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# ANU HIAF 14UD

## Controls Overview

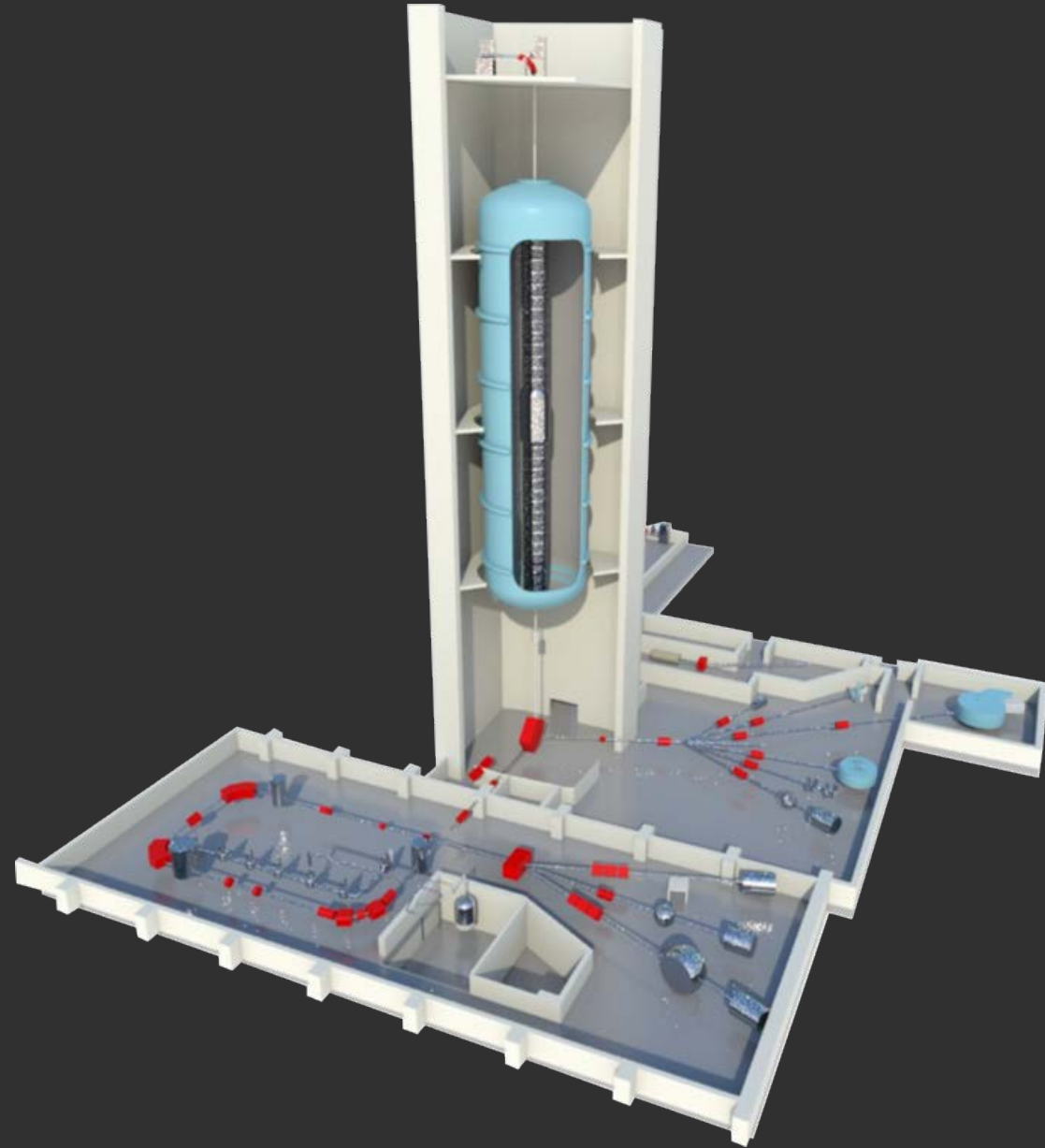
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Accelerator Technology Forum 2020



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# Our time capsule control room







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# Our time capsule control room



# Control overview

- Running EPICS since 2012
- Still on EPICS R3.14.x.x
- 5937 PVs
- 15 IOCs
  - 4 MVME3100 crates
  - 11 Technologic Systems TS-7520 ARM9
- I/O
  - Many VME cards
  - Group3 controllers (lots of analog outputs)
  - TS-7520 ARM9 industrial controller with data acquisition
  - Advantech ModBUS/TCP (ModBUS over Ethernet) units
- AccelNet (NEC) for AMS bouncing system linked to EPICS via protocol

# Control overview

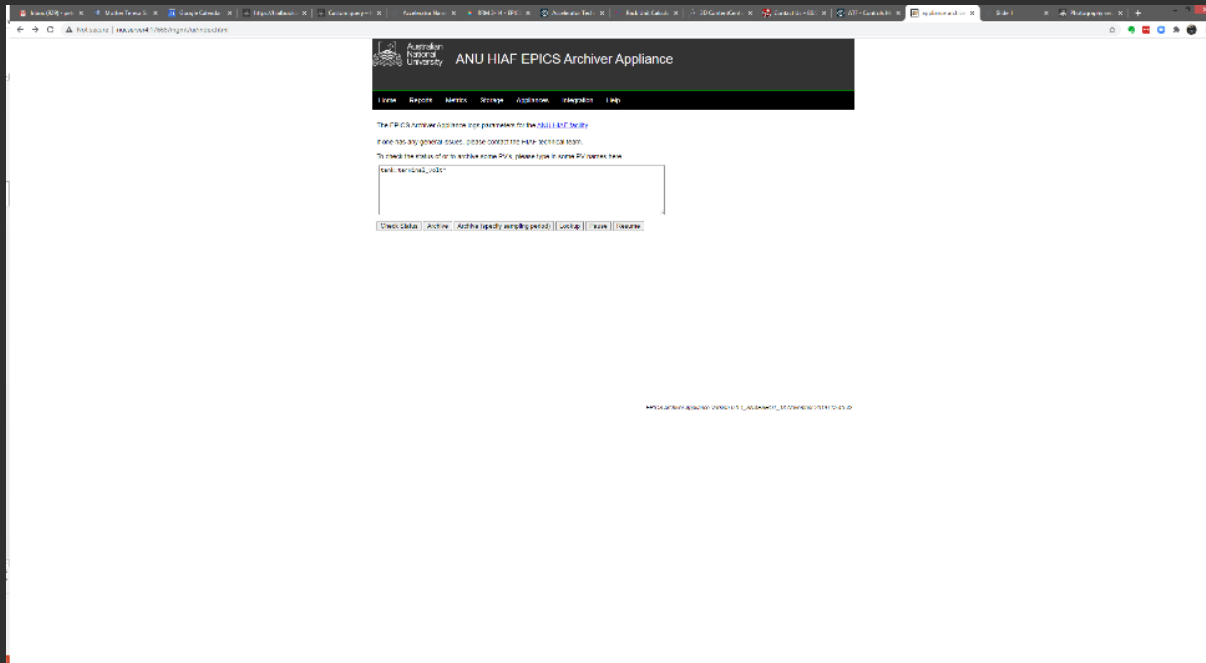
- Ubuntu server
  - boot server
  - EPICS development machine
  - PV database creation and editing
- Network boot display/control terminals (LTSP)
  - 7 radiation protection terminals
  - several general purpose terminals
- Handful of vacuum status displays running EDM on Raspberry Pi v3 and v4
- All IOCs boot from boot server pull their database and compiled EPICS application from there.

# Control overview

- Vacuum gauges
  - Pfeiffer
    - TPG256A maxi gauges (serial)
    - TPG262 dual gauge (serial)
  - Inficon
    - VGC503 (ethernet)
- Vacuum valve controllers
  - In house with status read backs
- Turbo pump controller
  - In house with new updates incorporating ADAM5000 units
- Generally lean toward using protocol files, don't write drivers, have some sequencer but generally avoid.



# PV Archiver - SLAC



EPICS Archiver Appliance Version 0.0.1\_SNAPSHOT\_13-November-2019T15-45-42





# PyEpics based main GUI

The screenshot displays the PyEpics based main GUI for the U238 +5 (24 MeV) beamline. The interface is divided into several sections:

- Top Left:** A schematic diagram of the beamline components, including the sample area, MSNICS, and various vacuum chambers. Key parameters shown include: Sample #1 In Position, 4.995 kV, 193.4 W, 1.5e-07 Torr, 257.1 amu, 9173.090 G, 32.5%, 1.0 mm, 1.2e-08 Torr, 1.1e-07 Torr, 2.5e-09 Torr, 11.6%, 17.57%, 4.29 mTorr, 98.32 kV, 2.0e-08 Torr, 33.0 C, 29.2 C, 4.207 MV, 32.0 C, 7.1e-06 Torr, 4.1 kV, HE vacuum 4.8e-08 Torr, 1.4-1.7 mm, 16911.40 G, 1.2 mm, 40.9%, 179.8 mm, 44.9 mm, -44.8 mm, and Negative.
- Top Center:** A box labeled "U238 +5 (24 MeV)" and "Beam in TA1".
- Top Right:** A box labeled "Big Blue Box" with "OK, Idle" status.
- Bottom Left:** A box labeled "Beam species: 3.98 MV".
- Bottom Center:** A box labeled "Beam species: 17092.6 G, 72775.78 kHz".
- Bottom Right:** A box labeled "Line 5".
- Right Panel:** A configuration panel with tabs for "MSNICS / Slits", "Tank / High Energy", "Strippers", and "Line 5". It contains several sub-sections:
  - MSNICS:** Oven Heater (29, 28.7V), Cathode Voltage (5.000, 4.995), Ioniser (23.000, 24.3 A, 8.0 V, 193.4 W), Immersion lens (5.000, 4.991 kV).
  - MSNICS Sample Wheel:** Current Sample (1), Go To Sample (01), Status (In Position, No Error).
  - MSNICS Focusing:** F1 Focus (1.340, PS(a) 1.329), F1 Up/Down (0.025, PS(b) 1.357), F1 Left/Right (-0.140, PS(c) 1.324), F2 Focus (13.000, 12.980).
  - Box Volts:** Power (checked), Interlock: On, Voltage (100 000, 100.55 kV), Current (0.11 mA).
  - Injecting Magnet:** Set by mass (257.0610, 257.1 amu), Set by field (09173.22, 9173.090 G, Average 9173.341 G), Set by current (089.5605, 89.409 A), Supply status (OK).
  - MSNICS Slits:** Common Position (1.0), Top (1.00, 0.99 mm), Right (1.00, 0.99 mm), Bottom (1.00, 0.98 mm), Left (1.00, 0.99 mm).
  - Low Energy Iris:** Common Position (20.1, 32.5%).
  - Low Energy Slits:** Common Position (1.0), Top (1.00, 1.00 mm), Right (1.00, 0.99 mm), Bottom (1.00, 0.99 mm), Left (1.00, 0.98 mm).
  - Tank Slits:** Common Position (4.0), Top (4.01, 4.01 mm), Right (4.01, 4.01 mm), Bottom (4.01, 4.01 mm), Left (4.02, 4.02 mm).
  - High Energy Slits:** Common Position (1.6), Top (1.770, 1.739 mm), Right (1.460, 1.431 mm), Bottom (1.520, 1.490 mm), Left (1.610, 1.583 mm).
  - TA1 Analysing Slits:** Common Position (1.2), Top (1.200, 1.181 mm), Bottom (1.200, 1.172 mm).



# Radiation Protection Displays

Radiation Protection Status@nucserver5

**Low Energy Cup**  
Cup Status: Out  
Check With Operator, Dangerous Radiation May Be Present

**Responsible Person**  
Name: Fifeild  
Contact Number:

**Accelerator**  
Terminal Voltage: 4.199 MV  
Selected Beamline: Line 5

**Watchdog Power**  
+12v -12v +24v 2KV  
OK OK OK OK

**Watchdog Interlocks**  
Zone Bypass: Disabled  
Interlock Override: Disabled

**Radiation Zones**

Target Area 1 Safe, open	0.1	0.2	
Lift Access Safe, closed	-0.2		
Tower Base Safe, open	-0.5		
Target Area 2 Safe, open	-0.1		
LINAC Safe, open	-0.1	0	0.2
Cryopit Safe, closed	0.1		

(All  $\mu$ Sv per hour)

**5 Doors Open**

linac_tower	ta2_exit_north	lift_exit	linac_cryo
cryo	ta1_tower	lift_tower	linac_external
ta2_exit_west	ta2_exit_east	tower_linac	
ta1_exit_north	ta1_exit_west	linac_tad	

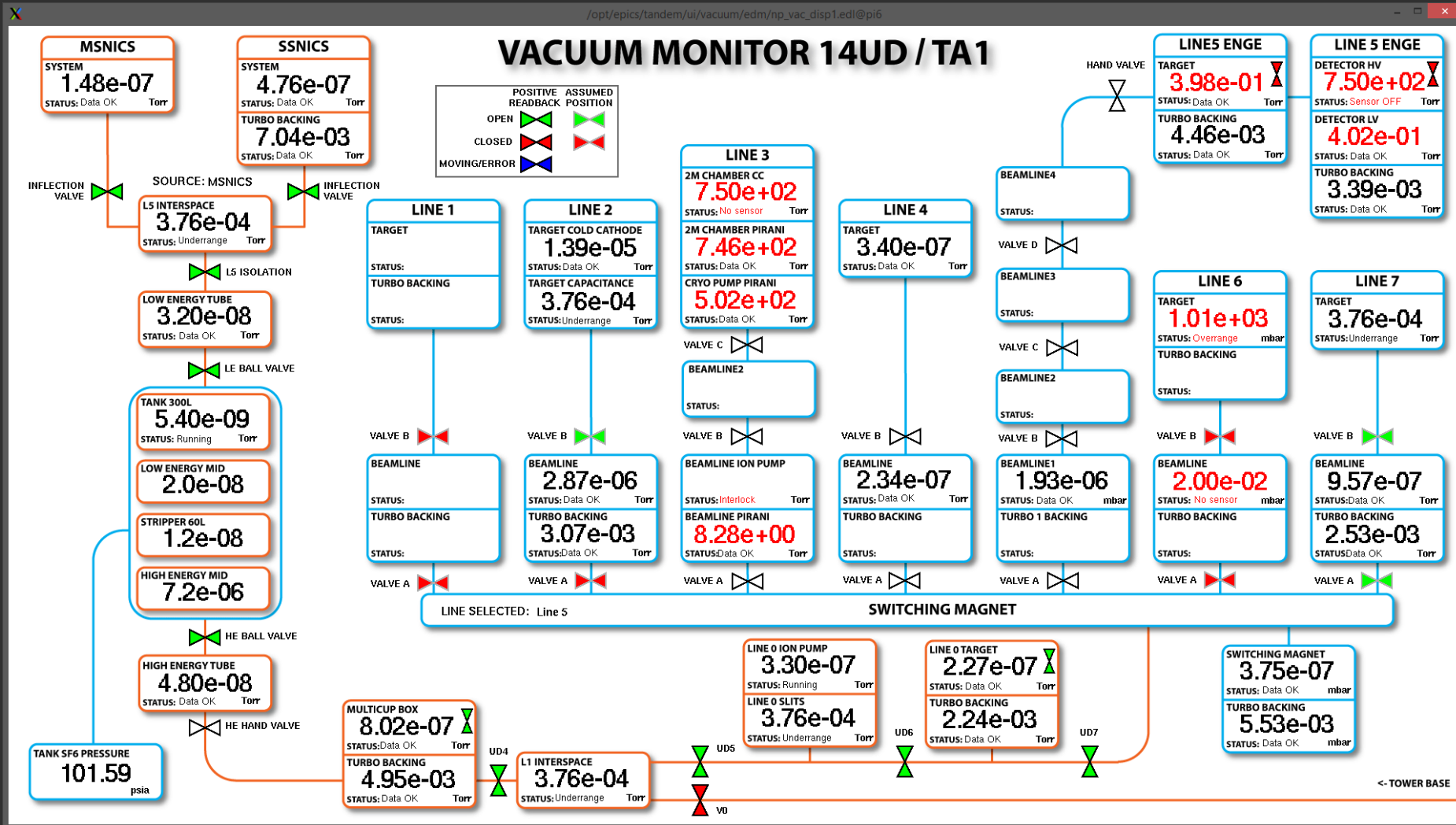
**Last Heartbeat Received**  
Wednesday, 21. October 2020 10:22:11

**Radiation Protection Zones**

Red flashing zones have dangerous radiation present.  
Orange flashing doors are open.  
Red bordered zones have Tripped and need to be checked, safely closed, and reset via wall button.



# EDM Vacuum Status Displays





# Direction of I/O

- Modular I/O System: ADAM-5000 Series





# Direction of I/O





# Measurement Challenges



- Accelerator currents
  - High energy tube
  - High energy column
  - Low energy tube
  - Low energy column
  - Chain 1
  - Chain 2
  - Chain 3



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Thank you