LiquidO: a Novel Neutrino Detection Concept

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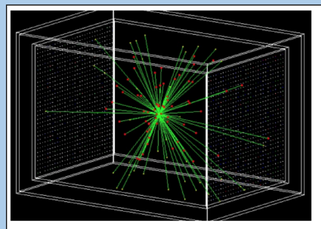
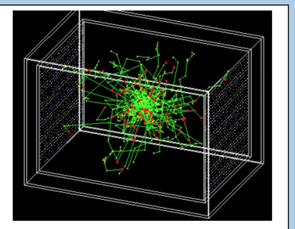


today's technology

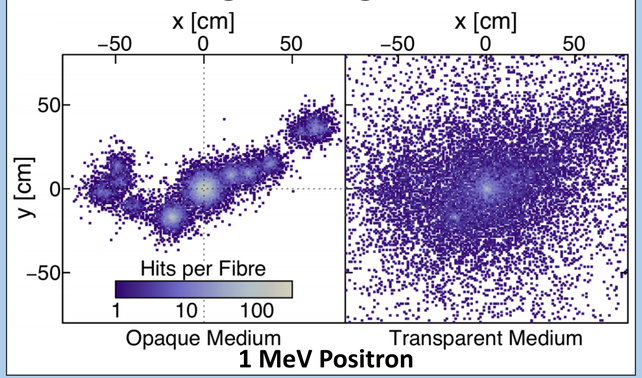


LiquidO technology

Basic principle

In LiquidO, the scintillator volume is a translucent medium traversed with a dense array of fibers for light collection. This translucency is achieved with a short scattering length, as opposed to a short absorption length, thus giving no decrease in light level.

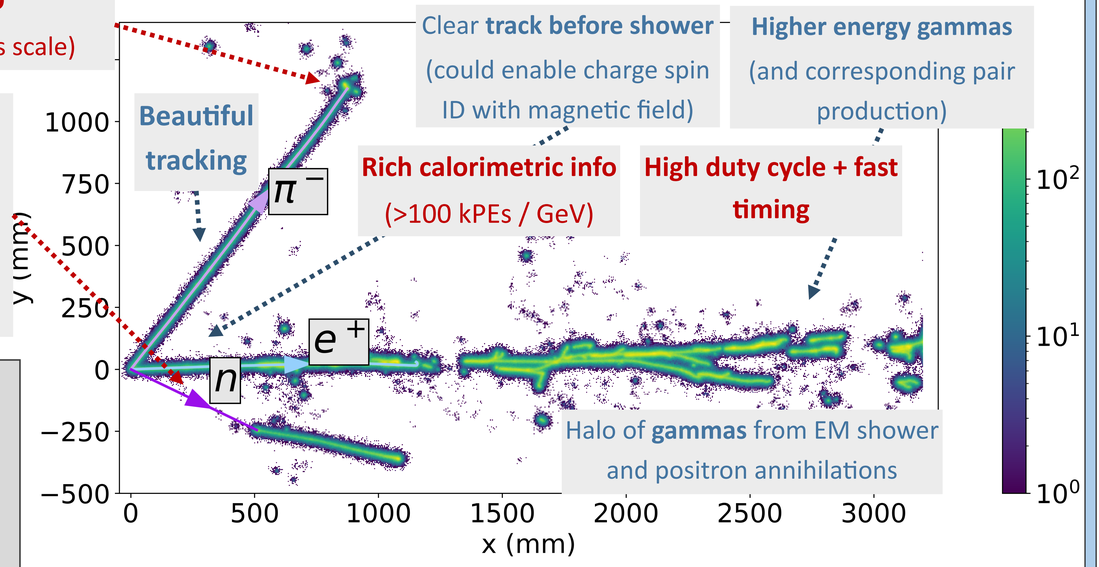
Millimetre resolution imaging with a self-segmenting detector



Charge sign ID
from $\pi^- \rightarrow \mu^- \rightarrow e^-$ (~µs scale)

Can **see neutrons**
- Measure energy via TOF
- Capture at the end (O(10) µs scale)

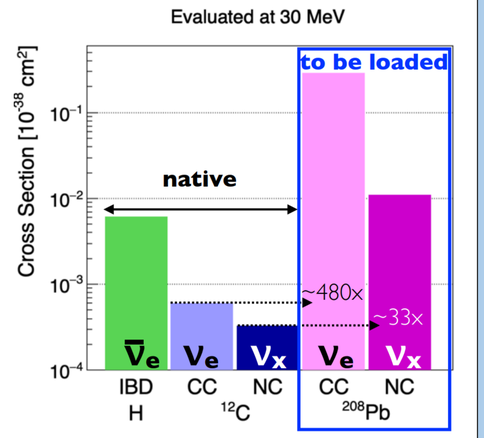
2 GeV anti-ν_e
- **4 mm fibre pitch**
- **1 mm scattering length**
- **Detection efficiency is accounted for**



Imaging capabilities comparable to LArTPC + **Complementary features unique to LiquidO**

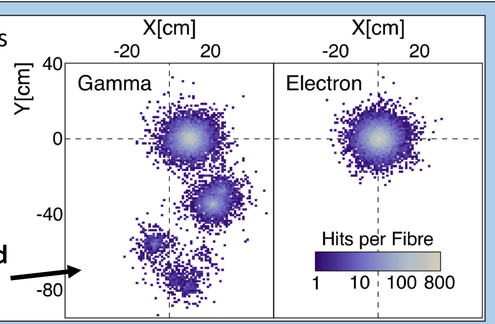
Loading in LiquidO

- The requirement for transparency typically limits the amount of doping possible in conventional LS detectors.
- LiquidO's natural affinity for doping allows for new materials and/or much higher concentrations.

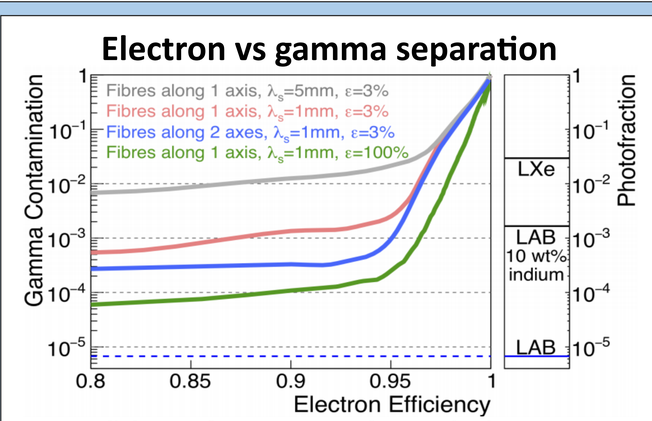


Powerful PID allows for **potent background rejection**, reducing the need for shielding.

2 MeV gamma and electron



Electron vs gamma separation



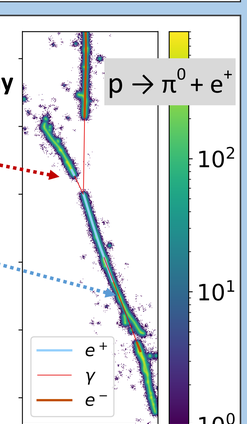
30x light Reference 3D Info Washed out

Possible application: search for proton decay

Double γ from π^0 decay

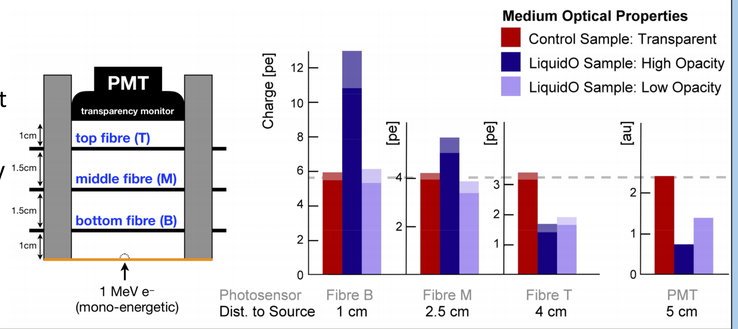
Long positron track

Other applications:
Reactor antineutrinos, geoneutrinos, neutrinoless double-beta decay, oscillation experiments



The **principle of stochastic light confinement** using an opaque detector medium has been **verified** with a small 3 fiber + 1 PMT configuration. Testing was done with LAB+PPO mixed with 10% paraffin at two temperatures, corresponding to two opacities.

It was clearly demonstrated that the scintillation light from a 1 MeV electron event was stochastically confined.

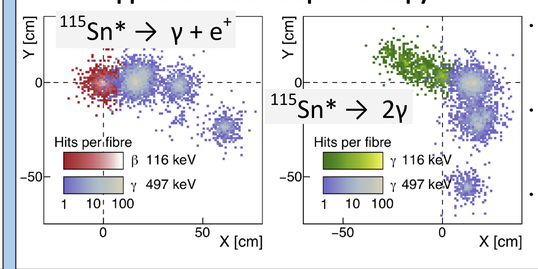


Organic medium
- **Small Z** → **Small photo-fraction**
- **High resolution** → **e+, e-, γ separation**

$\nu_e \rightarrow e^-$
$\bar{\nu}_e \rightarrow e^+$

Discrimination possible at MeV scale

Possible application: pp solar neutrino spectroscopy



$\nu_e + {}^{115}\text{In} \rightarrow e^- + {}^{115}\text{Sn}^*$ 114 keV threshold

- Delayed coincidence between gamma and positron in ^{115}Sn* → γ + e$^+$ key identifier.
- Point-like energy deposition from electrons distinct from Compton scattered gammas.
- High background rejection with LiquidO.

More info: https://arxiv.org/abs/1908.02859, Neutrino Physics with an Opaque Detector