

Time-tag in the HPgTPC

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ND general meeting

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Introduction

- The LBNC committee flagged that event t_0 in the HPgTPC may be a problem:

Measuring neutrino interactions on a gaseous argon target is compelling, with 4π coverage

But

Consider options for more robust t_0 determination in gaseous TPC or show that current design is good enough

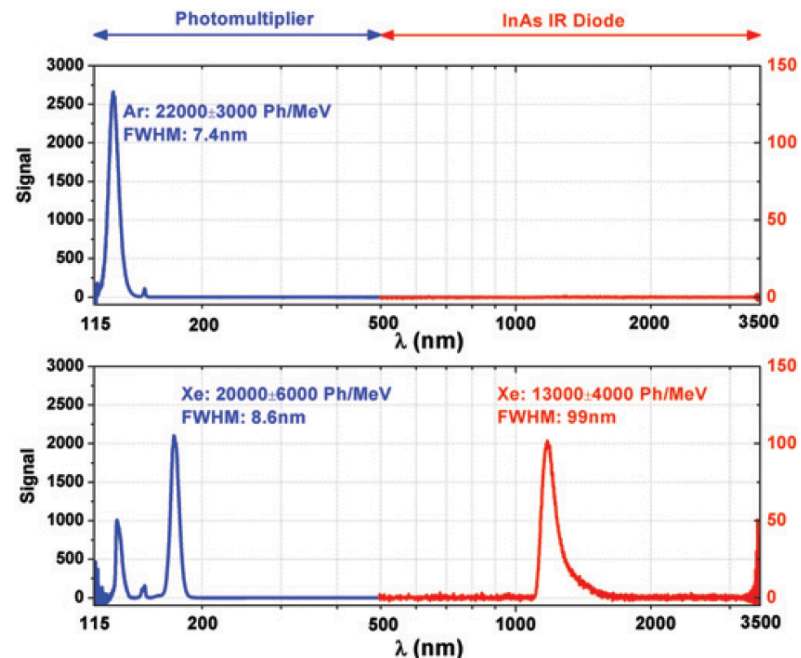
Fluorescence tagging in HPgTPC

- The TPC is an inherently slow device
 - Drift over 2.5m $\sim 50 \mu\text{s}$ (for $v_{\text{drift}} = 5\text{cm}/\mu\text{s}$)
- 10 μs spill
 - Yields ~ 50 cm uncertainty w/r to where the vertex is.
 - Not an issue for any event with a charge track leaving the TPC and entering the ECAL. However, not all events have such a track. Matching efficiency?
- Having a time stamp would help with the rest
 - This is a bit tricky, since many of the conventional gas mixtures (P10) quench all fluorescence.
- Promising ternary systems:
 - Ar + Xe + CH₄, Ar + Xe + CF₄, Ar + N₂ + CF₄
 - Fluorescence light in the visible?

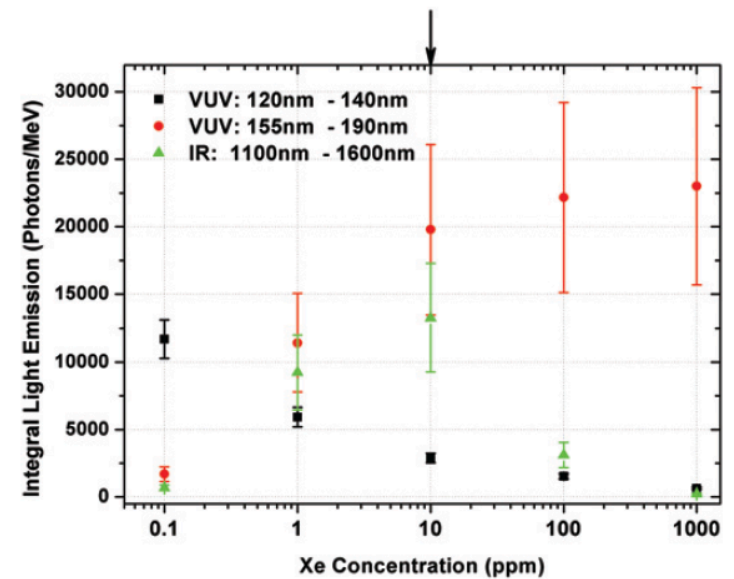
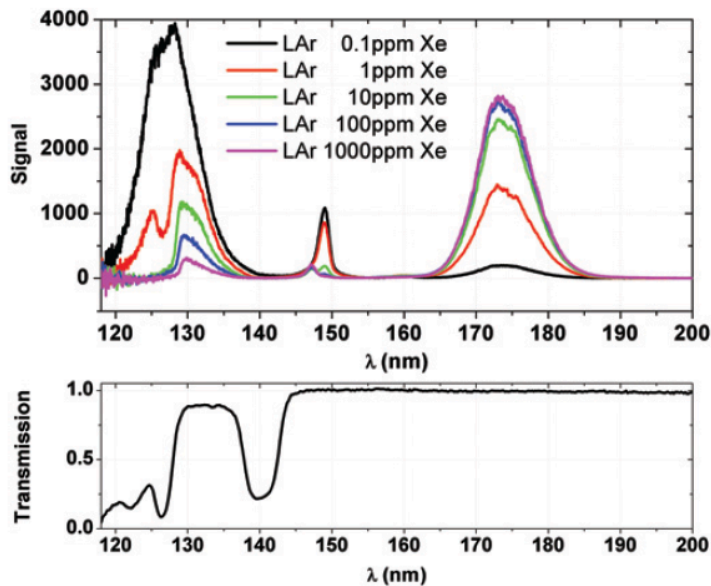
Near IR fluorescence

- There has been recent work in LAr to measure and use NIR fluorescence for light detection in order to vastly reduce Rayleigh scattering.
 - <http://iopscience.iop.org/article/10.1209/0295-5075/106/32001>
 - Carlos Escobar's work at PAB
- From IOP article

Neumeier et al.

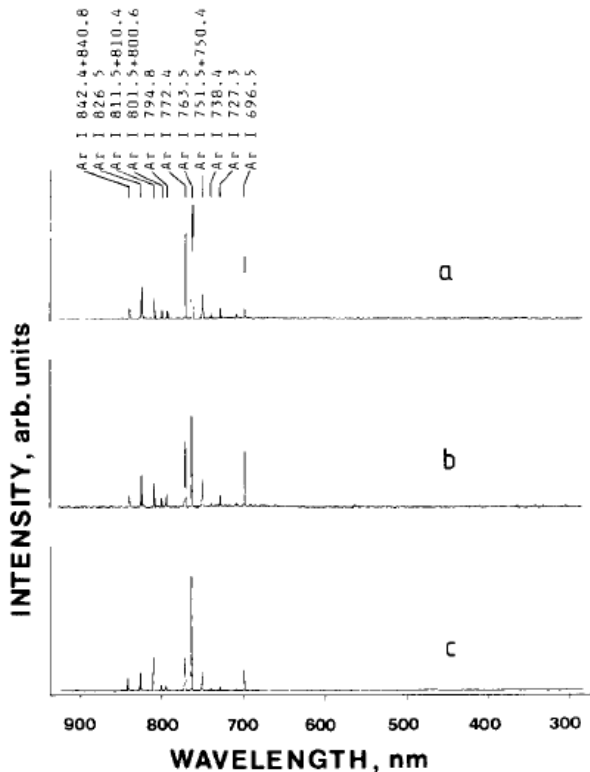


Very strong emission in IR: $\approx 127\text{nm}$ for pure Ar



In Gas?

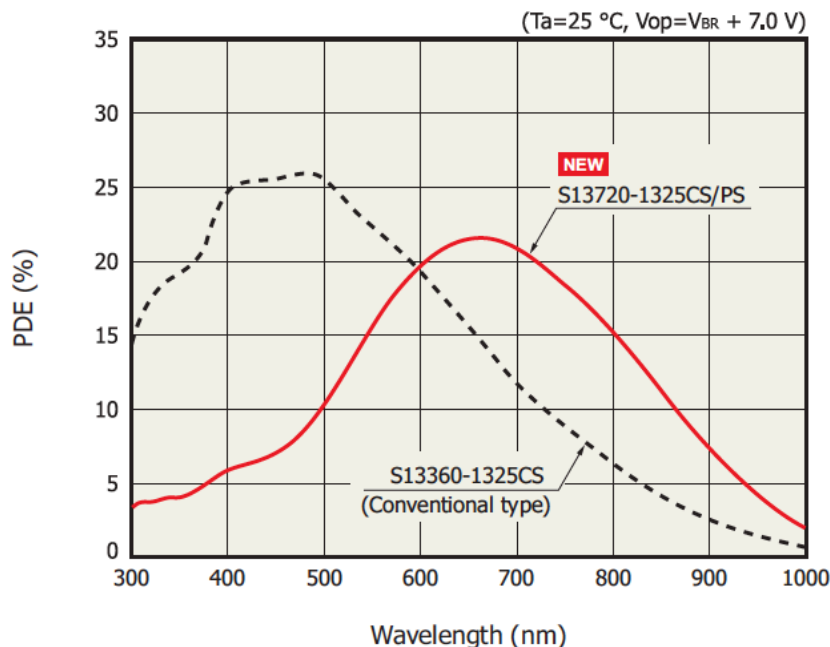
- Those data were in LAr. Are there data for gas?
- Well some, Lindbloom and Solin, NIMA 268, 1988, 204-208



- Pure Ar
- 2 Atm
- Electron beam excitation
- Quite faint
 - However, no yield info.
- What if Xe is added?
- 10 Atm?

Why is this so interesting?

- The 700-800nm emission is matched very well to a new SiPM
- Hamamatsu & FBK: SiPM for LIDAR applications
 - TOF imager for automobiles: self-driving cars
 - Potentially big market



- Excellent match to the fluorescence in Lindbloom paper
- Fast
- Low noise: 1.5 kHz dark count rate
 - This is VERY low for SiPM!
- Cheap?

Conclusions

- Fluorescence timing/tagging within the HPgTPC active volume, while allowing for stable MWPC operation at the gains we need 2-5k, looks possible.
- The NIR approach has many details to work out, but would be a game changer, if workable
- Institutions: IGFAE, Santiago de Compostela, Fermilab, UTA