

Physics potential and track reconstruction of the FASER experiment

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LHCP 2021, 7 - 12 June 2021

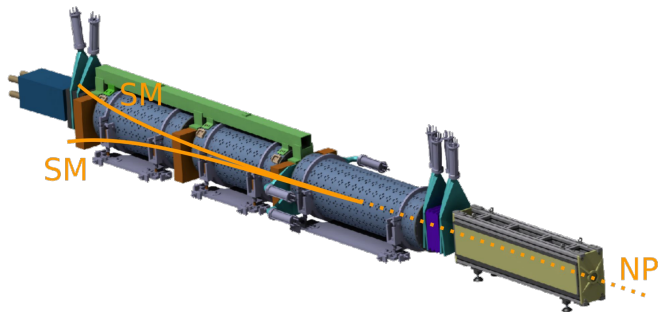


What is FASER?

- 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

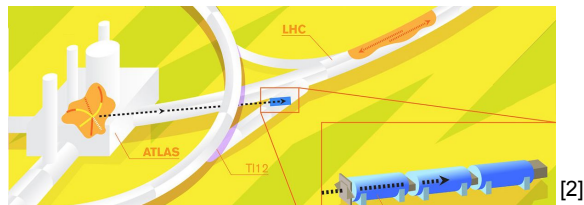


Signature

$pp \rightarrow NP + X$, NP travels ~ 480 m, $NP \rightarrow \text{tracks} + X$

Location

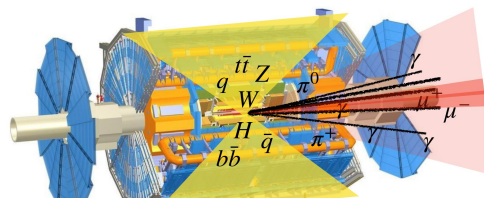
- on beam collision axis line of sight, 480 m downstream from ATLAS IP
- in TI12 tunnel



- high rate of hadrons in forward direction
- low background (shielding + deflection)

Forward physics

- hidden corners at the LHC

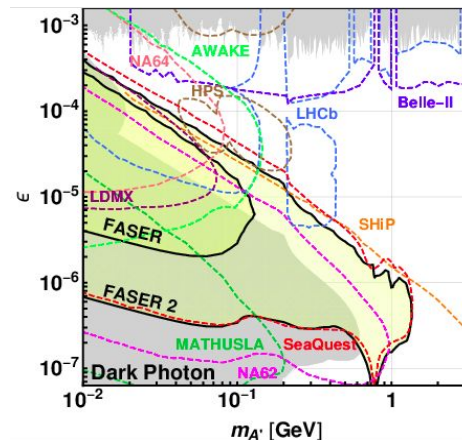
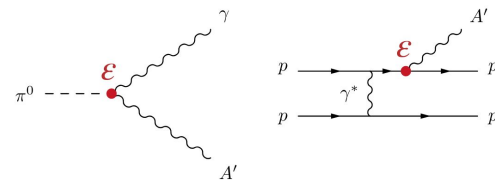


massive, high- p_T particles

light, weakly interacting particles

Physics potential

- example: dark photon



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

Detector

Calorimeter

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

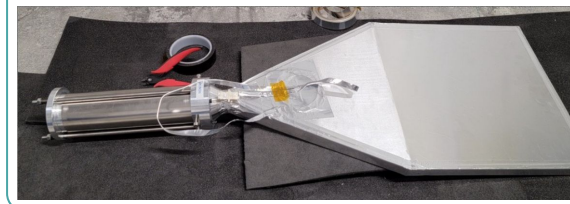


Magnets

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

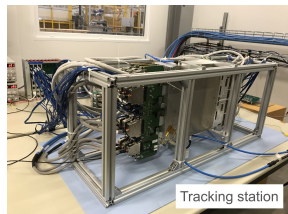
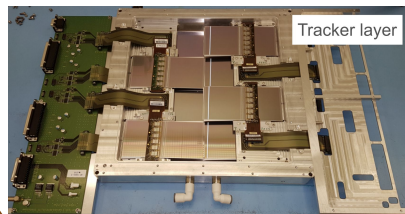
Scintillators

- for veto of incoming charged particles, timing and triggering



Tracking stations

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



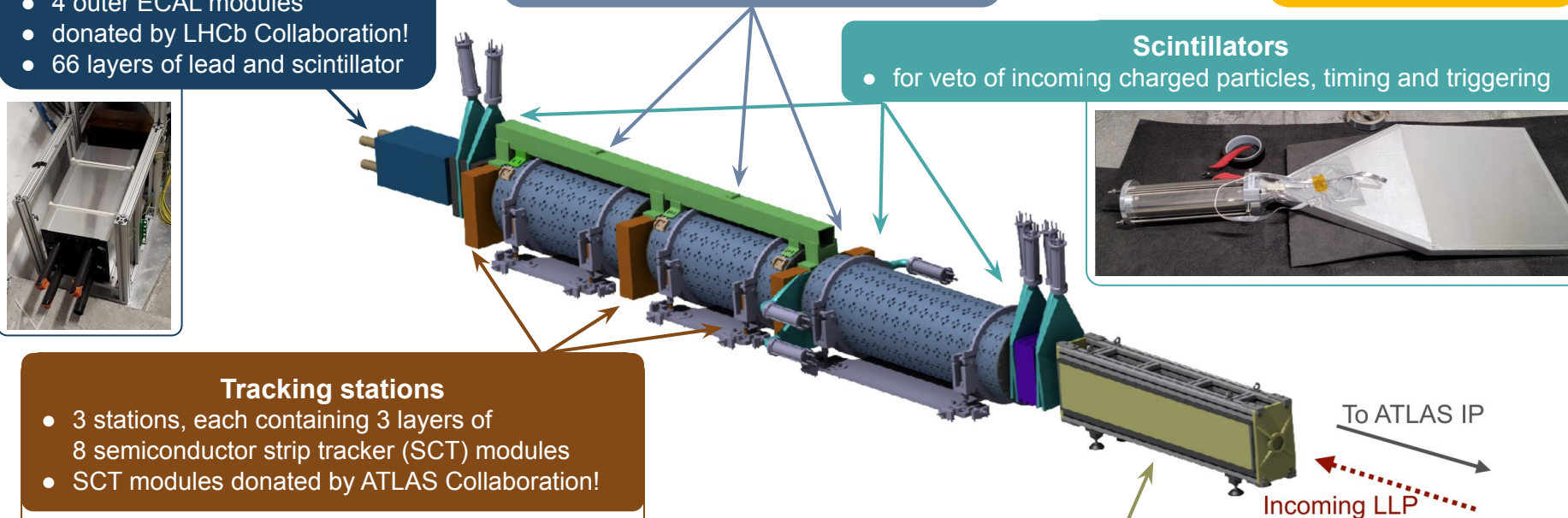
Neutrino detector

- 770 layers of emulsion film and tungsten
- emulsion replaced every $\sim 50 \text{ fb}^{-1}$

To ATLAS IP

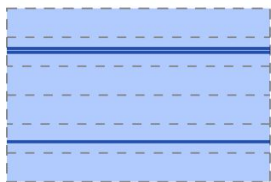
Incoming LLP

For details on the commissioning see poster by S. Shively

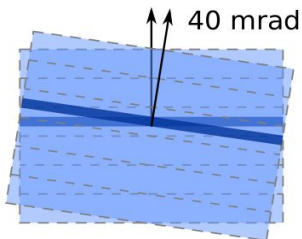


Track Reconstruction

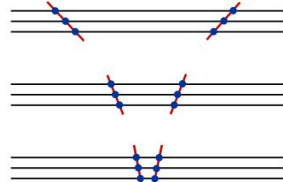
Cluster → Space points → Track Seeds → Tracks



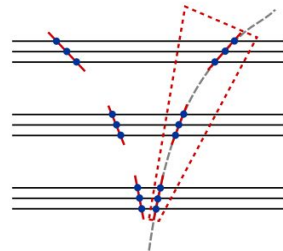
create clusters from semiconductor strips



combine clusters from front and back to a space point



create track seeds from linear χ^2 fit



use combinatorial Kalman filter for track finding and fitting

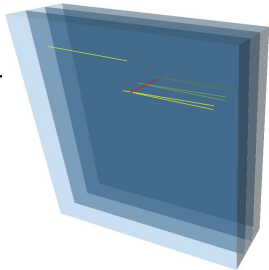
Offline framework

- based on Athena and ACTS [5]

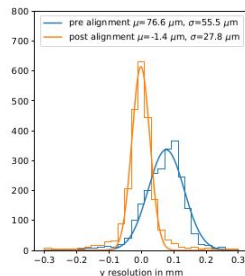
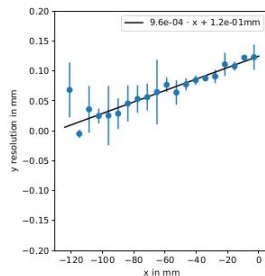


Track seeds

- linear X^2 fit of cluster in each station



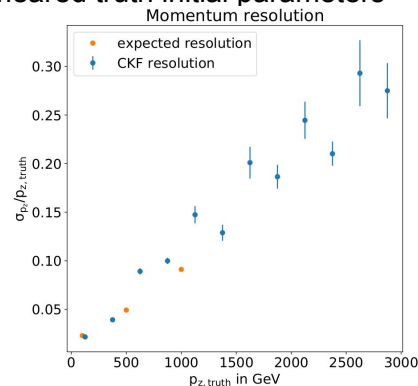
Alignment



	pre alignment	post alignment
mean in μm	-34.0 ± 35.2	-2.3 ± 5.8
sigma in μm	27.6 ± 7.0	26.3 ± 5.4

Track fitting

- tested with MC simulated muons
- smearing truth initial parameters



References

- <https://arxiv.org/abs/1811.10243>
- <https://www.symmetrymagazine.org/article/a-tiny-new-experiment-at-the-lhc>
- <https://arxiv.org/abs/1811.12522>
- <https://arxiv.org/abs/2105.06197>
- <https://arxiv.org/abs/1910.03128>