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Directional Dark Matter search with optical readouts and the CYGNO project

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We are going to present the project for CYGNO, a 1kg gaseous TPC Dark Matter directional experiment, to be hosted at Laboratori Nazionali del Gran Sasso. CYGNO (a CYGNus TPC with Optical readout) fits into the context of the wider CYGNUS collaboration, for the development of a Galactic Nuclear Recoil Observatory at the ton scale with directional sensitivity. The most innovative CYGNO's features will be the exploitation of sCMOS cameras and PMTs, coupled to GEMs amplification of an He:CF₄ gas mixture at atmospheric pressure. Compared to other optical approaches, these choices provide an improved signal/noise ratio, thanks to the 1-2 e⁻/pixel noise of sCMOS and high GEMs gains, combined with full 3D reconstruction, including head-tail, exploiting the large PMT signals. We will discuss the results of the Italian R&Ds with a 10 L detector prototype, demonstrating 3D tracking and background discrimination capabilities for O(100) keV nuclear and electron recoils, with O(100) μm spatial resolution over 20 cm drift distance. In parallel, we will illustrate the complementary work with low pressure CF₄ gases and CCDs readout by our collaborators of the University of New Mexico, showing 10⁻⁵ gamma rejection at 10 keVee, and their recent results with CF₄-SF₆ negative ion drift mixtures. We will conclude with the foreseen CYGNO-1kg experiment performances and sensitivity.

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