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Technical Memo On The Importance of Evacuating a Liquid Argon Calorimeter

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In my work with photosensitive dopants for liquid argon (LAr), I had to estimate the solubility of various materials. To do this I used Henry's Law which states that for a nonpolar solvent like LAr, the mole fraction of solute is proportional to its vapor pressure. It should be noted that the solubility is proportional to, and not equal to, the vapor pressure. This fact proved to be a powerful tool in selecting dopants for testing and explained why such materials as TMAE and benzene, both well known photosensitive agents, were unsuccessful as photosensitive dopants.

Henry's Law also has a consequence for large LAr calorimeters. Since a material with a low vapor pressure at room temperature will have no significant vapor pressure at LAr temperature, it will not be soluble in LAr. Therefore, it seems the most important aspect in cleanliness in cosntruction of a LAr calorimeter is a good evacuation to remove the materials with a high vapor pressure. The nice part is that the higher the greater vapor pressure, and therefore the greater the potential to poison the LAr, the easier it is to remove.

Thus I feel that a small turbo pump should be included in the design of all LAr calorimeters. One design would be to put an 8 inch turbo pump on a short 8 inch elbow with a butterfly valve. After pumping the calorimeter for sometime, the value could be closed and the calorimeter pressurized to slightly over one atmosphere. The pump could then be removed and the port blanked off, and evacuated to cut down heat loss.

It is my conviction that a good, long evacuation of the calorimeter will remove most, if not all, of the contaminants from such things as grease, fingerprints, solvents, and trapped gases in cables and printed circuit boards. It will not solve the problem of using bulk materials with high vapor pressures but simply knowing the vapor pressures, of these materials is probably sufficient. The publication "Outgassing Data for Selecting Spacecraft Materials" by Campbell et.al., NASA Reference Publications 1124, is very useful in that respect.

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