

TOAD Geometry and Sim/Reco Status

Anežka KLUSTOVÁ

a.klustova20@imperial.ac.uk

November 1st, 2022



TOAD Introduction

- **The Teststand of an Overpressure Argon Detector (TOAD)** is a slice of the ND-GAr detector and its electronics operating at FNAL in the 2022/23 beam year
- TOAD will obtain a large sample of proton-argon interaction data → need for simulation and reconstruction
- No need to reinvent the wheel → use DUNE and ND-GAr tools that are available



TOAD at DAB

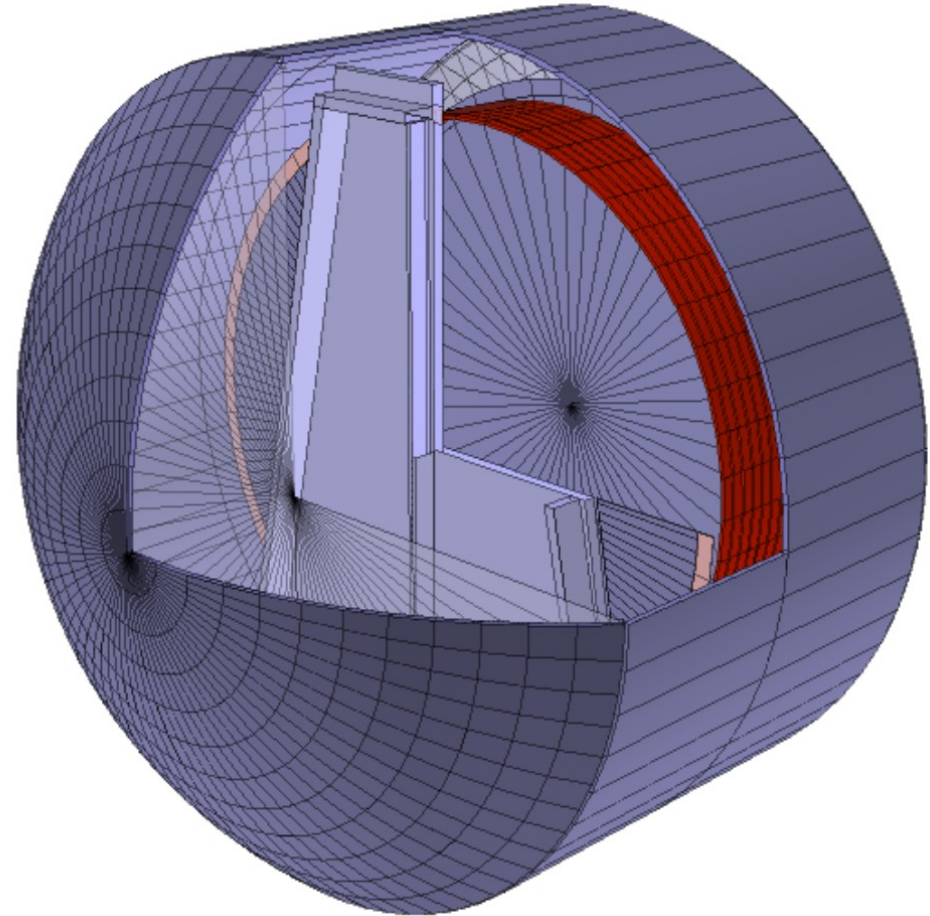
Last Time On Geometry and Sim/Reco & Current Status

- **At the CM**

- .gdml geometry file created using gegede package
- Started the implementation in garsoft
- Physics simulation amended to implement TOAD's geometry (1 drift, no magnetic field, etc.)

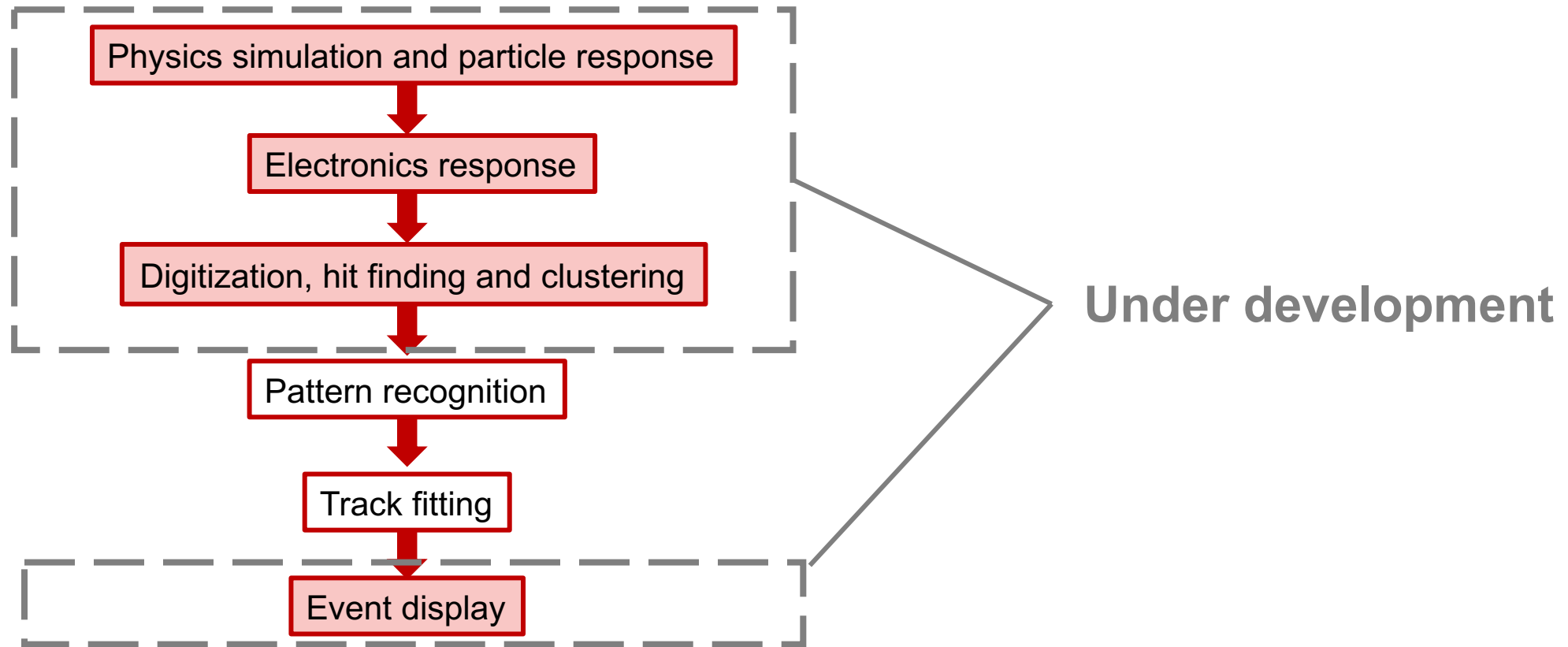
- **Current status**

- Simultaneous development of readout simulation (channel map) and event display
- *Progress up to the end of September, picking this up again this week*



garsoft: Software for ND-GAr (and TOAD)

- **First goal:** to see straight and kinked tracks in gas volume using full slice of ND-GAr
- Current plan is to make a working event display with clustered hits



Physics Simulation

- First iteration of physics simulation proceeds without issues (test runs with GENIE)
- Code amended to work with TOAD's geometry file
- Received LArIAT's G4beamline simulations particle lists from Supraja **NEW**

- **TO DO's:**

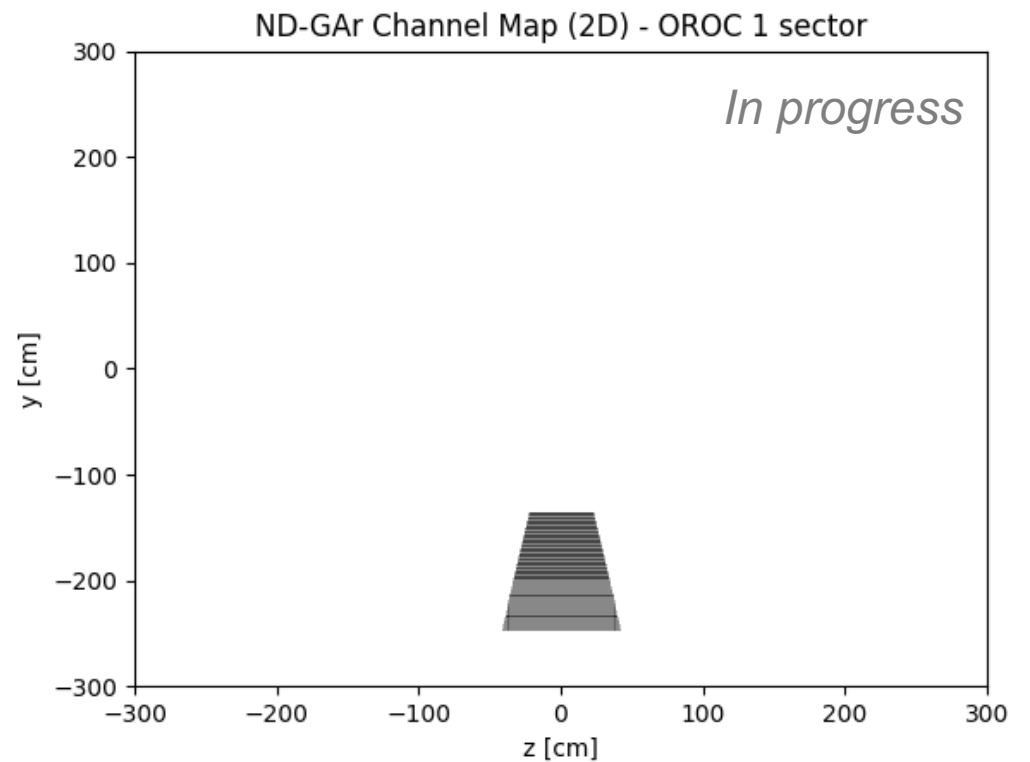
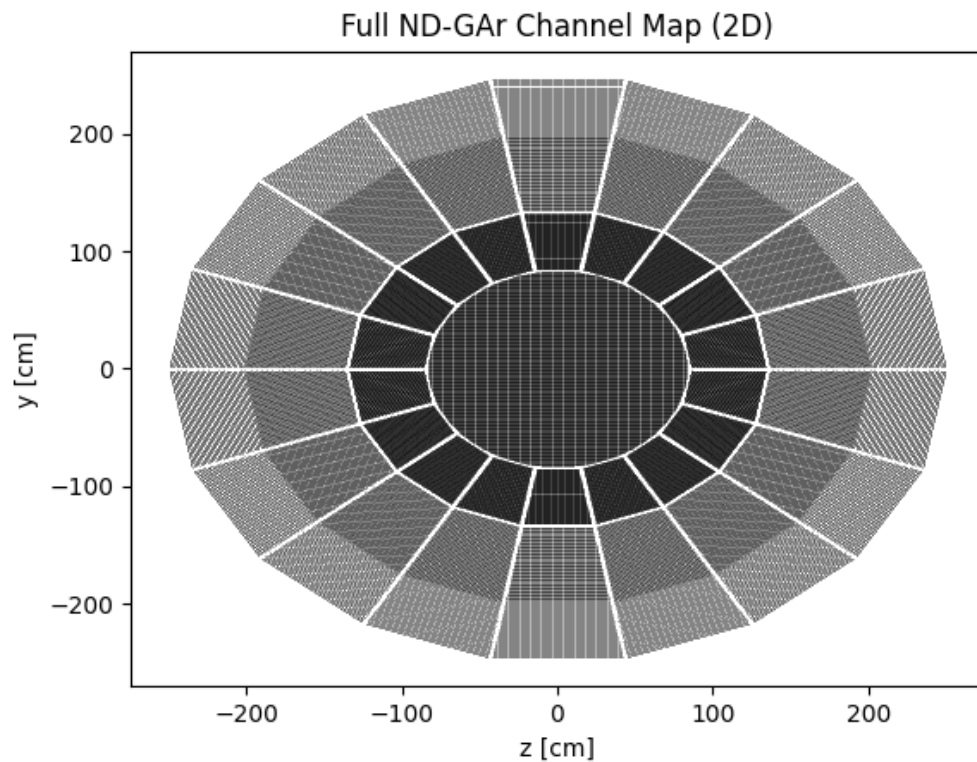
- Switch to particle gun using LArIAT's particle lists
- Redefine active region to include endcaps
- Redefine drift region from cathode to OROC and within the field cage (rather than the straight part of the vessel)



Readout Simulation: Channel Map

NEW

- Need to define formulaic channel map for TOAD (x, y, z position in space defines the readout channel)
- **TODO:** Fix channel numbering and shift in yz to align with the geometry



Readout Simulation: Electronics Response

- TPC readout simulation defined in TPCReadoutSimStandardAlg.cxx
- ElectronsToADCs()
 - Conversion factor n for number of ionization electrons to ADC: $V \propto Qn$
 - Seems to use just total charge, doesn't include convolution in time
 - Can integrate the theoretical prediction to remove the time dependence for now?

Theoretical prediction of electronics response:

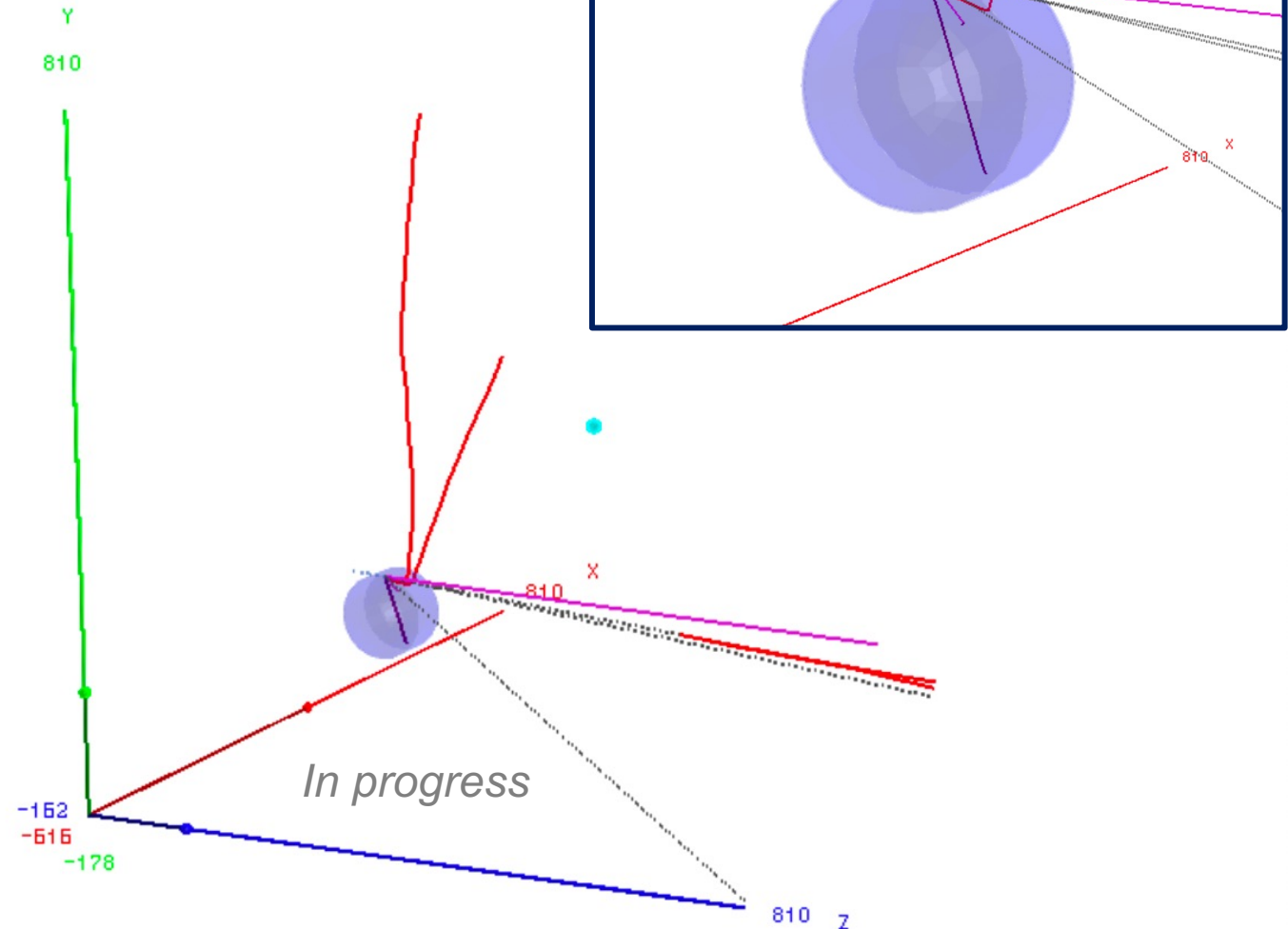
$$V_{out} = \frac{QA^n n^n}{C_f n!} \left(\frac{t}{\tau_s}\right)^n e^{-nt/\tau_s}$$

$n = 4$ (number of filters in the network)
 Q, A, C are network (digitizer) specific parameters
 τ_s is the peaking time (160 ns for SAMPA)

Event Display

- Developing 3D event display available in garsoft for TOAD
- Reads in geometry – need to define different volumes to be visible within the vessel and their transparency
- Testing with reco files generated for ND-GAr (needs completion of the channel map to cluster hits in TOAD)

NEW



Conclusions and Next Steps

- Implementation in garsoft under way, picking this up again after a month
- Current priorities are
 - 1) Finish channel map to be able to create raw digits
 - 2) Optimize event display to show individual volumes
 - 3) Change to particle gun
- Feedback and person-power to help with the development are welcomed!