A Scintillating Xenon Bubble Chamber for Dark Matter Particle Detection: Temperature and Pressure Regulation

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The purpose is to create a particle detector in the form of a bubble chamber to detect dark matter particles. This is done through determining the optimal temperature and pressure settings for the hydraulic fluid, dynalene MV, with which the fluid where particle interactions (superheated xenon) occur is controlled. The procedure first consisted of building and wiring an analogue control system and hydraulic cart, both of which are integral components of the detector. The analogue control system automates all machinery on the hydraulic cart. The cart controls the state of matter of dynalene MV, which controls the superheated xenon. The viscosity of dynalene MV was tested at different cryogenic temperatures, through measuring the delay time of its travel inside a tube. The ability of the bubble chamber to control the pressure of the superheated fluid was tested through the bellows of the chamber. The pressure of the bellows was changed with a pressure pump, while the subsequent volume change was recorded, in order to determine the range of the bellows compression and expansion. The results showed that dynalene MV retained a low viscosity/delay time at cryogenic temperatures, proving its ability to control superheated xenon. The results also showed that changing the pressure of dynalene MV through the bellows would result in an equal change to superheated xenon. Altogether, this new technology was proven effective and is expected to have a field-changing impact in the search for dark matter, as it is, as of now, technologically superior to all other detector technologies. Finally, the technology employed in this bubble chamber is expected to be used in identifying/localizing nuclear and radiological threats.

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