ID de Contribution: **11** Type: **YSF (Young Scientists Forum)**

Making sense of the local Galactic escape speed estimates in direct dark matter searches

lundi 16 mars 2015 19:44 (5 minutes)

The knowledge of the high velocity tail of the WIMP velocity distribution function has a strong impact on the way direct detection (DD) may constrain or discover light WIMPs in the GeV mass range. Recently, there have been important observational efforts to estimate the so-called Galactic escape speed at the position of the Earth, like for instance the analysis published in early 2014 by the RAVE Collaboration (Piffl et al., 2014), which is of interest in the perspective of reducing the astrophysical uncertainties in DD. Nevertheless, these new estimates cannot be used blindly as they rely on assumptions in the dark halo modelling, which induce tight correlations between the escape speed and other local astrophysical parameters (circular velocity, dark matter density, distance to the Galactic center). We make a self-consistent study of the implications of the RAVE results on DD assuming isotropic DM velocity distributions, both Maxwellian and ergodic. Taking as reference the experimental sensitivities currently achieved by LUX, CRESST2, and SuperCDMS, we show that the uncertainties inferred for the exclusion curves in the low WIMP mass region are moderate. We discuss the level of (dis)agreement of these results with other independent astrophysical constraints.

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Classification de Session: Young Scientist Forum 1

Classification de thématique: Theory