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Thermal Modelling for the Scintillating Bubble Chamber Experiment at SNOLAB

The Scintillating Bubble Chamber (SBC) dark matter experiment will operate a detector at SNOLAB, consisting of an active volume split into two distinct temperature regions, a cold region at the bottom and a superheated region at the top. This allows for any sediment or impurities to settle out into the cold regions at the bottom without nucleating bubbles while the superheated region can still maintain the high sensitivity needed for a dark matter search. Understanding fluid flow in the detector allows us to mitigate convection currents as needed to prevent the disruption of these distinct regions as well as better modelling the temperature distribution in the detector, which is important since the nucleation threshold for a bubble is dependent on temperature. The simulations were run in COMSOL multiphysics, modelling the time evolution of the velocity and temperature of the fluid components of the detector as it cools down. At this stage, several iterations of the simulation have been run, which can be compared to existing data from engineering runs at FermiLab. Convection currents do not appear to be a risk for the SBC detector at this stage, and further investigation is ongoing.

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