

Particle Physics PhD positions at Sheffield University.

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A number of PhD positions in particle physics are available in the particle physics and particle astrophysics (PPPA) group at the University of Sheffield. The group is involved in several particle physics projects:

- **ATLAS: High energy collisions at the LHC**
 - Group members have held high-profile positions in the experiment as physics coordinator, computing coordinator and run coordinator and also as physics and performance group convenors. We are involved in a number of high-profile measurements such as precision diboson production and scattering measurements that can be used in global fits to the W,Z and the Higgs bosons and to search for deviations from the Standard Model at high energies. We further search for additional Higgs bosons and measure Higgs Bosons properties in tau-decays and are try to observe Higgs decays into muons as well as di-Higgs production. Furthermore we are looking for new physics in photon-induced processes both in pp and in heavy ion collisions.
 - A series of upgrades to the Large Hadron Collider (LHC) accelerator complex are planned by CERN, the last of which is dubbed the High Luminosity LHC (HL-LHC) and is expected to begin collecting data in 2030. In order to meet the challenges associated with this upgrade, ATLAS will undergo extensive modifications. This project will focus on the construction of detector modules for the new all-silicon Inner Tracking detector (ITk), part of which is being built in the University of Sheffield Semiconductor Detector Development Facility.

- **Neutrino Physics**
 - The particle physics and particle astrophysics (PPPA) group at the University of Sheffield has a long-standing involvement in Japan's long-baseline neutrino programme. Currently, we are involved in 3 projects, T2K, Super-Kamiokande ("Super-K") and Hyper-Kamiokande ("Hyper-K"). To date, T2K has provided world-leading measurements of the parameters in the CKM neutrino mixing matrix as well as the first indications of CP violation in the neutrino sector.
 - The SBND (Short-Baseline Near Detector) experiment is part of the multi-detector Short Baseline Neutrino (SBN) programme located along the Booster Neutrino Beamline at Fermilab, USA. The main goal of the SBN programme is to address a number of anomalies observed by previous short baseline experiments through searches for sterile neutrinos and other beyond the Standard Model (BSM) phenomena. The SBND experiment began data-taking in July 2024 and has an extensive near-term physics program with substantial involvement from the University of Sheffield PPPA group. Our areas

of expertise include detector operation, modelling, software development, and data analysis.

- The Deep Underground Neutrino Experiment (DUNE) is a large international project to design, construct and operate a multi-kiloton scale liquid argon detector for neutrino physics, neutrino astrophysics and a search for physics beyond the Standard Model. The detector systems will be built deep underground at the SURF facility (South Dakota, USA). The PPPA group at the University of Sheffield is involved in the DUNE project with a broad range of responsibilities in detector construction, modelling and software development.
- **Dark Matter**
 - Our group at Sheffield leads the 'Quantum Sensors for the Hidden Sector' collaboration, and collaborates with the Axion Dark Matter Experiment (ADMX) collaboration in the USA. The objective of the project is the search for hidden sector dark matter, including QCD axions and axion like particles (ALPs).
 - The LUX-ZEPLIN (LZ) experiment is taking data in the deep underground laboratory at SURF (South Dakota, USA). The particle physics and particle astrophysics (PPPA) group at the University of Sheffield has been involved in the LZ experiment since 2013 and is currently involved in data analysis and Monte Carlo modelling. We are part of the global XLZD collaboration, working towards a future dark matter experiment. In Sheffield, we have several areas of responsibility for detector design and R&D and simulation-based detector modelling. We are part of a UK effort promoting Boulby (North Yorkshire) as a host laboratory.
- **Applied Physics**
 - Cosmic-ray muons are known to be useful in applications beyond particle astrophysics. They have helped with mapping structure of volcanoes and with finding voids in various geological structures. Other possible applications include studies of geological repositories including monitoring carbon capture, tracing illicit nuclear materials etc. The Particle Physics and Particle Astrophysics (PPPA) group at the University of Sheffield, in collaboration with other institutions and industrial partners, pursues a wide programme related to these muon applications.

The successful candidate will have a good knowledge of particle physics and excellent programming skills. Knowledge of nuclear physics and particle astrophysics is desirable. The project is open to home and international candidates but international students may need to secure funding to pay fees and living expenses. A variety of PhD projects are available within the group throughout our research portfolio. Candidates who are interested in multiple projects within our group need only register their interest once and will be considered for all projects in which they have an interest.

For further information, please email k.lohwasser@sheffield.ac.uk or look at the University's website: <https://www.sheffield.ac.uk/postgraduate/phd>