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Subject: Re: why is the number of PMT experts 2?

Date: September 30, 2015 at 12:29

To: Janet Conrad conrad@MIT.EDU, Bolton, Tim bolton@phys.ksu.edu

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Hello,

let me just add some thoughts to your exchange of emails on the Rn issue, hoping to contribute to the discussion.

The question of Rn emanation from filter I think it is not so easily solvable, and there are no immediate solutions to our issue coming from the experience of other groups/experiments.

Our filter are made by a mix of Cu catalyst for O₂ (Engelhard) and mol.sieve for H₂O (I think is a 5A type, I don't know any detail). Both types of material are made of (or based on) Alumina substrate that normally has a rather high content of ²³⁸U. The decay chain of ²³⁸U goes through ²²²Rn that is a gas (very volatile) and can thus be emanated easily.

Now,

-1) DM experiments - like DarkSide - use hot getters (e.g. SAES MonoTorr) to purify GasAr and then liquify it.

This is the best possible solution in terms of achievable purity, but one filter-unit purifies ~ 1L/hr of LAr ! it can be ok for O(Ton) detectors but it can be prohibitively slow for larger ones (adding many filters in parallel results in (?)prohibitively high in costs).

2) Active Charcoal is used with liquids, but I'm not aware of any use with LAr and would need some tests. In addition, I think Activated Charcoal is not effective for O₂ removal.

I also know that activated charcoal has the potential danger of producing carbon dust (and I wouldn't be happy to have conductive dust on the electrodes or the wires of the TPC).

3) In Icarus the molec.sieve is Hydrosorb: this is also an alumina based material whose content in ²³⁸U I don't know, but I expect to be similar to the uB mol.sieve (i.e. quite high).

The O₂ reactant is Oxisorb. This uses Chromium instead of Copper as catalyst.

The measured (at GS) ²³⁸U content of the Oxisorb is much lower than the measured content of the Engelhard Cu catalyst used by uB. However, U and Th content can vary a lot from batch to batch.

To note that I heard that use of Chromium based material in US is subject to severe safety constraints (at a level that can make the use of it almost impossible for Lab applications).

4) there are new products commercialized by BASF whose O₂ removal efficiency is much higher than both Oxisorb (Icarus) and Engelhard (uB). Radiopurity for one type of these new materials was measured at GS and is better than Engelhard, but worse than Oxisorb. But again, repeat measurements with different batches is necessary before drawing any conclusion.

5) finally, we don't know if Icarus had Rn emanated by their filters since their PMT system had a threshold much higher than the few MeV of the ²²²Rn decay products. So, if Rn was in Icarus they did not see it.

In WArP (using - I think - the same O₂ reactant and H₂O mol. sieve materials of uB) we did see Rn contamination at a non-negligible level for a DM experiment, but the origin from the filter was never really demonstrated.

I think MicroBooNE should investigate on this, possibly demonstrate that the origin is from the filter, and - I agree - MicroBooNE should take some action to reduce this contamination.

I'm not sure there is an immediate&easy solution though...

flavio