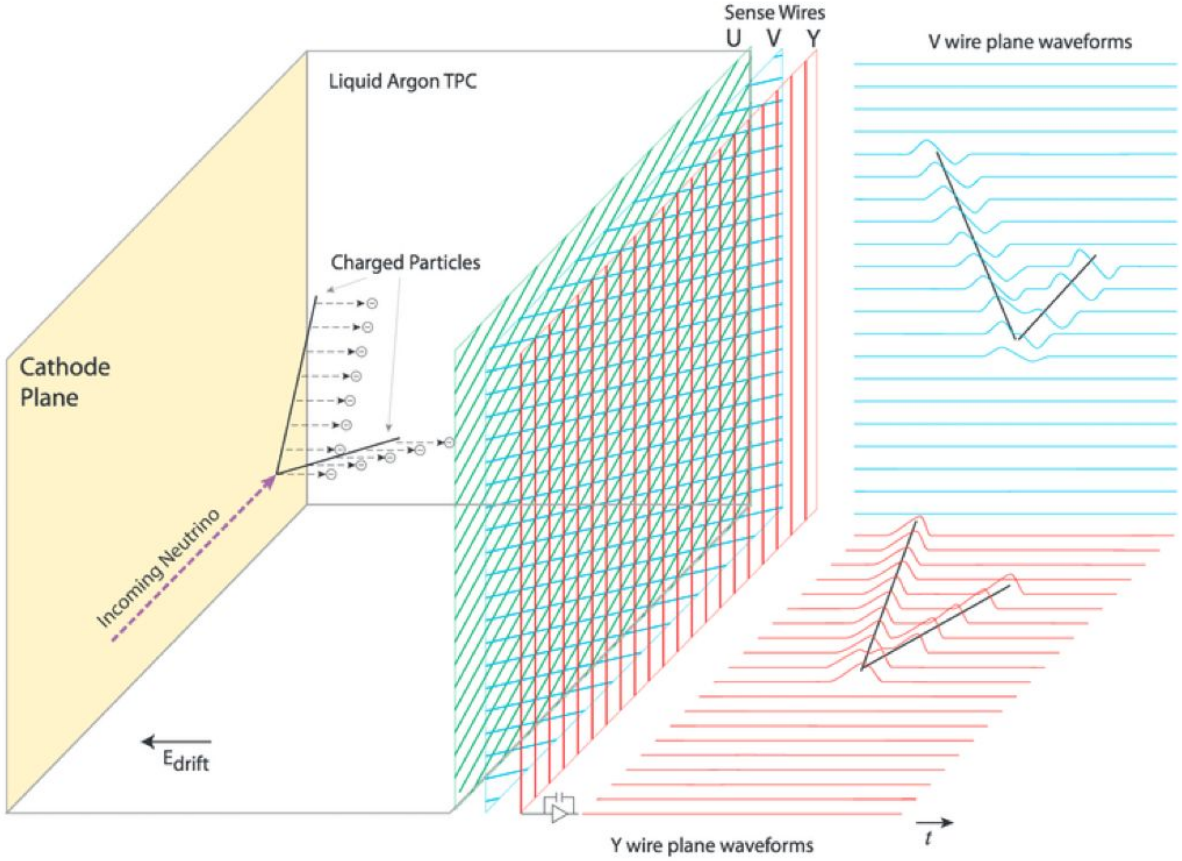
Light Detection in Liquid Argon

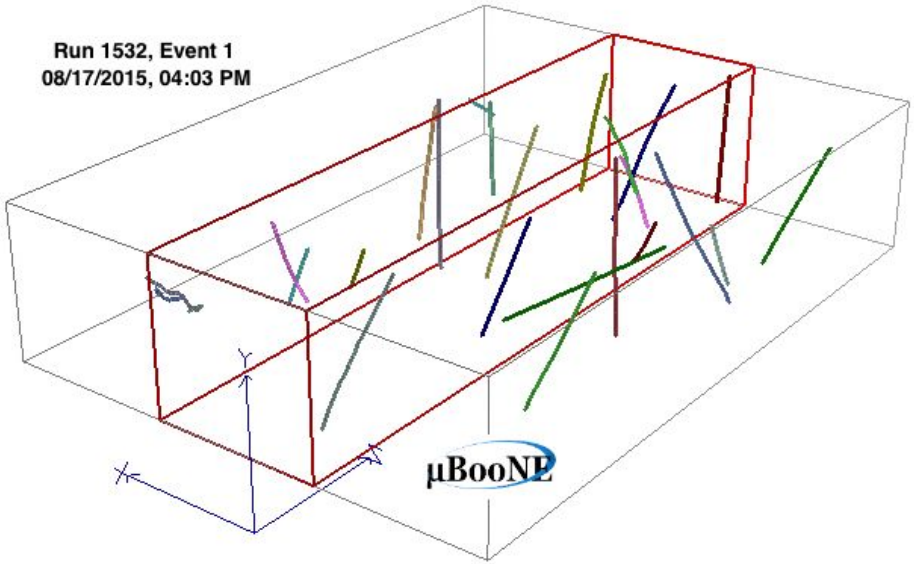
TPCs



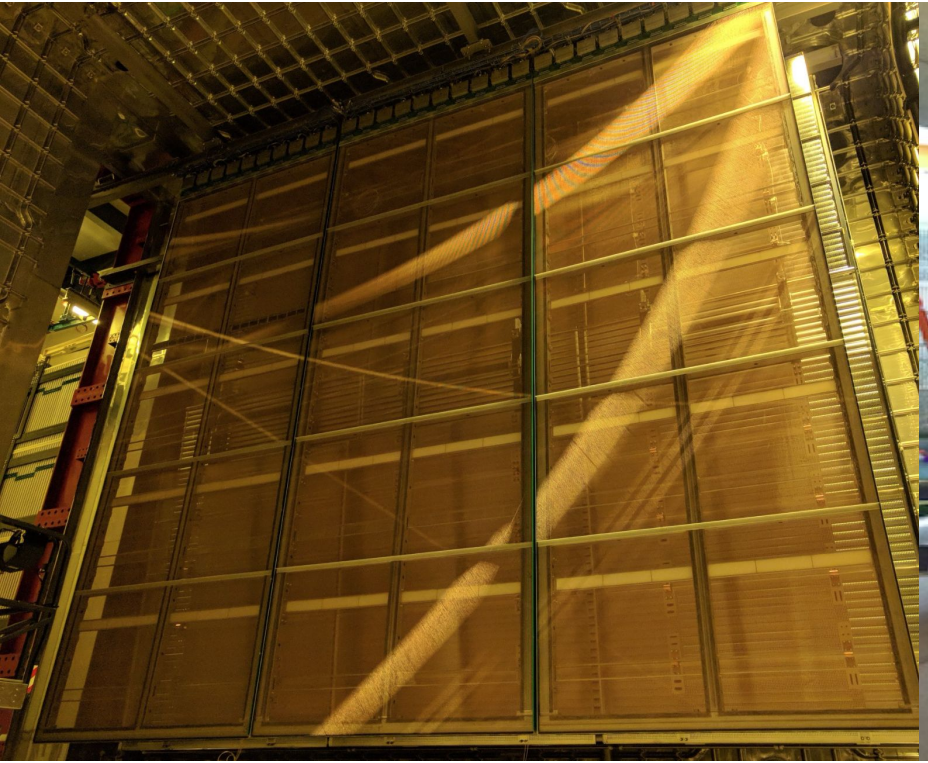
Wire planes collect charge deposition

Photon detection system for light collection

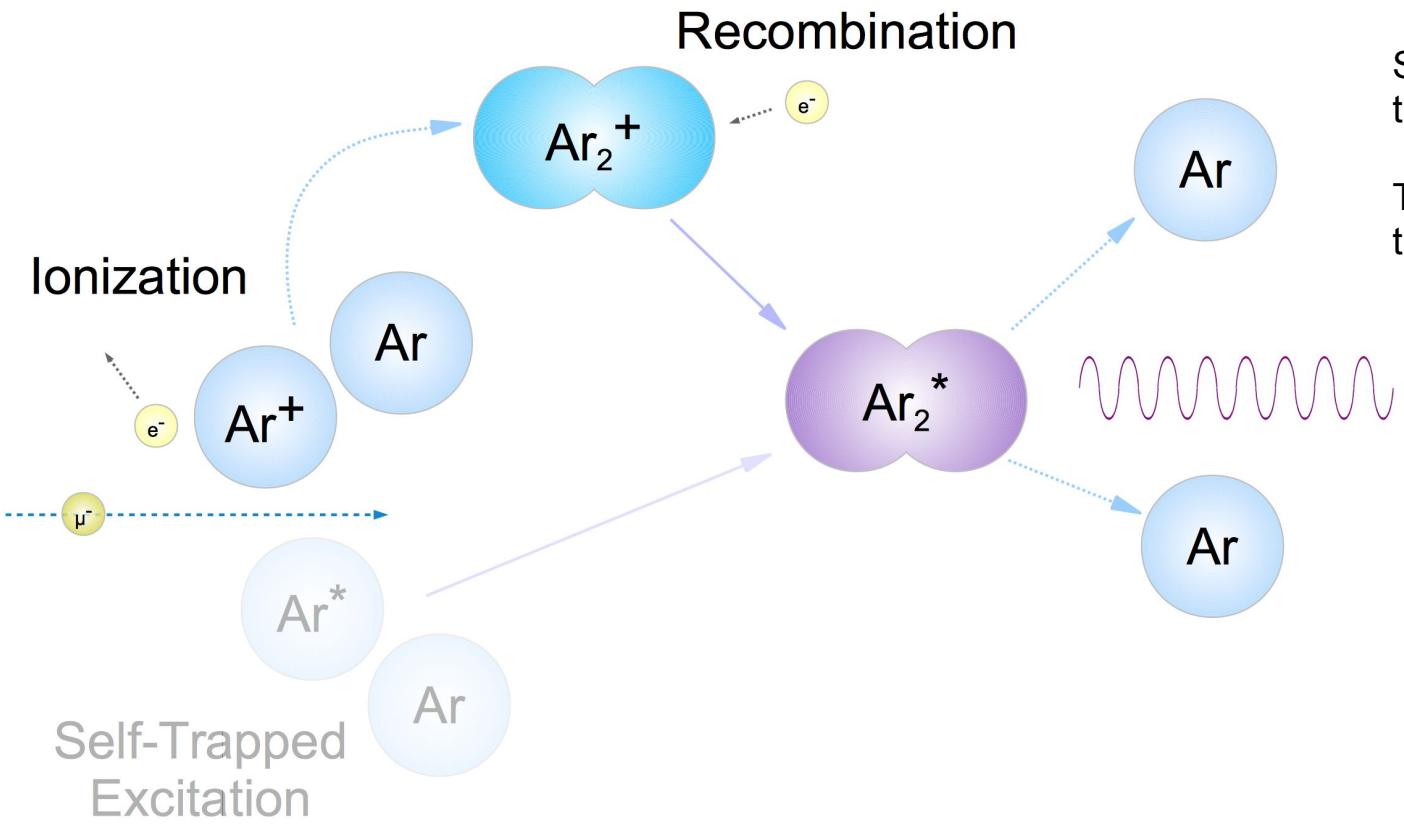
Ionization charge drifts slowly!



TPCs



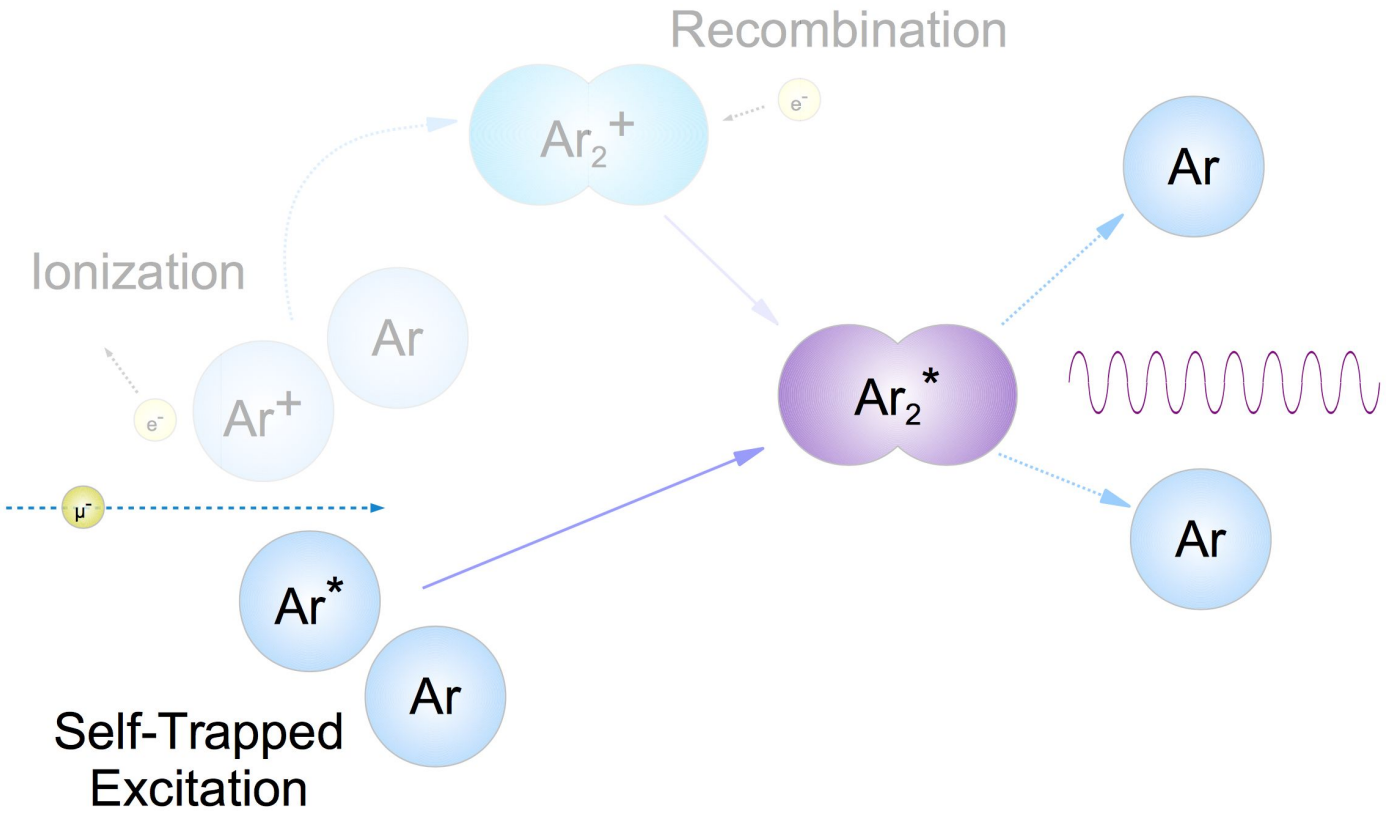
Scintillation Light in Liquid Argon



Singlet state: ~6 ns timescale

Triplet state: ~1.5 us timescale

Scintillation Light in Liquid Argon

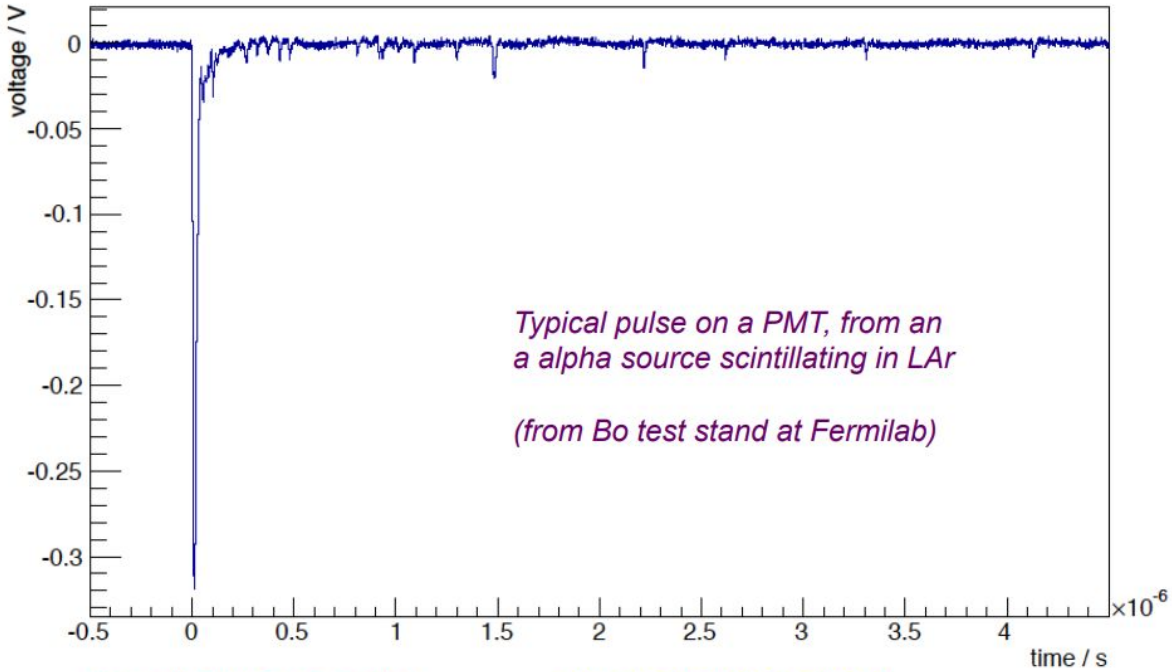


Singlet state: ~6 ns timescale

Triplet state: ~1.5 us timescale

Prompt and Late Light Example

Ben Jones



Prompt light, from singlet
(6ns time constant)

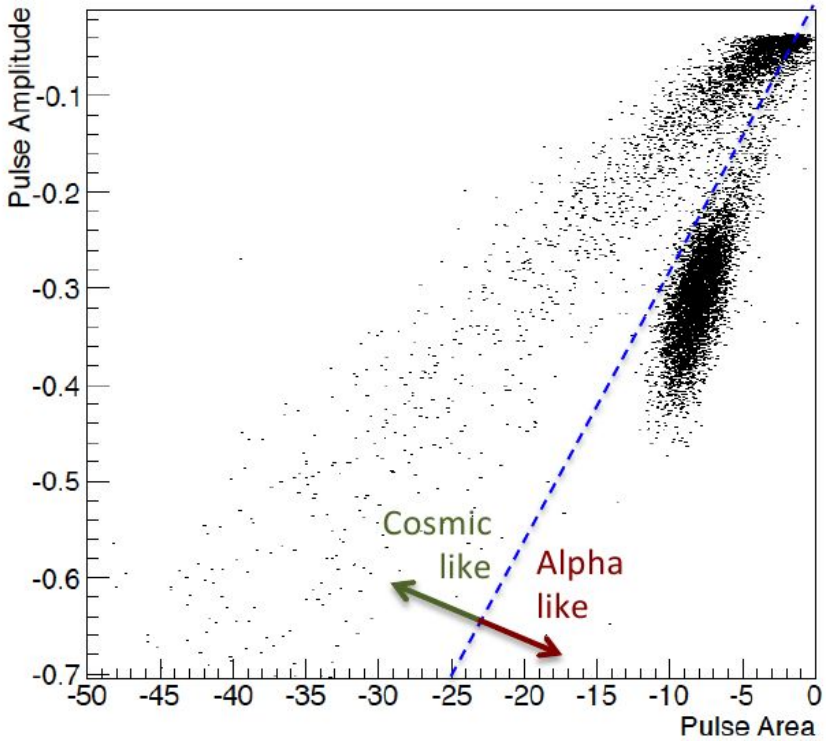
Delayed light from triplet
(1500ns, dribbling in as single photons)

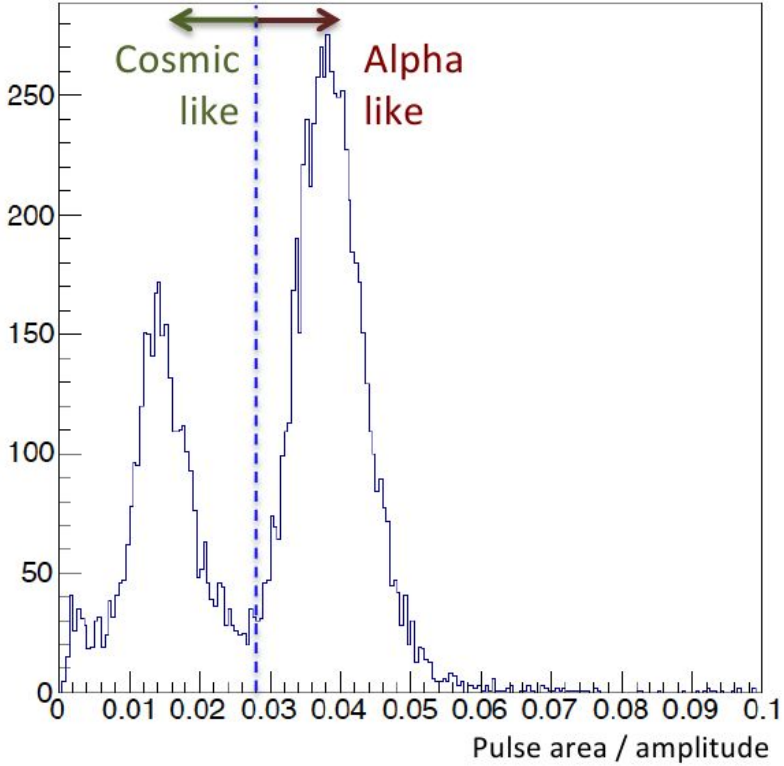
Singlet state: ~6 ns timescale

Triplet state: ~1.5 us timescale

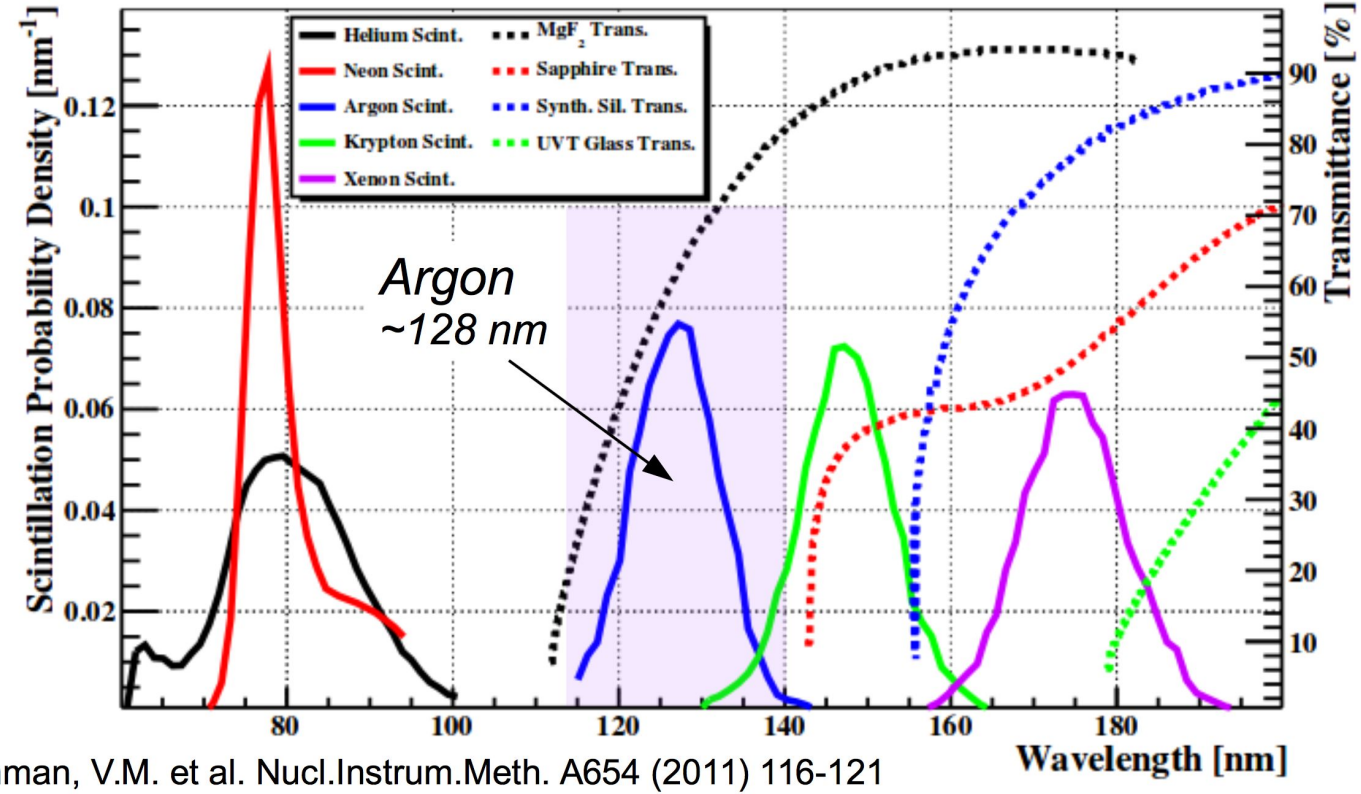
Pulse-shape discrimination

B. P. Jones et al. 2013 *JINST* **8** E09001
Data taken with Bo @ PAB



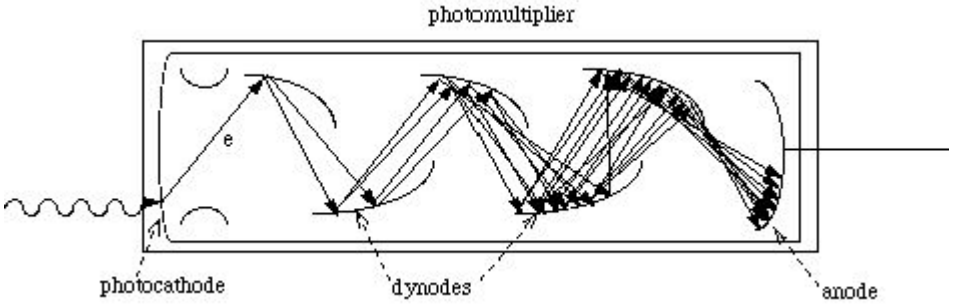


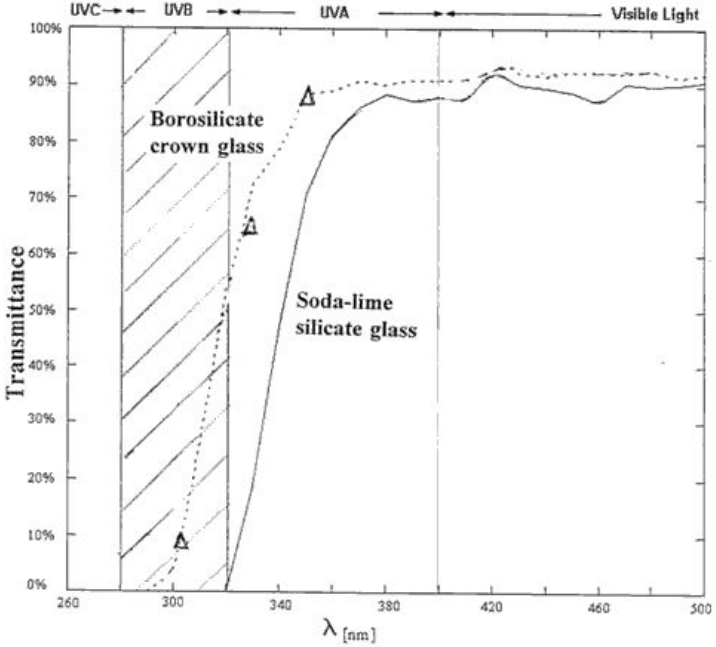
Scintillation Light in Liquid Argon



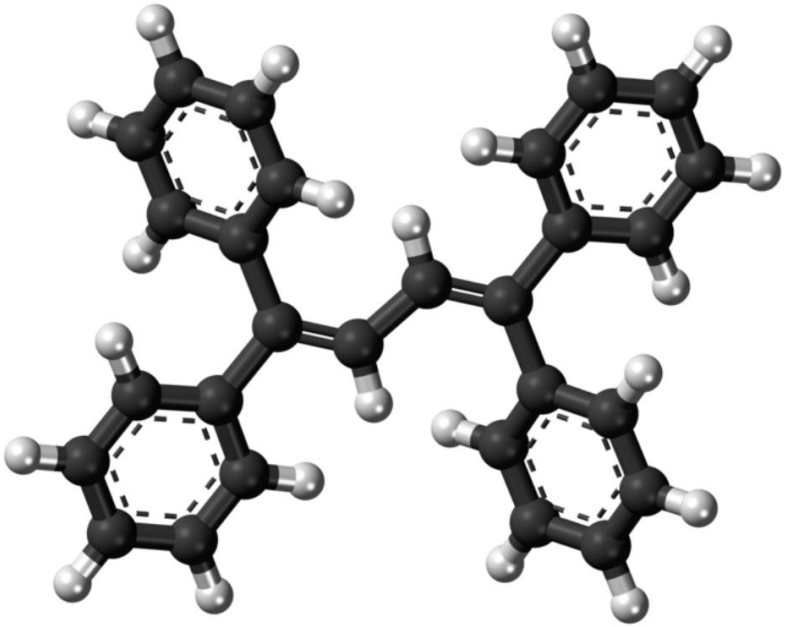
Gehman, V.M. et al. Nucl.Instrum.Meth. A654 (2011) 116-121

Light Detection with Photomultiplier Tubes

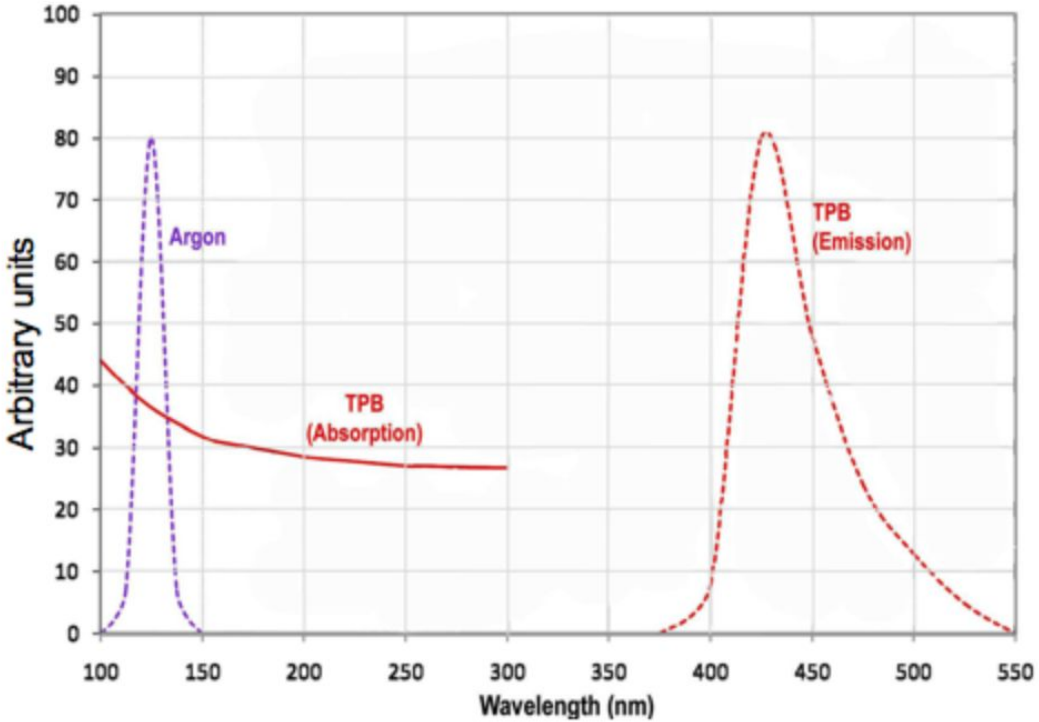




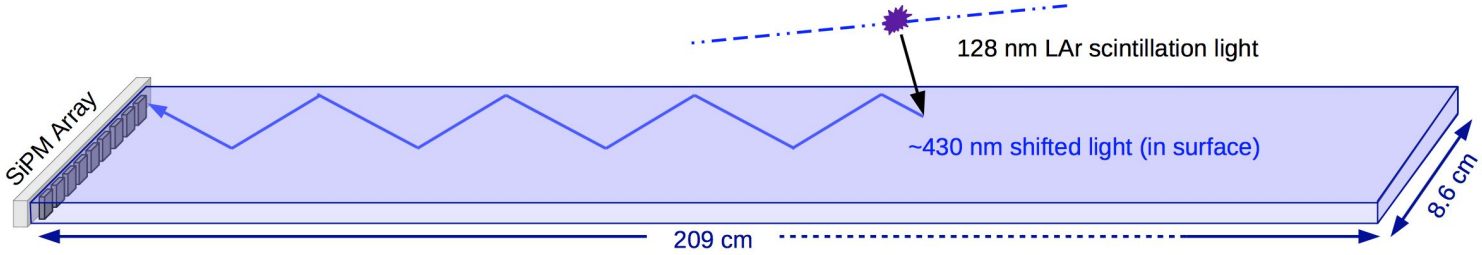
Introduce a Wavelength Shifter



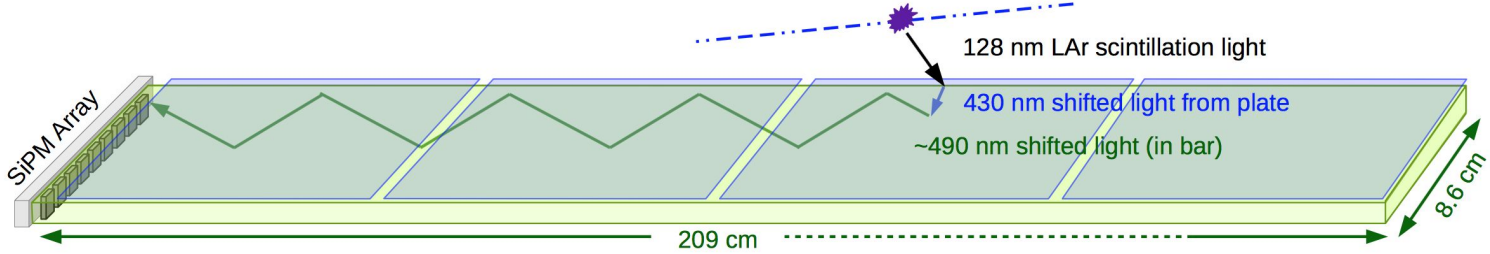
Tetraphenyl Butadiene (TPB)



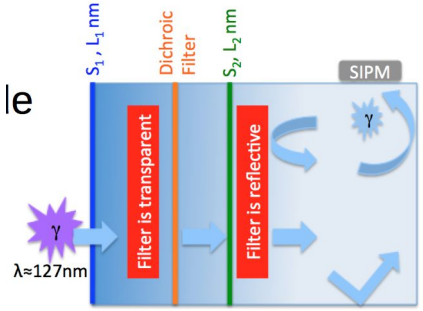
Photon Detector Designs for DUNE

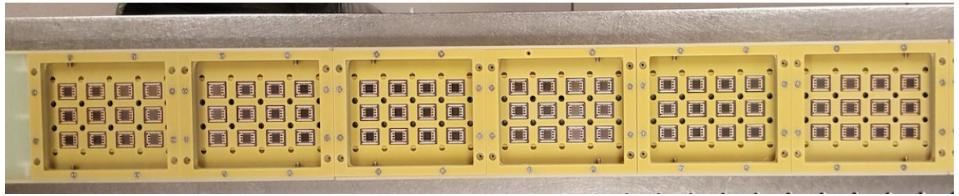


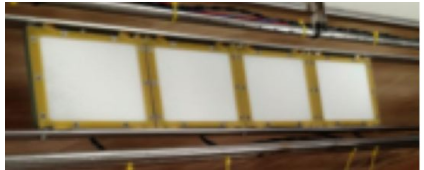
Acrylic bars dip-coated in TPB + acrylic + toluene solution



Spray coated TPB plates (VUV to blue) Commercial wavelength shifting light guide (blue to green)

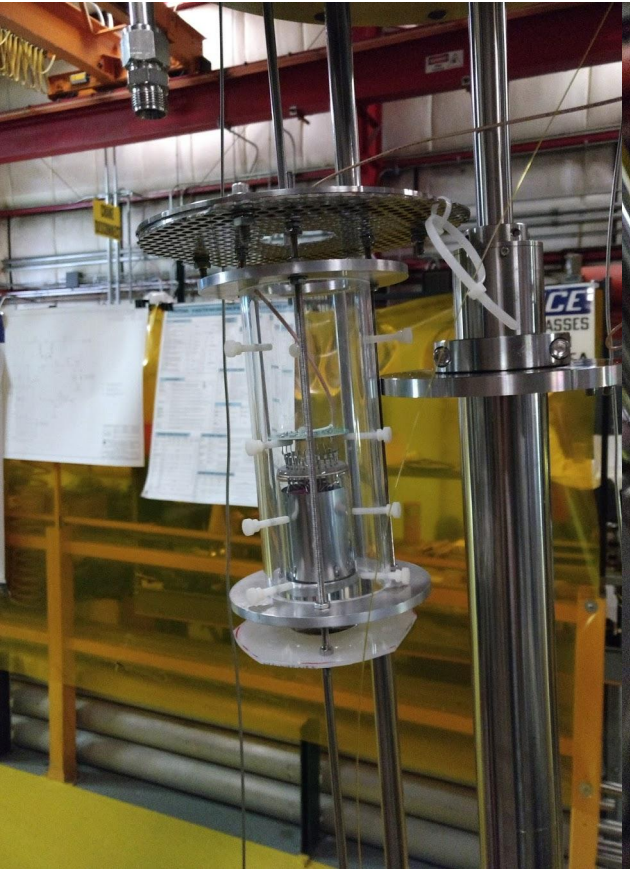


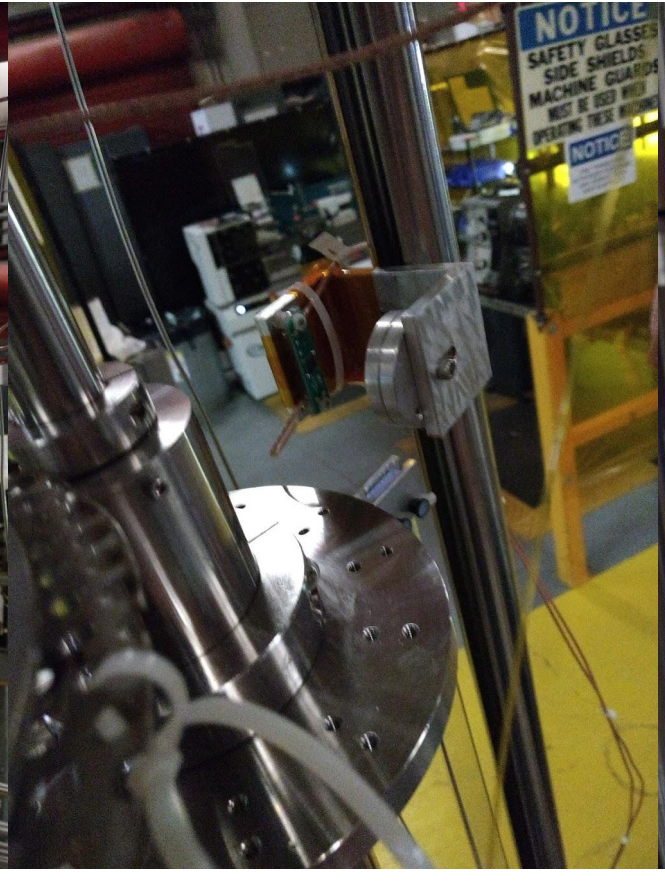




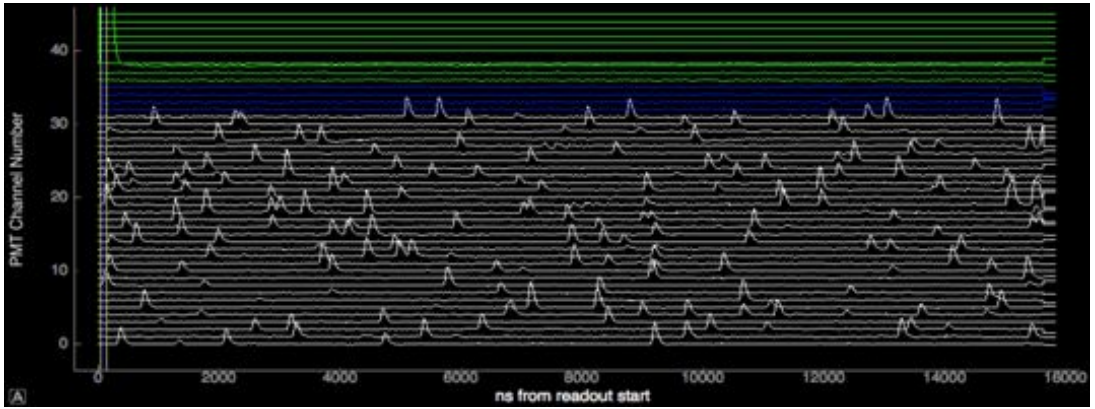
ARAPUCA, light traps, single pass filter with TPB trapping light in reflective box with SiPMs

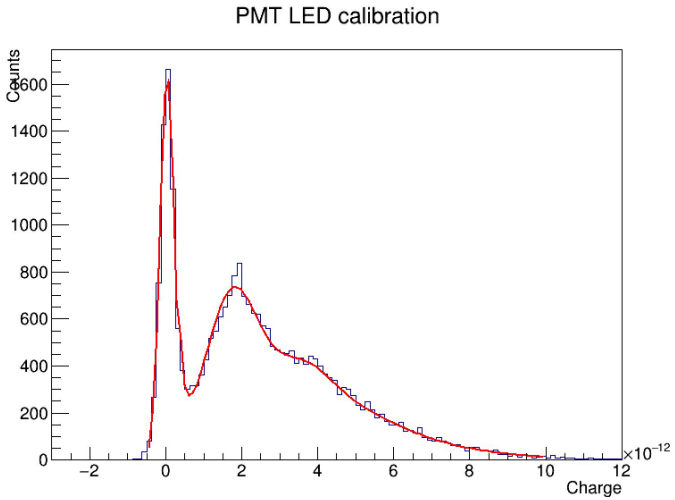
TallBo Experiment





Single photo-electrons





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A Measurement of the Absorption of Liquid Argon Scintillation Light by Dissolved Nitrogen at the Part-Per-Million Level - Jones, B.J.P. *et al.* JINST 8 (2013) P07011, Erratum: JINST 8 (2013) E09001 arXiv:1306.4605 [physics.ins-det]

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Scintillation Light from Cosmic-Ray Muons in Liquid Argon - Whittington, Denver *et al.* JINST 11 (2016) no.05, P05016 arXiv:1408.1763 [physics.ins-det]