MVTX prototype and tracking tests

Sho Uemura
P-25

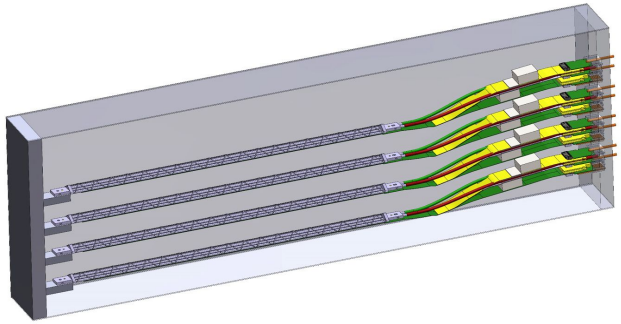
Goals for the MVTX prototype

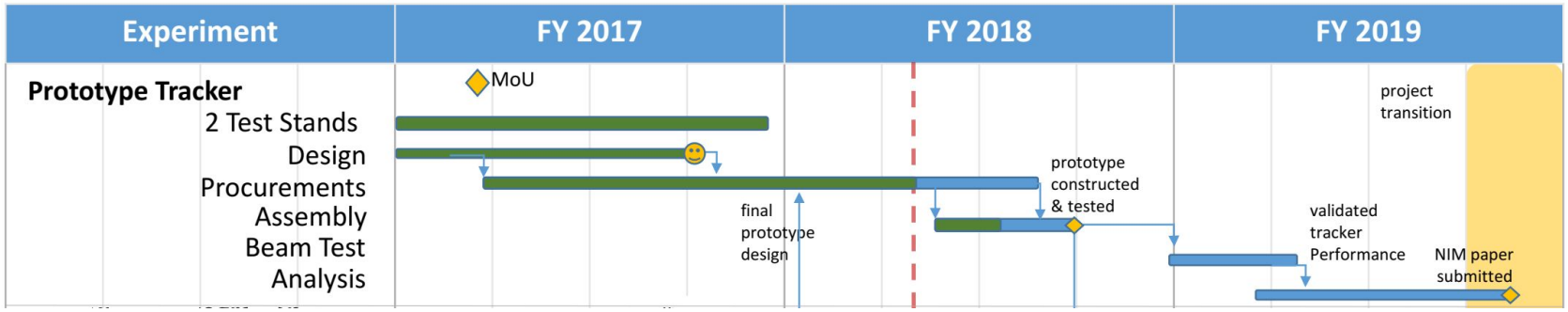
Prove the MVTX design meets physics requirements:

- Measure position resolution and hit efficiency
- Validate simulations of multiple scattering and cluster size
- Validate clustering, tracking, and alignment algorithms on real data
- Verify the full MVTX readout chain

Deliverables:

- MVTX prototype (the “telescope”) with single sensors or staves, and full readout chain
- Beam test measurements validating the MVTX design



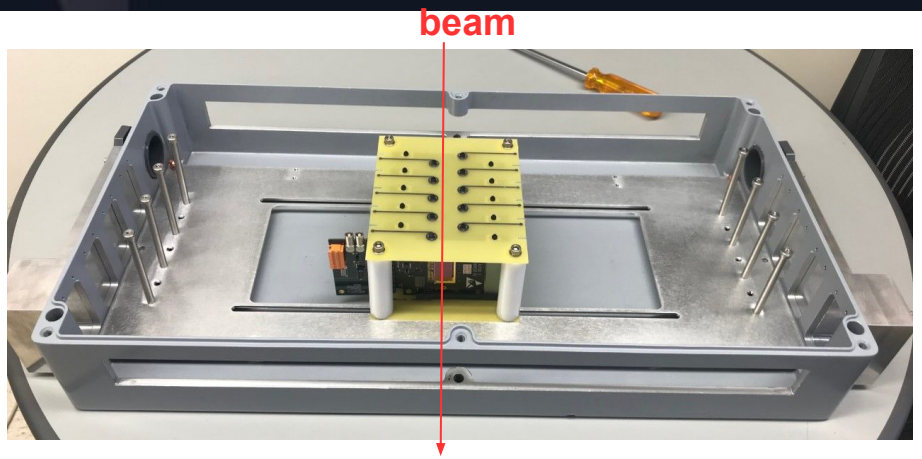


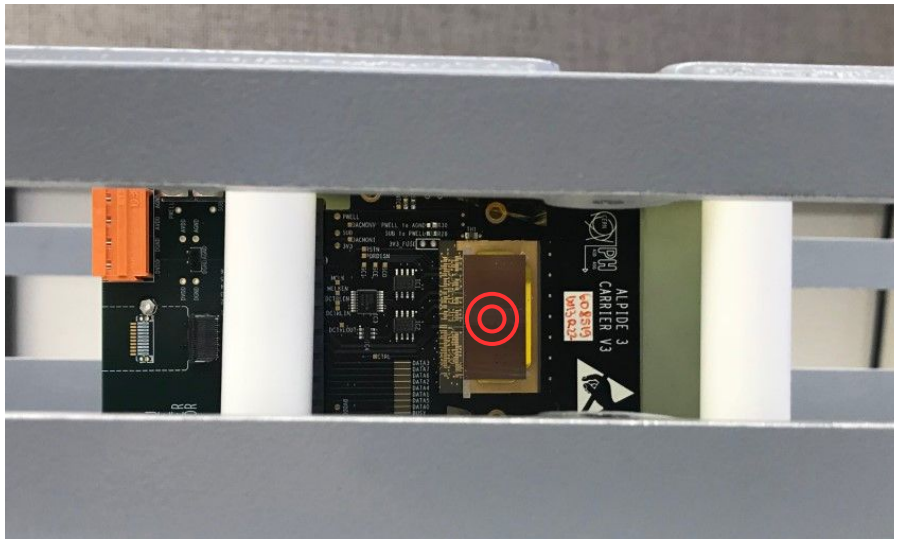
We have the hardware and readout: now we are ready to meet these goals in the next months

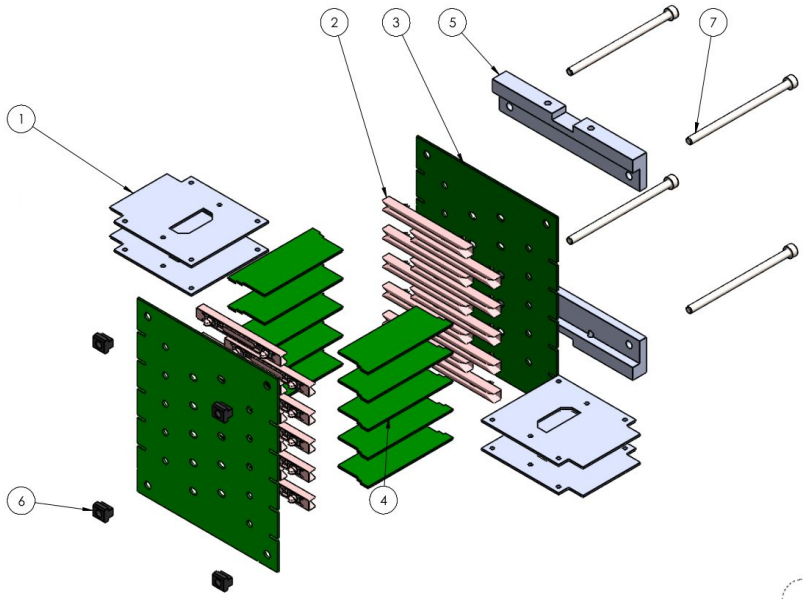
MVTX prototype box

One versatile box for different configurations

- Mounting hardware holds ALPIDE sensors or staves
  - We will run with three ALPIDEs and one HIC (unmounted stave)
- Windows for beam test, cable feedthroughs, air cooling vents





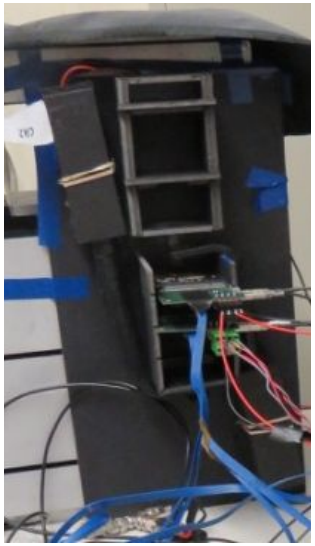


Adaptable for present and future needs

Testing program

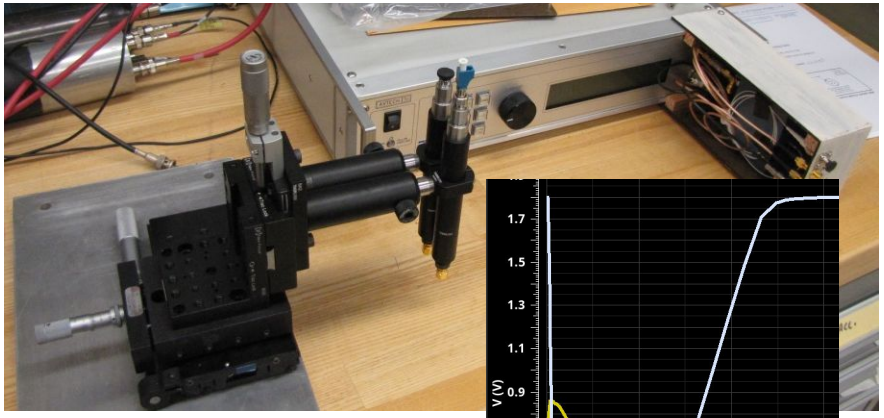
Cosmic rays

- Efficiency and resolution
- Preliminary alignment



Laser pulser

- Optimize ALPIDE parameters
- Validate ALPIDE simulations



Beam tests

- Large samples of clean tracks: precision alignment
- Momentum dependence
- High rate/high occupancy
- Integration with other sPHENIX subsystems

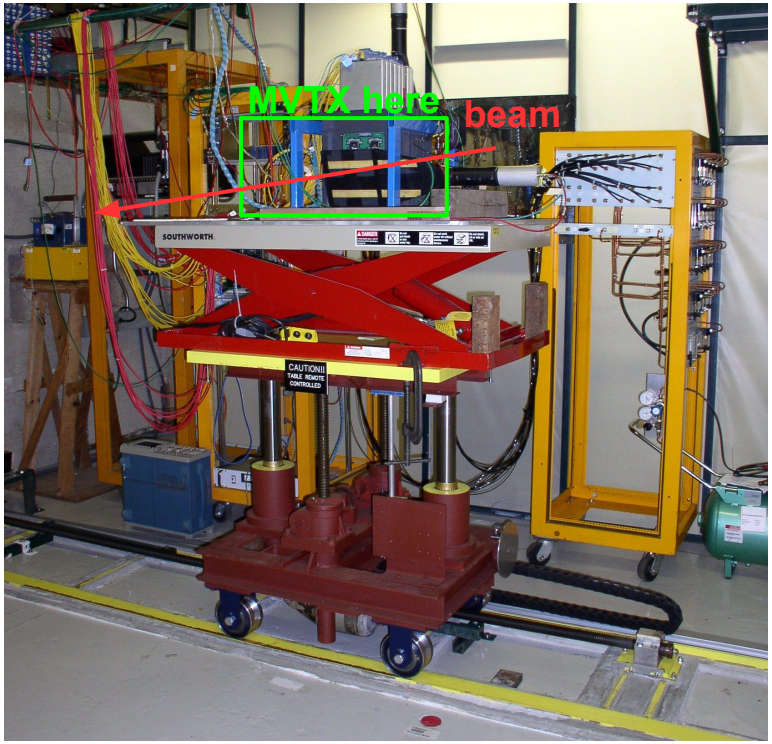
Beam tests are not essential, but very useful

LDRD
innovation for our nation

2018 beam test

Fermilab Test Beam Facility

- 120 GeV primary proton beam, 1-60 GeV secondary particles
- Great infrastructure: motion tables, cabling, trigger detectors



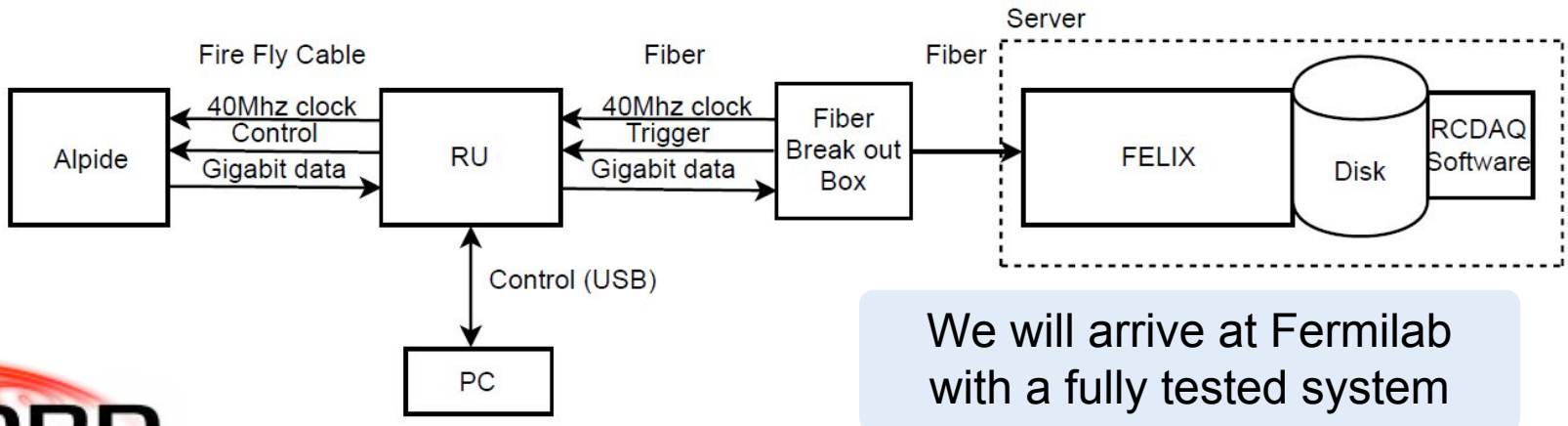
sPHENIX beam test

- Primary sPHENIX goal: test performance of the EMCal and HCal (month-long test program)
- The sPHENIX silicon detectors (MVTX and INTT) are opportunistic users: calorimeters are off March 6-9, INTT and MVTX will get beam

Ahead of schedule thanks to rapid progress on readout and prototype, and our good relations with sPHENIX

Same proven readout chain

- Single Readout Unit for whole MVTX prototype
- Control PC in beam enclosure: control power supplies, program and control Readout Unit
- DAQ server in control room: fiber link to the RU, network gateway to the outside
- Bench test: run full readout chain using 53 MHz clock and scintillator trigger, exercise the monitoring – just like at Fermilab

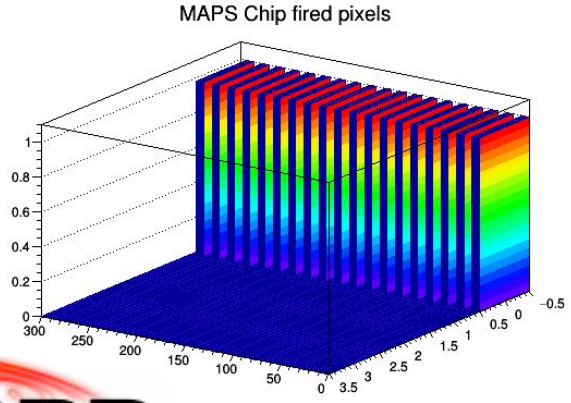


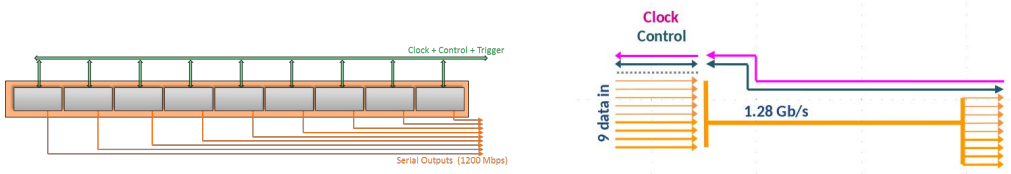
We will arrive at Fermilab with a fully tested system

2018 beam test: preparations

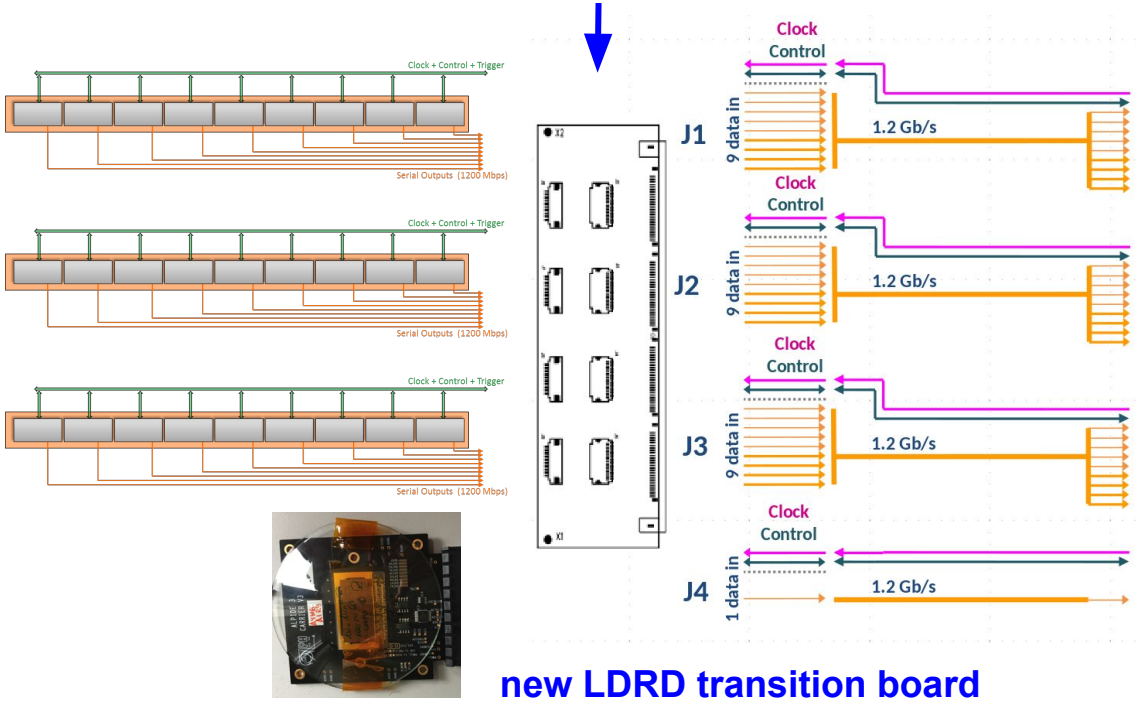
Development for the beam test

- New transition board supports four layers instead of one
- Clock and trigger: ready for test with 53 MHz clock and scintillator trigger
- Online decoding and monitoring using sPHENIX framework





default ALICE transition board



new LDRD transition board

Moving from development system to production

2018 beam test: schedule and run plan

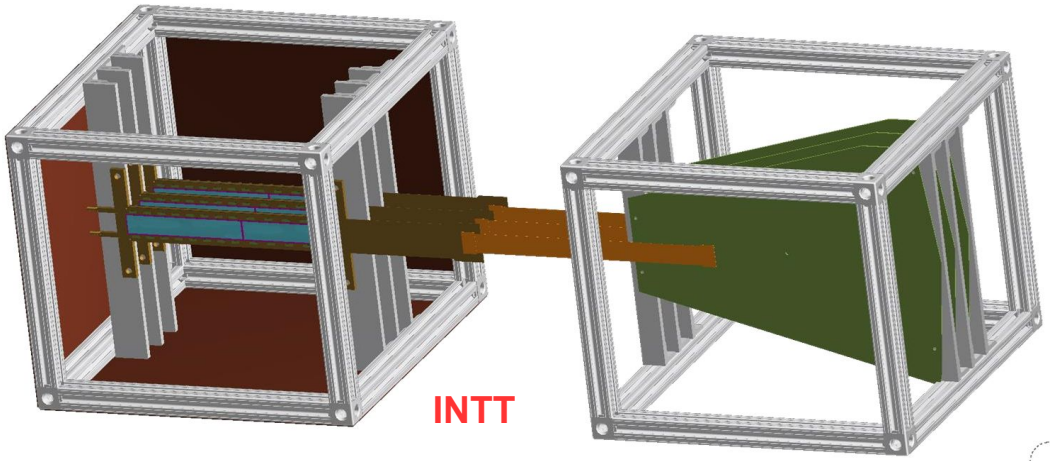
Schedule

- Pack and ship week of Feb. 12
- Arrive Feb. 19, install Feb. 21, safety walkthrough Feb. 22
- Return March 3, ready for beam
- Expect INTT/MVTX joint beam time March 6-9 (nights)
- Uninstall and ship, return March 13

Goals and stretch goals

- INTT is the primary user during our beam time: they are upstream of us and they request the beam: secondaries at 2 and 8 GeV, protons at 120 GeV
- Main goal: 1-hour runs for each beam type (100k-1M tracks)
- If possible: high occupancy run, latency scan, off-normal incidence, different ALPIDE configurations

Flexible run plan: we can meet our goals in one night, but we will use all the beam time we get

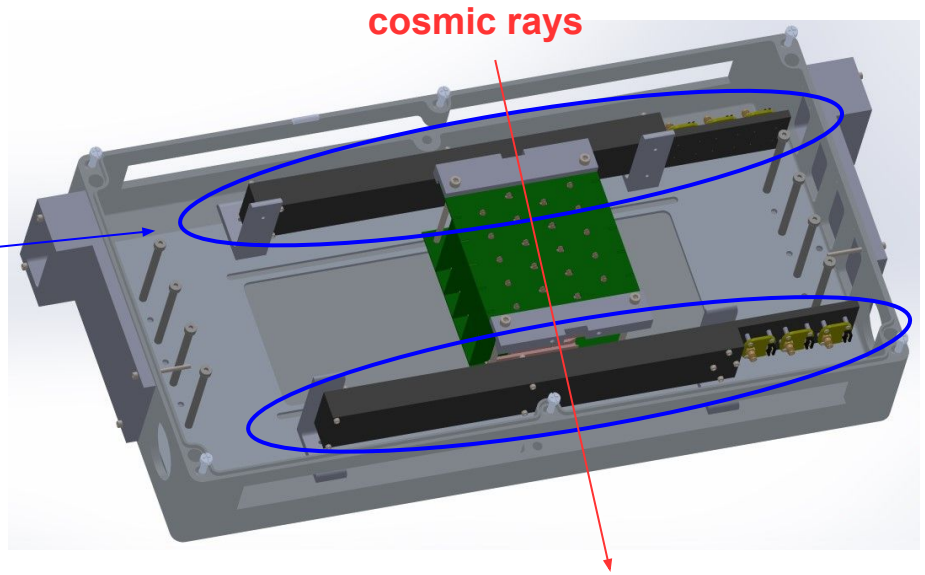


INTT

Future studies and beam tests

Cosmic ray telescope

- After the Fermilab beam test, use the prototype with cosmic ray muons and SiPM-based trigger boxes
- Switch to staves when available, test cooling and power
  - "Full goal" of a 1/10 slice of MVTX including support systems



Goals for a second beam test

- We will join 2019 sPHENIX beam test, or schedule dedicated MVTX beam time
- We will have staves, not single chips
- sPHENIX trigger will be better defined, allowing DAQ integration between subsystems
- MVTX readout will be feature-complete, ready for readout stress tests

LDRD innovation for our nation

Prove a full system with complete software, firmware, and hardware - ready for the transition to MVTX