ceccucci (CERN), H. Danielsson (CERN).
- 3. November 2022:** SHADOWS has been presented at the Open Session of the SPS Committee (<https://indico.cern.ch/event/1214949/>).
- 4. November 2022:** the German Community published a Final Strategy Statement for the future of particle physics in Germany. In this document the participation at a proton beam dump experiment in the ECN3 area for studying the physics of feeböy-interacting particles is endorsed and a preliminary budget profile presented. This budget profile includes about 600 kEuro for the triennium (2024-2027) and 5 MEuros for the triennium (2027-2030).
- 5. December 2022:** The ECN3 beamline task force has finalized a document that summarizes the various aspects of a possible upgrade of the beamline and area in ECN3, including a cost estimate that is currently of the order of 100-120 MCHF.

All these inputs have been discussed during the SPSC meeting in February 2023 and the preliminary outcome reads:

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.

This outcome represents a strong support for the upgrade of the beamline and the ECN3 area. This project will be presented to the CERN Research Board in March 2023, for endorsement.

In case of positive outcome, the money of the upgrade of the beamline and the area will be allocated in the forthcoming CERN Medium Term Plan, 2024-2028.

6. **December 2022:** The SHADOWS Muon team has finalized the milestone required by the AIDA-Innova Task 8.3.2 “Large Area scintillator detectors” (as presented by A. Montanari at the last AIDA-Innova meeting, Ref.xx) and shown the capability to build a full-size module detector for the SHADOWS Muon System, including the design of the front-end electronics and slow control, done entirely at LNF.

2 Work at LNF

Essentially all the milestones envisaged in the 2022 “Rapporto di attivita’“ have been completed, as summarized below.

1. Construction and test of the two full-size modules for the muon system (with Bologna/Ferrara): **DONE**.
2. Optimization of the FEE and design of the first prototype of the middle-end board (with Bologna): **DONE**.
3. Optimization and design of the Magnetized Iron Block (MIB) (with CERN Accelerator Division): **DONE**.
4. Study of the beam-induced background in the SHADOWS area (data and Monte Carlo) (with Mainz, Royal Holloway, CERN, Lancaster): **DONE with MC**, (to be validated with data this year).
5. Development of a full Monte Carlo package for the detector simulation (with Mainz group): **DONE**, (being optimized now for the Proposal).
6. Finalization of the Letter of Intent to be submitted to the SPSC by early 2023 (all groups): **DONE**.

3 Outlook

The work planned at LNF for 2023 is entirely focussed on the studies needed for the Proposal to be submitted to the SPSC by September 2023.

4 SHADOWS-related Talks given by LNF people

1. The Search for Feebly Interacting Particle with SHADOWS at CERN, Mainz, Germany, 14 December
2. The Search for Feebly Interacting Particles, International Workshop “Particle Physics: Phenomena, Puzzles, Promises”, 21-23 November 2022, Bangalore, India
<https://www.icts.res.in/discussion-meeting/p2p3>.
3. The SHADOWS project at the SPS, 147th SPSC Open Session, 22nd November,
<https://indico.cern.ch/event/1214949/>
4. The SHADOWS project at the SPS, PBC General Workshop, 7-9 November, CERN,
<https://indico.cern.ch/event/1137276/>
5. The SHADOWS project at the SPS, 12th Workshop of Long-Lived Particles (LLP) at the LHC, Oct 31st – Nov 4th,
<https://indico.cern.ch/event/1166678/>
6. SHADOWS project at CERN: status and prospects, FIPs 2022, Workshop on Feebly-Interacting Particles, 17-21 October 2022,
<https://indico.cern.ch/event/1119695/>.
7. Search for feebly-interacting particles at NA62 and SHADOWS, invited talk, Theory, Phenomenology and Experiments in Flavour Physics, Capri, 11-13 June 2022,
<https://agenda.infn.it/event/20160/>
8. The SHADOWS project, invited Seminar, KIT (Karlsruhe Institute of Technology), Karlsruhe, Germany, April 19th 2022.

5 SHADOWS-related Workshops/Conferences organized by LNF people

- G. Lanfranchi is in the Organizing Committee of the Second Edition of FIPs 2022, Workshop on Feebly Interacting Particles, CERN, 17-21 October 2022, <https://indico.cern.ch/event/1119695/> (about 300 participants).

6 SHADOWS-related publications in 2022

1. A. Alviggi *et al.*, *SHADOWS Letter of Intent*, CERN-SPSC-2022-030, SPSC-I-256.
2. W. Baldini *et al.*, *SHADOWS Expression of Interest*, CERN-SPSC-2022-006 / SPSC-EOI-022.