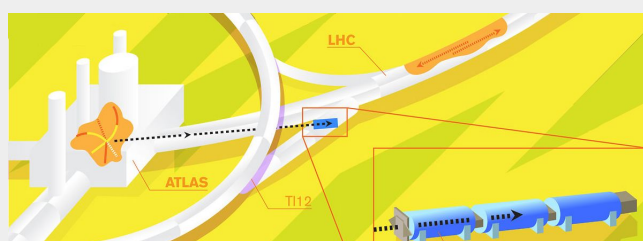




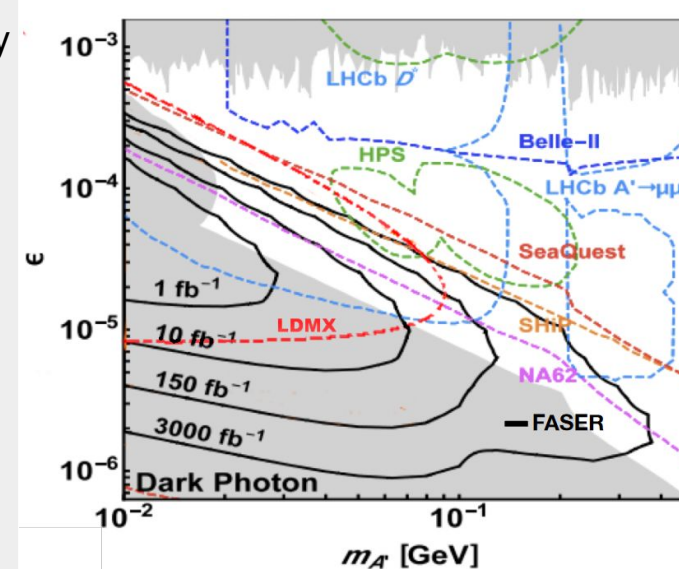
The Big Picture of A Small Experiment

- ForwArD Search ExpeRiment
- 480m downstream of ATLAS IP
- Located in TI12 [1,2]
- Looking for new physics and observing neutrinos
- Baseline installation complete; Ready for Run 3
- Filling in ATLAS' blindspot



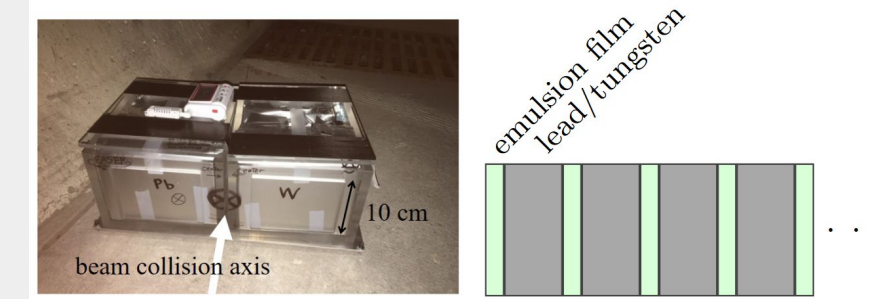
Dark Photon Reach

- FASER starts excluding currently allowed models with first fb-1 (the first month of Run 3!)
- FASER's reach is complementary to other LHC experiments
- Huge number of π^0 produced in FASER angular acceptance ($\sim 10^{15}$ expected in Run 3), allows probing of extremely small dark-photon $/\pi^0$ couplings.



Neutrino Reach with FASER ν

- 6 detector neutrinos detected during 2018 pilot run [3]
- Highest energy neutrinos produced along beamline
- Plenty to learn about tau neutrinos especially
- Big energy gap in accelerator measurements
- $\sim 1300 \nu_e$, $\sim 20,000 \nu_\mu$, and $\sim 20 \nu_\tau$ interactions expected [4]



- #### FASER ν
- Emulsion detector for ν 's
 - ~ 770 layers of emulsion films
 - Tungsten plates
 - Target mass ~ 1.1 tonnes

Tracking Stations

- 4 Stations, 3 planes each
- 8 silicon strip (SCT) modules per plane
- SCTs donated by ATLAS

Scintillators

- Veto - rejects muon background
- Trigger/timing - arrival time
- Preshower - veto & 2γ signal

Geometry

- 7m length
- 20cm aperture
- 1.5m decay volume

Magnets

- 0.57T Dipole
- e^\pm separation

Physics Signal

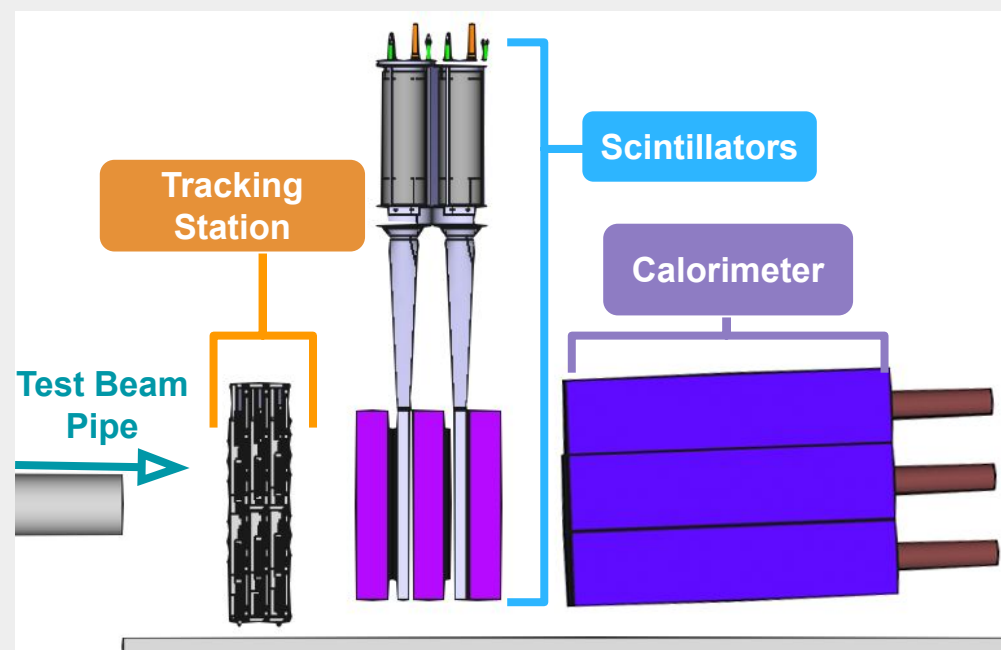
- Dark photons (LLP) and neutrinos from meson decay
- $pp \rightarrow LLP + X, LLP \rightarrow e+e-, \mu+\mu-, \dots$

Calorimeter

- Donated by LHCb
- Measures total energy of γ, e^\pm

SPS Test Beam

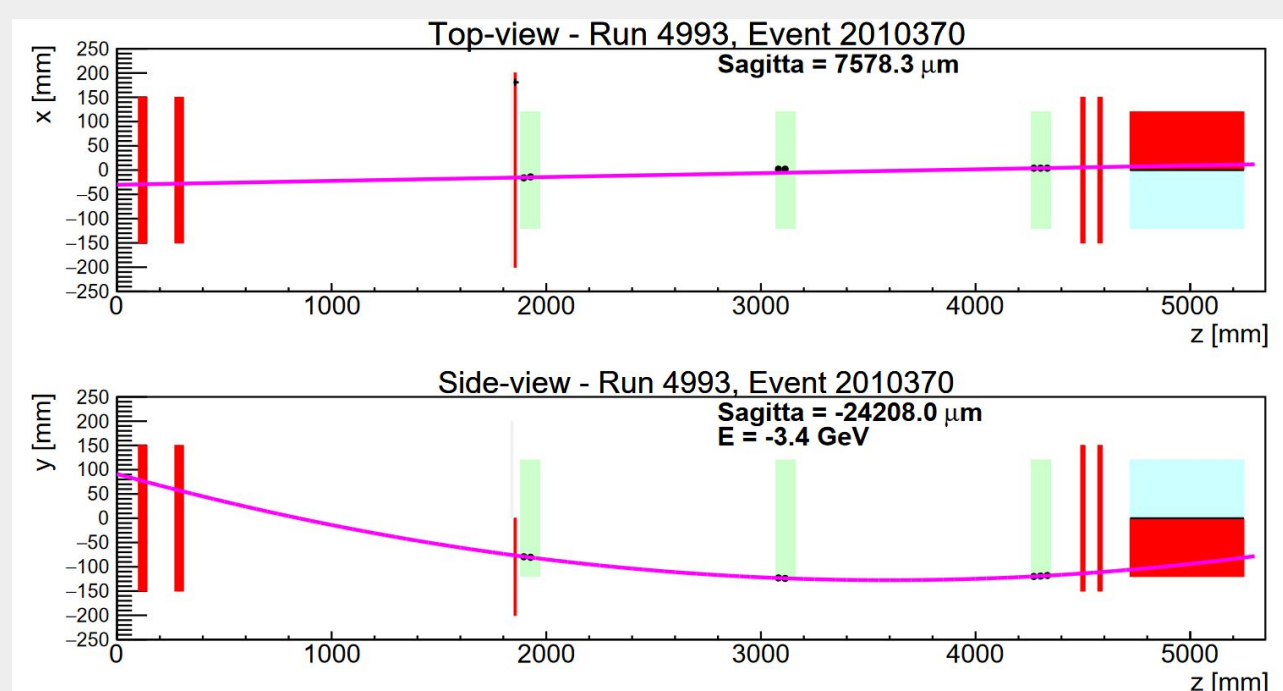
- Conducted July 2021
- Scans: 5-250 GeV e^- , 150 GeV μ^- , 200 GeV π
- Analysis ongoing
- Calibration of calorimeter modules to e/μ response
- Operations practice with each major component



Test Beam setup in EHN1

First Tracks from LHC Pilot Beams

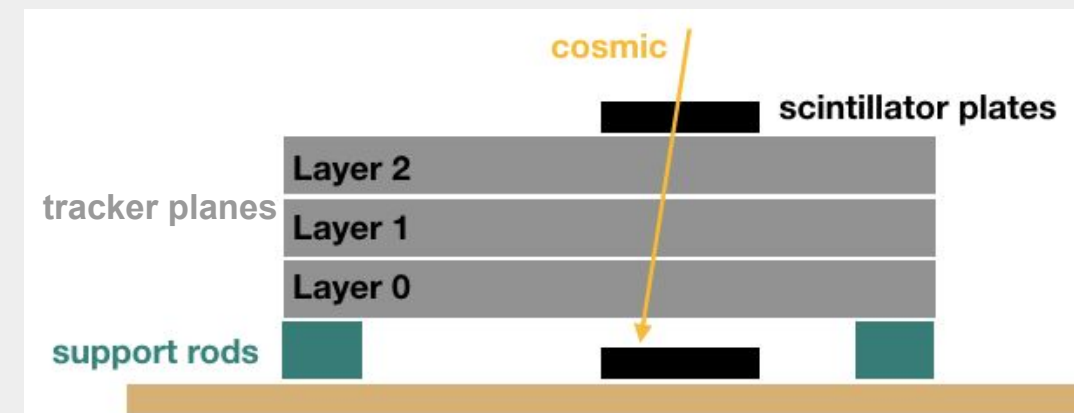
- During automatic alignment of the LHC collimator on Oct. 27
- Caused increase in trigger rate for FASER; observed ~ 500 events with tracks traversing the full detector
- Lower energy events showed track curvature due to magnets (pink)



Event display provided by Brian A. Petersen

Cosmics Studies

- Cosmic ray muons used to test tracker functionality
- Setups:
 - Single station on surface (Winter of 2020)
 - Full detector underground (Ongoing)
- CR simulation vs measurement
- Helpful for testing detector operations, detector performance and offline reconstruction
- Estimate of cosmic trigger rate in 1 station in TI12: 0.3Hz



Surface cosmics setup in EHN1 during Winter 2020

References

- [1] <https://arxiv.org/pdf/1811.12522.pdf> [3] <https://arxiv.org/abs/2105.06197>
 [2] <https://arxiv.org/pdf/1812.09139.pdf> [4] <https://arxiv.org/abs/1908.02310>