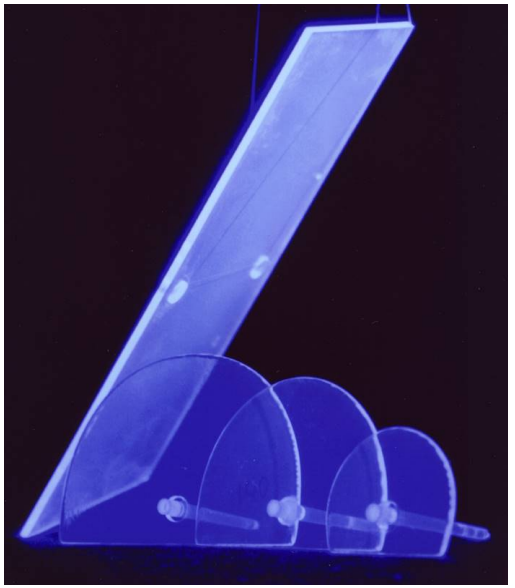
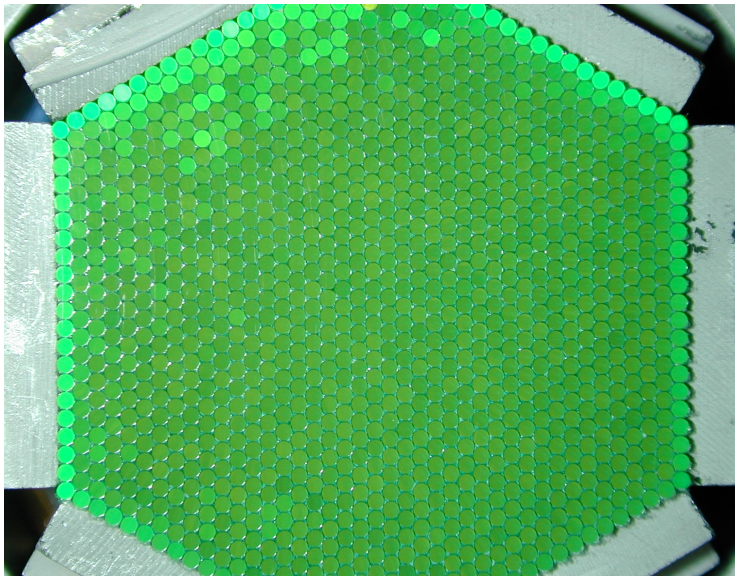
LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS

LOMAC

Laboratory of optics and scintillating materials





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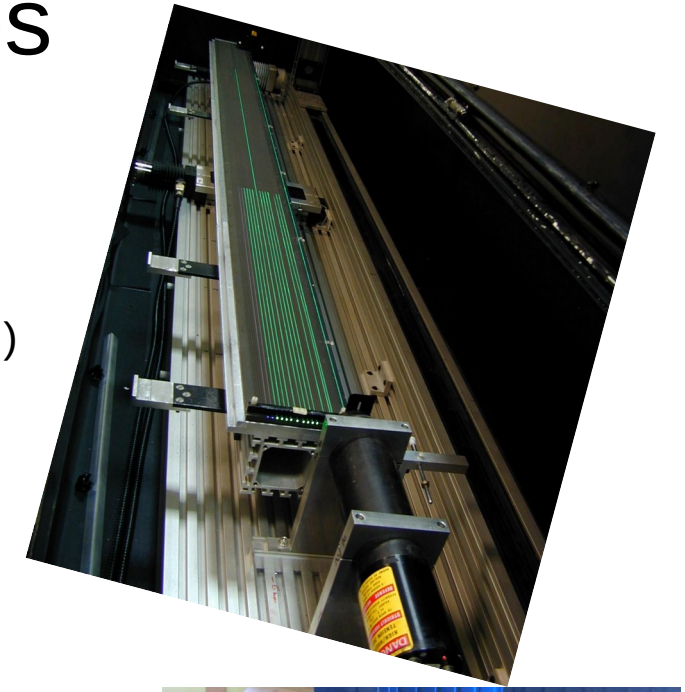
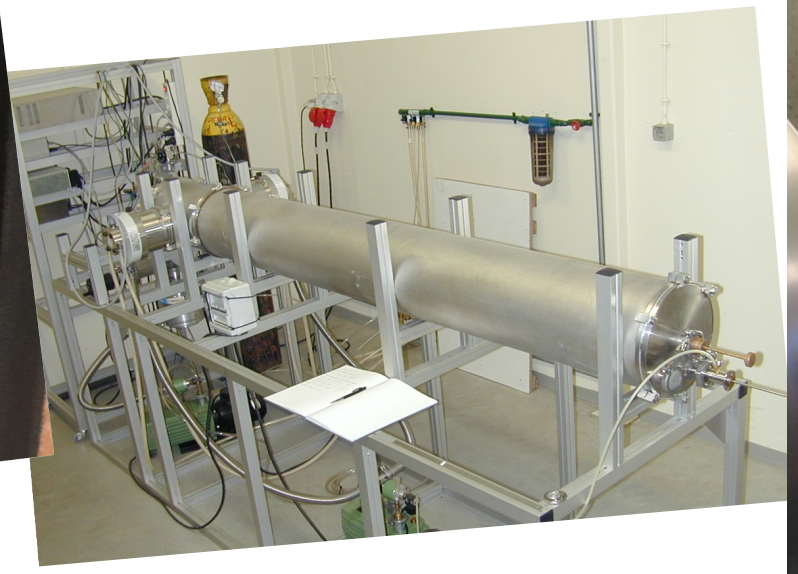
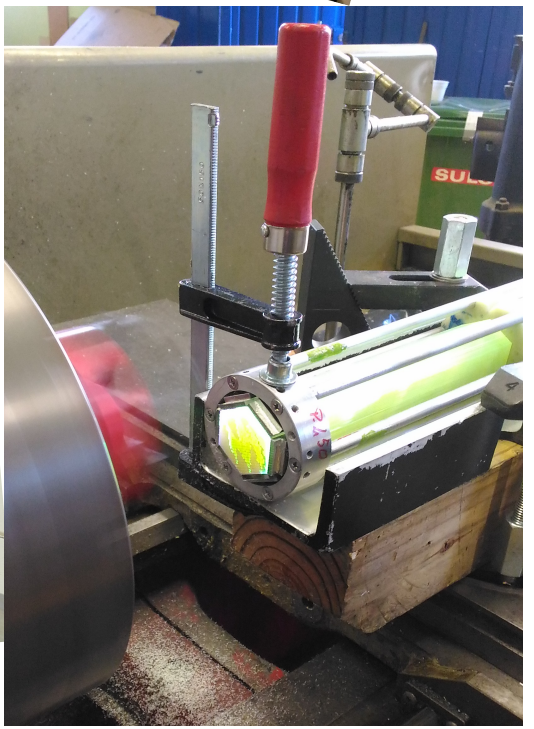
FCT Fundação para a Ciência e a Tecnologia
MINISTÉRIO DA CIÊNCIA, TECNOLOGIA E ENSINO SUPERIOR

LOMAC facilities

- What instruments do we have in the laboratory?
  - Dedicated test benches
    - Optical characterization of Optical fibers (Fibrometer)
    - Optical characterization of Scintillators (Tilemeter)
    - PMTs characterization
  - Sputtering setup for top aluminization of fibers
  - Oven for accelerated natural ageing
  - Milling machine (to be repaired/replaced)

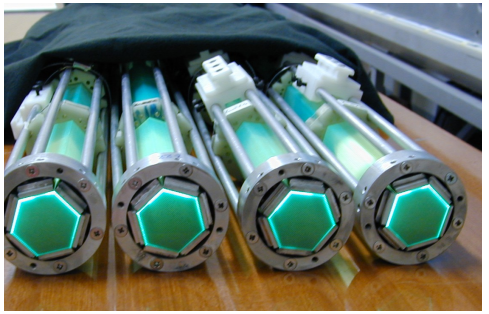


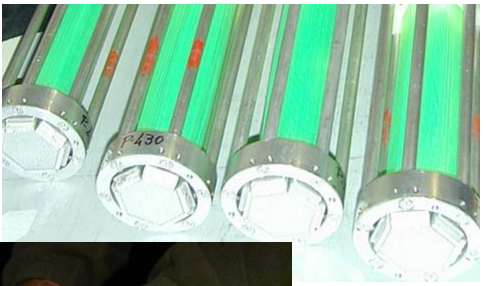


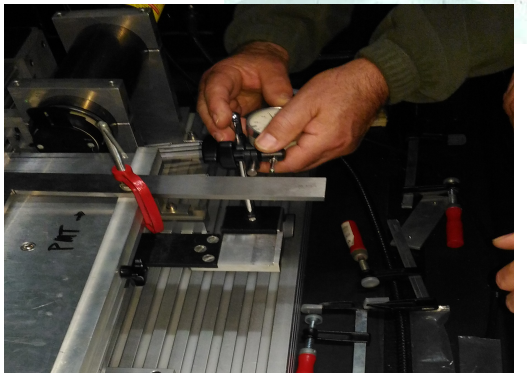


LOMAC facilities

- Expertise
  - Light yield, attenuation length, numerical aperture, mirroring and polishing of optical fibers, radiation damage, natural ageing, accelerated natural ageing, scintillators wrapping and masking
- Main Scientific Contributions
  - Optical fibers (WLS, Scintillating and Transparent)
    - TileCal/ATLAS, STIC/DELPHI, ALFA/ATLAS, SNO+
  - Scintillating tiles and PMTs
    - TileCal/ATLAS
- Currently installed at C8/FCUL
  - Move to LIP:
    - When laboratories are ready
    - BUT Should **not** constrain ATLAS Upgrade needs
- Most equipment requires maintenance and upgrades
  - Being implemented on a usage basis







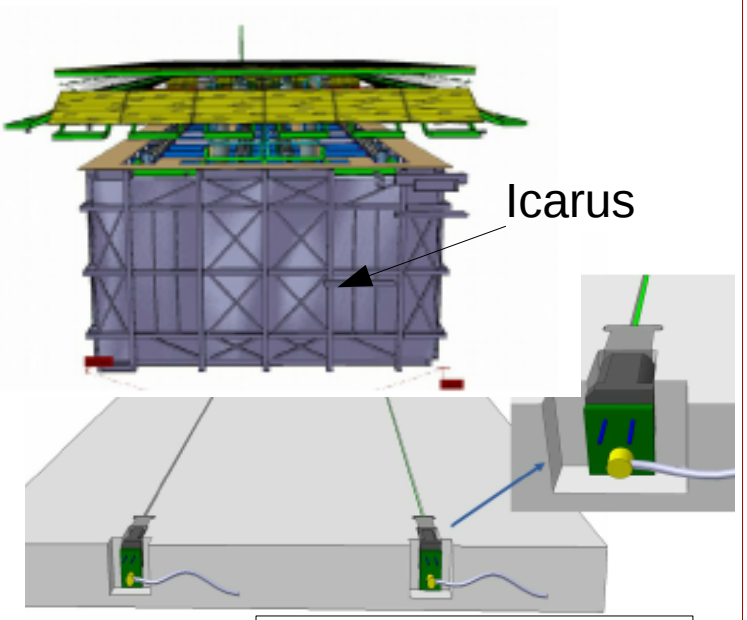
LOMAC current activities

- Fibers for WA104-Muon Tagger for a neutrino experiment
- Fibers and Scintillators for ATLAS/Upgrade
- Scintillators for future detectors (Exploratory)
- Education and Outreach

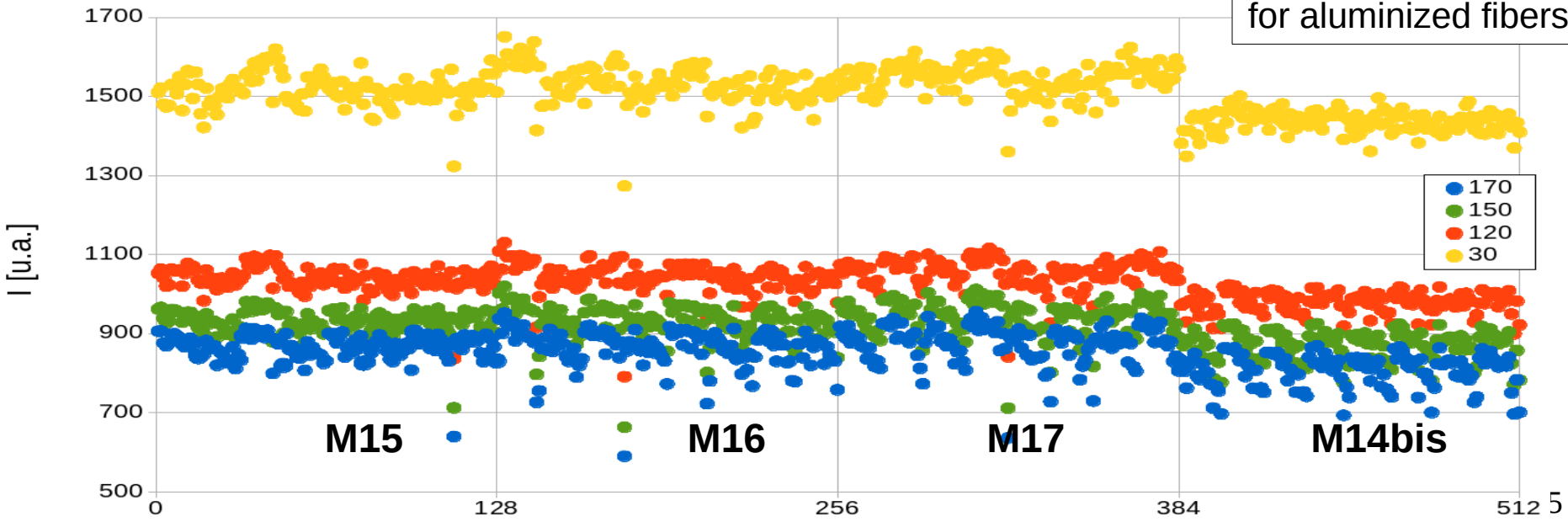
WA104-Muon Tagger/ICARUS

- Muon tagger for neutrino experiment
- Preparation of 5800 fibers for WA104
  - Bundles of 1261 fibers
  - Cut to size [1484,1489] mm polishing both fiber ends
  - Top end mirroring with aluminum
  - Quality control results
    - Results show good reproductibility I(170) **RMS < 8%**
    - Independently measured **R > 70%**
  - Send to CERN to be distributed to assembly sites

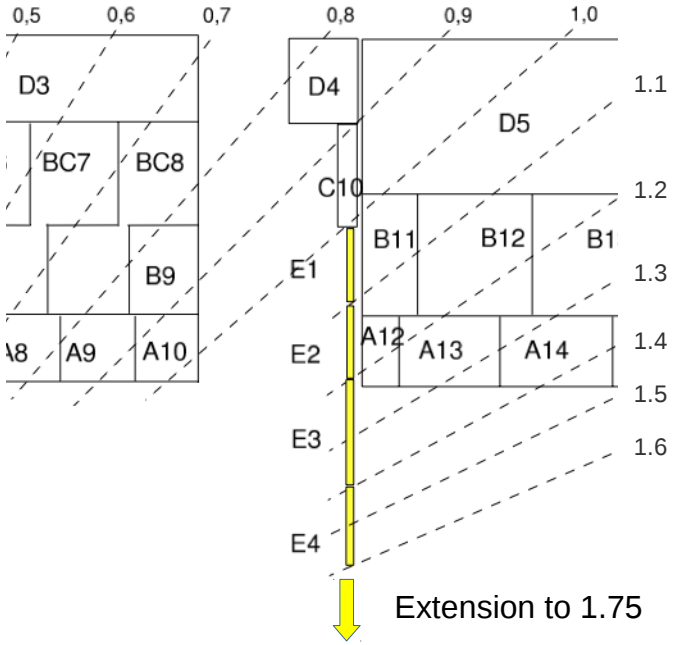
Muon Tagger (WA104/2016)

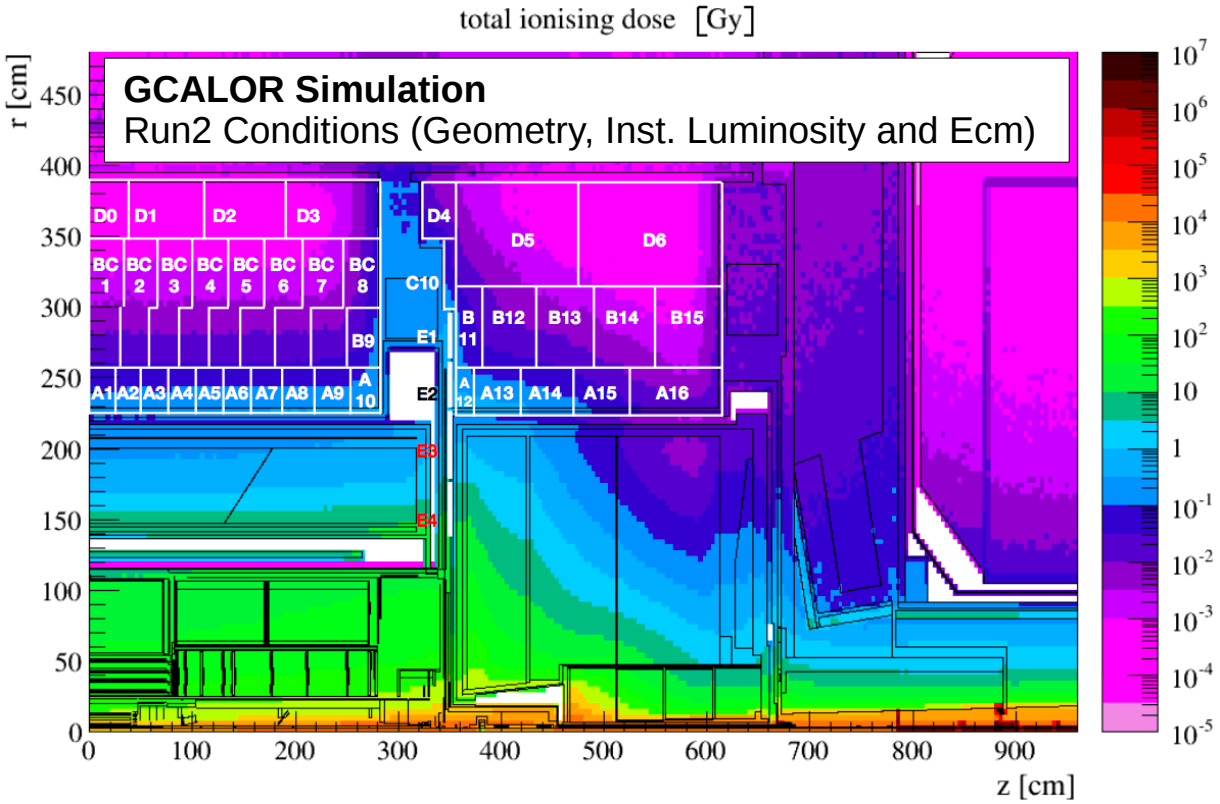


Light yield (I) results for aluminized fibers



ATLAS Upgrade – Optics replacement





Dose increases as we move close to the beam pipe

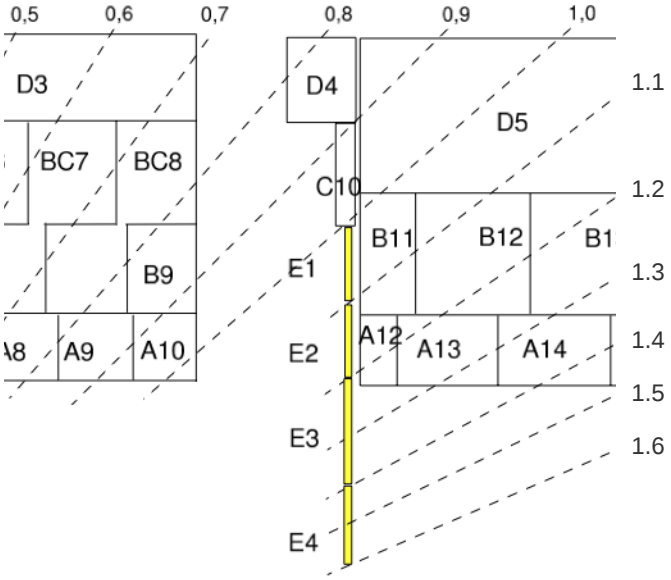
For TileCal main concerns are the scintillators from first radial layer **A Cells**: untouchable but mitigation possible by replacing PMTs (already foreseen for at least 800 PMTs)

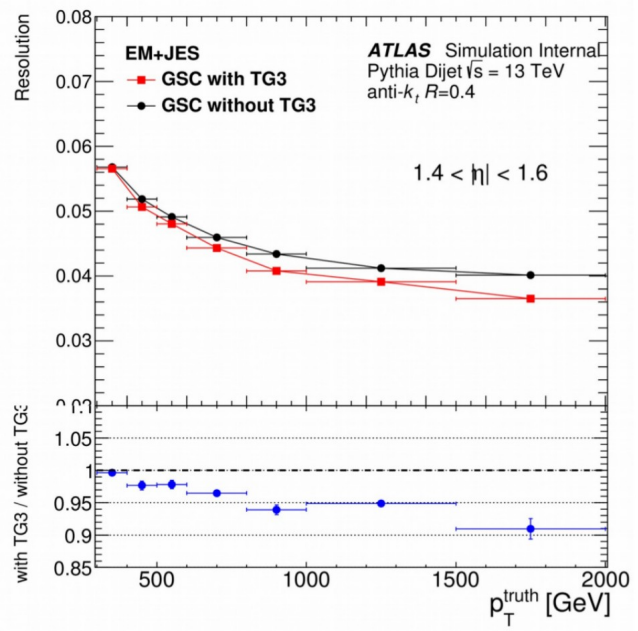
E cells accessible and replacement scheduled in ATLAS Upgrade calendar

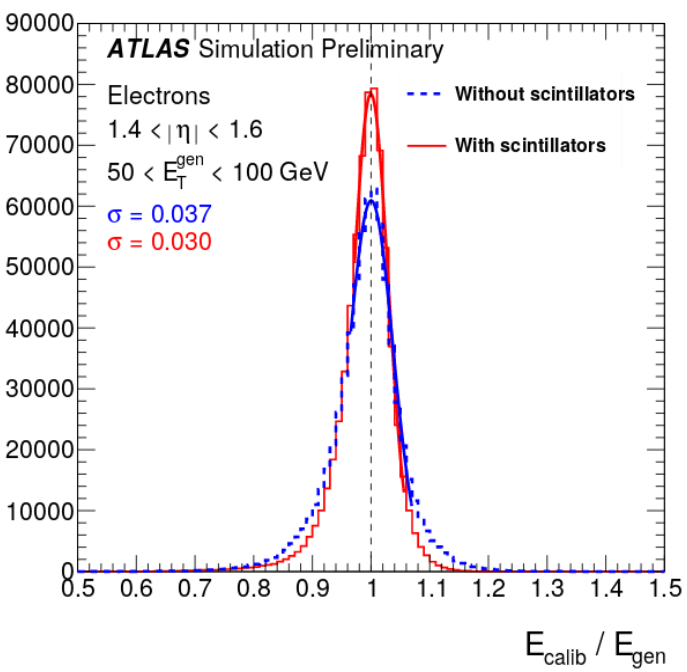
ATLAS Upgrade - Optics replacement

- Motivation
  - e/gamma and jet energy reconstruction
  - Fake Jets Rejection (Emanuel Gouveia – Poster Session)

A side





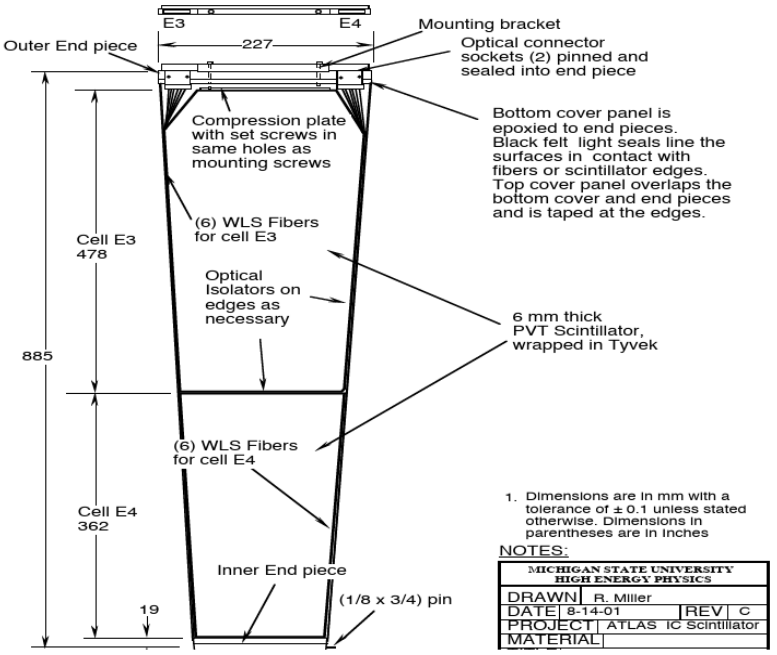


- GAP-CRACK scintillators and fibers
  - (2019-2020) Same type of scintillators and fibers
  - (2025-2026) Radiation Hard scintillators and fibers, and PMTs

Fibers, Scintillators and PMTs for the ATLAS Upgrade

ATLAS Upgrade (2019-2020)

- Not later than April 2018 decision on components and dimensions → **Optical fibers ordering**
  - **Optical fibers preparation and QC during 2018 at LOMAC**
- Pit opening for Long Shutdown **Jan 2019**
- Installation in Pit in two stages
  - C side (eta<0) May OR October 2019
  - A side (eta>0) April 2020
- Pit closing in **Jan 2021**



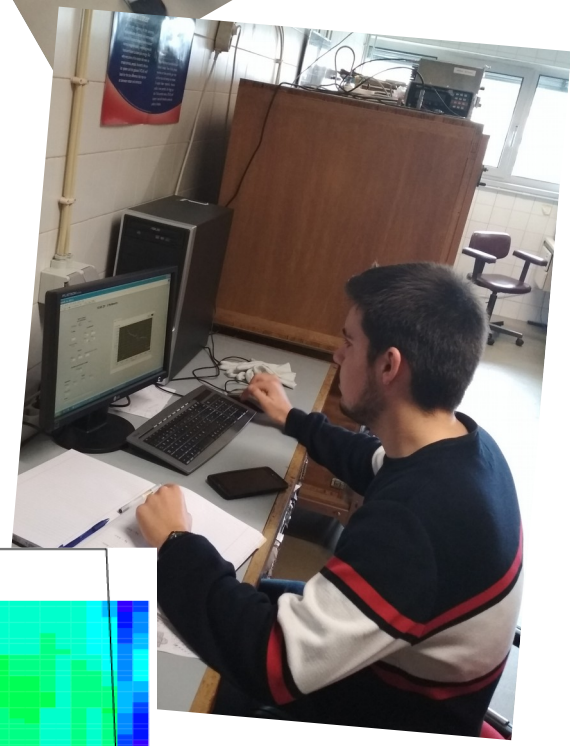
ATLAS Upgrade (2025-2026)

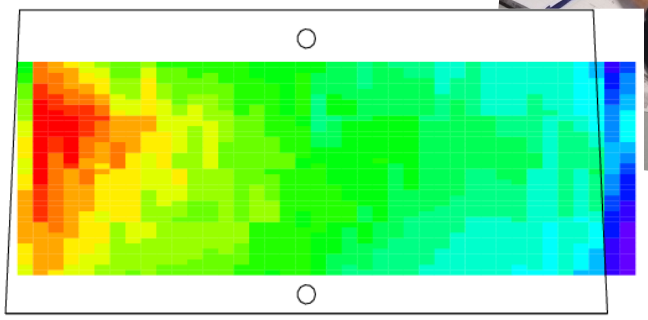
- **Current option** goes to replacement of Scintillators, fibers and PMTs
- Need to be optically characterized (individually and assembled) and evaluate radiation hardness
- **Characterization and rad hard studies of new** scintillators, WLS fibers, and PMTs

Scintillators for future detectors

- Effort being developed at CERN for prospecting technologies for future detectors for a Future Circular Collider (FCC)
- Proposed Hadronic Calorimeter (HCAL) follows TileCal readout principles
- **Exploratory** studies being developed at LOMAC
  - Start by the simplest and with available material
    - TileCal tile cut to size close to proposed FCC granularity
      - Collaboration with Precision Mechanical Workshop

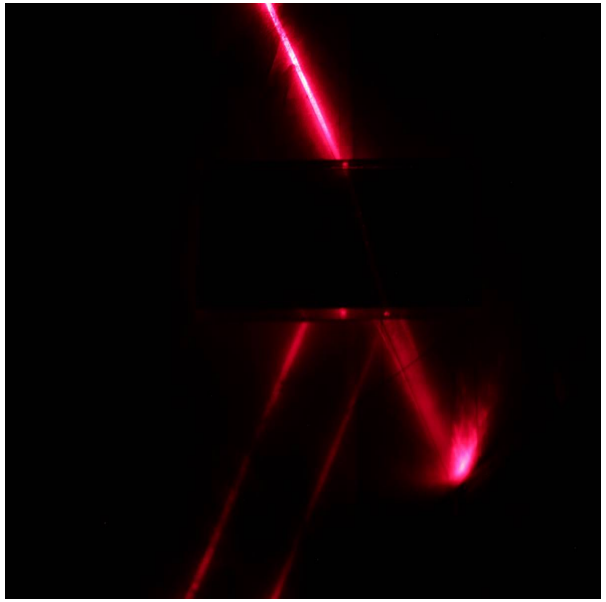
      Many Thanks!
    - Measure basic characteristics response, uniformity for top aluminized optical fibers, tiles and their combinations
    - Study radiation hardness
    - Input to HCAL/FCC simulation

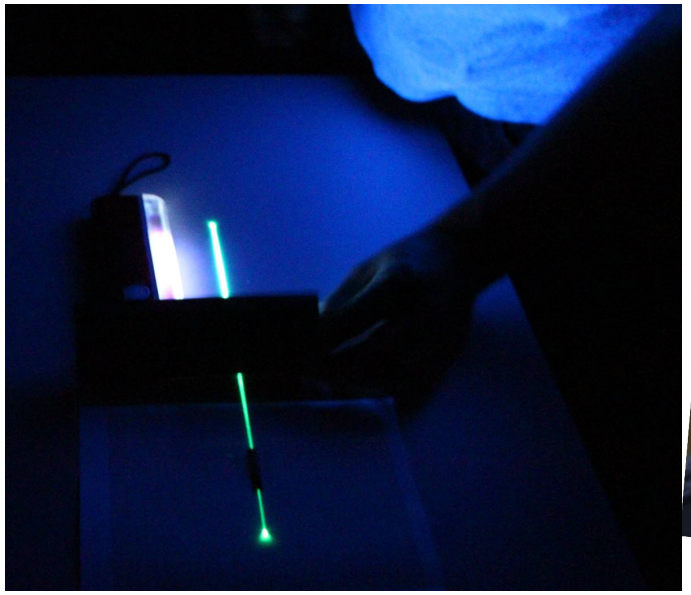




Outreach and education

- Summer Schools for MSc students
- Curricular Internships
- Visits from schools
- ‘Ocupação científica de jovens nas férias’
- Introduce concepts of scintillation and optical fibers detectors to FCUL graduation students





Summary

- LOMAC installed at FCUL
  - Some equipment has been installed, tested and used
- Fundamental for ATLAS Upgrade assumed responsibilities of the ATLAS LIP group
- Optical components preparation and studies continue
  - Optical fibers preparation for WA104 of a neutrino experiment
  - ATLAS Upgrade activities
  - Exploratory studies for the hadronic calorimeter FCC
  - Envisaged future work for future neutrino experiments
- Outreach activities are a pleasant and repeated practice on the year by year work at LOMAC