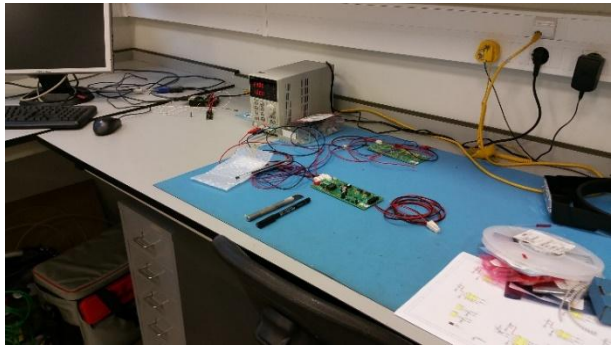
LABORATÓRIO DE INSTRUMENTAÇÃO
E FÍSICA EXPERIMENTAL DE PARTÍCULAS

e-CRLab

Cosmic
Rays
Electronics
Laboratory



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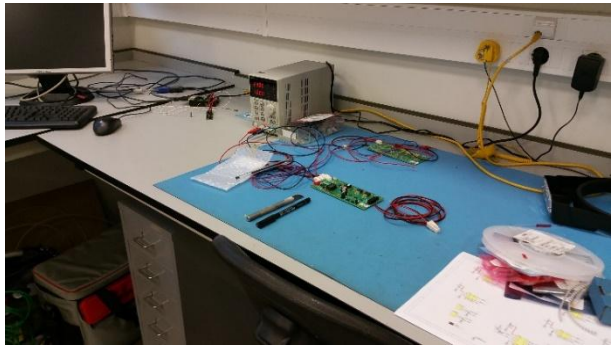
Electronics Laboratory



A more transversal infrastructure

Electronics for particle,
astroparticle
and related applications

- Support electronics developments not only in astroparticle experiments but also in accelerator experiments and in applications within particle and nuclear physics.

- Design of complex PCB, prototypes of simple boards, electronics assembly

Limited to

  - Small batches
  - Reasonable pitch packages (hard to do BGA-like components)

- a small range of mechanical tools allows for the creation of simple detector prototypes, their testing, and the implementation of corrections or new functionalities.

- Consultancy and support to various groups.
- Operates with shared human resources, often collaborating closely with research teams.

Auger:

Support and operation of DAQ setups and upgrades.

ATLAS

HGTD

Slow Control/Interlock/HV filter/LNB (temperatures)

Radiation test of Altiroc ASIC

Development/consulting of several boards.

Support of two master thesis at Coimbra

Medics:

Development of instrumentation / solutions for medical physics(RT) monitoring

LGADs for medics

Collaboration with CMS

Space RAD:

Support for instrumentation

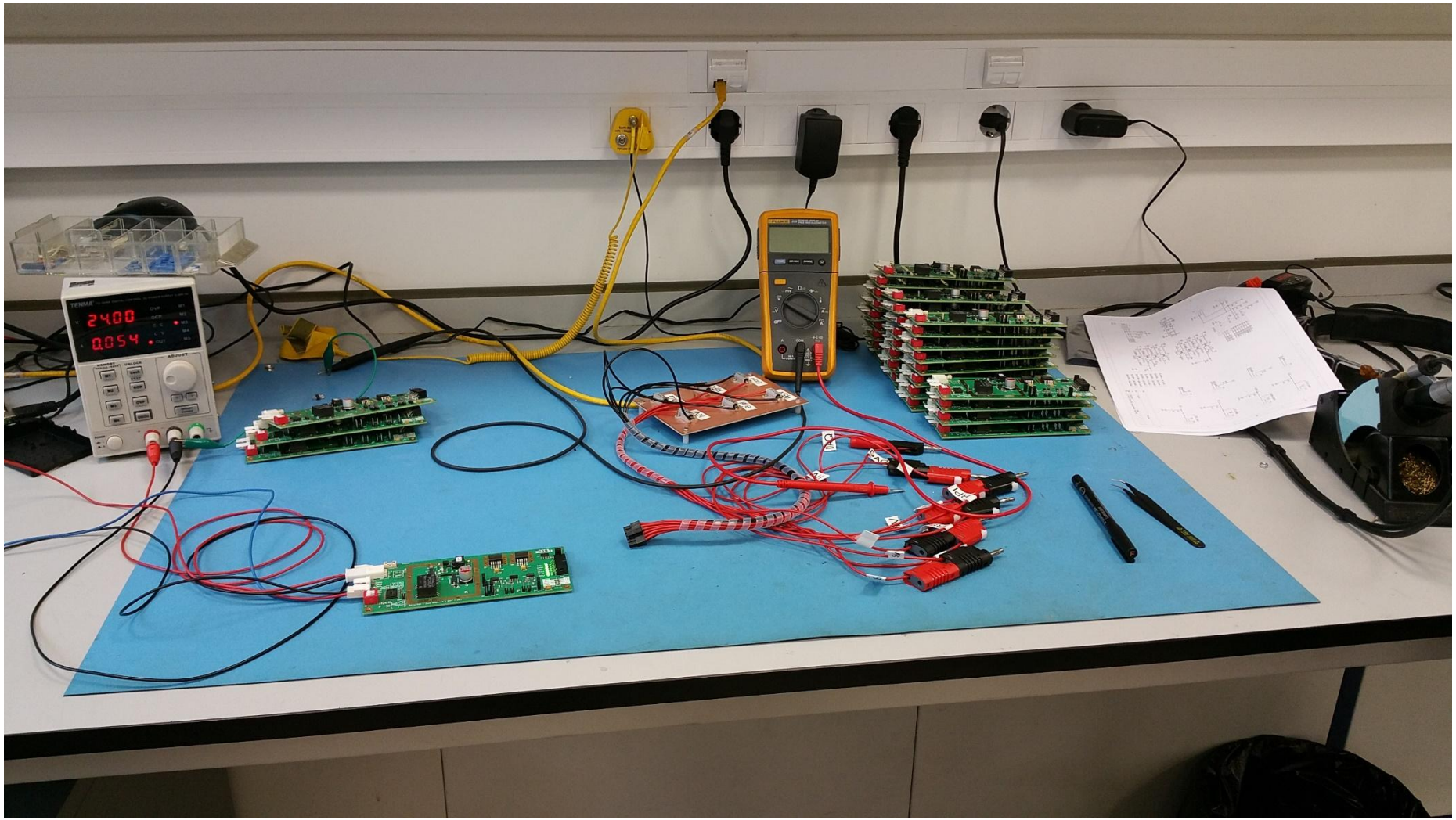
Component radiation testing

Plans for the future

Boost capabilities with equipment investment:

Flagships:
Laser for Solid State excitation
Irradiation facility (Xray) for radiation testing

Thank you



Electronics Laboratory

Team:

Team Leader:
Pedro Assis
1 Researcher:
Ricardo Gonçalo
3 Technicians:
José Carlos Nogueira, Luís Mendes, Miguel Ferreira
2 PhD students:
José Patuleia Venâncio, Rui Fernandez
2 External Collaborators:
Marco Alves Pinto, Pedro Brogueira

Executive Summary

The Electronics Laboratory primarily focuses on the development of electronics for particle and astroparticle experiments, as well as related applications, with a particular emphasis on fast electronics. The laboratory has the expertise to design complex printed circuit boards (PCBs) and to produce prototypes of simpler PCBs. For more complex boards, production and assembly are handled externally. Additionally, a range of mechanical tools allows for the creation of simple detector prototypes, their testing, and the implementation of corrections or new functionalities.

Formerly known as e-CRLab, the laboratory has expanded its scope to support electronics developments not only in astroparticle experiments but also in accelerator experiments and in applications within particle and nuclear physics. This broader focus has led to its renaming as the "Electronics Laboratory," reflecting its role as a wider-scope infrastructure.

The Electronics Laboratory serves as a transversal infrastructure within LIP, offering consultancy and support to various groups. It operates with shared human resources, often collaborating closely with research teams.

Recent activities have concentrated on the MARTA project of the Pierre Auger Observatory, the HGTD detector for the ATLAS upgrade, and support systems for ATLAS. Furthermore, the laboratory contributes to developments in diverse applications, including space and medical technologies, through experimental setups and electronics development.

Overview

The e-CRLab was originally established as a laboratory dedicated to developing data acquisition (DAQ) systems for cosmic ray experiments. In recent years, it has expanded its scope and evolved into a transversal infrastructure now known as the "Electronics Laboratory."

Today, the Electronics Laboratory primarily focuses on developing electronics for particle and astroparticle experiments, emphasizing fast digital electronics implemented in FPGAs and front-end electronics. The laboratory has the expertise to

design complex printed circuit boards (PCBs) and to produce simple PCB prototypes in-house. The production and assembly of more complex PCBs are outsourced. Additionally, the laboratory has the capability to perform rework on PCBs. A small set of mechanical tools supports the production of simple detector prototypes, mainly for proof-of-concept purposes.

The laboratory facilities at LIP-Lisboa include an office, an instrumentation room, and additional rooms dedicated to developing and testing various setups. Standard and state-of-the-art equipment are available. A small mechanical workshop for detector prototype development and a dark room are available to complement its activities. The laboratory is staffed by three electronics technicians and benefits from the support of several researchers. It also involves PhD and MSc students in its activities, fostering academic and technical collaboration.

Assessment of the Past Year: Objectives vs. Achievements

During the past year, the Electronics Laboratory has actively contributed to various projects and initiatives. The MARTA setup at the Pierre Auger Observatory was successfully operated, maintaining overall stability. Stable versions of the slow control and acquisition systems were developed, and future developments for this setup will now be led by the Auger group.

In the ATLAS experiment, the laboratory participated in radiation tests for the ALTIROC V2 and monitored the development of V3. However, limited human resources and local resources constrained the continuation of this activity. The laboratory also contributed to the HGTD detector, focusing on systems such as the interlock and high-voltage systems.

The laboratory began the initial development of systems for medical physics, involving PhD students in the process. These activities are primarily centered on the instrumentation of photodetectors and the exploration of novel silicon devices for particle identification in medical beams.

Additionally, the laboratory continued to provide support to various groups engaged in electronics system development. This included both hands-on support and consultancy services.

Lines of Work and Objectives for Next Year

During this year, we plan to continue supporting and upgrading the operation of the MARTA setups for cosmic ray measurements using RPCs at the Pierre Auger Observatory. The operation is expected to remain stable, with efforts to reduce gas flow while estimating detector performance. An upgrade to the DAQ system is being considered to streamline the simultaneous acquisition of physics and calibration data.

For the ATLAS experiment, we plan to further develop monitoring and slow control systems, such as temperature monitoring and high-voltage systems for the HGTD. We also aim to identify new opportunities within the HGTD ecosystem, particularly involving the ALTIROC ASIC and the instrumentation of LGADs. These activities will be carried out in close cooperation with the ATLAS group.

We intend to enhance the laboratory's support to the LIP community by providing consulting services and developing small electronics projects. One notable initiative is the creation of the first mini-school in electronics, designed to provide training in basic electronics design to the community. Additionally, the training of new students involved in these activities will be a key focus.

Finally, we will continue the instrumentation of medical devices, leveraging the expertise available in the laboratory. We expect to develop acquisition systems for SiPM sensors and silicon-based detectors. The Electronics Laboratory will play a central role in developing the fast electronics system for the BoneOscopy project.

Medium-Term (3-5 Years) Prospects

The infrastructure plans to consolidate its expertise in front-end DAQ, digital electronics, and system integration. The systems developed will be refined to a mature level, with efforts to exploit their potential uses by seeking both external and internal partnerships.

We will continue to pursue synergies with research groups at LIP, applying and expanding the competencies acquired while supporting their activities when needed. A key focus will be the development of faster systems with improved time resolutions and higher bandwidths. Collaboration with the ATLAS group will be strengthened through testing and advancements in front-end electronics for fast systems.

In the coming years, we aim to bring this expertise to applications in medical physics. This includes leveraging advanced electronic systems to address challenges and opportunities in this field, reinforcing the laboratory's role as a leader in innovative electronics development.

SWOT Analysis

Strengths

The competences acquired in digital logic design as well as the competence in the design of complex electronic systems. Competence in handling several types of detectors such as RPCs, scintillators coupled to photomultipliers and Silicon Photomultipliers. Activities developed in the context of research projects. Capability to develop characterization systems. Possibility to plan and perform irradiation campaigns.

Weaknesses

Up to now it was not possible to attract direct funding for the development of detectors. In Portugal the typical level of funding is incompatible with the responsibility for full detectors.

Opportunities

The MARTA Engineering array opens up the opportunity to lead the development of a medium size project from end-to-end. SWGO poses a mid-term opportunity to consolidate activities. In the long term, ATLAS offer the opportunity to consolidate activities on fast and digital electronics. The radiation damage studies present the possibility to attract students and funding through the SpaceRad group. Training activities, courses lectured in the Laboratory and Master thesis developed in the Electronics Laboratory can allow to increase manpower in the laboratory and allow to pursue different projects. The know-how acquired in the laboratory can also boost the participation in novel projects related with fast timing and the development of instrumentation for medical physics.

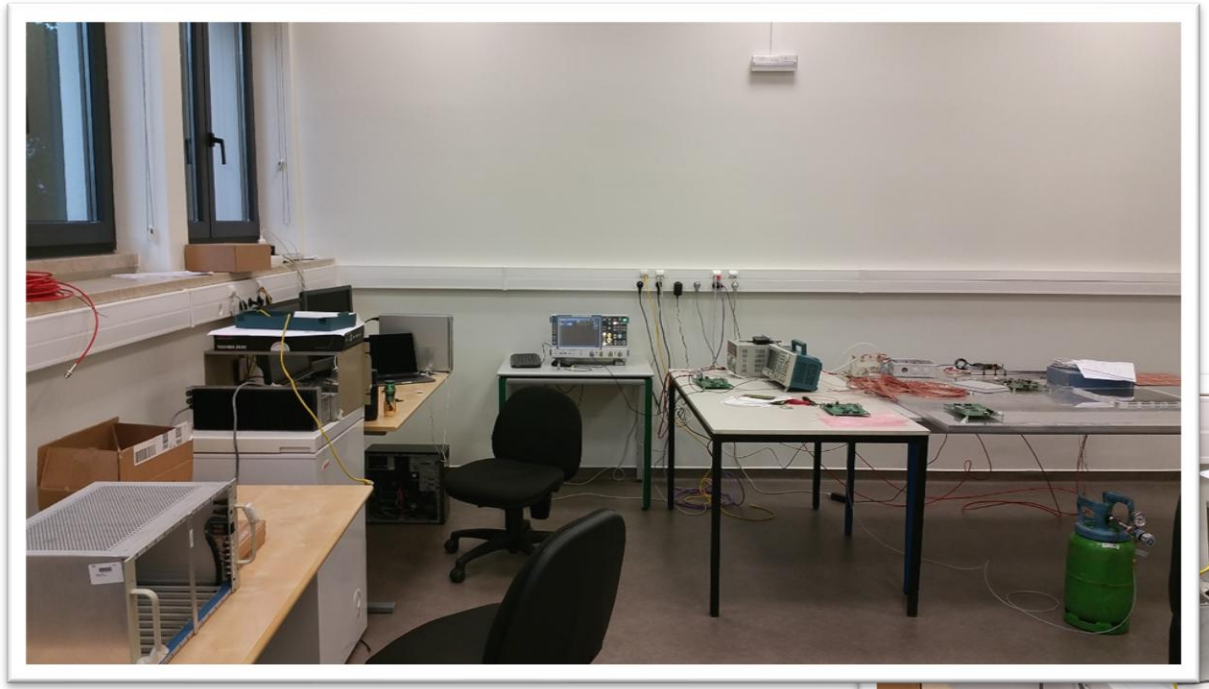
Threats

Funding is always a key issue when developing hardware that needs to spend in service acquisition and materials. Lack of manpower could also be an issue in the mid-term.

Office

electronics

Detector integration and testing



Detector prototyping workshop

Detector prototypes room