The second generation Extreme Universe Space Observatory on a Super-Pressure Balloon (EUSO-SPB2) mission has been approved by NASA for a long duration flight (up to 100 days), starting from Wanaka, New Zealand, in 2023. EUSO-SPB2 will monitor the night sky of the Southern hemisphere from 33 km altitude to study Ultra-High Energy Cosmic Rays (UHECRs) and astrophysical and cosmogenic neutrinos, and it will represent a proof of concept for POEMMA (Probe of Extreme Multi-Messenger Astrophysics). EUSO-SPB2 features two main independent telescopes, a Cherenkov (CT) and a Fluorescence (FT) Telescope. A trigger code running on the 1.05 μs datastream of the FT looks for multiple clusters of excess signal within a certain time window. Its hardware implementation and performance both in terms of rejection of noise and ability to detect fast signals is tested taking advantage of the TurLab facility, hosted at the University of Turin.

**EUSO-SPB2 Fluorescence Telescope**

- Focal surface: 3 PDMs [Photo Detection Module]
  - PDM = 48×48 pixels
  - 3 PDMs = 3×48×48 pixels = 6912 pixels
- Schmidt optics
  - 6 mirror segments in 2×3 configuration
  - Pixel field of view: 0.2°
- Single photon counting
  - Peak Sensitivity ~300-400 nm
  - Time resolution 1.05 μs = 1 GTU (Gate Time Unit)
  - double pulse resolution ~6 ns
- Pixel size on ground (assuming flight altitude of 33 km): 115 m
- Flight velocity: ~100 km/h

**EUSO-SPB2 FT trigger logic**

Works at MacroPixel level (i.e. sum of a 2×2 square grid of pixels)

- residence time in a pixel for medium to high inclined shower is less than 1 μs.
- MacroPixels fully contain the signal.
- EUSO@TurLab Project

**Black box test**

Functionality tests in the black box. Background produced by a white LED Track generated through a LED focused by a rotating mirror. Detect microsecond timescale track-like signals

**The To-EC Detector**

Scaled-down version of the FT
- only one EC (16×16 pixels)
- exact same electronic of the balloon
- optical system based on a 30 cm focal length, 1° plano-convex lens.

**The EUSO@TurLab**

TurLab is a facility hosted at the Physics Department of the Torino University equipped with a 5 m-diameter rotating tank
- light intensity artificially controlled
- detector can be hung from the ceiling
- light sources and different materials can be placed inside the rotating tank

**The EUSO-SPB2 Fluorescence Telescope trigger test within the EUSO@TurLab Project**

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The EUSO-SPB2 payload. The two telescopes pointing nadir and towards the limb are the Fluorescence telescope and the Cherenkov Telescope, respectively.

The detector used for the tests (To-EC detector) while being hanged to the ceiling over the rotating tank.