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Toward Understanding the Nuclear Efficiency Threshold of Bubble Chamber Detectors

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A bubble chamber using fluorocarbons or liquid noble gases is a competitive technology to detect a low-energy nuclear recoil due to elastic scattering of weakly interacting massive particle (WIMP) dark matter. It consists of a pressure and temperature-controlled vessel filled with a liquid in the superheated state. Bubble nucleation from liquid to vapor phase can only occur if the energy deposition is larger than a certain energy threshold, described by the "heat-spike"Seitz Model. The nucleation efficiency of low-energy nuclear recoils in superheated liquids plays a crucial role in interpreting results from direct searches for WIMPs-dark matter. In this research, we used molecular dynamics simulation to study the bubble nucleation threshold, and we performed a Monte Carlo simulation using SRIM to obtain the bubble nucleation efficiency curve. The goal is to construct a real physics model to explain the discrepancy observed between the experimental results and the current Seitz model. The preliminary results will be presented and compared with existing experimental data of current detectors.

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Please select: Experiment or Theory

Experiment

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