ForwArd Search ExpeRiment at LHC

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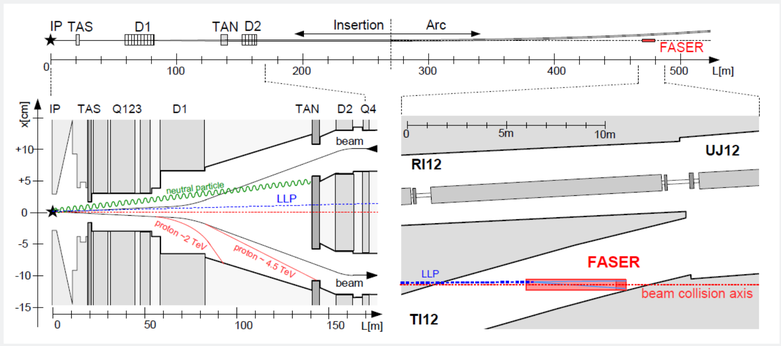
Introduction

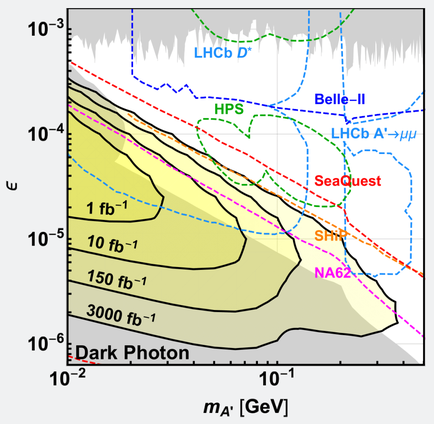
- FASER is a small **new experiment** looking for decays of **exotic weakly-interacting particles**, produced in pp collisions at ATLAS in the very forward region, **out of the ATLAS** detector **acceptance**
- it will be placed 480 m downstream of the ATLAS interaction point (IP) in unused service tunnel TI12



FASER location inside TI12 with respect to the ATLAS IP.

Physics motivation

- **large numbers of light particles** is produced in pp collisions with **very low** p_T
  - possible exotic light particles weakly coupled to SM
- large boost factors → probability of long–lived particles (LLPs) decaying in FASER
  - dark vectors, dark scalars, heavy neutral leptons, axion-like particles (ALPs), ...



FASER's reach for dark photons. ϵ is the coupling parameter of dark photon to SM. Gray–shaded regions are excluded by current bounds.

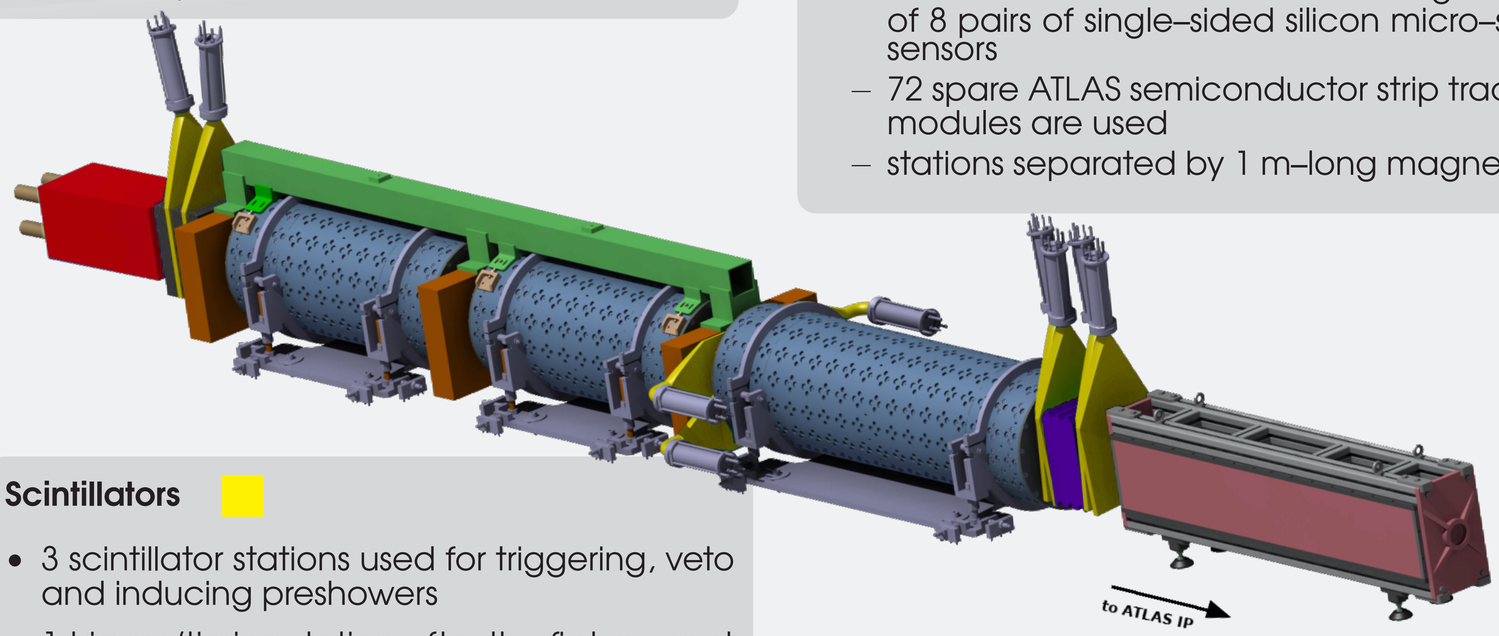
Detector design

Calorimeter

- electromagnetic calorimeter designed to stop highly energetic photons and electrons, identify them and measure their energies
- uses four spare LHCb outer ECAL modules

Tracker

- 3 tracking stations used to detect two oppositely charged tracks originating from common vertex
  - each station consists of 3 tracking layers of 8 pairs of single–sided silicon micro–strip sensors
  - 72 spare ATLAS semiconductor strip tracker modules are used
  - stations separated by 1 m–long magnets



Scintillators

- 3 scintillator stations used for triggering, veto and inducing preshowers
- 1 trigger/timing station after the first magnet and before the first tracking station

TDAQ

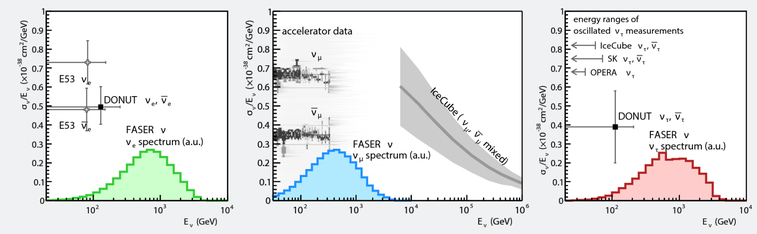
- scintillators and calorimeter provide triggering functionality
- trigger rate of 650 Hz (based on muon rates in situ measurements and FLUKA simulations)
  - dominated by timing scintillator

Magnets

- one 1.5 m–long (decay volume)
- two 1 m–long permanent magnets (spectrometer)
- 0.55 T to distinguish pairs of oppositely charged, high–energy SM particles, originating from decays of new physics particles

FASERν

- FASER sub–detector – designed to detect **collider neutrinos** for the first time
  - approved in December 2019
- composed of a repeated structure of emulsion films interleaved with 1-mm-thick tungsten plates (1000 emulsion in total)
- design of the detector will allow to study properties of neutrinos of **all flavors** in ranges of **energies** which are currently **unconstrained**
- expected to detect 1300 ν_e, 20 000 ν_μ, and 20 ν_τ during Run 3



Simulated spectra for neutrinos of all three flavors with marked regions of cross section measurements from other experiments.

Civil engineering works

- removal of unused services, installation of dust protection and antennas for communication in the tunnel TI12

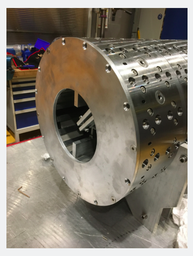
TI12 before and after removal of pipes.

- digging a **trench** in the floor of TI12 will have to be done to allow right detector positioning
  - work on the trech is currently in progress

Photo of the recent civil engineering works – work on the trench has just started.

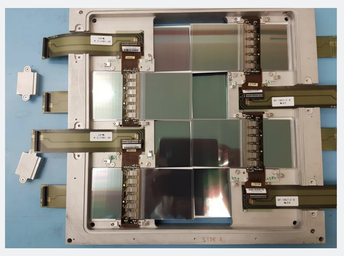
Commissioning

- commissioning of tracker planes in B161 at Meyrin CERN site
- on-ground commissioning of **whole detector in ENH1** hall in Prevessin starting now
  - everything will be assembled on ground before building detector in TI12
  - partial on-ground system commissioning should be completed over spring
- **underground** installation of whole experiment **in summer**
- **magnets** are currently being produced and should be delivered in spring
- linearity and gain tests of **calorimeter** has been performed
- **first scintillator** module made in January
- **tracker** planes being produced and tested
  - all tracker modules have already been tested
- **trigger board** produced and tested
- **DAQ software** under production



Production of magnets.

The first scintillator with a light guide.



Tracker plane prototype.

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