



Facilities for test beams and irradiation

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4D Tracking Workshop

Session structure

- **Overview of sites**

*Note: this is not a complete list and does not present sites in equal detail.
Selection is biased by personal experiences*

- **Closer look at some facilities**

- FNAL (Artur)
- Facilities in New Mexico (Sally)
- SSRL
- CENPA
- (UHawaii)

- **Community discussion: using [Google Doc](#)**

- BeamNet US
- Test beam and irradiation needs / Gaps in current availability or accessibility
- Test beam facility instrumentation
- Interest in common project/proposal for 4D-tracking detector beam tests?

Overview of US sites



Test beam

- Fermilab
- ANL
- LBNL
- SLAC
- UW CENPA
- UCD Crocker Lab
- Sandia National Lab (UH Manoa)

Irradiation

- LANL LANSCE
- Fermilab
- Sandia National Lab
- Rhode Island Nuclear Reactor



Community discussion

1. Other irradiation and/or test beam facilities that you have experience with, should be mentioned?

Fermilab

Fermilab test beam facility ([FTBF](#))

- User facility, proposal-based – some by established big experiments (CMS, ATLAS), or by other groups
- Strip-pixel telescope, MCP timing reference
- Parasitic running is often possible
- 120 GeV protons
- Schedule: ~ Oct – May

More recently: also irradiation facility

Covered by Artur

New Mexico

Los Alamos Neutron Science Center ([LANSCE](#))

- 800 MeV protons

Sandia National Laboratories

- [Gamma ray and low-dose irradiation facility](#)
- [Annular Core Reactor Research Facility](#)
- [Ion Beam Laboratory](#)

Cf. Sally's slides

Stanford Synchrotron Light Source

LCLS(-II)

- User facility; scope is far beyond only HEP / NP! Structural analysis, soft matter, condensed matter, photon science, ...
- Multitude of beamlines and end stations
- Proposal-based: scientific proposal is evaluated and approved for 1-3 years, and receives certain number of beam shifts that can be used, but need to be applied for separately in calls for beam time
- Schedule: ~year-round
- Synchrotron x-rays in bunch trains / buckets, keV to tens of keV
 - Can be similar to MIP in energy deposit, but with point-like interaction, naturally no particle-/track-level tracking
 - Studies of gain linearity with energy deposit, dependence of gain on depth of interaction, 2.1 ns pulse separation, etc

BELLA

- Laser plasma accelerator at LBNL
- Proposed user facility k-Bella with 100 GeV electrons: uncertain funding and future
- ‘Regular’ BELLA beamline: ~10 GeV electrons → muons and gamma background; high beam current, operated in short bursts with beam dump, little stability or user control, ~ some Hz rate
- Not intended as user facility, but has been used for RD53 chip assembly studies

UH Manoa FEL

- Electron LINAC / FEL constructed by inventor John Madey
- Upkeep and maintenance had been low for several years, rekindled effort by the department and new faculty
 - Recently funded EPSCoR grant with SLAC
- Low-medium energy electrons (tens to hundred(s) MeV) in precise bunches – study repetition rate capabilities and timing resolution
- No intentions of making this a formal user facility, but collaborative experiments welcome

Center for Experimental Nuclear Physics and Astrophysics at University of Washington, Seattle

- [Van De Graaff Tandem Accelerator](#)
- Primarily H and He, 100 keV – 18 / 27 MeV, also heavier ions available
- Relatively precise energy distribution
- Several beam lines and chambers for ion implantation, molten lithium, Project8, Rutherford backscattering
- Heavily ionizing particles can mimic e.g. stopping pions and muons: RBS chamber has been used to study gain suppression in LGADs as function of incidence angle
- Outside users are welcome and accommodated, but no formal application process as e.g. FTBF or SSRL

Note on HEPAP

Dec 5/6 HEPAP meeting will include a lengthy session about irradiation and test beam facilities in the US and worldwide – remote participation should be possible (with registration). Link will be shared when available.

Community discussion

2. Irradiation needs

- **Traditional irradiation sites:** LANL for protons, JSI / Ljubljana for reactor neutrons, CERN for high-e protons, CERN/PSI for pions, KEK for high-e electrons
- **Up-and-coming or less used:** FNAL Irradiation facility, Rhode Island nuclear reactor, others?
- Sometimes problematic: susceptible to technical issues, rescheduling of irradiations; release time for practical or radiation safety-related reasons – unpredictable delays in receiving irradiated samples

Requirements for lower fluences in lepton colliders, EIC

- *Demand for lower rates, more precise dosimetry? Gradient irradiation?*

TID irradiations?



BeamNet US

<https://www.beamnetus.org/>

Participating facilities: UITF, BELLA HTT, ATF, AWA, HiRES, IOTA/FAST, FACET-II, NLCTA, UED

Weekly seminar series ongoing October through December 2024, expecting to put out a call for proposals in January 2025

Collaborative network on accelerator and components R&D, featuring several national labs – different focus, but some facilities and the network itself could also be leveraged for (4D Tracking) detector R&D?

Community discussion

3. Test beam needs

- Suitable beam characteristics?
- Access to facilities?
- Availability of beam time; evaluation, prioritization of proposals?
- **Beam line instrumentation – especially for 4D Tracking: telescope, precise timing reference? Existing or would need to bring or add on own detectors?**

In turn: development of beam monitors / beam telescope utilizing LGADs for improving facilities?

Community discussion

3. Test beam needs

Is there interest in and motivation for a joint project/proposal/collaboration for applying for beam time as a 4D Tracking Consortium at one or several facilities?

What would be the scope and path towards this?

- Could also include development, maintenance, distribution of 4D tracking software?
- Share information on available facilities, also smaller or less well known and developed ones, create contact to local groups or more experienced users

In turn: development of beam monitors / beam telescopes utilizing fast or 4D tracking detectors (e.g. LGAD-based) for adding new capabilities at beam lines? Also a useful demonstrator and test platform for future collider detector prototypes...

Thank you!

