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The CYGNUS project

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The CYGNUS proto-collaboration aims to establish a Galactic Directional Recoil Observatory at the ton-scale that could test the DM hypothesis beyond the Neutrino Floor and measure the coherent and elastic scattering of neutrinos from the Sun and possibly Supernovae. A unique capability of CYGNUS will be the detailed measurement of topology and direction of low-energy nuclear and electron recoils in real time. Other key features of CYGNUS are modular, recoil sensitive TPCs (electron and/or negative ion drift operation) filled with a Helium-Florine based gas mixture at atmospheric pressure for sensitivity to low WIMP masses for both Spin Independent and Spin Dependent couplings. Installation in multiple underground sites (including the Southern Hemisphere), with a staged expansion, is foreseen to mitigate contingencies, minimise location systematics and improve sensitivity. Current and near-term, m^3-scale detectors can be used for precision studies of final state topology, such as measurements of the Migdal effect, and searches for beyond the Standard Model (BSM) physics at beam dumps and neutrino beams. Next generation, 10 m^3 detectors should allow measurements of CNO solar neutrinos via coherent elastic scattering, and produce improved limits on spin-dependent DM scattering. A ton-scale observatory would probe unexplored DM parameter space, including below the neutrino floor, and can be used to confirm the galactic origin of a dark matter signal. We will review the key features and expected physics reach of CYGNUS, and the programs currently underway in several laboratories to optimise gas mixture, technologies and algorithms towards the realisation of this concept.

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