SHiP experiment at the SPS Beam Dump Facility

SHiP Collaboration[1] [2]

The SHiP Collaboration has proposed a general purpose Beam Dump Facility (BDF) at the CERN SPS accelerator to search for feebly interacting GeV-scale particles. Returning to full exploitation of the current SPS would give access to 4×10^{19} protons per year at 400 GeV without affecting HL-LHC and the other existing beam facilities. The BDF/SHiP facility includes apparatus to both search for decay and scattering signatures of models with heavy neutral leptons, dark photons, dark scalars, light dark matter and other feebly interacting particles. The detector also has the capability to perform unprecedented measurements with tau neutrinos.

BDF/SHiP offers a unique opportunity to enter a new era of direct exploration at the intensity frontier which is complementary to the high energy and the precision frontiers. The European Strategy for Particle Physics Update (EPPSU) concluded that "Among the proposals for larger-scale new facilities investigated within the Physics Beyond Colliders study, the Beam Dump Facility at the SPS emerged as one of the front-runners" [1]. The strategy recognised the financial challenges associated with the implementation of BDF, requiring clear priorities for the exploration of the intensity frontier at CERN as well as R&D plans to be formulated as part of continued studies.

BDF/SHiP status and plans

The SHiP Expression of Interest was submitted to the SPSC in 2013 [2], resulting in a recommendation to form a collaboration and to prepare a Technical Proposal (TP) for the detector and the experimental facility. The TP was submitted to the SPSC in 2015 [3]. Under the initiative and experimental guidance of the SHiP Collaboration, the TP was complemented by the SHiP Physics Case [4], put together by a large collaboration in the theory community. In response to the review of the TP, the SPSC concluded with a recommendation to the CERN Research Board and the CERN management for SHiP to proceed with a three-year Comprehensive Design Study for both the detector and facility [5]. The study of the SHiP detector and BDF were included as R&D projects under the newly launched Physics Beyond Collider forum (PBC), with the further recommendation to submit an advanced proposal to the EPPSU by BDF/SHIP, and an evaluation of the physics prospects by the PBC.

The outcome of the CDS study has been documented in the proposals for BDF [6] and SHiP [7], submitted to the EPPSU, and in the CDS reports [11, 12] submitted to the SPSC. The reports are comprehensive records of the physics opportunities, the technological studies, prototyping and beam tests, and the preliminary designs of all components involved in the facility and in the detector.

In the summary documents prepared by the PBC on the technological and the scientific prospects [9, 10], BDF/SHiP was ranked as a mature and competitive project ready for implementation. The project was extensively discussed at the Open EPPSU Symposium in Granada, and drew significant attention and support as a "major potential player in the search for Feebly Interacting Particles". The EPPSU Physics Briefing Book [8] reflects these conclusions.

The CDS phase has generated a detailed understanding of the physics performance and the detector, together with the remaining challenges and the available options. The feasibility of the facility is proven, the technologies and techniques, although challenging, appear to be within CERN's established competencies. Given the resources, the project is ready to move towards the detailed design phase. A complete road map and cost for the R&D and the construction of the facility and the detector have been presented. In conjunction with continued development of the BDF, the SHiP Collaboration is committed to further develop the physics case to optimise the facility, and proceed with sustained R&D activities towards TDRs.

[1] URL:Author list

[2] Contact persons: Andrei.Golutvin@cern.ch; Richard.Jacobsson@cern.ch; Mike.Lamont@cern.ch

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