

# Australian Experimental Update

Lindsey Bignell

# Cygnus: Australian Involvement

International Steering Committee involvement (Greg Lane).

Funding via Centre of Excellence: ISAC report named Cygnus as strategic objective.

Australian contributors (personnel, not FTE):

Experimental	Lane (ANU), Bignell (ANU), Slavkovska (ANU), McKie (ANU), Dastgiri (ANU), Bashu (ANU), Urquijo (UMelb), McNamara (UMelb)	2x Senior academic 2x ECR 4x HDR students
Engineering/Technical	Baroncelli (UMelb), various ANU technical	1x Engineer Several technicians

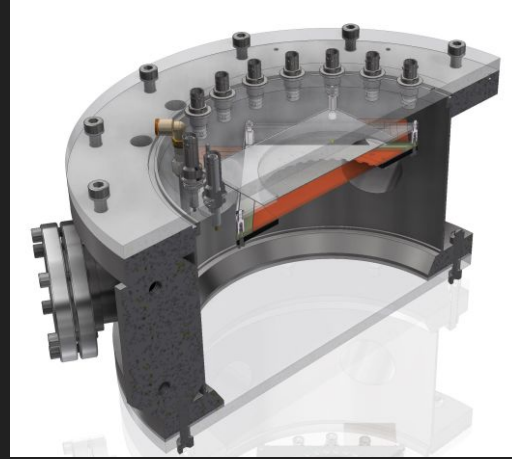
Fortnightly joint theory/experiment meetings. Active theory program.

Aim to embed theory in experiment (and vice-versa).

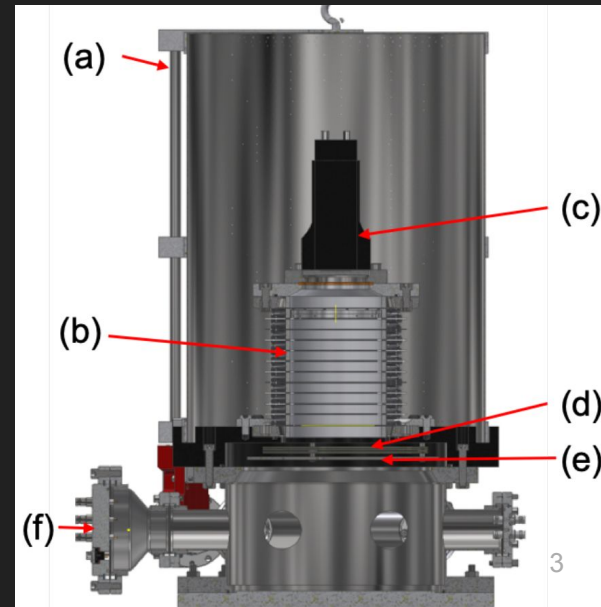
# Experimental Program

- 2020: 100 mL prototype Cygnus-Lite
  - First (1D) directional measurements.
- 2021 → 2024: 6 L prototype, Cygnus-1
  - Detector R&D
    - Gas mixtures
    - Readout
    - Quenching factor
    - Reconstruction/background rejection
  - Possible early physics: Migdal effect.
- 2023 → onwards: 1 m<sup>3</sup> prototype @ SUPL
  - Demonstrate technology at scale
  - Physics measurements?
- Longer-term: Cygnus modules as part of major international experiment

Cygnus-Lite



Cygnus-1



# Cygnus-1

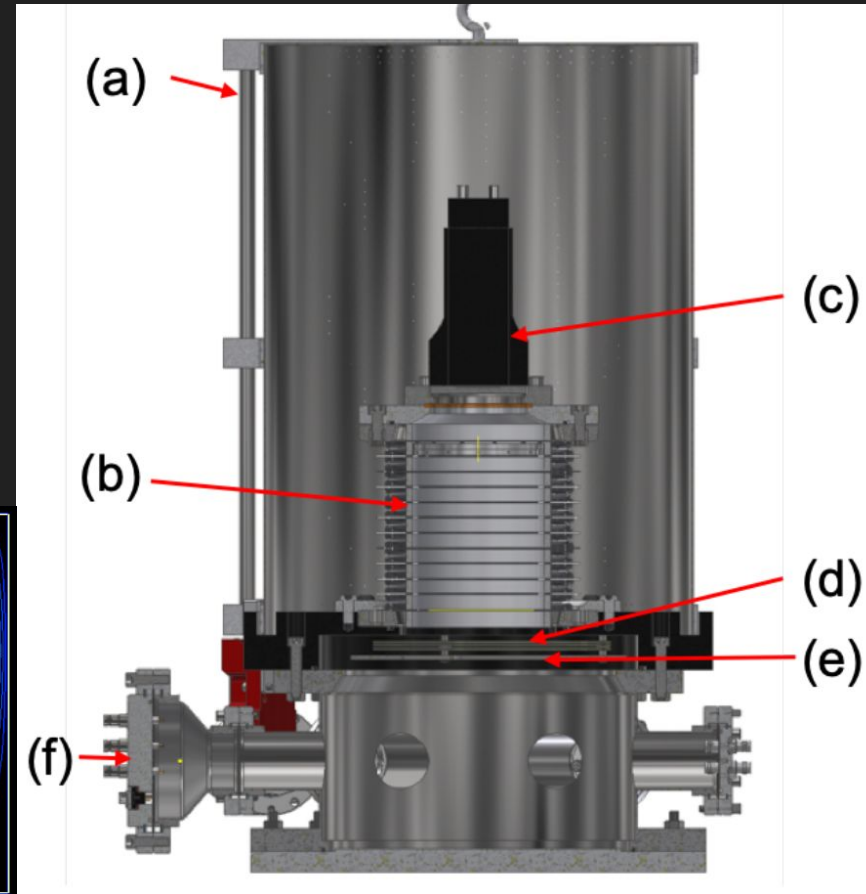
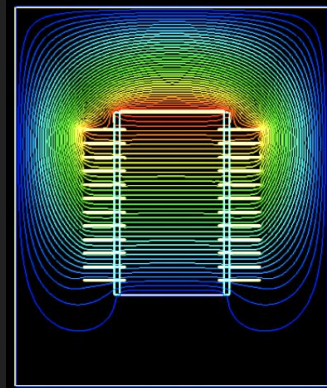
- (a) HV interlock
- (b) Drift volume (old accelerator tube)
- (c) PMT (primary + avalanche scintillation)
- (d) Triple GEM gain stage
- (e) Multi-wire proportional counter (charge)
- (f) Feedthroughs, etc.

Below atmosphere operation.

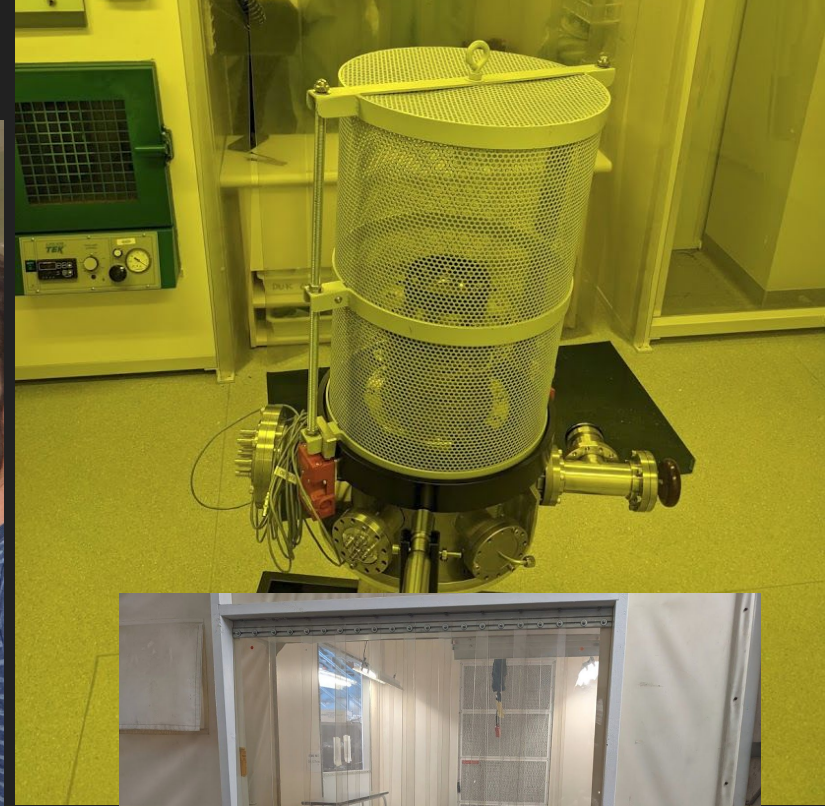
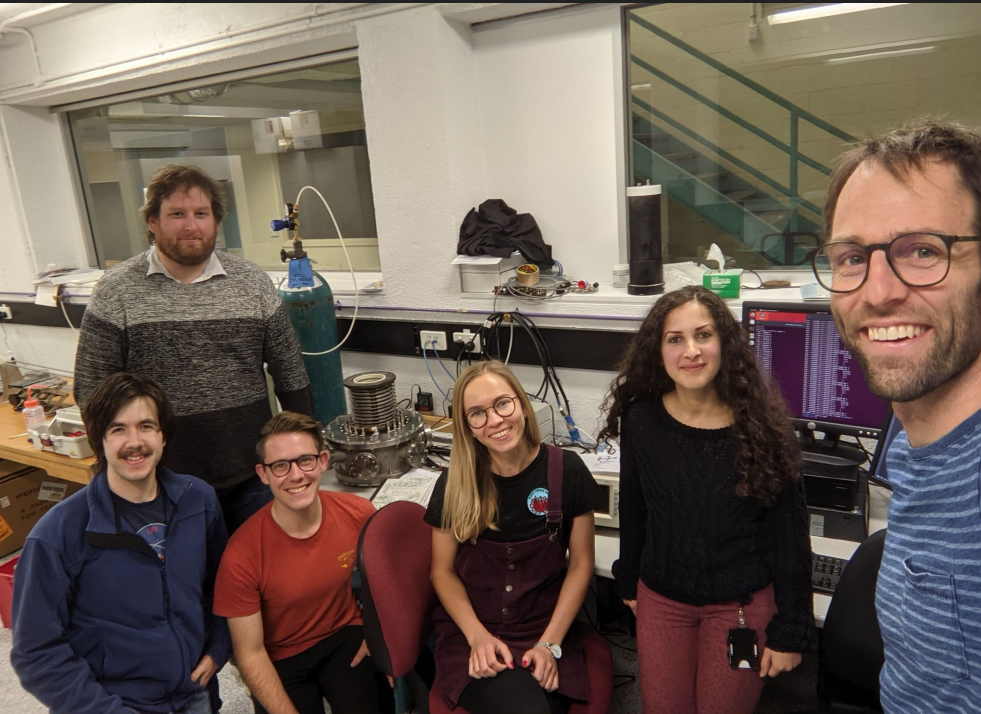
Outgassing studies.

Negative ion + other gas studies.

Scintillation/charge yield studies.



# Cygnus-1



Assembled May 2021.  
Developed local clean room for easier (dis)assembly.  
Lockdown halted experimental work for ~remainder of 2021.

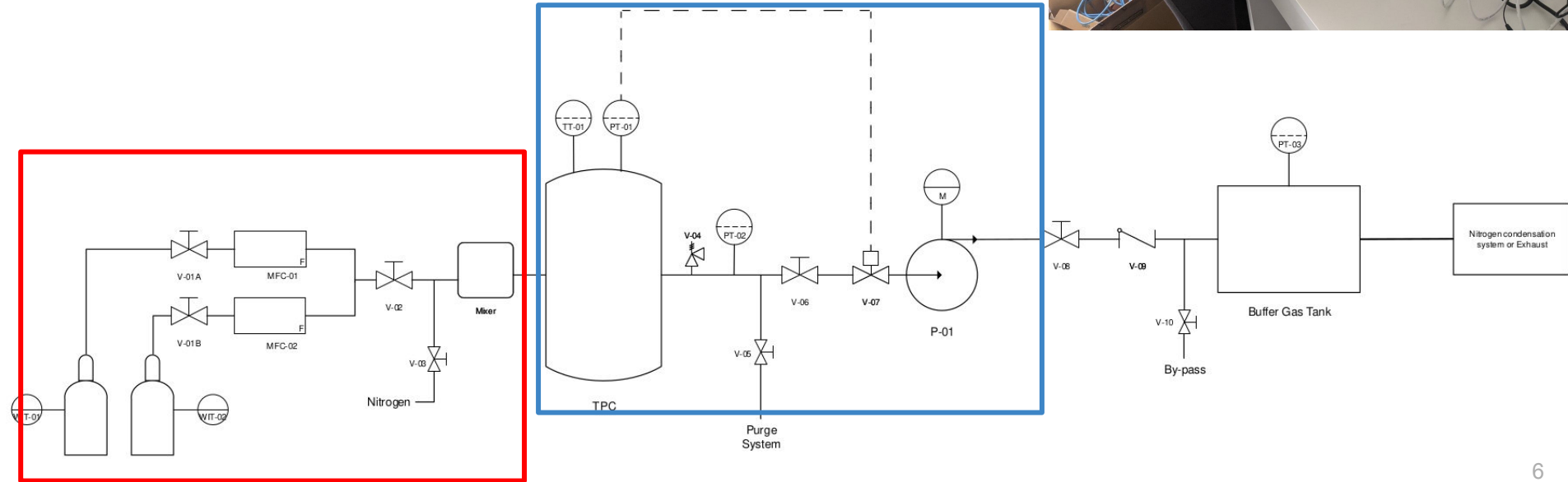
# Cygnus-1 control system

Mass flow control -- binary (soon tertiary) gas mixtures

Vacuum control -- 10<sup>-7</sup>-760 Torr operation

HV control for field cage + 3 x GEMs + wires

32 channel DAQ





# Cygnus-1 control system

Bluetongue  
(Run configuration/control)

Mass flow control -- binary (soon tertiary) gas mixtures  
Vacuum control -- 10<sup>-7</sup>-760 Torr operation  
HV control for field cage + 3 x GEMs + wires  
32 channel DAQ



## Bluetongue

Run Control

DAQ Settings

HV Control

Gas Control

### CYGNUS-1 Run Control

Run name

Initial Comment

Run class

Calibration

Run type

Events

Number of run type

DAQ Status

RUNNING

1-10ch-falling

HV Status

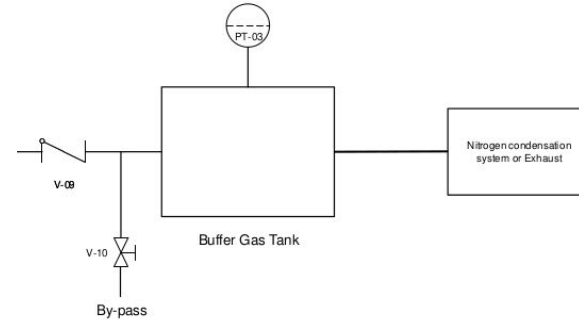
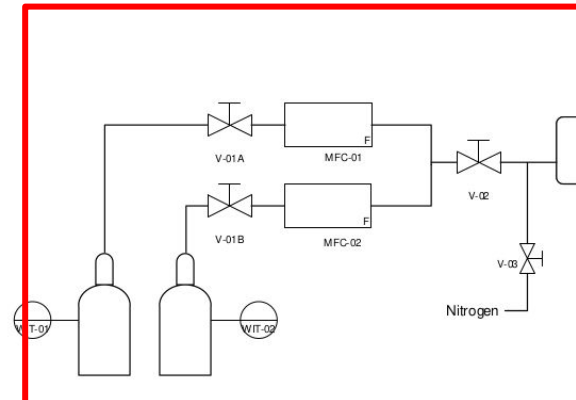
RUNNING

PMT-1000-100-10-250

Gas Status

RUNNING

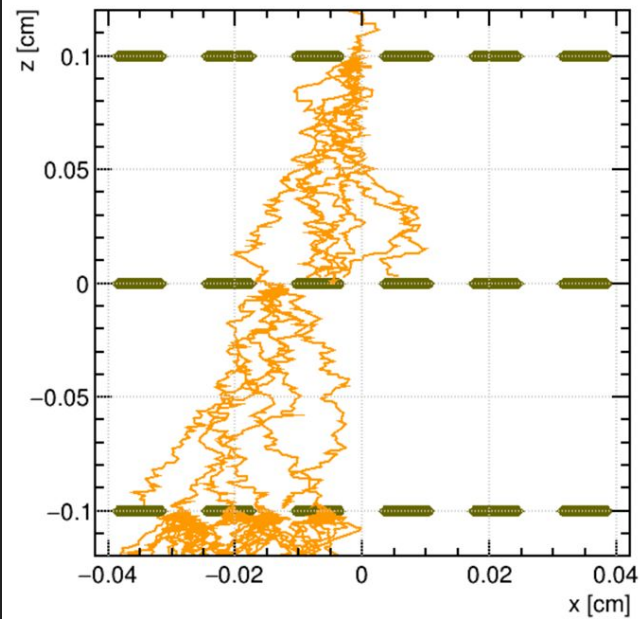
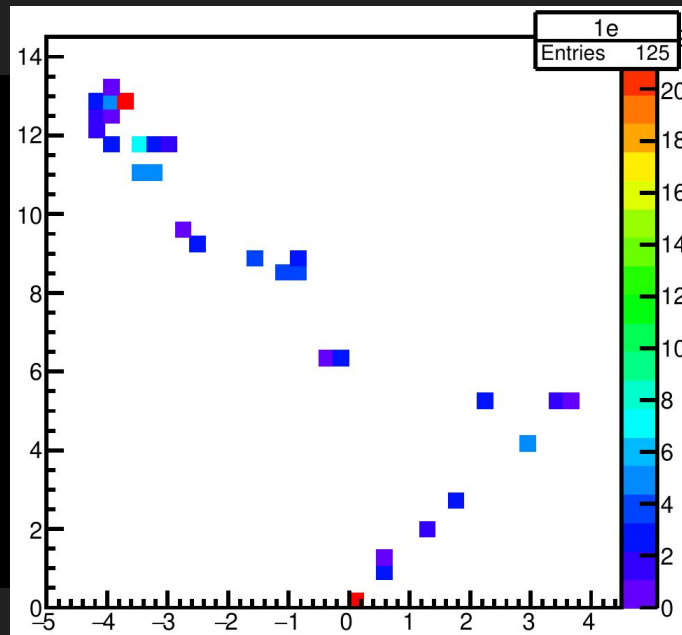
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Begin

# Simulations and Reconstruction

- Geant4 simulations of ER (and NR) events
- Readout emulation.
- GEM simulations
- Study reconstruction fidelity.





# Prototype Upgrade

Next phase (2022?): add intensified camera.

- PMT-like sensitivity, with camera sensor granularity.
  - $< \sim 1$  keV threshold.
- Triggerable.
  - More detailed event-by-event info.

Light and charge, micropatterned readout.

