LN2 Cooling Development

D15.8 Cold Irradiations at Birmingham Cyclotron Facility

The University Of Sheffield.

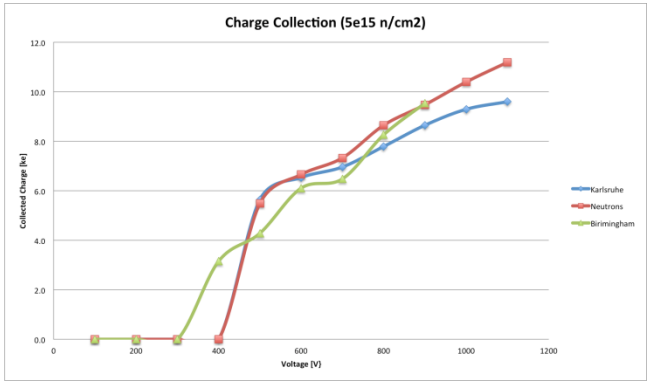
UNIVERSITY OF BIRMINGHAM

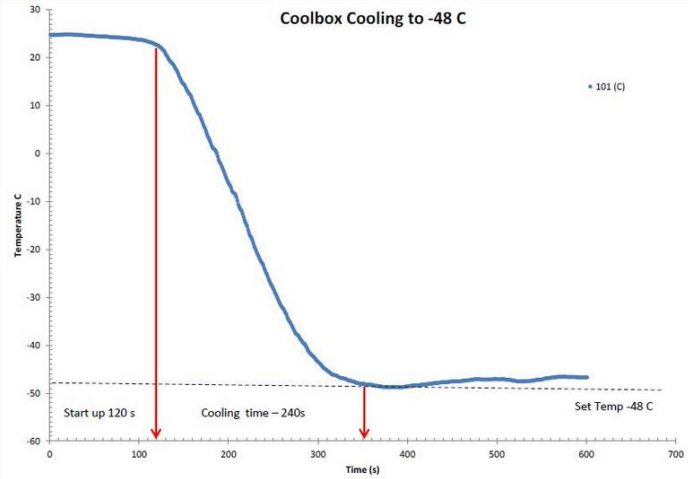
UNIVERSITY OF LIVERPOOL

AIDA 2020

- A crude but now refined prototype cold box has been made with a larger volume and target window size.
- It is now obvious that this window size can be reduced, allowing for a smaller cold box and improved cooling performance.

- Norhof LN2 system installed in the High Energy beam area Cyclotron.
- The LN2 is dripped at a controlled rate on to a heat sink located at the base of the cool box . Evaporating to produce very cold N2 gas.
- LN2 flow is adjusted automatically by the system,
- By monitoring the temperature and pumping in LN2. Pre-set temp.
- The new cooling system can achieve a stable temperature of -50°C in 30 minutes.
- The xy scanning robot then moves the sample mounted in the cold box through the proton beam to complete a cold irradiation.





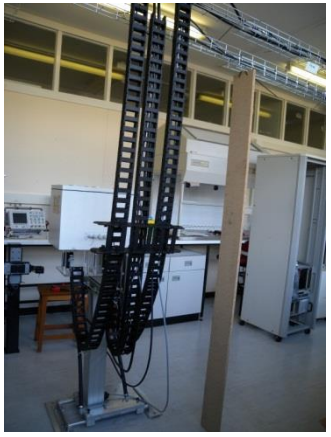
- The new, more robust cold box is now designed and ready to go into production in the Sheffield workshop (est March ‘17 completion).
- This will allow capacity for silicon sensor irradiation when fully powered and instrumented with DAQ.
- Pre-cooling the cold box using a re-circualting glycol chiller system (slow curve from 22°C to <-8°C) less thermal shock to the cold box materials (LN2 evaporation gives audible creaking noise from box structure). The new smaller cold box, whilst more robust is still susceptible to this rapid cooling. If needed we will use the pre-cooling as an option but is not considered necessary right now.

The University Of Sheffield.

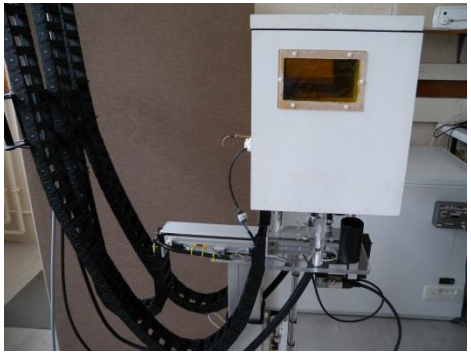
Duplicate system

For development not to damage in parallel to irradiation work at Birmingham

- Designed to be the prototype system
- Allows deployment in real-time of software updates and hardware alterations
- Can remotely connect to B'ham system to upload (network permissions needed)
- Theoretically we could operate the B'ham system from Sheffield via remote connection



- Overall unit length with a parallel mounted motor is 598mm long to reduce working space



- Motors and cables connect to the scanning table in a straightforward and simple manner.

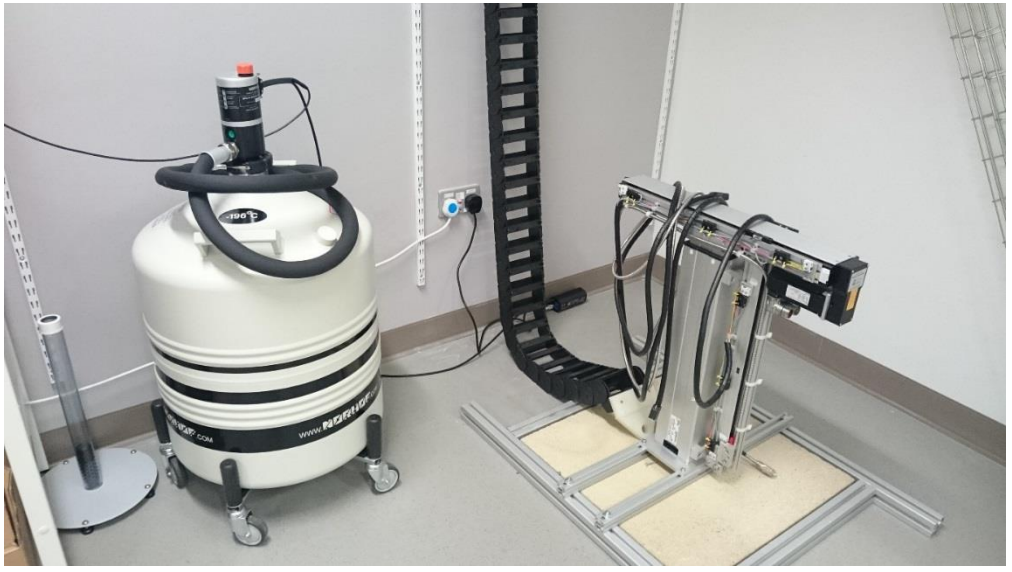
Installation completed

To test and implement upgrades to the scanning system and software, a second scanning system and LN2 cooling unit is undergoing installation in Sheffield Robotics. Sited in the 300m^2 Robotics Foundry in the new purpose built 7 story, 5355m^2 Pam Liversidge Building for “Interdisciplinary Research”.

This 2nd system is used for:

- Remote troubleshooting of the system in Birmingham
- Testing of software to improve user instructions
- Student teaching
- Staff training (software, engineering & users)
- Continued upgrades to the prototype system.

Effectively we can now work independently of a very full irradiation programme and increase pace for the R&D elements.

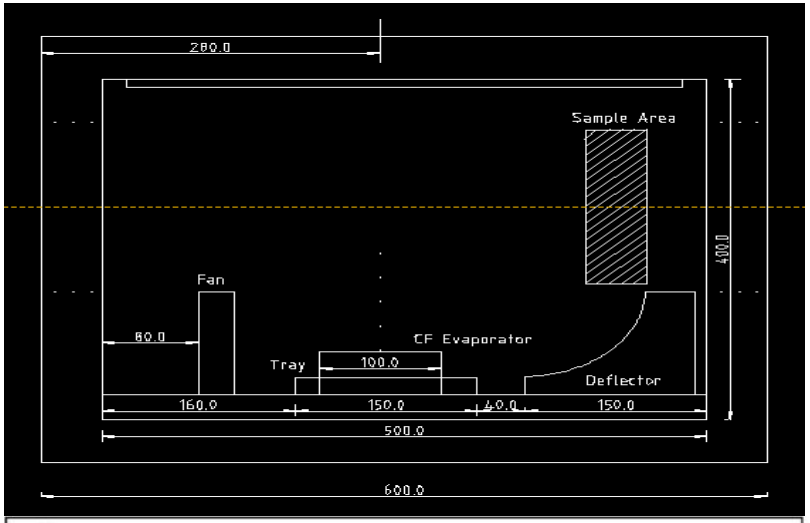


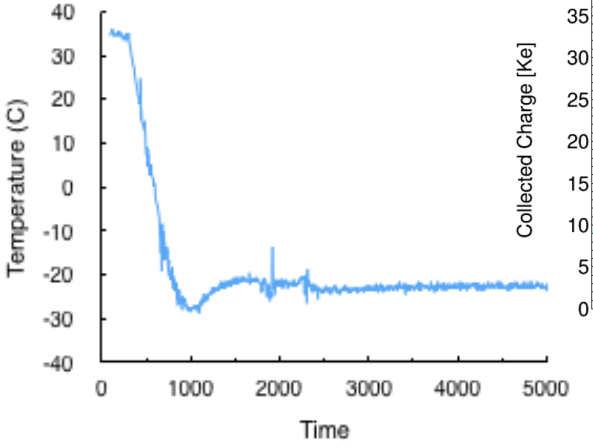
Prototype cold box

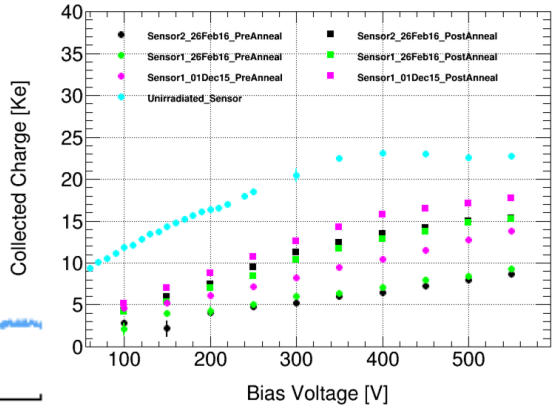
The previous design has a number of fundamental flaws.

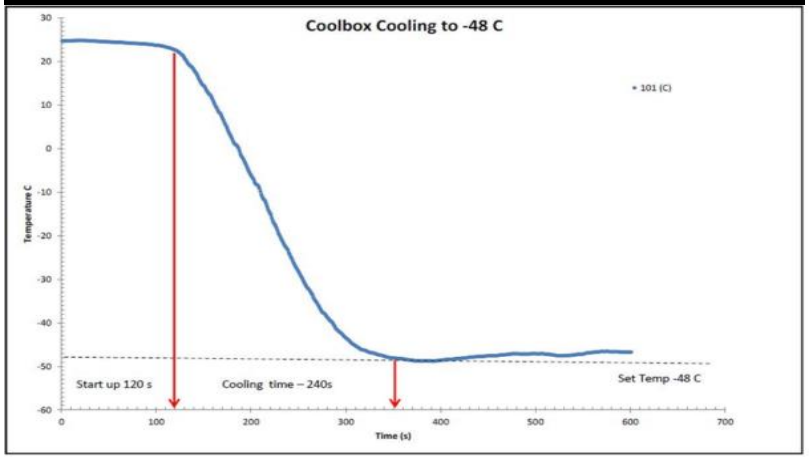
- Too large a window
- Too large in overall dimensions
- Very high payload on robotic system
- Bigger volume to cool

However, it did its job and proved the LN2 concept.









Success measured as the CCE in sensors now matches other AIDA 2020 irradiation facilities (Feb 2016)

Temperature within the thermal chamber when cooled, operates uniformly at -25°C

The University Of Sheffield.

New cold box status

- Design of main structure completed
- Materials ordered
- Workshop time booked for machining of materials and construction
- Evaporator plate design fixed, materials ordered and will be completed with the box structure
- Fixtures to robotic system improved
- LN2 dosing nozzle mounting designed and tested in Sheffield

Current Schedule:

- Box production begins in February 2017
- Box construction completed by end March / early April 2017
- Evaluation will take place understanding cooling effects
  - Check the cooling performance is not altered
  - Check the cool down and warm up times

- Sensor electronics & DAQ feedthroughs will be copied from previous design as this works well.
  - Small changes in fixings and location of cable routing will be made