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CYGNUS-Oz development of directional dark matter detection capabilities using a gaseous time projection chamber for the Cygnus experiment

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As dark matter detectors continue to probe into increasingly lower mass and cross-section regions of the phase space for Weakly Interacting Massive Particles (WIMPs), coherent scattering of solar neutrinos from the neutrino floor (increasingly termed the 'neutrino fog'[1]), will pose an irreducible background that needs to be overcome. Directional detectors such as gaseous time projection chambers (TPCs) are an attractive means of overcoming this background by using directional information to distinguish solar neutrinos from dark matter in the galactic halo. To date, however, the gaseous TPCs, have not been demonstrated to be able to meet the performance criteria required to probe the neutrino fog [2].

The Australian National University is part of the international CYGNUS effort that aims to demonstrate the viability of gaseous TPCs as a WIMP detector capable of exploring the neutrino fog, amongst other potential physics uses. To this end, the CYGNUS-Oz collaboration has been initiated to unify the Australian contributions to CYGNUS. This presentation will provide a general overview of the CYGNUS-Oz experimental work underway at the ANU, which centres around a prototype gas TPC with 7 L of sensitive volume. The current experimental status and an overview of the potential physics reach of CYGNUS will also be presented.

[1] C.A.J. O'Hare, New definition of the neutrino floor for direct dark matter searches, Physical Review Letters 127 (2021)

[2] S.E. Vahsen, C.A.J. O'Hare, D. Loomba, Directional Recoil Detection, Annual Review of Nuclear and Particle Science 71 (2021).

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