Addendum

FASER: ForwArd Search ExpeRiment at the LHC

FASER Collaboration

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Abstract

This addendum to the main FASER document describes the community interested in FASER, as well as FASER's timeline, construction and operating costs, and computing requirements.

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I. INTERESTED COMMUNITY

The FASER Collaboration currently includes the following people:

- Experimentalists: Jamie Boyd (CERN, co-spokesperson), Akitaki Ariga (Bern), Tomoko Ariga (Bern and Kyushu), Franck Cadoux (Geneva), David Casper (UC Irvine), Yannick Favre (Geneva), Didier Ferrere (Geneva), Shih-Chieh Hsu, (Washington), Giuseppe Iacobucci (Geneva), Enrique Kajomovitz (Technion), Susanne Kuehn (CERN), Lorne Levinson (Weizmann), Hidetoshi Otono (Kyushu), Brian Petersen (CERN), Osamu Sato (Nagoya), Matthias Schott (Mainz), Sergio Sevilla (Geneva), Anna Sfyrla (Geneva), Aaron Soffa (UC Irvine), Yosuke Takubo (KEK), Eric Torrence (Oregon), Gang Zhang (Tsinghua, China).

- Theorists: Jonathan Feng (UC Irvine, co-spokesperson), Iftah Galon (Rutgers), Felix Kling (UC Irvine), Jordan Smolinsky (UC Irvine), Sebastian Trojanowski (National Centre for Nuclear Research, Warsaw and Sheffield).

In addition, a large number of CERN staff, although not members of the Collaboration, are supporting FASER in essential ways. Many of them and their contributions are listed in FASER's Letter of Intent [1] and Technical Proposal [2].

For FASER 2, the Collaboration can be expected to grow considerably, given the large and growing interest in light and weakly-interacting particles. The broader community includes collaborators on complementary experiments with similar physics targets, including HPS [3], Belle-II [4], LHCb [5, 6], NA62 [7], NA64 [8], SeaQuest [9], SHiP [10], MATHUSLA [11, 12], CODEX-b [13], AL3X [14], and LDMX [15]. For a more complete list of current and proposed experiments, see, e.g., Ref. [16].

Of course, in addition to those who might work on FASER, the community interested in FASER includes all who are interested in the fields of physics FASER will impact. These fields include physics beyond the standard model, dark matter, particle cosmology and astrophysics, neutrino physics, flavor physics, and also possibly cosmic ray physics.

II. TIMELINE

The timeline for the FASER program is set by the LHC running schedule. The FASER detector will be constructed in Long Shutdown 2 from 2019-20 in time to collect data during the LHC's Run 3 from 2021-23. After successful operation of FASER, FASER 2 could be constructed and installed during LS3 from 2024-26 and collect data during the HL-LHC era from 2026-35.

III. CONSTRUCTION AND OPERATING COSTS

An essential feature of the FASER program is its ability to do world-leading physics at a very affordable cost, thanks to the size and location of the experiments. FASER's decay volume is just 0.047 m^3, and the entire experiment fits in a box with dimensions 1 m $\times$ 1 m $\times$ 5 m. In addition, FASER's location in TI12 is quiet, so detector components do not need to be radiation hard, and background radiation for electronics is not a great concern.

A detailed cost estimate of FASER has been presented in the FASER Technical Proposal [2]. The total cost for construction is approximately 800 kCHF, with roughly half of the cost in magnet construction. FASER's low cost and rapid construction schedule are made possible by re-use of hardware from other experiments. In particular, the ATLAS silicon tracker (SCT) and LHCb Collaborations have generously allowed FASER to use their spare tracker and calorimeter modules, respectively. The entire cost of FASER construction and installation, as well as some operating expenses, is expected to be funded by two private foundations through grants totalling roughly 2 MCHF. An additional cost of roughly 300 kCHF, largely civil engineering and transport costs, is expected to be borne by CERN. Planning for FASER 2 is still in its early stages, but its cost may be roughly $\sim 5-10$ times that of FASER.

IV. COMPUTING REQUIREMENTS

FASER's computing and storage requirements will be orders of magnitude smaller than the flagship LHC experiments. The detector's 72 ATLAS SCT modules represent less than 2% of the corresponding ATLAS sub-detector, and the occupancy is lower by a similar factor. Reconstruction of FASER data will consume negligible CPU time. Simulation time is dominated by showers in the calorimeter, and can be made negligible by standard parameterization and fast simulation techniques.

Work on FASER 2 is still very preliminary, but as with the construction cost, its computing requirements would be somewhat greater than FASER's. Depending on the detector technology, the occupancy per event may not be much different, but the trigger rate will scale with the detector's larger area and the HL-LHC's higher luminosity. Even so, these requirements will remain insignificant compared to those of the large LHC experiments.

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