Particles4Health

Radiotherapy Application Development and Optimization

Research Area	Development of new instruments and methods
Research Line	Instruments and methods for biomedical applications
Group acronym	Particles4Health
Group name	Radiotherapy Application Development and Optimization



Activities

- Activities mainly related to technology development for beam control and monitoring with very fast detectors and electronics
- Three main activities at this moment:
 - BoneOscopy
 - FlashGuard
 - PicoMonitoring





- An EIC grant to estimate calcium concentration during proton treatments
- LIP responsibilities
 - Trigger detector to signal particles entering treatment room
 - Electronics: Fast front-end electronics
 - Participation in all WP
- Funding: 550 k€
- Timeline: 5 years



FlashGuard

- A Cherenkov detector to monitor FLASH beams
- Applicable to all RT beams
- Patent application
- Selected for 2nd phase of lab2market
- 2 prizes at JEF awards
- Application to La Caixa Health impulse, stage 1
- 1 PhD, 1 Master, 1 Graduation student involved



PicoMoni

- To detect particles in the beam using LGADs
- LGADs have timing resolution in sub-nanosecond scale
- 1 PhD in co-supervision with HIT

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Proposal for the creation of a research group

During the past decade LIP has been strongly engaged in fostering the creation of a Cancer Charged Particle Therapy Facility for the treatment of Cancer in Portugal. LIP played a pivotal role in creating the Prototera association, along with Técnico, CTN, Universidade de Coimbra, and the Portuguese network of Oncology Institutes. In this context, it was necessary to increase the expertise in this domain in Portugal, and LIP has been engaged in providing advanced training in the field of radiation and particle therapy applications. In addition, LIP's research groups in health and biomedical applications have been working in a synergetic way towards developing devices and tools that could lead to technology transfer from particle and detector physics towards clinical applications.

It is then proposed to create a research group within the research line "Instruments and methods for biomedical applications" of the research area "Development of new instruments and methods".

The title of the group is

• Particles4Health - Radiotherapy Application Development and Optimization

The research team proposed is composed of 4 senior researchers and several students. As researchers Pedro Assis (coordinator, 50 % dedication), Patrícia Gonçalves (25%), Bernardo Tomé (25%) and Rute Pedro (15%) will initially join the group. Two PhD students, Gonçalo Ribeiro and Rui Fernandez will join the group with 100% allocation of their time. Carolina Miranda will join as Physics MSc and Gonçalo Roriz will join as a BSc student (expected to develop his master thesis within the group). It is also foreseen that two extra students will join to work in the framework of Boneoscopy.

The group will work on several scientific projects that will help to advance radiotherapy and applications in health. Firstly, the group will be actively developing the BoneOscopy project, a EIC with ~3 M€ funding where LIP is responsible for the trigger detector and fast electronics. The group is also developing an instrument, based on the Cherenkov effect, to monitor RT beams using FLASH technology. Beam modulation to improve dose delivery in FLASH context (Range modulators) is also being considered. Contacts have already been established to cooperate with groups from Germany, Italy and USA. We are also considering the use of other very fast detectors to be used in beam monitoring in the context of FLASH such as LGADs.

These projects gain from their integration at LIP. We can translate the expertise gained in Particle and Astroparticle Physics to applications in medicine, namely in Radiotherapy. LIP can provide a valuable insight into beam control and monitoring. These projects involve several infrastructures from LIP: LOMAC; Electronics Laboratory, Detectors laboratory and Mechanical Workshop to develop prototypes of the detectors and associated electronics. In fact LIP's responsibility in BoneOscopy will require the use of the infrastructures. Several components of the project require the simulation of the interaction of particles with matter, where LIP competence Centre in simulation and big data can play an important role. Moreover, we foresee the use of ML in some applications where the competence center can help. Some simulations need to be exhaustive and a strong infrastructure in computing, like LIP is recognized to have, is an impactful factor.

The group activity in the medium term will be focused in the BoneOscopy project which is funded with ~500k€. We also plan to apply for funding programs in health and applied science. We will apply to a La Caixa Health impulse grant with the Cherenkov monitoring device for FLASH which has a patent pending and was selected for the second phase of the Lab2Market programme from IST. We will also consider applying to other EIC programme either as partners or as coordinators when suitable. Applying for Exploratory PTDC can be another possibility for funding a proof-of-concept. For ideas that are mature and have a clear application we will search for industrial partners. Such partnerships will allow us to access funding such as COMPETE or PhD grants in non-academic context.



BoneOscopy Live Cell Spectroscopy Analysis for Personalised Particle Radiation Therapy of Metastatic Bone Cancer



Pedro Assis | BoneOscopy information Scientific Council plenary meeting | LIP | 19 Dec. 2024



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