LHAASO Further References- part 2
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I. ANALYSIS OF THE FURTHER REFERENCES

The 3-d reconstruction of the direction recoil has been schematized for the implications of the detection efficiency on the detection of the angular resolution [1]. The distribution of the reconstructed angle θ between the track and the apparatus target might not be assumed as following a Gaussian-distribution variable-type by definition. These considerations play an important role in spin-dependent DM detection, and in neutron spectroscopy from neutron-induced nuclear-recoils spectra.

The methods for estimating directional recoil rates $dR/d\cos\theta$ (with θ the angle measured from a preferred reference direction in the Sky) and 'folded' directional recoil rates $dR/d(\cos\mid\theta\mid$ were studied in for the comparison of analyses of standard dark halos and anisotropic models in [2].
The energy E for the recoil of nuclei (in the target of the detector) is estimated as

$$E \equiv E_{max}\cos^2\theta_R \tag{1}$$

with θ_R the angle of the recoil of the nucleus wrt the initial particle direction, and E_{max} the maximum energy which can be trasferred to the ucleus by the incoming particle.
The folded directional recoil rate is formulated as

$$\frac{dR}{d\mid\cos\theta\mid} = \frac{dR(\cos\theta)}{d\cos\theta} + \frac{dR(-\cos\theta)}{d\cos\theta}. \tag{2}$$

According to the particle-nucleus cross section hypothesized, it is possible to separate spin-independent contributions $(S.I.)$ and spin-dependent ones $(S.D.)$, for to the directional recoil rate $dR/d\cos\theta$, as

$$\frac{dR}{d\cos\theta} = \frac{dR}{d\cos\theta}^{(S.I.)} + \frac{dR}{d\cos\theta}^{(S.D.)} \tag{3}$$

Gaussian velocity distributions (functions) can be analyzed analytically; differently, numerical analysis is needed.

[3] The recoil versor is defined as $\hat{r} = \sin\theta\cos\phi\hat{x} + \sin\theta\sin\phi\hat{y} + \cos\theta\hat{z}$, which are pointed towards the North, the West and the Zenith directions wrt to the Earth reference coordinate systems, useful to measure th the angular dispersion of recoiling tracks and the charge collection asymmetry.
The nuclear recoils can be modellized as dipole-like angular distribution, i.e. s. t. the anisotropy hypotheses can be tested by means of the means of the measurement of the mean angle between the detected recoil directions and the direction of motion of the Sun:

$$< \cos\theta > \equiv \frac{\sum i = 1^N \cos\theta_i}{N}, \tag{4}$$

where $\cos\theta_i$ is the 3-rd angle between the direction of Solar motion and the i-th recoil versor, and N is the number of events. In the anisotropic case, θ_i is found in the interval $[-1, 1]$.
If the recoil direction is neglected, in the case the measurements is performed by recording axial-models data rather than rather than vectorial-model data, the mean angle between the detected recoil directions and the direction of motion of the Sun is expressed as

$$<\mid\cos\theta\mid> \equiv \frac{\sum i = 1^N \mid\cos\theta_i\mid}{N}, \tag{5}$$

where the variables are defined as for Eq. (4).
If non Gaussian variables, the velocity distribution (function) can be evaluated by their Bessel-Fourier transform, or by the assumption of a discretized velocity distribution.

For anisotropic logarithmic-ellipsoidal Galaxy models, observational evidence and numerical simulation hint that galaxy halos result as best analyzed by means of triaxial models with anisotropic velocity distributions.

In [5], the proposal to achieve a detector as a quantum harmonic oscillator has been proposed for its advantages in obtaining an analysis of the quantum evolution nonperturbatively, such as by using the symplectic formalism for the Gaussian states and the related operations, operations in relativistic quantum theory for quadratic Hamiltonians, and as by solving also numerically a set of coupled, ordinary, first-order, linear differential equations, wrt to the other techniques analyzed.
The model of an ascillator allows one for the analysis of Gaussians with zero mean.
It is furthmore possible to solve Hamiltonian system with respect to a suitable choice of a time coordinate, which does not coincide with any (Astro-)physically-defined time, i.e. not with the proper parametric coordinate time, nor with the proper time of the physically-interacting system, but by defining Heisenberg operators for the apparatus frame; this follows from the use of an Unruh-DeWitt Hamiltonian-like systems, for which the time traslation among different processes with different proper (interaction) time is easied (as far as the requested calculations for the, also, numerical, solutions of the associated Hamiltonian problems are concerned). The analysis resulting from the calculation performed in such a phase space (endowed with its symplectic structure) and in the corresponding Hilbert space provide one with the same results for the covariance matrix.

Experimental techniques associated with s directional neutron detector based on a recoil-proton telescope were examined in Kaneko1997, for an incoming-neutron direction angle corresponding to 21^o, for which the direction sensitivity was obtained at up to half the neutrons at 0^o for an energy range of the incoming neutrons E_n s.t. $2.4Mev \leq E_n \leq 14MeV$ for the measure of the recoil proton energy spectrum in high γ-Ray background. The directionality of the neutron detector and the features of the collimator systms were set in such a way able to maximize the number of events detected. The apparatus resulted efficient in avoiding the recoil protons form entering the scintillator for the neutron incident angle, in limiting the γRays to a low energy region, and in rendering the reaction in the photomultiplier tubes neglegctable. The experimental noise was subtracted by removing the counts by the radiator. After the modelization offered by the simplified toy-model, several tens/ a hundred neutron detectors are estimeted to be needed for the proper performance of a realistic emission-profile monitor, i.e. for totally eliminating the background noise.

II. FURTHER REFERENCES

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