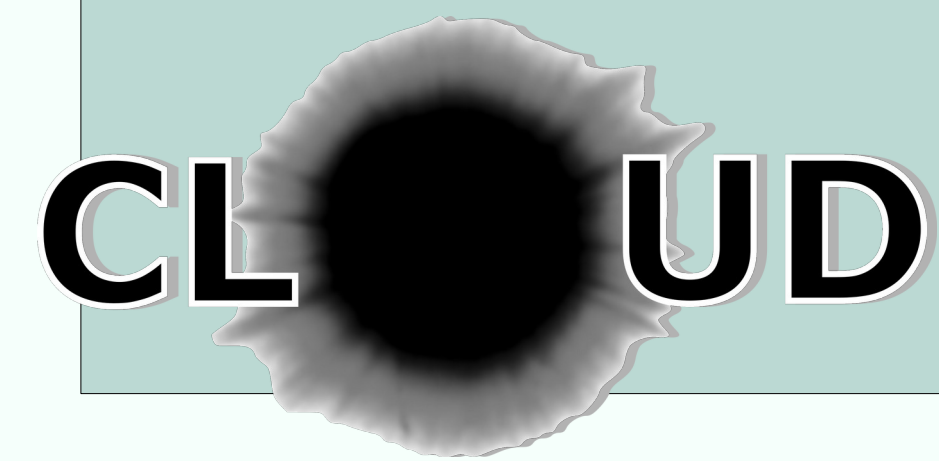# Simulation of CLOUD
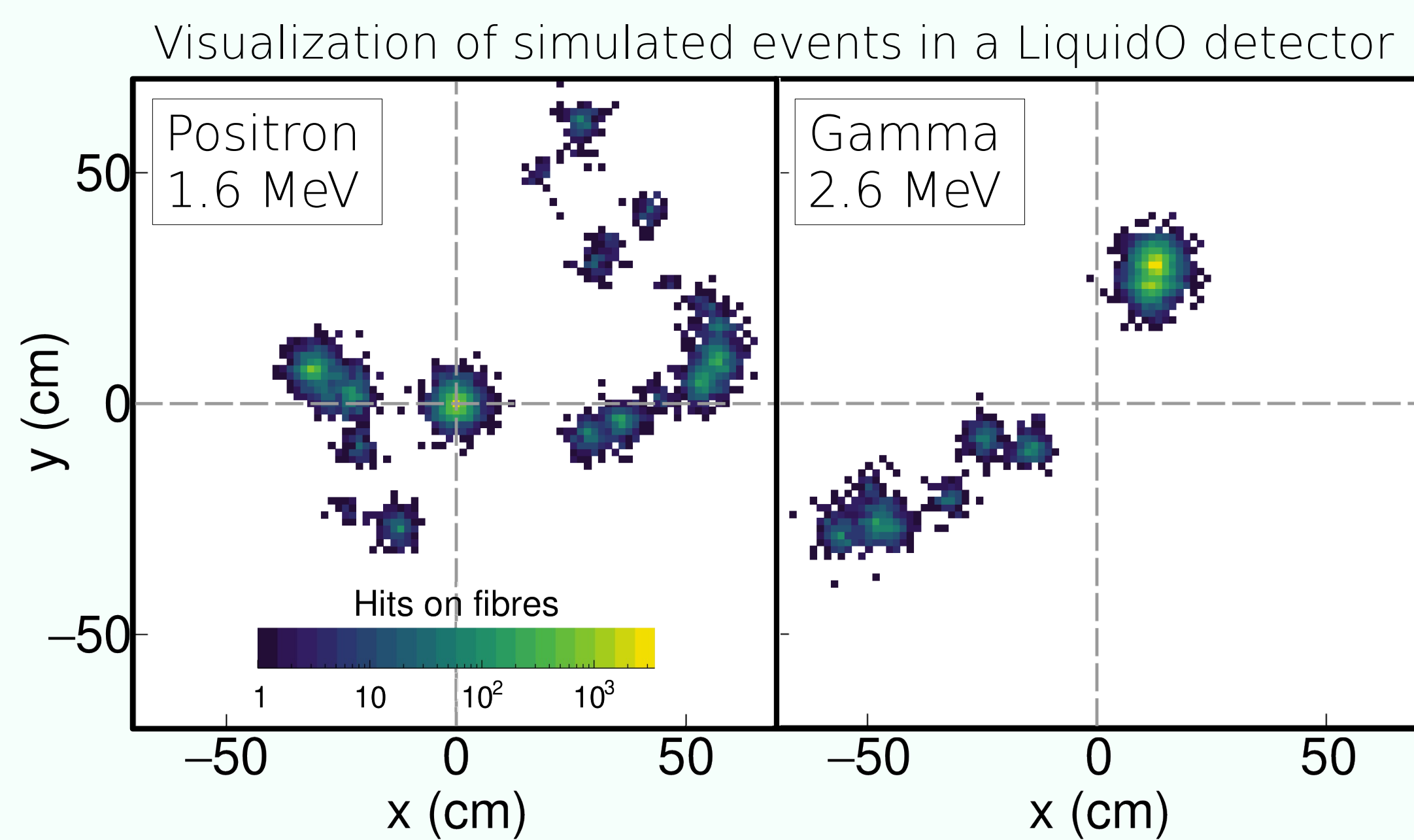# The first LiquidO reactor neutrino experiment

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LiquidO – New technology
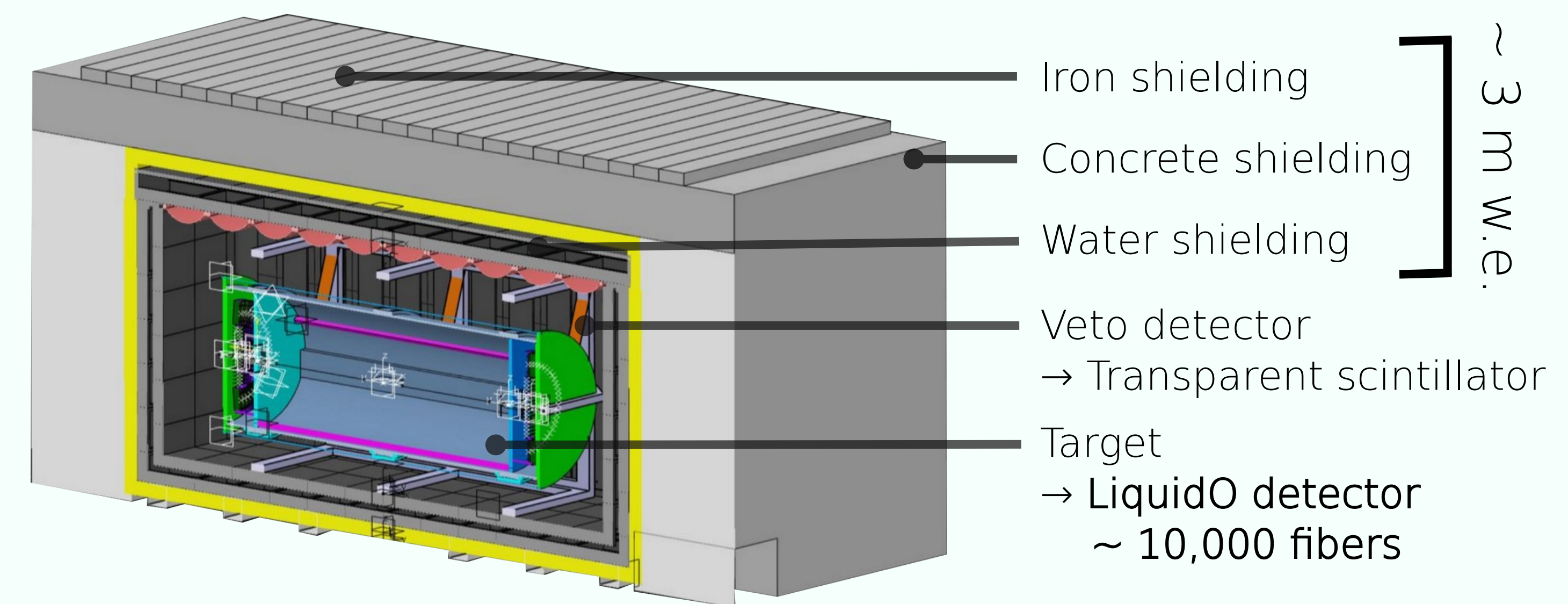
Particle detection using **opaque liquid scintillator** (LS)

→ Light ⎰ confined near its creation point
⎱ collected with WLS optical fibers

→ Powerful **particle identification** (PID)

Visualization of simulated events in a LiquidO detector

Positron 1.6 MeV

Gamma 2.6 MeV

Hits on fibres

2 successful prototypes, another under construction

CLOUD - Reactor neutrino experiment

‣ 5 to 10 ton detector @Chooz power plant
‣ **Ultra near site**: 35 m from reactor core
‣ **Detector at surface**
‣ ~ 10,000 IBD/day

~ 3 m.w.e.

Iron shielding
Concrete shielding
Water shielding

Veto detector
→ Transparent scintillator

Target
→ LiquidO detector
~ 10,000 fibers
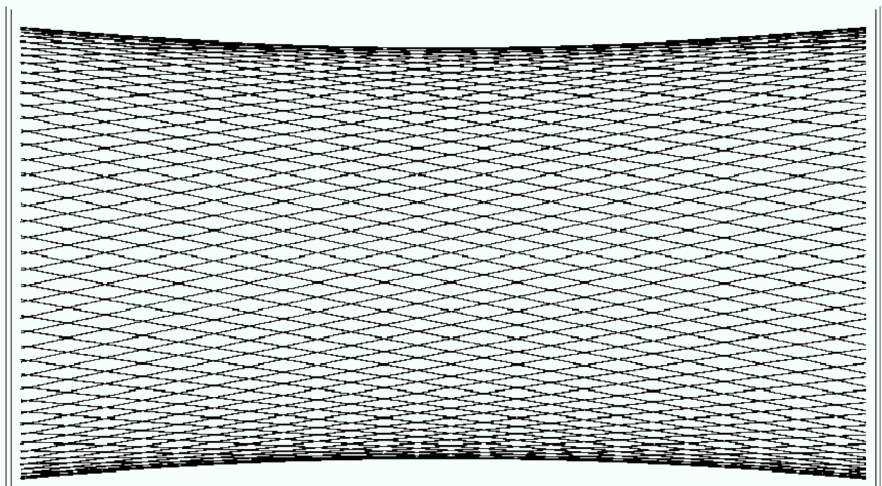
→ See Diana Navas Nicolás poster - today - #328

Simulation of CLOUD – Guiding the detector design

Building a detector at surface @UND comes with contraints
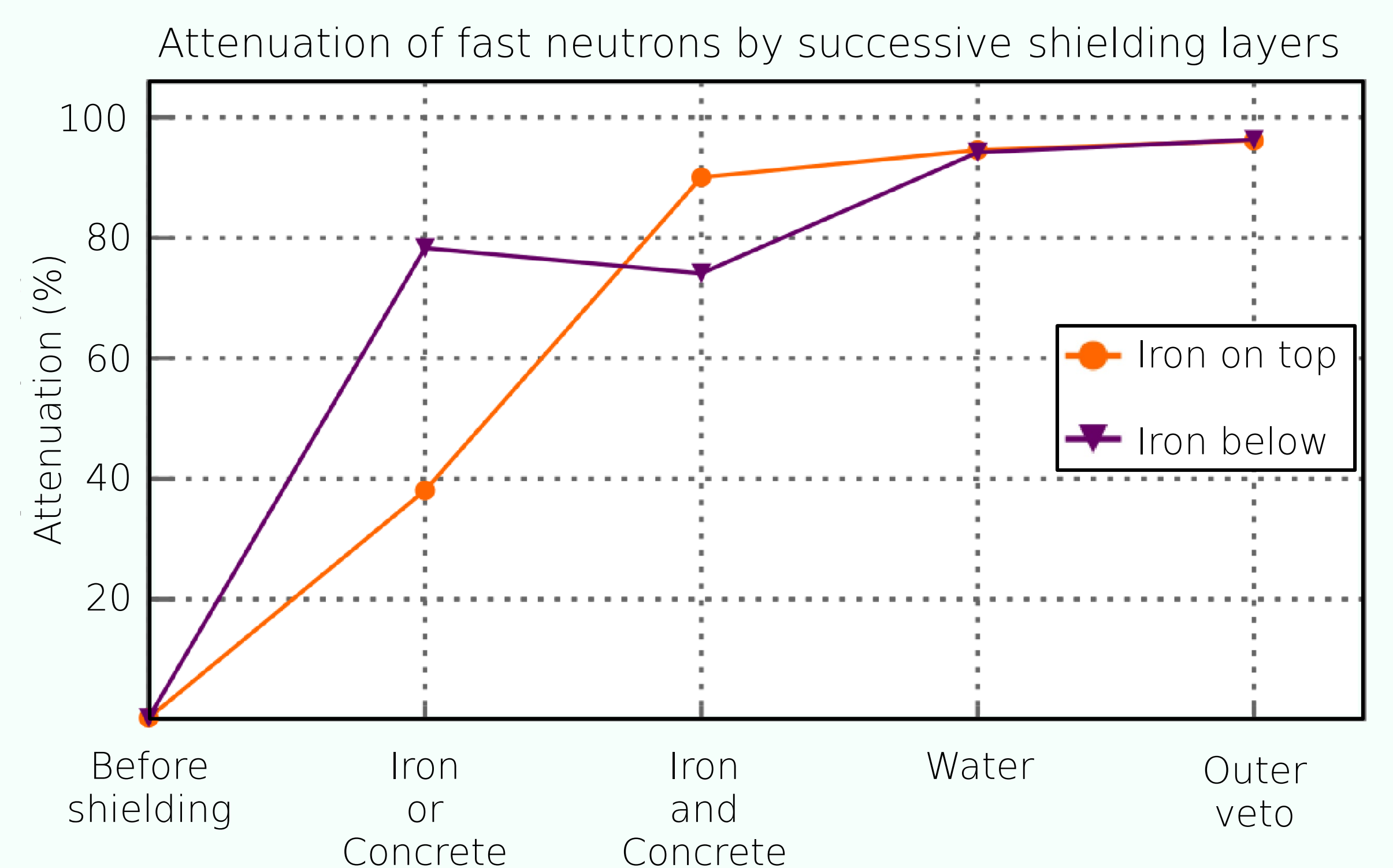Preliminary results on shielding design have been obtained using

‣ a toy geometry
‣ Geant4 simulations of background (gammas, neutrons...)

Next step:

Design of the target detector **fiber array**
→ Goal: improve **position resolution** and
Background rejection with **stereo geometries**

→ See Susanna Wakely poster - # 393

Attenuation of fast neutrons by successive shielding layers

Iron on top
Iron below

Attenuation (%)

Before shielding / Iron or Concrete / Iron and Concrete / Water / Outer veto

Towards full simulation of CLOUD – Ratpac-2

Rat-pac: C++ simulation and analysis package using GEANT4 and ROOT

Rat-pac for CLOUD: from particle generator to SiPM simulation

‣ Implementation of fiber **PDFs** to **speed up** simulations (by 2 orders of magnitude)
‣ Simulation of **DAQ trigger**
‣ Production of simulations for **neural network training**

Next steps:

‣ Finalize full software chain with **integration of reconstruction** in the pipeline
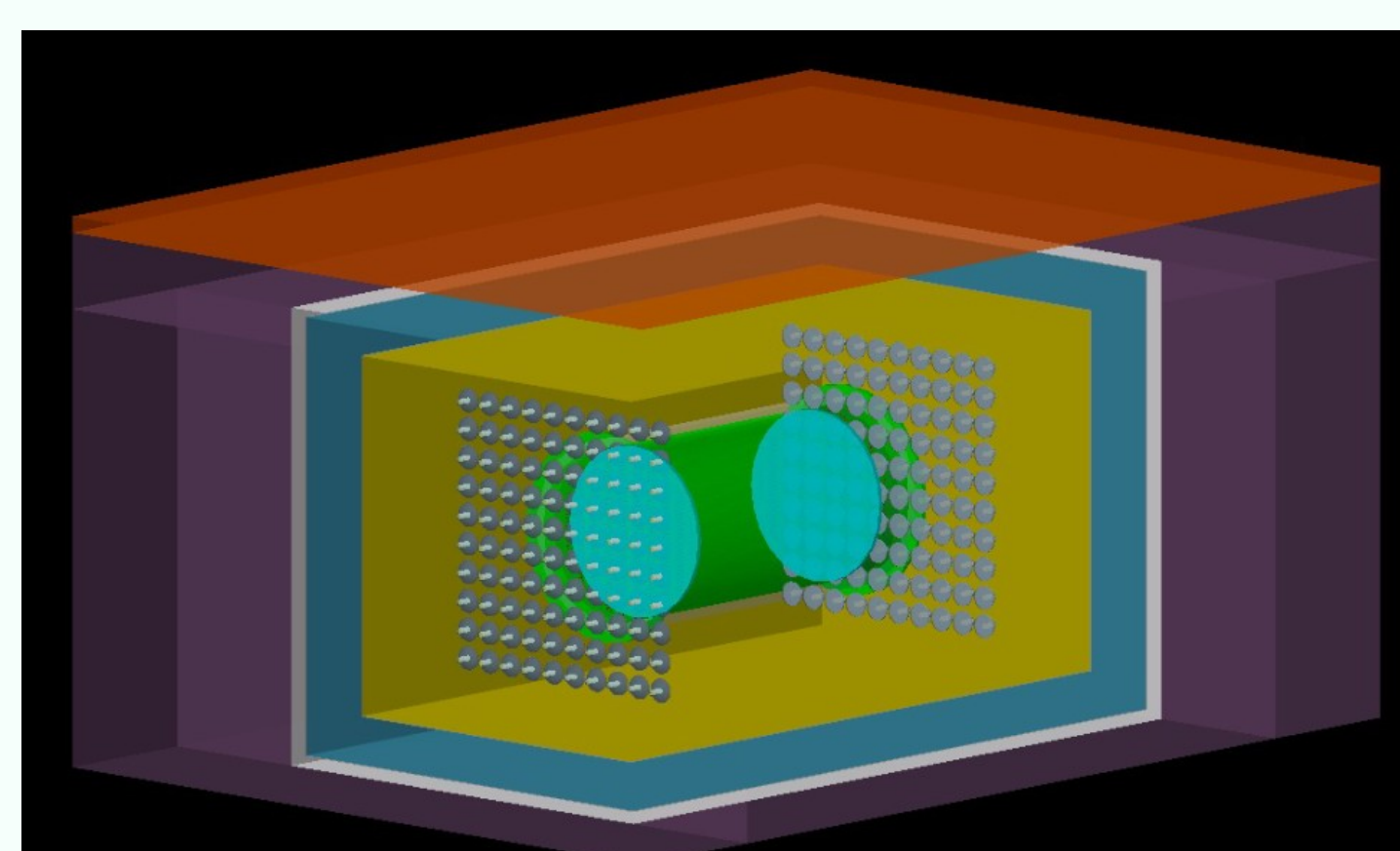
Visualization of the detector geometry with RatPac

Positron ID – Event topology reconstruction

Simulated positron in a LiquidO detector
Cambridge-Aachen jet reconstruction algorithm

Positron 1.6 MeV

Exploring complementary reconstruction possibilities:

‣ Traditional approach: Cambridge-Aachen **clustering algorithm** for jet reconstruction
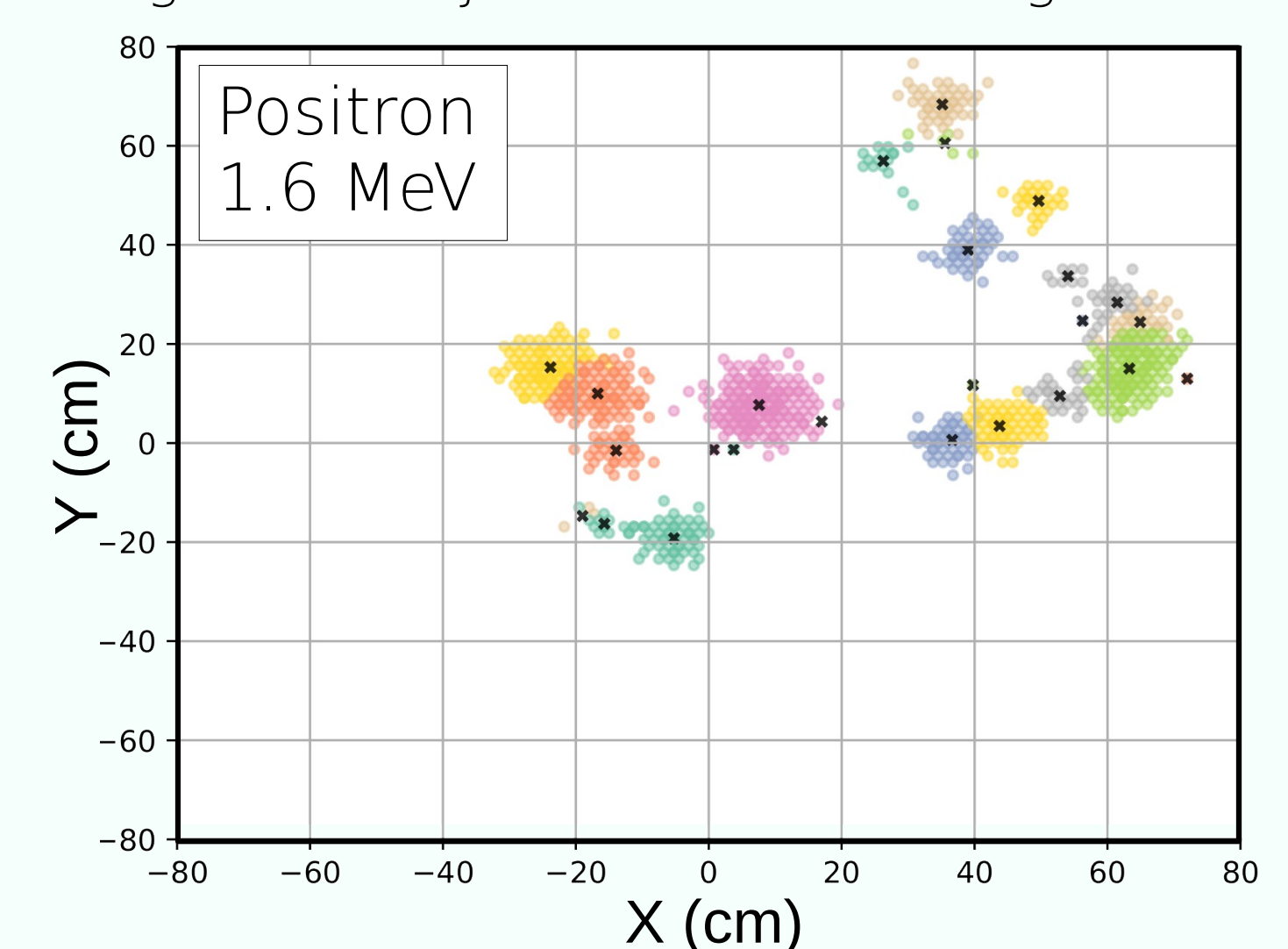
‣ **Neural Network**: powerful, especially if we choose stereo geometries
→ See Garrett Wendel poster - today - #612

Goal: **PID**, **energy** and **vertex** reconstruction
→ Using the full detector simulation