NOTE ON PROPORTIONAL COUNTER OPERATION AT LIQUID ARGON TEMPERATURE

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Two independent requirements for the use of proportional counters at liquid argon temperatures simultaneously arose. One was to improve the spatial resolution of a neutrino detector using a liquid argon calorimeter by the incorporation of proportional counter or drift chamber planes in it; since at least one set of planes per absorption length is needed, the ability to operate them in thermal equilibrium with the calorimeter would be most useful.

The other requirement involved a need to detect and measure the energy of x-rays in the 8-10 KeV region from stopping kaons. The stopping medium was to be hydrogen gas at low temperature and moderately high pressure. In this case it was important to retain good energy resolution.

The difficulty with low-temperature operation of proportional counters is the fact that almost all quenching agents freeze out at low temperatures. The one with the lowest operating temperature

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is methane, which boils at 112° and has a vapor pressure of 60 mm at 88°, the boiling point of argon. Attempts to use CO, still gaseous at this temperature, as a quenching agent were unsuccessful.

In the absence of adequate cryogenic equipment, a preliminary trial was made by running the counter gas through a trap at liquid argon temperature and then testing it at room temperature. In this way we found that methane condensed out from a 90% argon - 10% methane mixture, leaving a mixture which still counted, but with poor energy resolution, indicating inadequate quenching. The performance was improved by mixing the Ar-Me with roughly equal amounts of helium.

A final test was made by immersing the counter in liquid argon; the above results were confirmed. The deterioration in energy resolution with 50% He was about a factor of two; this would be significant in x-ray spectroscopy, and could be cured only by raising the temperature enough to restore sufficient methane vapor. That can be achieved by raising the pressure to about two atmospheres. For use in a liquid argon neutrino or hadron calorimeter, the helium mixture should be perfectly satisfactory even at atmospheric pressure.

Since the drift velocities are essentially unchanged at these temperatures, the operation of drift chambers at liquid argon temperature should remain equally feasible; we were unfortunately not equipped to verify this.