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Testing facilities

Some collated thoughts

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With help from others!

What do we consider Facilites?

Anything that is too expensive to replicate at point of need - context here is typically “detector testing” in the largest sense of it

- Irradiation Facilities
- Testbeam Facilities
  - Both might benefit from a look at: https://indico.cern.ch/event/1003419/ (AIDAinnova kickoff meeting)
- Large Tests (cubic meters)
- Expensive Tests (> 100k equipment)
- Expensive Simulation

Irradiation, what we need

- Radiation:
  - Up to 10^{18} neutrons/cm^2
  - O(100MGy) total ionising dose
  - Biased and/or chilled!
  - Good protons to mimic the above in combination
  - Uniformity/Speed/Monitoring
- What about neutrinos?
- What about DM? (Basically the opposite) -> **Boulby**
- Other use cases of facilities we need - can we use other people's tools (UKAEA ?)

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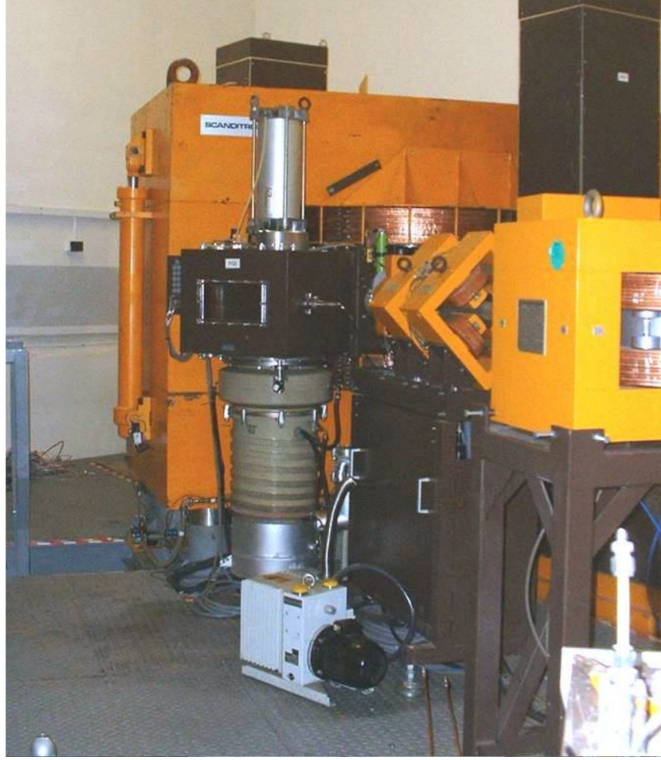
Irradiation (a subset in reach)



- Protons
  - CERN irrad facilities: 24 GeV
  - **Birmingham: 27 MeV**
  - KIT: 23 MeV
  - ***Clatterbridge (60MeV)? Christie(Manchester, 230-ish)? ISIS Linac (currently 70MeV)?***
- Neutrons
  - **ISIS (depending on your application) - chipIR and other**
  - **Birmingham (coming up)**
  - Ljubilliana
- Photons
  - **X-ray sets at RAL, Oxford, Glasgow** and CERN
  - CERN Gamma Irradiation Facility (GIF++)
  - ***Possibility at Diamond - monoenergetic x-rays - to be looked at…***
  - ***Dalton Manchester Gamma Irradiator***
- Ions?
  - Where to do SEE studies
- There are more, see e.g.: https://radnext-network.web.cern.ch/main/
  - Transnational access under EU funded AIDAinnova/RADNEXT

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Irradiation, and then

- Samples will become harder to remove from irradiation facilities due to increasing dose
- Facilities can provide testing in place, e.g. at JSI/CERN
- What testing do we actually want to do:
  - Wirebonding after irradiation (usually not worrying, but procedural overhead)
  - Destructive testing (materials), worry about dust generation
  - (Cold) Storage and later disposal of radioactive samples?

Testbeam

- SLAC (45GeV electrons, repetition rate limited)
- CERN (Pions/electrons/muons at 100s GeV, about 1spill/min)
- DESY (electrons: 1-6GeV with varying rate)
- Fermilab (120GeV, 4 spills per minute, 3e6 particles/spill)
- Diamond x-rays
- Others?

- Accessibility, in particular with radioactive samples needs to be looked at

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Large infrastructure (non-ACC)

Any object that is measured in m^3 will often run into local limitations

- National infrastructure at DL, RAL, others
  - Metrology (TD, typically budget code limited)
- Thermal tests/cycling (Many)
  - Often need ranges down to -60C now, volumes with at least one dimension >1m
  - Think NSTF for something properly big - presumably expensive, how would we access?
- Can we understand project based/generic access to existing facilities somehow? (If it is always based on a Budget code, how do we plan for it and make sure we get maximum benefit)

Expensive infrastructure

- E.g. High speed oscilloscopes, now > £100k
  - Such items can (and do) exist in a central pool and could be loaned for limited time/specific purposes
  - Central infrastructure with use requests easier to justify than individual infrastructure - could make a wish-list?
- What about (expensive) FPGA boards?
  - Might not be a classic loan item due to quick loss of sexiness
- Please think of things that are of general interest, but too expensive!

Simulation, a facility?

E.g. TCAD at RAL, even if you have a TCAD license running on a local machine:

- Parameter scans scale linear with the number of variations you're going through
- 22 TCAD licenses (max 88 threads) available within RAL (NOT for commercial use)
- Enough dedicated computing infrastructure to use these easily (With enough RAM for decent size 3D meshes)
- Some local expertise that is happy to help!
  - Not trying to take the work away from you, just offering to help with processing it

Radiation Modelling for future experiments:

- Setting the simulation up right
- Getting the wanted answer, rather than "some" answer
- Linkage between the envisaged application and testing thereof (simulating the test facility)
- UK expertise exists (e.g. QMUL), but are we using it and if we don't - can we?

A word on Boulby - a classic Facility

Wasn’t sure it’s mentioned anywhere else:

- UK's deep Underground Science Facility
- 1.1km deep (2805m we), giving a factor 1 million reduction of cosmic rays - and with low background surrounding rock (salt)
- Experimental space, facilities and expertise to support UK-involved ultra-low background science projects
  - 4000m^3 class 1K and 10k clean room experimental space - for hosting low background projects
  - BUGS (Boulby UnderGround Screening)facility - with a number high-sensitivity germanium and surface alpha clusters for ultra-low background material screening.
- Get in touch: Boulby@stfc.ac.uk

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What now?

- Have we got what we want?
  - Testbeam/Irrad facilities are O(£100M)
  - FCC-hh enthusiasts will find it hard to get samples irradiated to their wanted doses
  - Technology pistonheads will find it hard to test for the right things to the right level (SEE/SEL)
- How to set up the access to facilities we already have?
  - Can we tap into ISIS/Diamond in a simple way?
  - Can organise access to Christie's protons?

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Discussion

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BACKUP

References

- Latest yellow report: https://cds.cern.ch/record/2764325/files/129-122-PB.pdf
- AIDA finale: https://indico.cern.ch/event/911818/
- Examples of guidelines for testing

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Recommendations

- What to recommend for irradiation facilities - Do we need a proper review of facilities
  - Lack of SEE facilities
  - Lack of neutrons
  - What protons do we want?
    - A 200MeV Linac is pretty much what neutrons want next? Silos to be broken, can we tap into synergies?
- If the UK gets an XFEL, how can we ensure we get a tap into (10+GeV) electrons? (a la SLAC)