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Reaching neutrino smog in noble liquid detectors and condensed matter aspects of dark matter searches

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Recent publications on solar neutrino detection in large dual-phase Xe detectors cite the absence of condensed matter physics models and use Bayesian analysis, like toy Monte-Carlo simulations and data-driven correction to account for delayed electron and photon emission and other detector physics effects. We tried to fill the gap and consider possible microscopic mechanisms of observed detector phenomena. We conclude that changes in low-energy background spectra with increased detector size are not due to changes in effects producing delayed electron and photon emission but are caused by changing electron extraction efficiency and suppression of low-energy events detection due to accumulation of unextracted charges on liquid-gas interface. The agreement of the current analysis with other measurements of Solar 7B neutrino flux does not validate the implicit assumptions made about detector physics which can lead to systematic uncertainties in the analysis results - up to missing interactions with dark matter particles. We formulate questions in condensed matter physics terms, describe experiments required to find answers, and discuss how unwanted effects can be suppressed or mitigated by changes in the detector design. In our opinion, the current uncertainties are the result of insufficient interactions between condensed matter and particle physics communities in the advanced detector development.
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