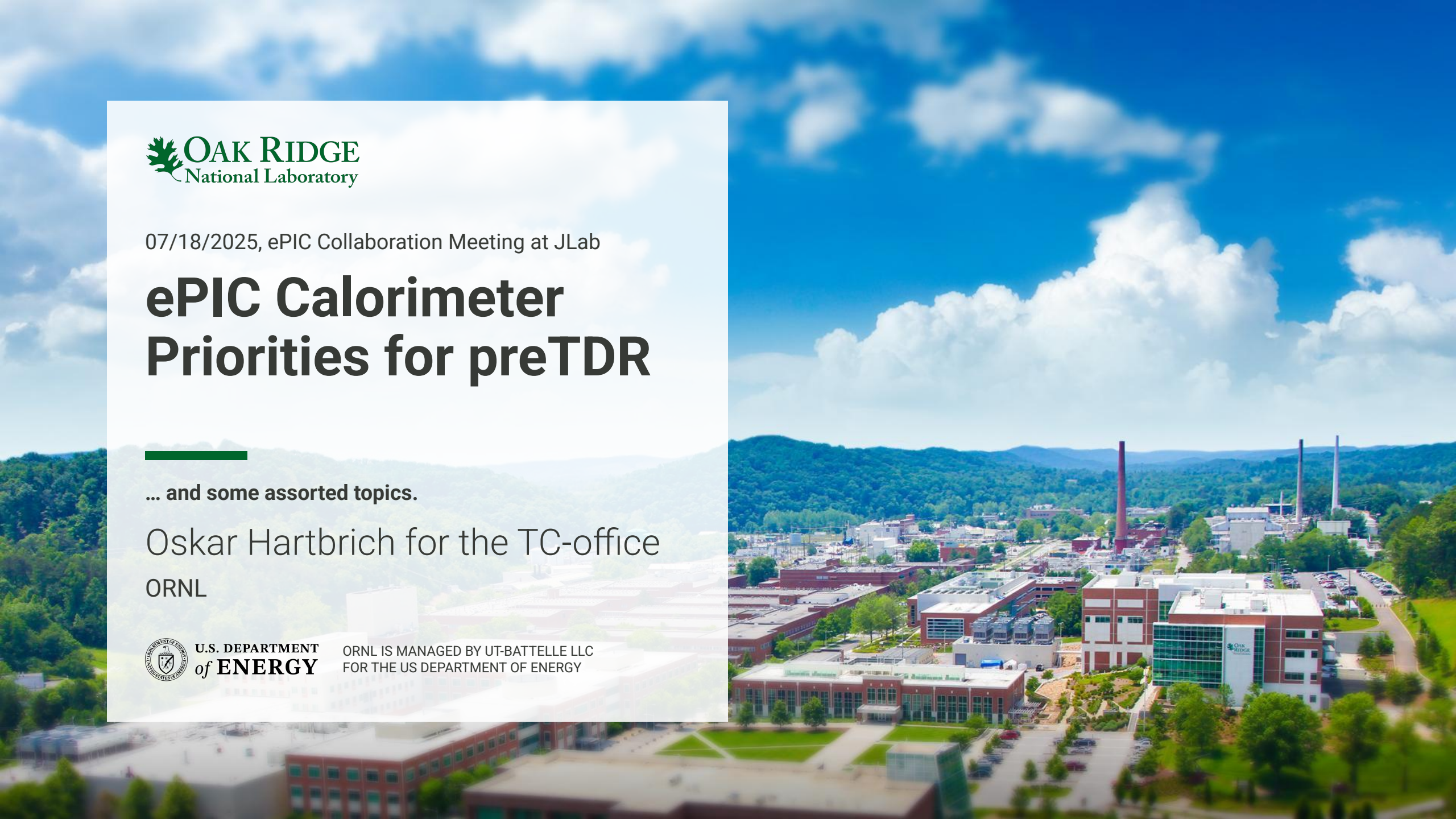

OAK RIDGE National Laboratory

07/18/2025, ePIC Collaboration Meeting at JLab

ePIC Calorimeter Priorities for preTDR

… and some assorted topics.

Oskar Hartbrich for the TC-office

ORNL

U.S. DEPARTMENT of ENERGY

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Open Questions on ePIC Calorimeter Systems

- LFHCAL/Insert:
  - Justification of high granularity insert vs. simply extending LFHCAL towards the beam pipe
  - Needs bullet proof simulation study to prove performance vs. increased complexity and risk
- Barrel HCAL:
  - Momenta in ePIC barrel region are low -> barrel HCAL largely contributes to neutral+muon reco
  - Needs bullet proof simulation study to prove performance with individual tile readout
- Backwards HCAL:
  - Needs bullet proof simulation study to prove physics need
  - Is modified LFHCAL-style design appropriate?

- We need answers to these questions in the preTDR by the end of the year

Readout Options for FEMC/EEEMC + HGCROC Validation

- Most ePIC calorimeters plan for HGCROC/CALOROC readout
  - Great global efforts ongoing to use and understand HGCROC in labs and beams
  - Operating HGCROCs and providing feedback towards CALOROC design must be (and already is) a prime priority for calorimetry groups
  - Yet, many steps needed towards reliable large-scale HGCROC systems

- FEMC and EEEMC are the only two ePIC calorimeters considering discrete readout electronics
  - FEMC plans on fully custom, discrete readout
- EEEMC testing both discrete and HGCROC readout in beam tests
  - Does HGCROC linearity and dynamic range meet requirements for EEEMC performance goals?
    - ePIC physics depends on this.

Impact of SiPM Irradiation on Calorimeters

- Impacts on: detection thresholds, noise, data rate
  - UCR-led SiPM irradiation studies: https://arxiv.org/abs/2503.14622
  - Expected ePIC radiation doses: https://wiki.bnl.gov/EPIC/index.php?title=Radiation_Doses
- Detailed studies presented in past few CC-Calo WG meetings
  - https://indico.bnl.gov/event/28287/, https://indico.bnl.gov/event/28712/, https://indico.bnl.gov/event/28900/
  - However: Methodology and interpretations differ between systems

- Can CC-Calo WG unify the demonstrated approaches and quantify sensor irradiation impact on all calos?

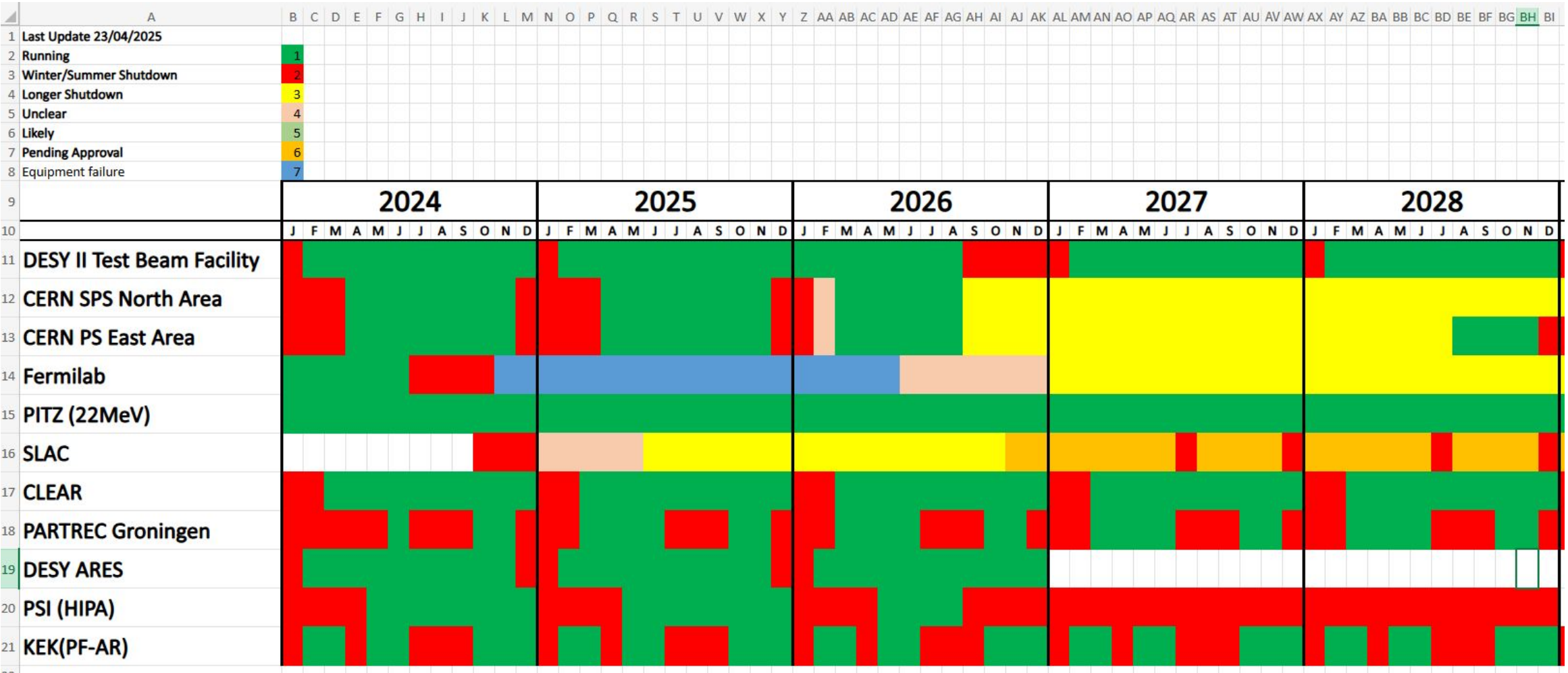
ePIC Beam Time Requirement Projections

- ePIC consists of (at least) 15 independent Detector Subsystem Collaborations (DSCs)
- Estimated beam time requirements (input for European Particle Physics Strategy Update EPPSU):
  - 2026: 31 weeks
  - 2027: 27 weeks
  - 2028: 28 weeks
  - … this is a significant fraction of available beam facilities in the world.

Beam Facilities Availability 2024+

From CERN Database:

- https://test-beam-facilities.web.cern.ch/
- https://cernbox.cern.ch/s/wRuLiYuAwqgS5xx



The Great Hadron Drought of 2026+

- We are entering a true drought in hadron beam facilities starting 2026
  - Even if all facilities come back on schedule, they will be seriously overbooked

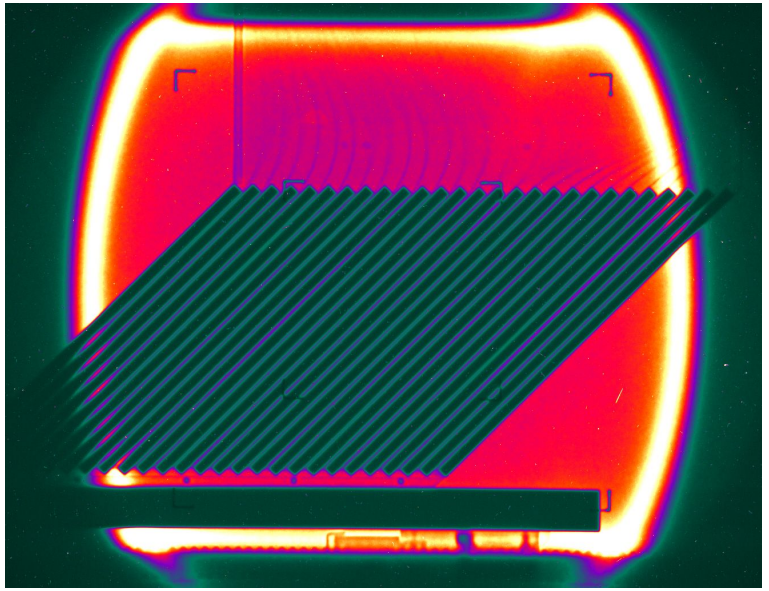
- **ePIC cannot afford to under-utilize granted beam times**, especially at SPS
  - We ask DSCs for detailed beam test preparation presentations at TIC meeting
  - We will coordinate beam test application for next PS/SPS beam periods via TC-office

- A (hadron) beam test facility at BNL would be a significant reduction of risk for ePIC
  - There are ideas for such a facility at BNL AGS, see e.g. recent CFNS workshop: https://indico.cfnssbu.physics.sunysb.edu/event/430/

Test Beam Available at BNL

at the BNL NASA Space Radiation Laboratory (NSRL) beam line

- Beam Available:
  - Protons: up to 2.5 GeV kinetic energy, $2x10^{11}$ protons per spill (~400 ms beam, every ~4.2 sec).
  - Ions, for example, ^{56}Fe kinetic energy up to 1.0 GeV/n, $2x10^{9}$ Fe-ions/spill
  - Quick changes of beam energy and species, in minutes.
- Beam Shapes:
  - uniform beam: 10x10, 20x20, … 60 x 60 cm^2
  - pencil beam ~1 cm spot size.
- Supports Available:
  - Remote controlled tables for rotation and positioning
  - Patch panels for HV, signal, ethernet cables.
  - Electronics for trigger setup, a simple DAQ, ADCs TDCs.
- Easy and quick access to the experimental area



PHENIX Zero-Degree Calorimeter being tested with ^{56}Fe-beam (1 GeV/n), beam size: 20x20 cm^2

More details at: https://www.bnl.gov/nsrl/
Please plan ahead and tell us what you need.
Xiaodong Jiang: xjiang3@bnl.gov

Parasitic beam test: UC Riverside group tested a prototype calorimeter detector for EIC at NSRL, with 1 GeV and 2.5 GeV proton beams, on July 8th, 2025.