



SHiP

Search for Hidden Particles

Vacuum Vessel workshop

*Far from the first to have
had a research vessel frozen...*





Collaboration on the BDF R&D



◉ What makes us BDFans?

- *Availability of 4×10^{19} p/year slowly extracted on dense target at 400 GeV on with existing accelerator!*
- Huge potential for a rich and high-profile physics programme on Intensity Frontier
- Motivation is unchallenged, investment today is
- Several measurements in the coming ~5 years have significant chances of being game changers!
 - Search and characterisation of Dark Matter (cosmofrontier) → Hidden Sector search and LDM
 - Flavour physics → TauFV and neutrino interactions

◉ Main objective for coming years

- Maintain knowledge, improve (~cost), and prepare with modest investment
- Evaluate and ensure physics potential (competitiveness) along with physics scene and progress

◉ Given the extra time:

- Review current design strategies
- Review location → review experiment layout
- TauFV – very limited work on this for the CDS, strong motivation
- Muon shield and decay volume key drivers of several facility parameters
- Stay flexible on priorities for the physics programme
- Not compromise on physics performance
- Maintain and develop SHiP's software essential



MoU in preparation

for Collaboration on the SPS Beam Dump Facility (BDF) R&D Programme

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MoU SPS Beam Dump Facility R&D Programme

Preamble

- (a) An Expression of Interest for a new experimental facility was submitted to the SPSC in October 2013 [CERN-SPSC-2013-024]. Following the SPSC recommendations, a group of Institutes from CERN Member and non-Member States, and CERN agreed to form the SHiP Collaboration and proceed with the preparation of a Technical Proposal (TP) on the detectors and the proposed SPS experimental facility, and an extensive report on the Physics Case, submitted to SPSC in 2015 [CERN-SPSC-2015-016, CERN-SPSC-2015-017]. The review of the TP concluded with a recommendation to proceed with a three year Comprehensive Design Study under the auspices of the CERN Physics Beyond Colliders (PBC) initiative, with the goal of submitting a proposal for the facility (BDF) and the detectors (SHiP) to the 2020 European Particle Physics Strategy Update
- (b) With regard to the BDF/SHiP proposal, the underlying Deliberation Document of the 2020 Update of the European Strategy for Particle Physics [CERN-ESU-014, March 2020], while recognising that the project is one of the frontrunners among the new large-scale facilities investigated within the PBC studies, concluded that, as of 2020, the financial conditions imply that the construction of the Beam Dump Facility cannot be recommended considering the other recommendations of the Strategy.
- (c) In line with recommendations of the Strategy Update to continue developing scientific programmes complementary to the high energy frontier, the CERN Medium Term Plan 2021 - 2025 stipulates [CERN/SPC/1141/Rev., CERN/FC/6412/Rev., CERN/3499/Rev., 11 September 2020]

"Given the importance of a diverse scientific programme to addressing the outstanding questions in particle physics in a way complementary to high-energy colliders, PBC activities are funded with an increased budget of 3 MCHF/year in this MTP (up from 1 MCHF/year). These resources will also be used to continue R&D and design studies (beam extraction and transfer, target system, radiation protection, etc.) for a beam dump facility at the SPS, so as to be ready to start construction before the end of the decade if a decision is taken on its implementation by the time of the next ESPP update."

- (d) According to c) and building on the work performed up to and including the Comprehensive Design Study, results on updated R&D work on the design of the BDF, and its physics potential, shall be made available by the time of the next Update of the European Strategy for Particle Physics in order to allow a timely realisation, should a favourable decision be taken on its implementation.

Purpose of this MoU

- (e) This MoU establishes a common understanding between the Participants and CERN for the collaborative effort required to support the BDF R&D Programme.
- (f) This MoU provides the framework for the participation of Institutes having an interest in the BDF facility in the execution of the BDF R&D Programme.

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MoU SPS Beam Dump Facility R&D Programme

- (g) By signing this Memorandum, the signatory becomes a Participant in the BDF R&D Programme, together with the other institutes, laboratories, universities and their funding agencies who are, or who subsequently become, Participants in the BDF R&D Programme.
- (h) This MoU replaces the preceding Collaboration Agreement KN3774/EP.

Scope

- (i) The priorities and the specific objectives of the BDF R&D Programme are to be established in agreement with the Physics Beyond Colliders study group (PBC) and with the SPSC.
- (j) It is expected that the participating Institutes contribute to the BDF R&D Programme by performing studies that are critical to demonstrate the feasibility of the physics programme and strongly influence the layout of the facility. In particular, focus should be on those systems that are fundamental for the suppression of background, and that require extensive simulation studies, prototyping and beam tests.
- (k) The collaborative effort on the BDF R&D Programme shall provide input for the future of CERN's scientific diversity programme, through the PBC.
- (l) Each Institute's contribution to the BDF R&D Programme shall be organised as an individual project with partnership established in the form of bilateral or multilateral agreements between CERN and the involved Institute(s). Each project shall be defined in a dedicated Addendum to this MoU, to be signed by CERN as the Host Laboratory and the Institution(s) participating in the Project, addressing, inter alia:
1. Project organisation;
 2. The contributions by Institutions;
 3. The sharing of work packages and/or deliverables and related costs;
 4. Project Milestones.
- (m) A template for a Project-specific Addendum is provided in Annex 2.

Participants

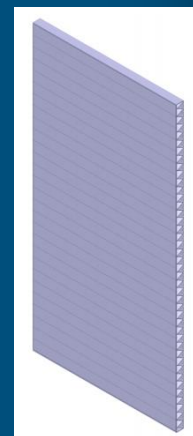
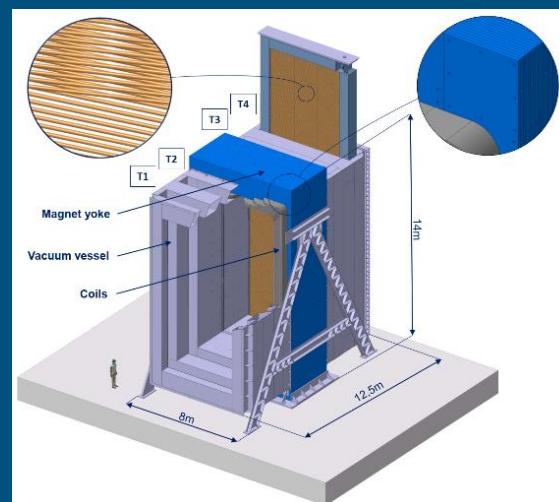
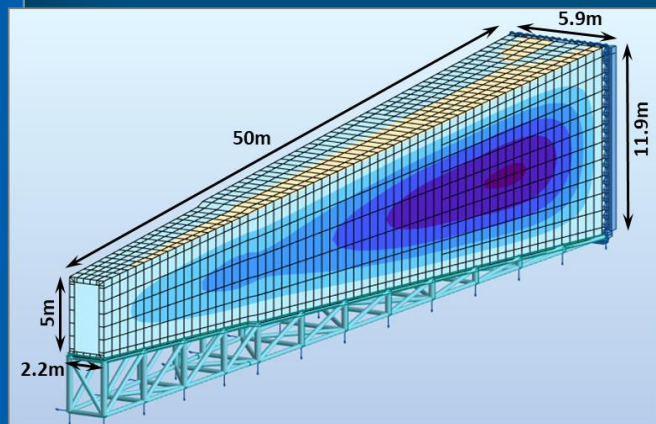
- (n) Any Institution that wishes to become Participant shall secure the necessary resources and shall accept this MoU and any related agreement that is in place between Participants and CERN, and is disclosed to it.
- (o) This MoU is not legally binding, but the Participants recognise that the success of the Study depends on all Participants adhering to its provisions. (Legal: What about the research agreements?)

Organisation

- (p) CERN shall act as the host organization for the Participant's activities related to the BDF R&D Programme.



Applied to vacuum vessel



Goal of this workshop:

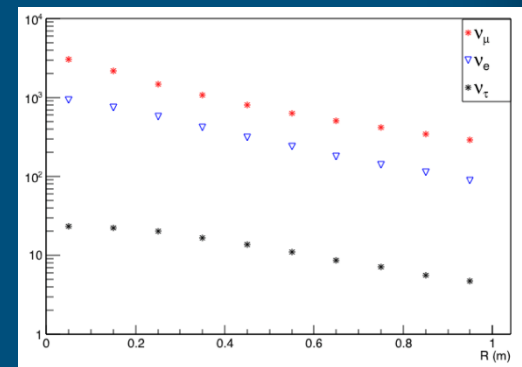
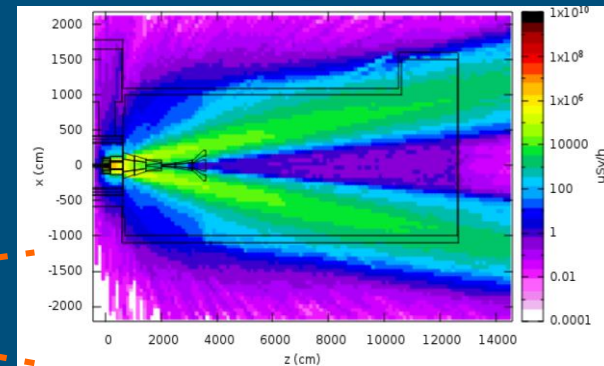
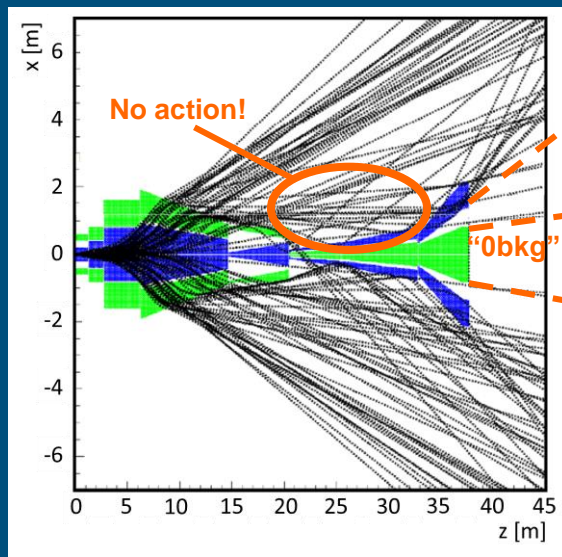
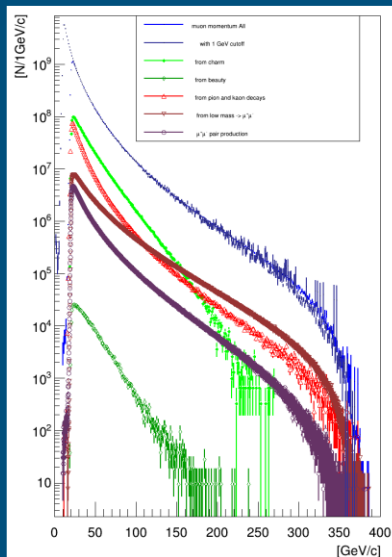
- Review the current activities
 - Identify the most important points to address
 - Jointly define “optimized” programme of prototyping
- ➔ Work package for an addendum to MoU
1. Maintain and continue develop the current design ➔ final understanding
 2. Assess and take on board lessons from alternative designs
 3. Stay open to alternative designs



Muon shield – vessel coupling



...or, why we will still be rocking the boat...!



Naïve question

- Background suppression is convolution of muon shield and detector
 - ➔ Relaxing muon shield can be compensated by suppression from reconstruction
- ➔ What if we reduce the weight factor of high energy muons in the shield optimisation?
 - Focus on deflecting low/mid-momentum muons over shortest distance, ignoring $\max \int Bdl$
 - ➔ Goal: reduce muon shield length to move detector closer but not fully scale down aperture linearly
 - ➔ Neutrino background yield decreases at larger angles
- Consequences for vacuum vessel?
 - ➔ Dreams: smaller, lighter, cheaper... money goes in detectors...