SABRE and the Stawell Underground Physics Laboratory: Dark Matter Research at the Australian National University

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The direct detection of dark matter is a key problem in astroparticle physics that generally requires the use of deep-underground laboratories for a low-background environment where the rare signals from dark matter interactions can be observed. The dark matter interaction rate from Weakly Interacting Massive Particles (WIMPs) in an Earth-based detector, is expected to modulate yearly due to the change of the Earth's speed relative to the galactic halo reference frame. There is a long-standing result from the DAMA experiment at the Gran Sasso National Laboratory (LNGS) in Italy that used NaI(Tl) scintillator for the detector medium; their observed results are consistent with this scenario [1,2,3]. However, the magnitude of the signal is in tension with a number of other direct detection measurements that use different detector technologies [4].

SABRE (Sodium-iodide with Active Background REjection) is a new NaI(Tl) experiment [5,6] designed to search for galactic dark matter through the annual modulation signature. Arrays of NaI(Tl) detectors with unprecedented radio-purity will be operated inside volumes of active liquid scintillator to veto against both external and internal backgrounds, especially the 3 keV signature from the decay of trace amounts of ^{40}K within the crystals. SABRE will be a dual-site experiment located at both LNGS (Italy) and at the Stawell Underground Physics Laboratory under development in Victoria, Australia, that involves over 50 people from more than a dozen institutions in Europe, Australia and the US. The operation of twin full scale experiments in both the northern and southern hemispheres is an important factor that will strengthen the reliability of a dark matter detection result by discriminating against possible seasonal systematic effects.

SABRE relies on detector materials and measurement techniques from nuclear physics. This presentation will describe the SABRE experiment, plans for the new laboratory in Australia (anticipated to be the first deep underground laboratory operational in the southern hemisphere), and the results from nuclear physics experiments performed at the Australian National University with our 14UD tandem accelerator that support the SABRE detector development effort.

The SABRE experiment has been the instigator for a cohesive program of Australian effort in dark matter research (WIMPs, WISPs, indirect detection, theory) and the status of this program and future effort will also be briefly described.

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