Physics potential and track reconstruction of the FASER experiment

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What is FASER?
- ForwArd Search ExpeRiment [1]
- new, small experiment to search for New Physics
  and observe Neutrinos
- currently constructed, data taking during Run 3

Goal
- detect simple striking signal:
  new particle decaying in two SM particles

Location
- on beam collision axis line of sight, 480 m downstream from ATLAS IP
- in TI12 tunnel
  - high rate of hadrons in forward direction
  - low background (shielding + deflection)

Physics potential
- example: dark photon

Signature
pp→NP + X,   NP travels ~480 m,   NP → tracks + X

Forward physics
- hidden corners at the LHC

- further interesting channels [3]
  - heavy neutral leptons
  - axion like particles

massive, high-p_T particles
light, weakly interacting particles
Detector

- Tracking stations
  - 3 stations, each containing 3 layers of 8 semiconductor strip tracker (SCT) modules
  - SCT modules donated by ATLAS Collaboration!

- Magnets
  - 3 x 0.55 T permanent dipole magnets
  - to separate highly collimated tracks

- Scintillators
  - for veto of incoming charged particles, timing and triggering

- Neutrino detector
  - 770 layers of emulsion film and tungsten
  - emulsion replaced every ~50 fb$^{-1}$

Calorimeter

- 4 outer ECAL modules
- donated by LHCb Collaboration!
- 66 layers of lead and scintillator

For details on the commissioning see poster by S. Shively

Geometry

- 5m length
- 20cm aperture
- 1.5m decay volume

To ATLAS IP

Incoming LLP
Track Reconstruction

- Cluster
  - create clusters from semiconductor strips

- Space points
  - combine clusters from front and back to a space point

- Track Seeds
  - create track seeds from linear $\chi^2$ fit

- Tracks
  - use combinatorial Kalman filter for track finding and fitting

**Alignment**

- Pre alignment
  - mean in $\mu$m: $-34.0 \pm 35.2$
  - sigma in $\mu$m: $27.6 \pm 7.0$

- Post alignment
  - mean in $\mu$m: $-2.3 \pm 5.8$
  - sigma in $\mu$m: $26.3 \pm 5.4$

**Track fitting**

- tested with MC simulated muons
- smeared truth initial parameters

**Offline framework**

- based on Athena and ACTS [5]

**References**