

Update for the Boulby Deep Underground Science Facility

S.Paling

s.m.paling@sheffield.ac.uk

Boulby Underground Laboratory, Boulby Mine, United Kingdom

ABSTRACT

The Boulby Underground Laboratory is the UK's 1.1km deep science facility located in a working potash and rock-salt mine on the North East coast of England. Since the late 1980s Boulby has hosted Dark Matter search experiments, beginning with Sodium Iodide studies and moving on to the current ZEPLIN and DRIFT detector technologies. The Dark Matter search projects at Boulby continue and the scientific programme at Boulby is expanding with projects emerging in the areas of geology, microbiology, climate and the environment as well as potential future large-scale rare event studies.

The underground facility at Boulby, funded by the UK's Science and Technology Facilities Council (STFC) consists of a 120m long main experimental hall with 3 service areas with offices, workshops and support infrastructure. The facility has air conditioning and filtration, lifting capability and internet / telephone communications. Underground operations are supported with a dedicated surface building on the mine site with office and administration space and workshops. The facility also benefits from a special relationship with the mine operators Cleveland Potash Ltd (CPL) who provide wide ranging operational support from health and safety to provision of electricity, communications and delivery of materials. At 1.1km deep (2805mwe) the cosmic ray muon flux at Boulby is reduced by a factor of 1 million compared to surface levels. The relatively radio-pure rock-salt surrounding the laboratory means the local neutron backgrounds are low and the radon levels at Boulby are the lowest of all of the laboratories in Europe.

Current experiments at Boulby include the ZEPLIN-III and DRIFT-II dark matter search experiments. ZEPLIN-III: a high sensitivity, 12kg, 2-phase Xenon target detector has recently completed a >300 days second (and final) science run following an upgrade of low-background PMTs and active veto after first operation. Analysis of the data is now underway. DRIFT-II: a negative ion drift TPC using low pressure CS₂ and CF₄ gas target and dual MWPC readouts is currently the world's most sensitive directional Dark Matter detector. DRIFT-II is currently operating and plans are emerging for an expansion of the project and development of a larger multi-module DRIFT detector system (DRIFT-III).

The future science plan for the facility is to continue hosting dark matter and rare-event searches in addition to emerging multidisciplinary underground science projects. Since 2007 Boulby has hosted the SKY project: a study of the role of atmospheric ionization (from Cosmic rays) on aerosol production and climate. The first 'SKY-ZERO' experiment is now complete and plans are in place to build a next generation experiment, 'SKY-II', to be operated at Boulby in 2012/13. Other projects emerging include proposals to better exploit the ultra-low background gamma spectroscopy capabilities at Boulby for various environment-related 'radio-ecology' studies, to develop and test techniques for monitoring structural changes for Carbon Capture and Storage sites, and to establish a deep underground geo-microbiology and astrobiology centre connected to the existing facility. Future plans also include consideration of the facility for hosting potential future large-scale neutrino and rare-event projects – in particular the LAGUNA project and the variable-baseline DAE DALUS study.