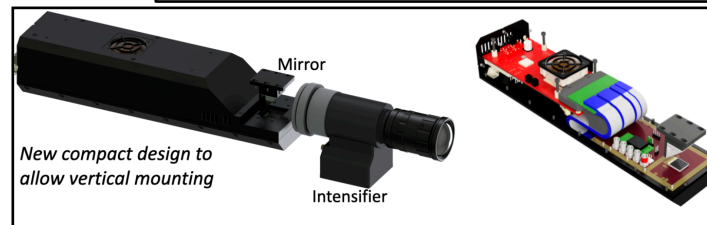
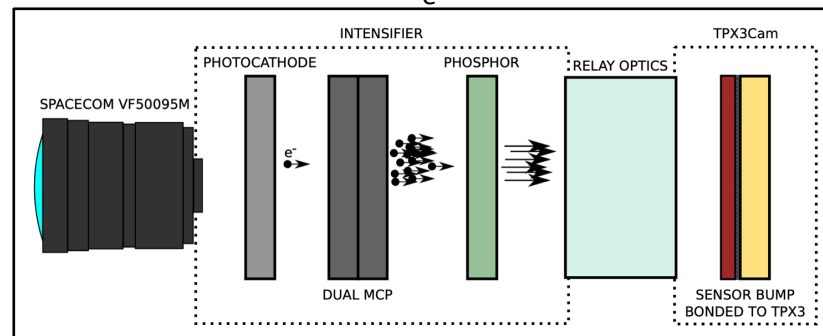
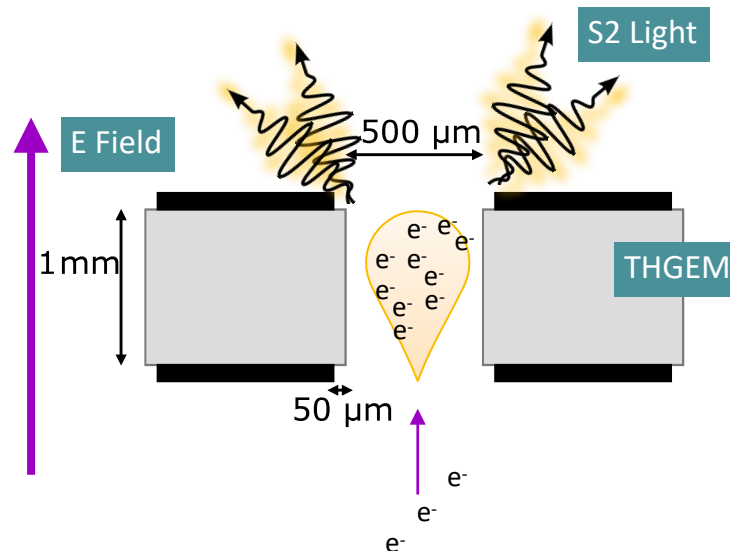
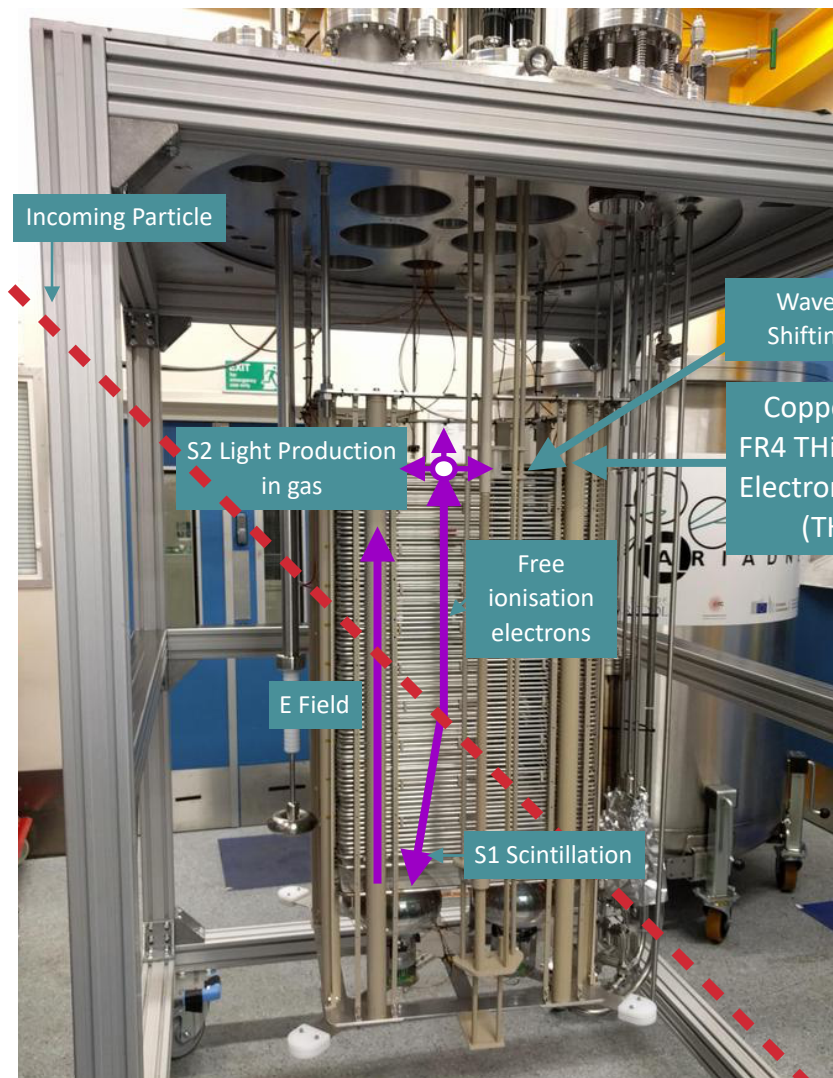


ARIADNE (ARgon ImAGING DetectionN chambEr)



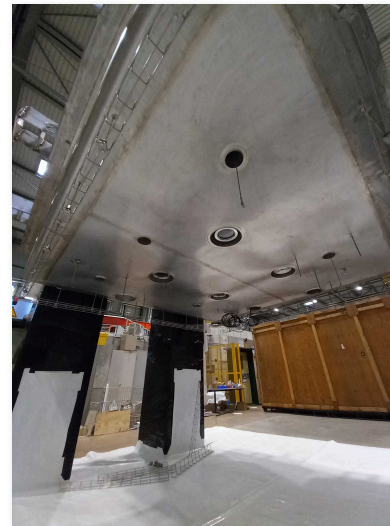
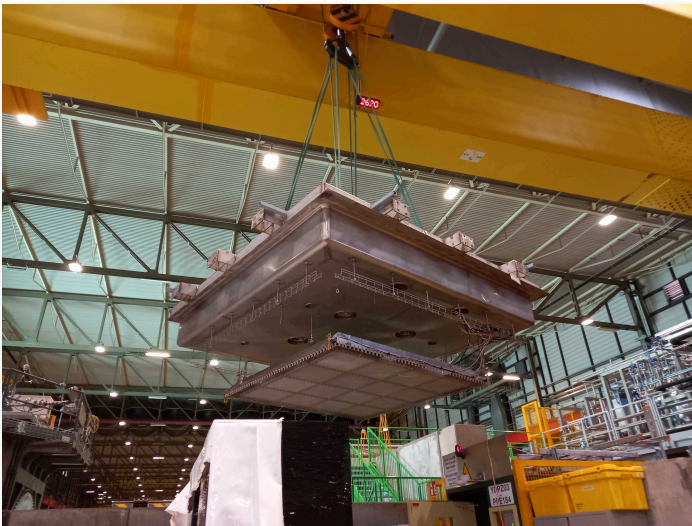
ARIADNE Detector - 1 Tonne LAr TPC located within the Oliver Lodge Building

The ARIADNE+ Detector

- ProtoDUNE Charge Readout Plane (CRP) test cryostat, also known as the Cold Box, is a 15 tonne TPC located at the CERN Neutrino Platform at Prévessin, France next to ProtoDUNE Dual Phase
- Mounted underneath is the 2.5 x 2.5 m ARIADNE+ Light Readout Plane (LRP) imaging cosmic muons with 4 TimePix Cameras; 3 imaging visible and 1 Vacuum Ultraviolet (VUV) light

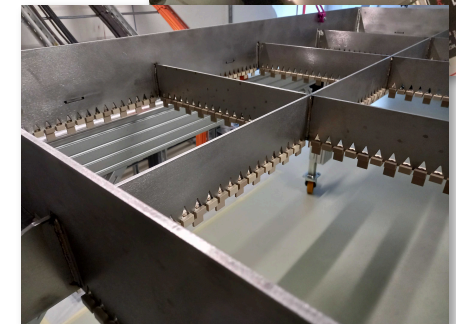
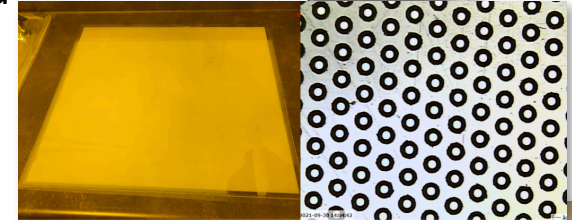
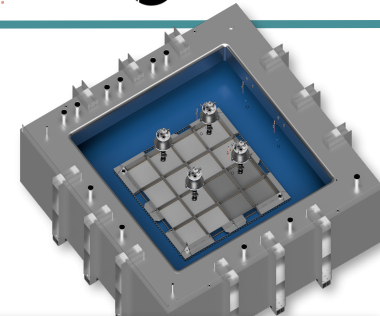


ProtoDUNE as seen from the cold box



The ARIADNE+ Detector - Innovative Ideas

- Glass THGEMs - Less prone to sagging compared to FR4 at larger surface areas, conical hole shape collects charge over time and increases light output
- Polyethylene Naphthalate (PEN) Film coated glass panels for Wavelength Shifting (WLS) - commercially available in different easier to apply to surfaces than alternatives (TPB)
- VUV intensifier - imaging the THGEM directly without the need for any WLS
- Invar support structure - Uniquely low coefficient of thermal contraction, ideal for keeping glass THGEMs and glass WLS panels in one piece!
- Chemically etched extraction grid - 15 mm from THGEM instead of 10 mm on ProtoDUNE dual-phase



Second Year Work

- July - October 2021
 - Refining the procedure and making the 12 pieces of WLS glass
 - Assembling the top of our re-entrant viewport hats that TPX3 assemblies will mount to
- November 2021 - January 2022
 - Move to CERN!
 - Making a **cleanroom** from scratch in preparation for the arrival of shipments from USA, Liverpool and DSM



Second Year Work

- February - March 2022
 - Received the materials to **begin construction** and preliminary **THGEM testing** in Mini-ARIADNE (MARIA)
 - Setting up the DAQ on the CERN network
 - **Install the LRP** (Light Readout Plane) within the Cold Box
 - **Begin data collection**
- April - Present 2022
 - Decommissioning the detector
 - **Data analysis**



Building the ARIADNE+ Cleanroom

ARIADNE+'s base at the CERN Neutrino Platform

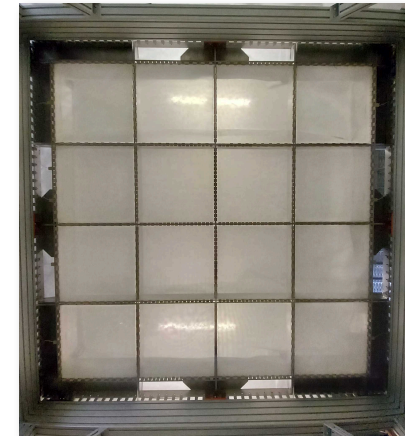
From this...



To this...

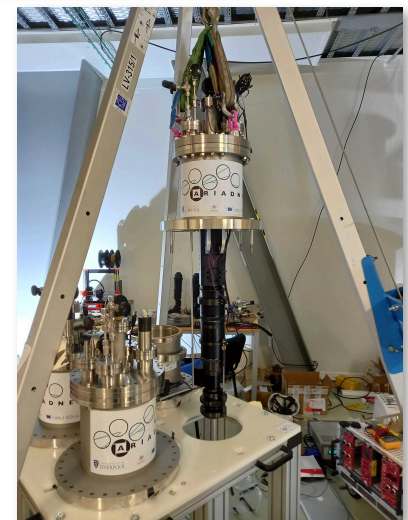


Finished Product



Constructing the Light Readout Plane (LRP) and Re-entrant Hats

- Consisting of nearly 1000 PEEK pieces, 12 sheets of WLS glass, 16 50 x 50 cm glass THGEMS and a stainless steel extraction grid
- Month and a half of assembly
- Nitrogen flushed re-entrant hats - mounting for the TimePix3 assembly with motorised on/off and focusing



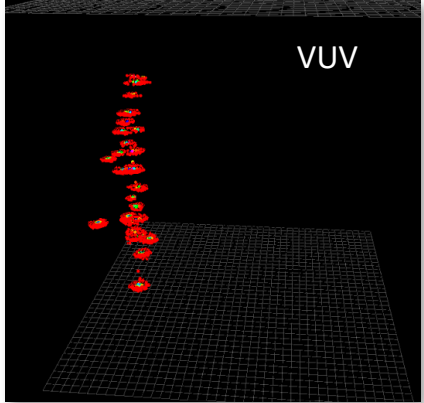
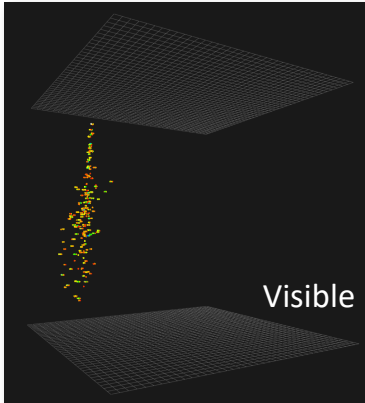
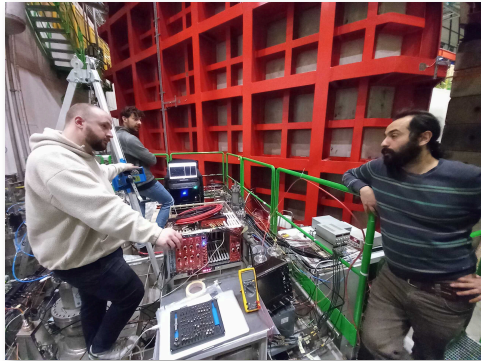
THGEM Testing using MARIA

- Parallel with LRP assembly, select glass THGEMs were tested in Mini-ARIADNE (MARIA)
- Essential for understanding behaviour and “training” before mounting in LRP
- Secured in a mini-LRP, tests were done in gas with an alpha source and EMCCD
- First time glass THGEMs of this size used in a TPC



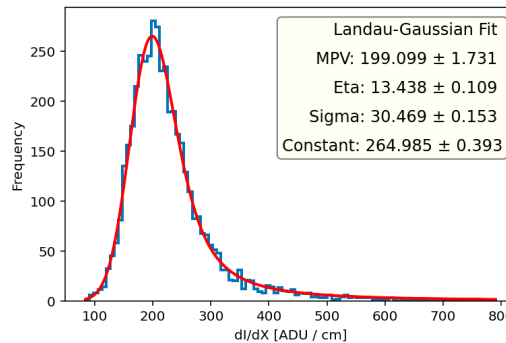
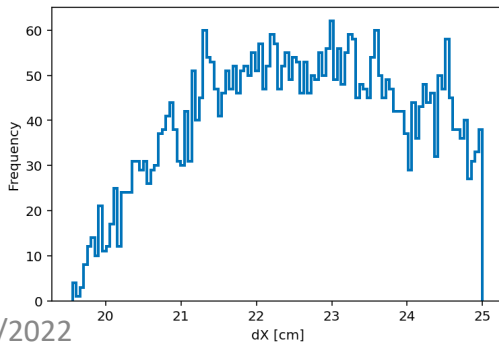
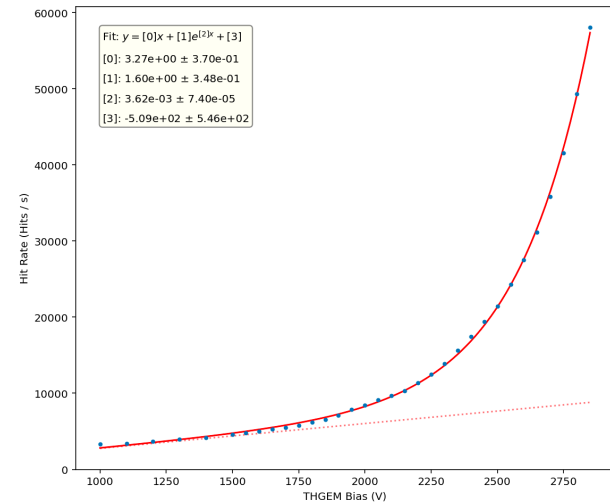
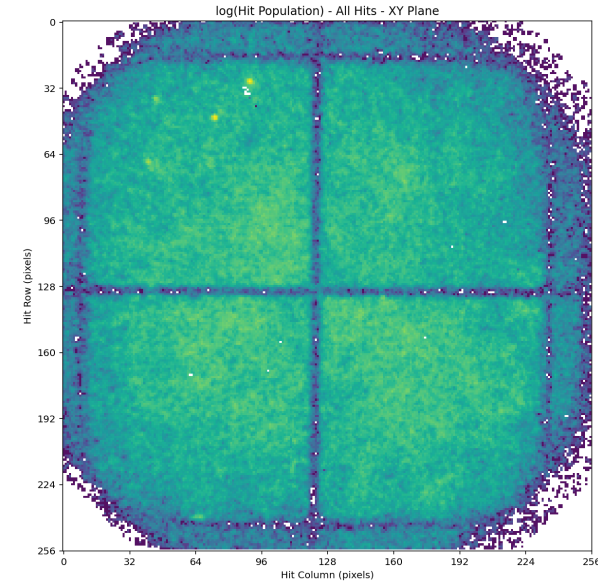
Data Taking

- Good Cold Box purity was assured for a week at a time, data taking split over two weeks - 5 of us taking data for 18 hours a day!
- Monitoring LAr level with temperature sensors, level meters and webcams
- Working in conjugation with the Galician Institute for High Energy Physics (IGFAE), part of the ARIADNE+ collaboration, assisting with taking S1 data with photo-detectors embedded in the cathode (known as ARAPUCAS)
- Plan is to correlate S1 with S2 data in the future



Preliminary Analysis

- Of 255 x 255 pixels TimePix3 chip, each pixel images approximately 4.6 mm of the 1 x 1 m active area
- 30 second camera exposure (visible light) hits heat map
- Glass THGEM gain graph - has a clear linear and exponential region
- Initial calibration/resolution -
 - Energy conversion : 199.10 ± 1.73 ADU / MeV
 - Energy resolution : 16.73 ± 0.16 %



dX and dl/dX for 4483 events



Optical sensor bump bonded to TimePix3 chip

Simultaneous 10 bit **Time over Threshold (ToT)** and 18 bit **Time of Arrival (ToA)** readout

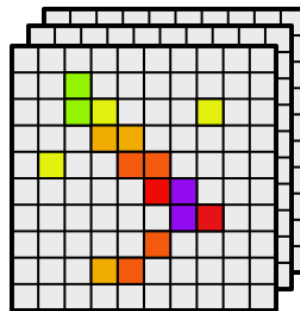
ToT is used for calorimetry, ToA for timing

Only active pixels readout for instant background suppression

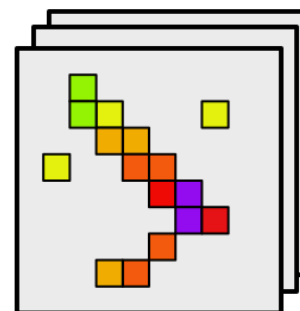
Superior timing resolution compared to EMCCD (1.6 ns)

Native 3-D readout

Frame-based Readout
(EMCCDs)



Events



Data-driven Readout
(TPX3CAM)

ToT	ToA
100	
102	
107	
110	
111	
114	
116	
117	
120	
122	
126	
127	
129	
132	
134	
137	

