

Thermal simulations with COMSOL that characterize the temperature and pressure which define the threshold in the PICO-40L bubble chamber

The need to perform a thermal simulation for the PICO-40L detector stems from the fact that the transition region isn't ideal for delimiting the two temperature zones. Indeed, the geometry adopted, "right side up" (RSU), requires a cold area ($< -30\text{ }^{\circ}\text{C}$) and a warm region ($\sim 13\text{ }^{\circ}\text{C}$). The active fluid (C3F8) must be kept cool in the lower part, as it's in direct contact with the stainless steel (SS) bellows. If this were not the case, bubbles would incessantly form on this wall, and the experiment would be impossible to carry out. In the hot section, the target liquid is in contact with the smooth surface of a fused quartz glass, which reduces the risk of phase change, even though it's in a superheated state. Several sheets and blocks of HDPE are installed in the cold zone to isolate it from the rest of the detector. To stabilize the hot area, two heating plates are housed above the HDPE. The latter is placed in a water bath that regulates the temperature of the warm zone. A cooling coil and a retroreflector are positioned in the upper part of the PV to reduce the temperature of the hot oil that rises. It's not possible to install RTDs in the region of interest for reasons of radio purity. However, several temperature sensors were installed near the sensitive region which allows the temperature to be extrapolated in the C3F8 target using thermal reconstructions with COMSOL. Since convection can have an impact on the results, simulations with and without this parameter were performed. The correlation between the temperatures obtained from the simulations and the values recorded by the RTDs makes it possible to validate one model over another.

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