AM-OTech: A large scale LiquidO-based neutrino detector for reactor monitoring

University of Sussex

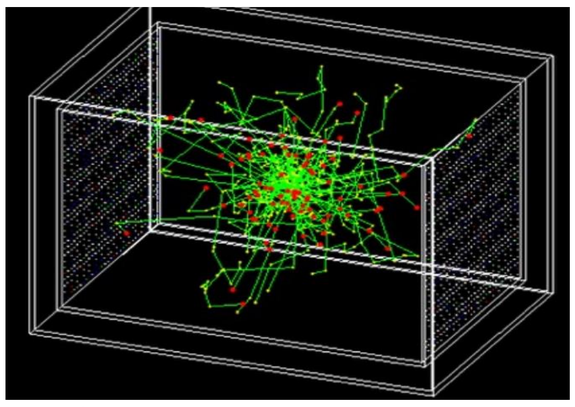
Adam Wong on behalf of the AntiMatter-OTech collaboration

Introduction

AntiMatter-OTech (AM-OTech) is a project funded by the European Innovation Council (EIC) and UK Research and Innovation (UKRI) with the goal of building the world's first large scale LiquidO based neutrino detector for reactor monitoring. The detector will be situated at the EDF Chooz-B nuclear reactor site located in France.

LiquidO is a new and emerging technology relying on the use of opaque liquid scintillators to offer better particle identification, background rejection and vertex reconstruction. With the help of LiquidO, AM-OTech aims to achieve high precision antineutrino flux measurements (uncertainties < 1%) for real-time reactor monitoring.

LiquidO: Opaque Liquid Scintillators

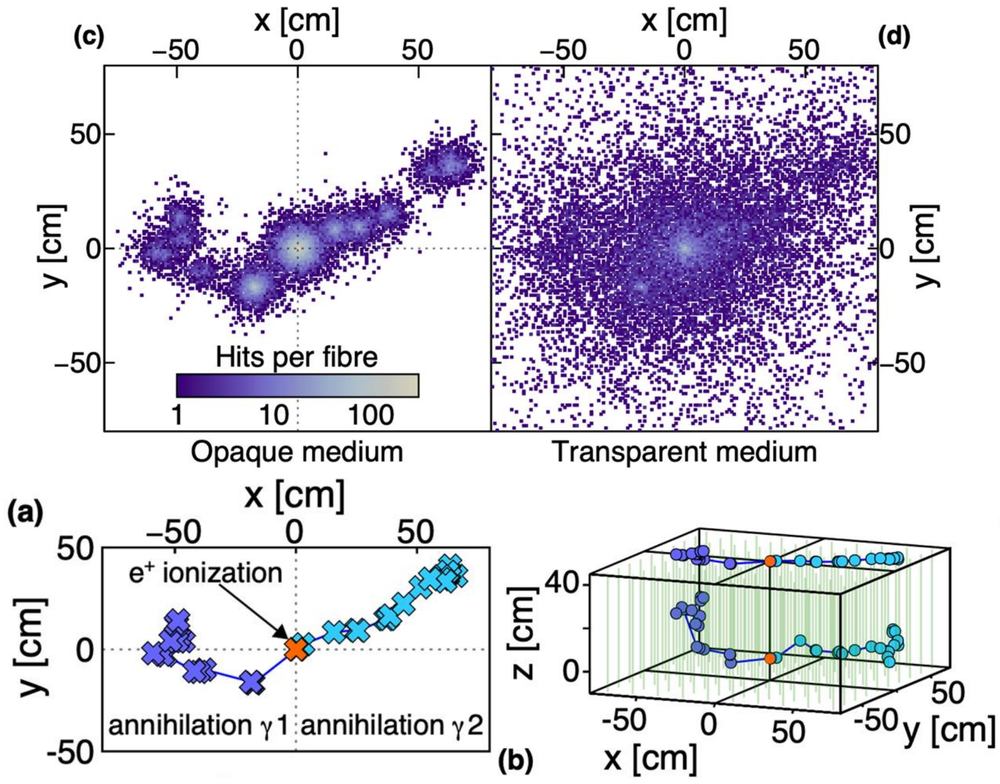


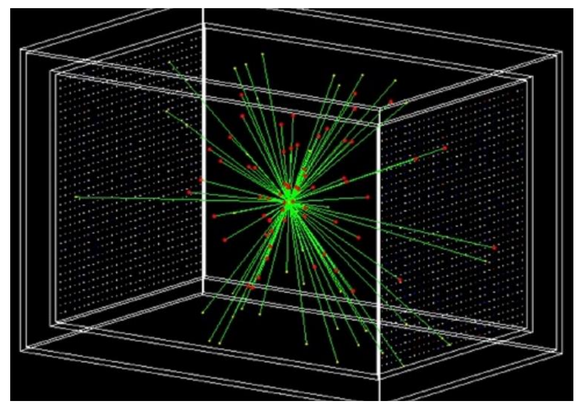
LiquidO Technology

Opaque scintillator

- Short scattering length (~mm)
- Long absorption length (~m)

⇒ Stochastic light confinement





Today's Technology

Transparent scintillator

- Long scattering length
- Long absorption length

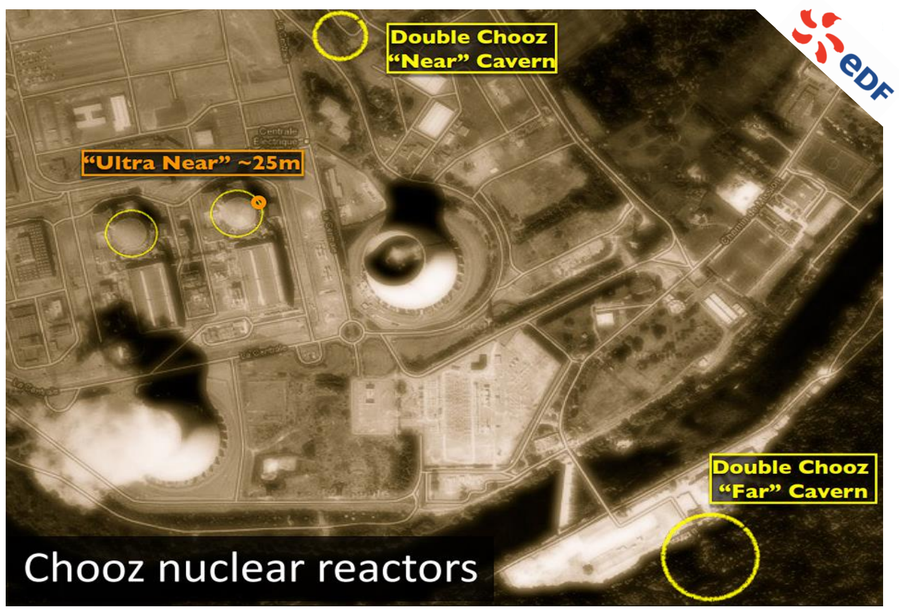
⇒ Topology lost unless physically segmented

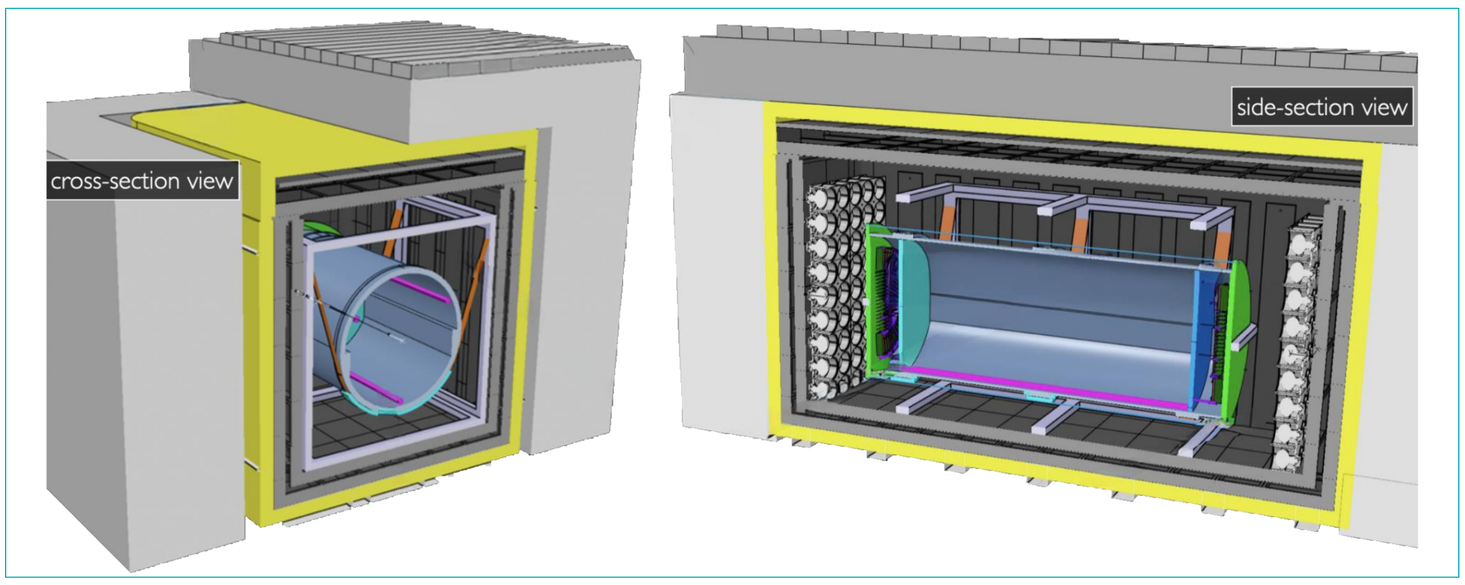
AM-OTech: Nuclear Reactor Monitoring with LiquidO

Electron antineutrinos ($\bar{\nu}_e$) are produced during the β-decay of nuclear fission products. Nuclear reactors emit a high flux of $\bar{\nu}_e$, proportional to the fission rate. Accurate measurements of the $\bar{\nu}_e$ flux will thus reveal information about the real-time state of an active reactor.

LiquidO seeks to improve $\bar{\nu}_e$ **detection efficiency** and provide better **background control** through:

- Confinement of light into "light balls" around each ionization point
- Discrimination of individual e^+, e^- and γ events at 1MeV scale
- A self-segmented detector (no dead material)

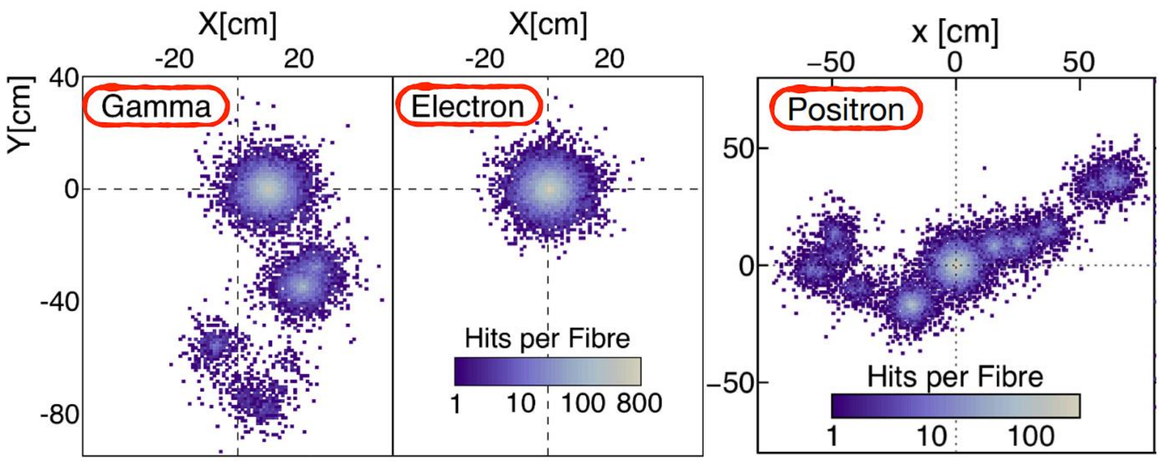


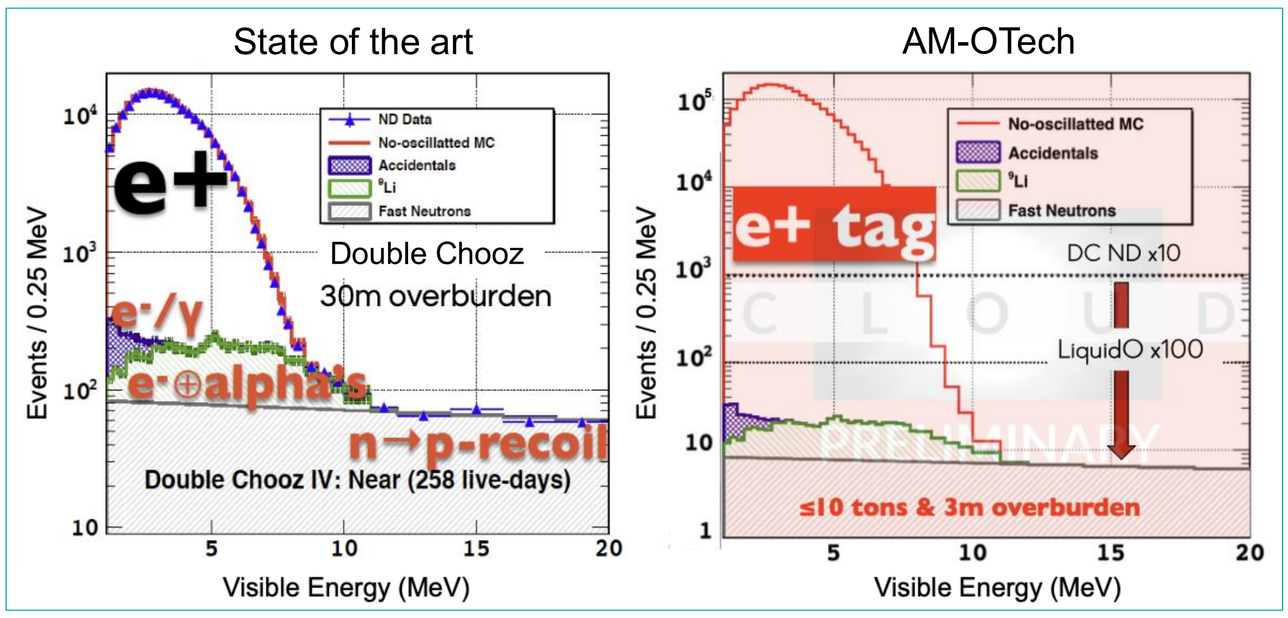


- 10,000 $\bar{\nu}_e$ interactions/day
- S/BG >100 (Reactor ON)
- S/BG >1 (Reactor OFF)
- Reactor neutrino flux (<1%)
- Reactor ON-OFF transition

- 5-10 tons of opaque liquid scintillator
- 10,000 WLS fibres
- 20,000 SiPMs
- 1.8m diameter
- >200 PE/MeV light yield

Signal (Inverse Beta Decay): $\bar{\nu}_e + p \rightarrow e^+ + n$





WIN 2025
9–13 June 2025
University of Sussex, Brighton, UK
WiN 25

European Innovation Council

LIQUID

UK Research and Innovation

References

1. LiquidO Consortium. Neutrino physics with an opaque detector. *Commun Phys* 4, 273 (2021).
2. Cabrera Serra, A., Stefano Dusini, Jeff Hartnell, Pierre Lasorak, J. Pedro Ochoa-Ricoux, & Joshua Porter. (2019, November 12). LiquidO: An Appetiser for Beam Physics Capabilities. DUNE Module of Opportunity Workshop.
3. Thiago Bezerra. (2024, March 9). A New Reactor Neutrino Experiment at Chooz. Les Rencontres de Physique de la Vallée d'Aoste