

Simulating LiquidO detectors for prototype research and development

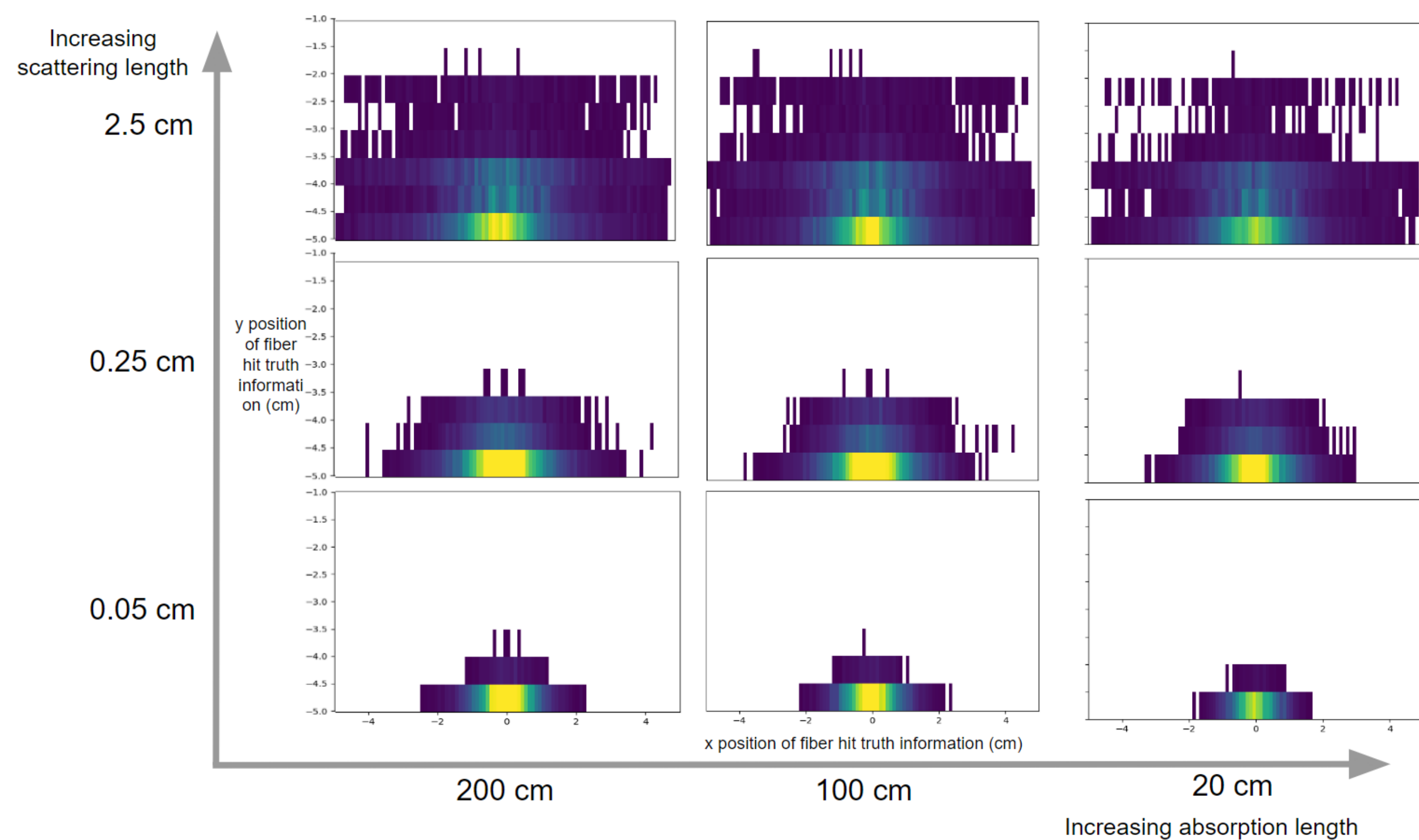
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LiquidO Consortium

Introduction

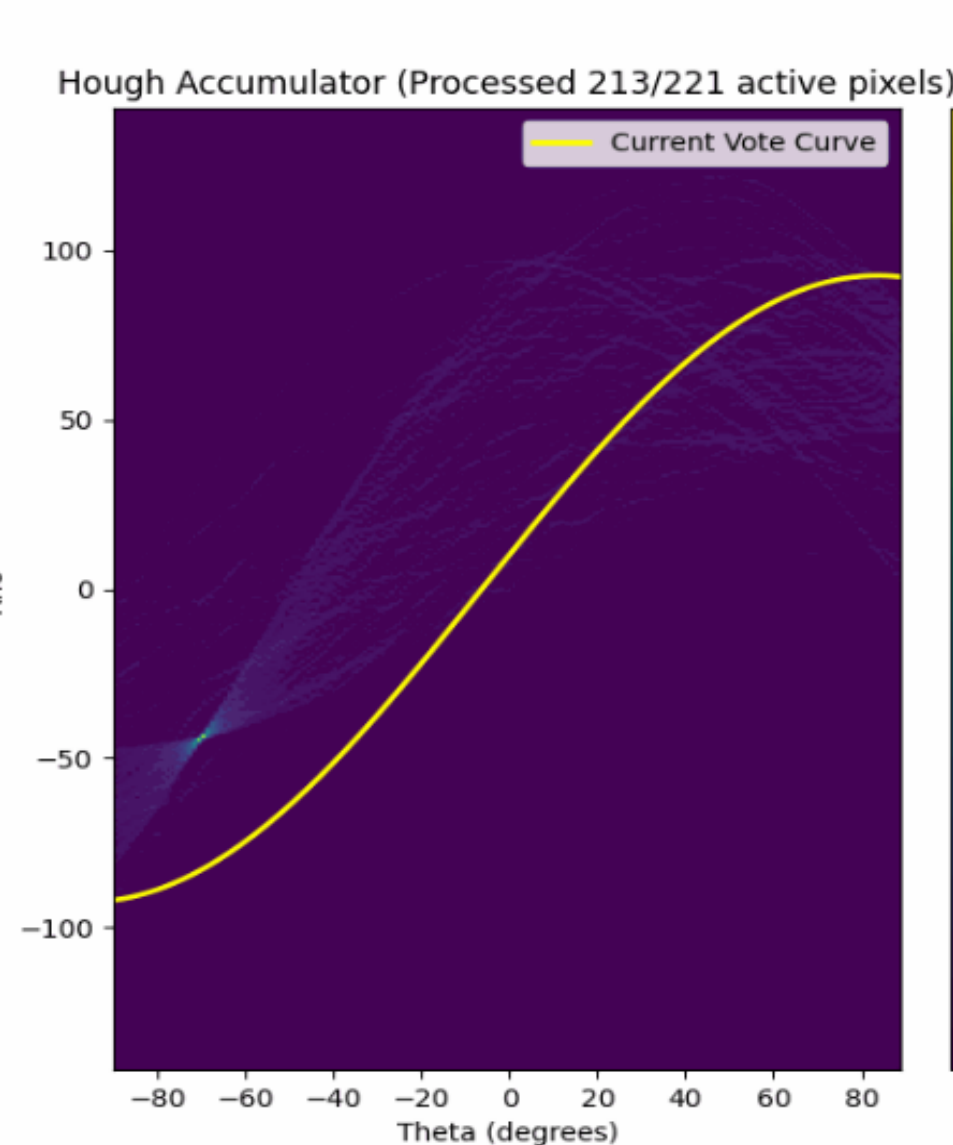
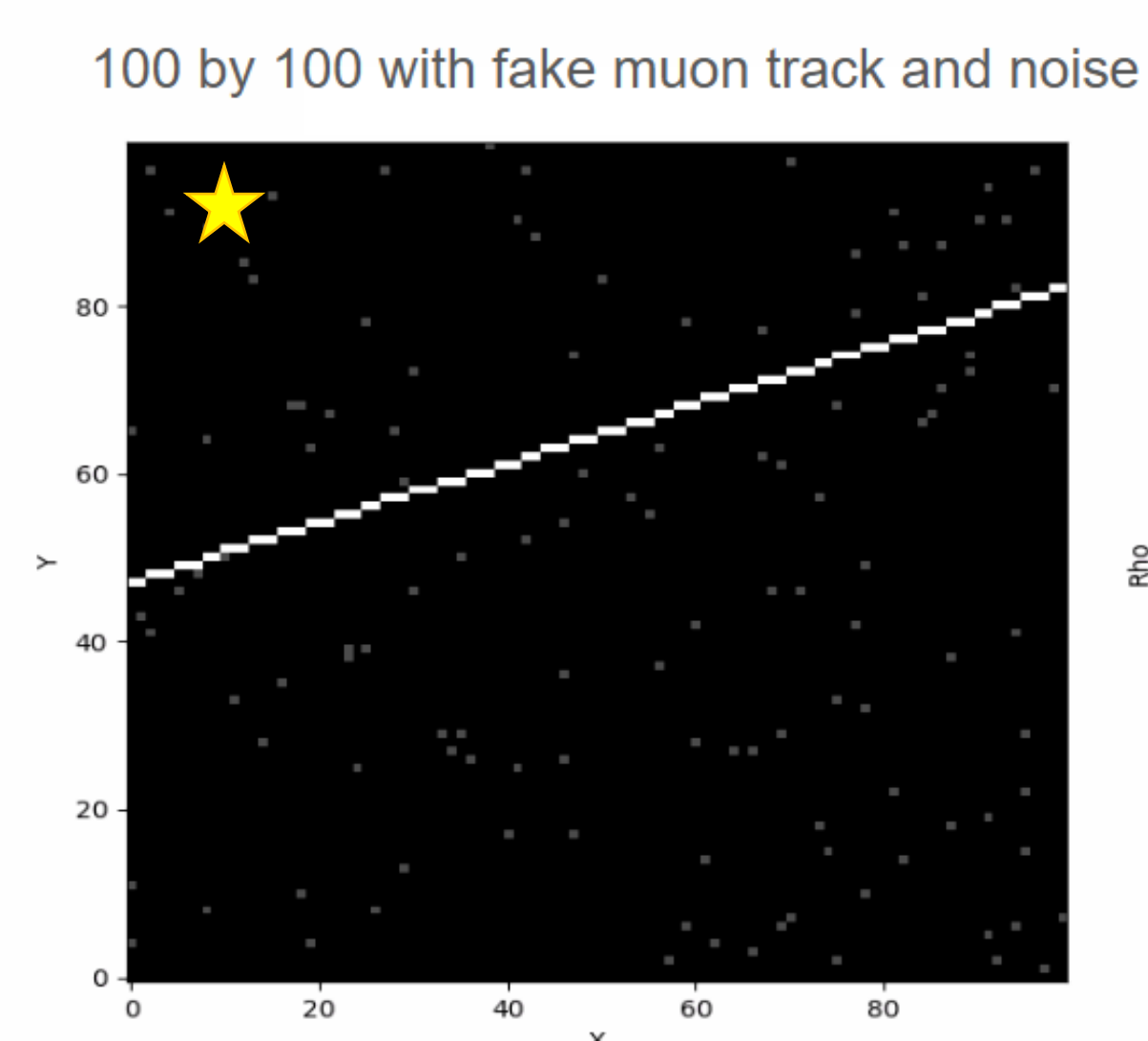
- **LiquidO** is a novel detector technology that uses the stochastic confinement of light in an opaque medium to increase particle identification efficiency.
- Light is collected using an array of **Wavelength Shifting Fibers**
- The Geant4 based Simulation toolkit **RATPAC 2** is used to generate large event response datasets and study light propagation.
- We have implemented a **Hough transform algorithm** for muon track reconstruction.
- Once the **Cosmic Muon** has been identified, it should be possible to find the deposited energy along the track alongside identifying any **Delta Rays** produced and scattering events that occurred.

Light ball formation



For the LiquidO bottom left is best, with a short scattering long absorption length. Colour indicates light level.

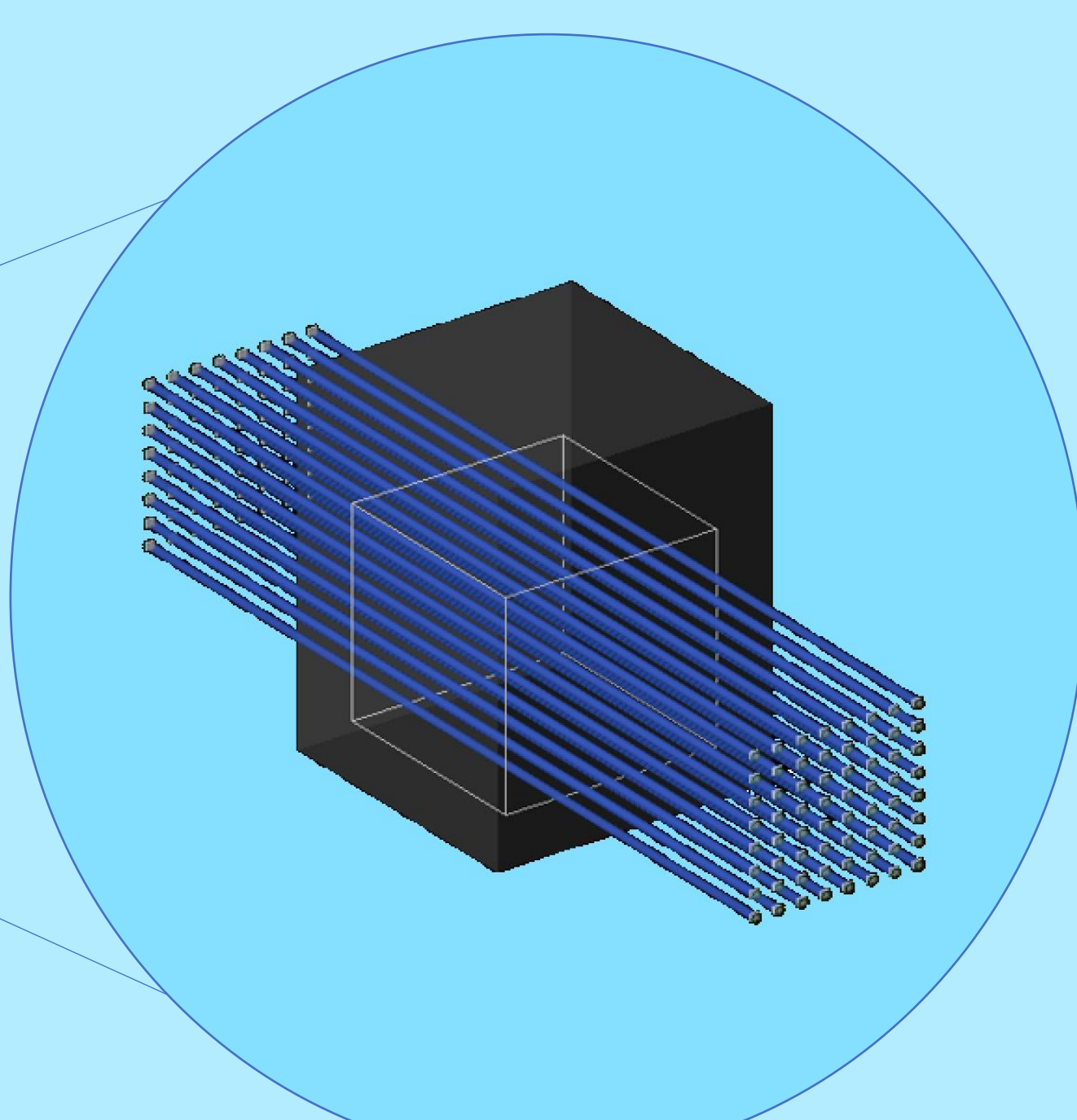
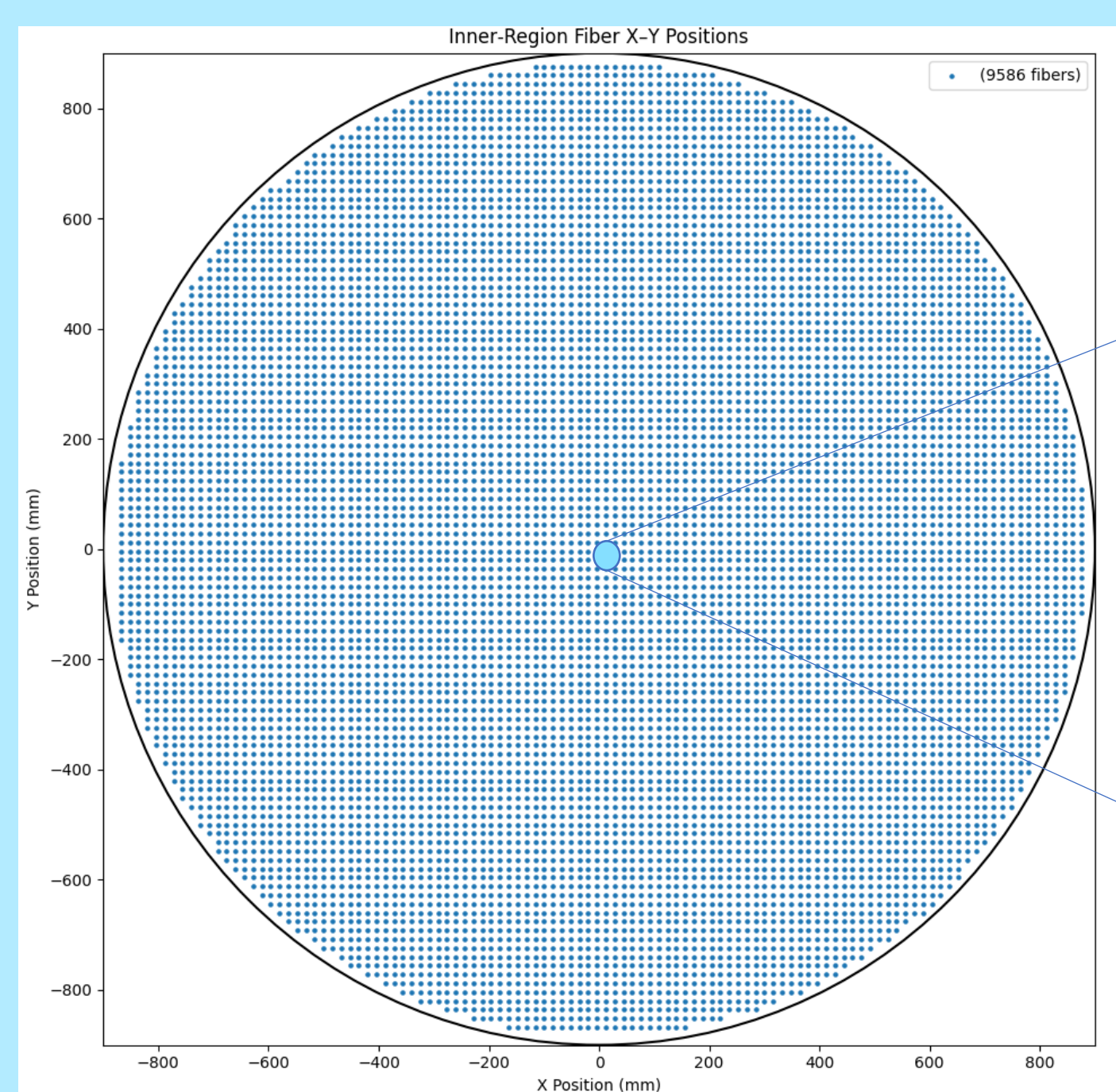
The Hough Transform



- Find all lines that pass through each pixel
- Add line parameters to vote grid
- Find position with highest vote
- You have found a muon track!

Simulated Geometries

From Big to Small



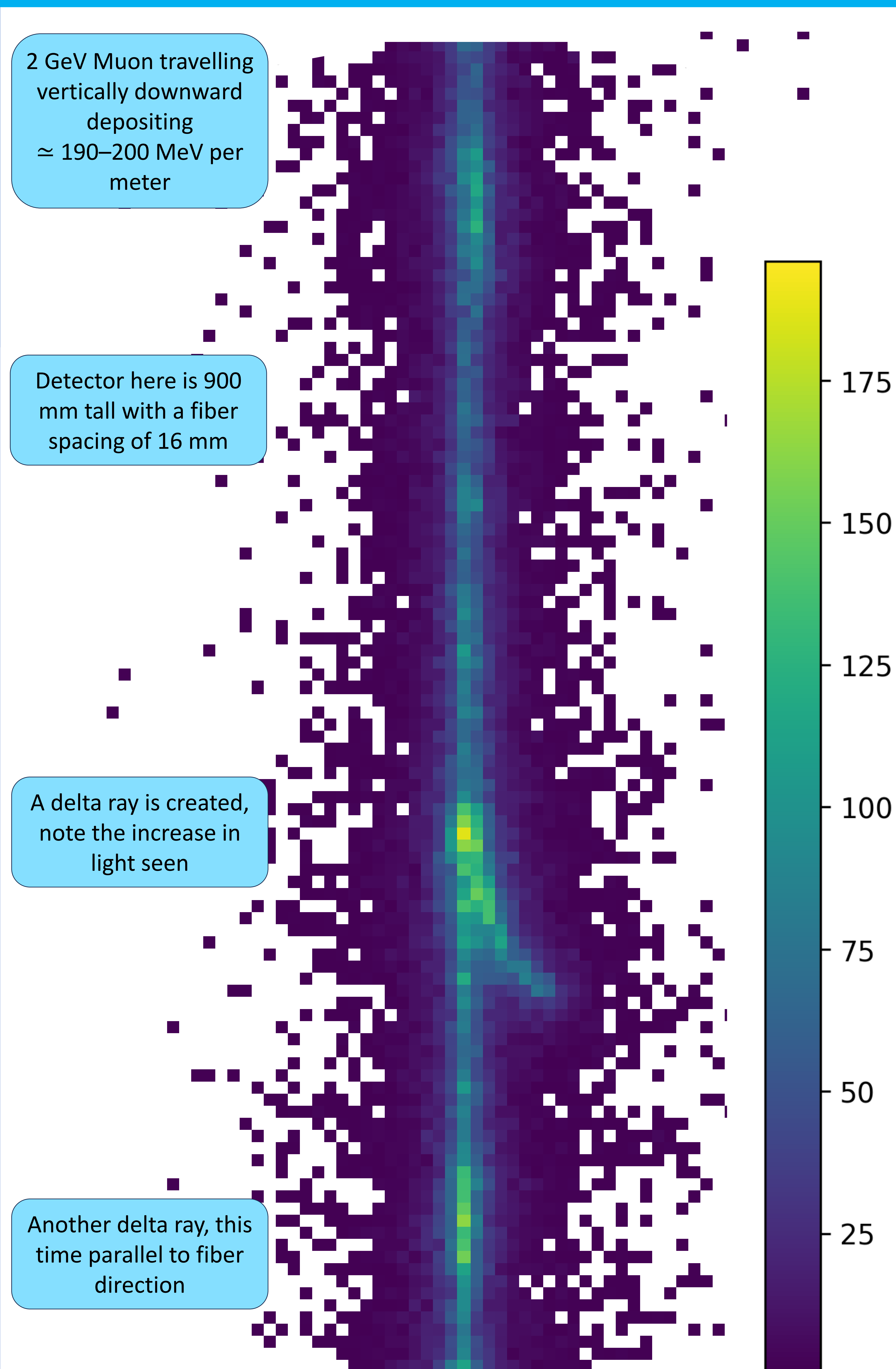
We use a custom implemented "nested" G4Tub array class alongside a Ratpac2 Processor for light propagation in optical fibers. This improves the simulation start up time & run time

2 GeV Muon travelling vertically downward depositing $\approx 190-200$ MeV per meter

Detector here is 900 mm tall with a fiber spacing of 16 mm

A delta ray is created, note the increase in light seen

Another delta ray, this time parallel to fiber direction



The Hough transform has been tested on simulated data from the Cube

The next step is to test on a larger detector

The main goals:

- Muon track identification for veto and track parameters
- Delta ray identification
- "Energy along track" to identify potential sites of spallation

