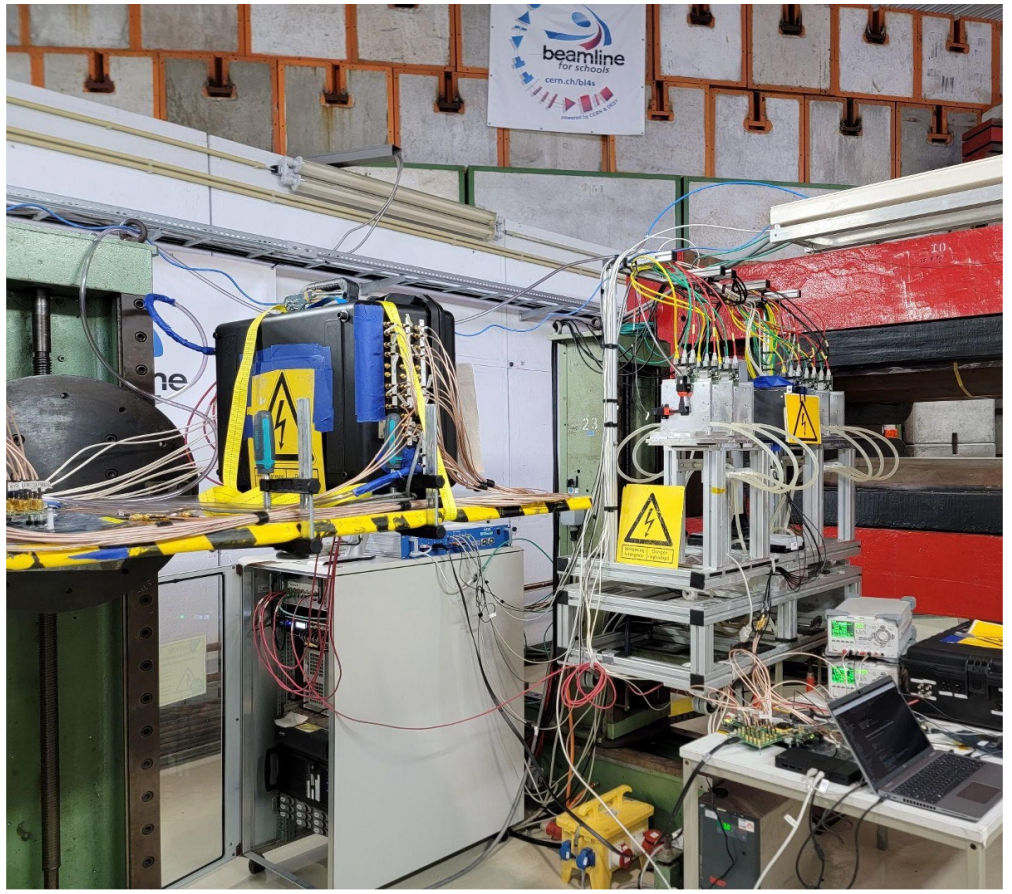
Test Beam Plans: DESY June 10-23, 2024

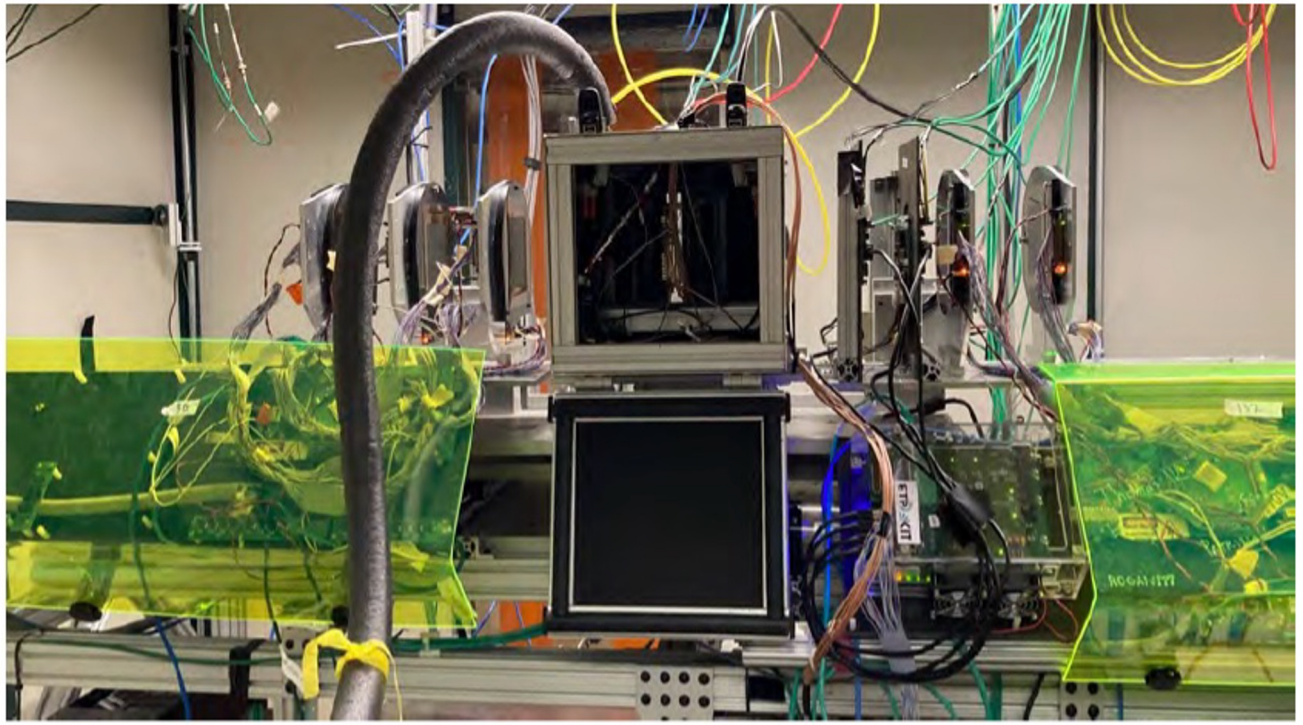
Before Installation

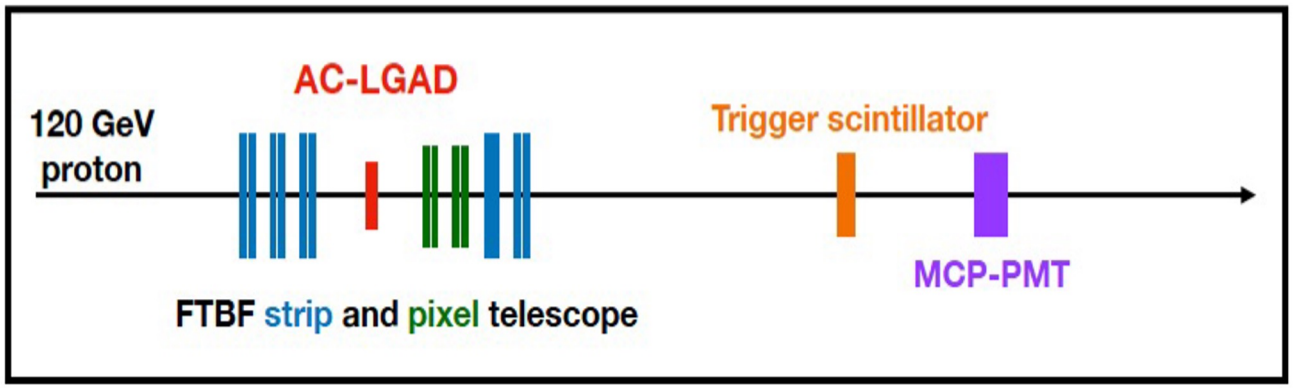
After Installation



Current plan for this test beam: New HPK Sensors, EICROC0, FCFDv1
Beam Facility: telescope with 3 um resolution, trigger from scintillators
Users: DUTs, reference time (T0) detector, PS, DAQ

Test Beam Plans: Fermilab 2024?





BTOF Frontend Readout ASIC

- Discussing with FNAL ASIC designers (Artur et al.) and ePIC DAQ group (Fernando et al.)
  - Agree on the specifications of the ASIC
  - Get FNAL and ePIC project on-board to develop such an ASIC
- Documentation of the specifications and discussions: link

Questions from ePIC DAQ group

- Deadtime by channel (or maximum hit rate by channel)
  - BTOF: average O(3) Hz/channel from collisions, O(30) Hz/channel from noise (5-sigma for 100MHz)
    - Signal rates: 500 kHz interaction rate * 5 particles/collision * 3 strips/hit / (2.4M channels) ~ 3 Hz/channel
    - Noise rates: 5-sigma probability (1/3.5M) for 100 MHz ~ 30 Hz
  - Lumi Tracker: maximum O(50) kHz from collisions (https://indico.bnl.gov/event/22305/)
- Readout size per hit (including segmentation)
  - Hit: 25b=7b channel ID+8b TDC+10b ADC
    - 7b channel ID: 2^7=128
    - 8b TDC: (1/98.5MHz) / (20 ps) = 508, so 2^8=512
    - 10b ADC: AC-LGAD S/N~40, 1/2^8 equivalent bit ADC resolution is 0.4% = 1/6 * (N/S), 10 bits
- Data volume limits (and whether the limit is by channel, or by ASIC, or by segment).
  - TBD
- Data content (TOT, TOA, Sampled ADC, etc.)
  - Header, Chip ID, BCID, NHITS, HITS (channel ID, TDC, ADC), Trailer
- Whether any of these are impacted by hit size, or other parameters.
  - Data volume increases linearly with the number of hits
- Output data format
  - Event DATA: Header + ChipID + BCID + NHITS + HITS … + Trailer

Questions from FNAL ASIC Designers

- What can be the dead time?
  - O(100 us) frontend, Streaming Readout
- What frequency for ADC is needed per channel? How often is a channel hit? FNAL already has an ADC that is 50 kHz, would it work for this?
  - TBD: AC-LGAD signal rise time O(500 ps), pulse duration O(5 ns)
- What is the ADC precision needed?
  - O(0.4%)
- What is the data rate needed : GB/s
  - BTOF: 1 Mb/s
  - Lumi Tracker: 400 Mb/s
- Zero suppression: digital FIFO or arbitration?
  - TBD
- In the google doc we have “Output format: include 14b Chip ID, 12b BCID, and 7b channel ID+12b TDC+10b ADC per hit “, could you break down each of them why those numbers are needed?
  - 11b BCID: 1160 bunches in EIC, 2^11=2048
  - 6b Chip ID: 128 chips on a stave, read out from both ends (128/2=64), 2^6=64
  - 7b channel ID: 2^7=128
  - 8b TDC: (1/98.5MHz) / (20 ps) = 508, so 2^8=512
  - 10b ADC: AC-LGAD S/N~40, 1/2^8 equivalent bit ADC resolution is 0.4% = 1/6 * (N/S), 10 bits