Letter of intent: **LASH**

Please specify an acronym, a project title and the name(s) of the project leader(s)

Large Area Sensor for Hadron Physics (LASH)

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In the sections below, please provide details on *(2 pages max.):*

1. Research objectives

One of the most important longstanding problems in theoretical and experimental physics remains the disagreement between the expectation of the hadronic vacuum polarization (HVP) obtained from recent lattice calculations and those obtained from hadronic cross-sections. A new generation of experiments at CERN (MUonE) and at JPARC (g-2) are being built to address this challenge. The outcome will provide an insight as to whether the existing data are, a triumph of the standard model or a definitive indicator of new physics. This requires a consolidation of the HVP prediction. To this aim, MUonE employs an entirely new approach to determine the HVP. The technique relies on an exquisitely high precision pioneering measurement of the distribution of muon-electron scattering in a low-Z (Be, C) target. The goal is to measure the shape of the elastic μ-e differential cross section at 10 ppm.

A prerequisite for MUonE is the use of light and possible thin target material to minimize the multiple scattering and background effects. The tracking detector, required to study the events, must provide an excellent hit resolution (~5 μm), a large active area (10 ×10 cm^2) and minimal detector material. The tracking efficiency must be kept as high and uniform as possible, with variations not exceeding 10^{-5} over the whole surface of the detectors. Furthermore the detector must be capable of operation at O(100) MHz in an asynchronous mode. No such tracker system and matched data acquisition currently exists. We have designed suitable mechanics (Liverpool) and new high density readout silicon sensors (25 micron pitch) of 10×10 cm^2 are being provided by Micron Semiconductor. Here we propose to develop the first phase demonstrator of **LASH** (**L**arge **A**rea **S**ensor for **H**adron Physic) and qualify (and test) the underlying sensor performance of this system in beam. We will manufacture a true 0 CTE prototype tracker 8-plane station (<0.5 ppm) for LASH using customized carbon fiber composites. The LASH sensors will be equipped with LHC speed (40MHz) electronics, which is the readout system with closest performance to LASH specifications. Results with this system will allow to specify the architecture of a next generation 120MHz compatible high sensitivity ASIC and define a phase 2 tracker station customized to the requirements of MUonE. This will form the core deliverable of the LASH project which we plan to achieve within the 4-year project.

LASH will require the collaboration of key teams and stakeholders across Europe including Liverpool, CERN, FBK and Rome. Liverpool is already providing prototype sensors and mechanics for MUonE in the BMS system. It has previously tested readout and designed and delivered sensors and, DAQ and tracking for LHCb VELO (with Rome) and protoDUNE. It is thus well placed to test and quantify the performance of the assembled LASH and design and

provide the DAQ for both the prototype and the final system. The tests will require integration of new mechanics and modules into a tracker station into test-beam facility at CERN and careful metrology. Understanding of the sensors will be performed in collaboration with Rome. The flex circuits (onto which the sensors and ASICs are mounted) and modules will be built and assembled by Liverpool. Interaction with FBK on the development of the new readout ASIC and possible solutions is expected.

Connection to Transnational Access infrastructures (TAs) and / or Virtual Access projects (VAs)

CERN (beam and laboratory tests, meetings)

FBK (meetings & tests on readout ASICs)

3. Estimated budget request

The budget requested is 400kE which will be used to hire a scientist/engineer for the 4-years period (320kE), travels between the nodes (40kE) and consumables (40kE for sensors, laboratory usage and maintenance**)**

4. Participating and partner institutions

University of Liverpool (UK), University of Rome La Sapienza (Italy)