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DM directionality approach using ZnWO_4 crystal scintillators

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The development of low-background anisotropic detectors can offer a unique way to study those Dark Matter (DM) candidate particles able to induce nuclear recoils through the directionality technique. This approach is based on studying the correlation between the nuclear recoil's direction and the Earth's motion in the galactic rest frame, thanks to the anisotropic features of such detectors.

Among the anisotropic scintillators, the ZnWO_4 has unique features and is an excellent candidate for the purposes. Both the light output and the scintillation pulse shape depend on the impinging direction of heavy particles (p, α , nuclear recoils, etc.) with respect to the crystal axes and can supply two independent modes to study the directionality and discriminate the γ/β radiation.

In this talk, the measurements to study the anisotropic response of a ZnWO_4 scintillator to α particles and to nuclear recoils induced by neutron scattering are reported. The quenching factor values for nuclear recoils along different crystallographic axes have been determined for the first time in the three different nuclear recoil energies; the measured difference is at the level of 5.4σ of C.L. These results open the possibility to realise a realistic pioneering experiment to investigate, through directionality, the DM candidates mentioned above. A new perspective will be addressed.

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