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# Systems for detecting and measuring backgrounds with the SABRE South experiment

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The SABRE (Sodium iodide with Active Background REjection) experiment aims to detect an annual rate modulation from dark matter interactions in ultra-high purity NaI(Tl) crystals which will provide a model independent test of the signal observed by DAMA/LIBRA. It will consist of two separate detectors in the Northern and Southern hemispheres. SABRE South will be located in the newly completed Stawell Underground Physics Laboratory (SUPL), the first deep underground laboratory in the southern hemisphere. As the first large detector in SUPL, SABRE South will also be used to measure backgrounds from radiogenic and cosmogenic sources. SABRE South is intended to disentangle seasonal or site-related effects from the dark matter-like modulated signal and as such measuring and understanding these backgrounds is essential for the reliability and consistent performance of these searches.

SABRE South is designed to detect the signals generated by radiation and cosmic rays using both a 17kL liquid scintillator detector which will be contained in a steel vessel, and a plane of plastic scintillator modules located above the vessel to more reliably detect muons from cosmic-rays. The liquid scintillator is instrumented with 18 PhotoMultiplier Tubes (PMTs) which will be immersed in the liquid. The plastic scintillator has 8 modules each instrumented with 2 PMTs allowing position resolution below 5cm.

During the ongoing construction and commissioning of the final SABRE South experiment, the plastic scintillator system is being used to measure the muon flux at SUPL as a function of energy and angle. In addition the performance of the liquid scintillator has been measured using a small scale setup which combined with dedicated simulation studies allows for particle identification and position reconstruction. To achieve the best identification and reconstruction the behaviour of the PMTs have also been extensively measured and studied.

This talk will report on the capabilities of the liquid and plastic scintillator detection systems including calibration procedures, methods for particle identification and position reconstruction, results of and comparison to Geant4 simulation, as well as the first measurements of muon flux observed by the plastic scintillator system at SUPL.

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