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Technological challenges and efficient solutions for the development of a compact low energy proton accelerator with FLASH capabilities in the Basque Country

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Within the framework of the Science Industry strategy of the Basque Country, LINAC7 is a project that pursues the generation of knowledge and qualification in the field of accelerator science and technology. With the design and construction of a compact low energy (7 MeV) proton accelerator, the project presents the ideal framework to develop efficient technological solutions and meet the needs of the scientific and industrial communities. TEKNIKER participates in the project with the main role of transforming the requirements and characteristics of the system, defined with the University of the Basque Country, to reality. The project includes many different tasks, such as state of the art requirement definition, dimensional and geometrical tolerance definition, thermal and mechanical calculations, magnetic calculations, analysis of the beam, 3D design, prototyping of the intermediate validators, integration and assembly of the whole solution in an aligned functional compact Linac (example in Figure 1). Currently, the ion source, LEBT and beam dump are already finished, tested, and characterized, and shortly also the RFQ will be integrated in the line (Figure 2).

Recently, TEKNIKER conducted an assessment to determine the necessary shielding for maintaining a dose rate below 2.5 μSv/h near the shielding walls. This assessment was part of the request for an appropriate facility on the UPV/EHU campus to install an accelerator. The accelerator is anticipated to generate a 5 MeV proton beam later this year, as outlined in Figure 2 of the system scheme. Taking these safety measures into account is crucial to ensure a secure environment for the accelerator installation.

TEKNIKER has repurposed its accelerator, originally designed for generating radioisotopes for Positron Emission Tomography (PET) [1], to explore its potential for ultra-high dose rates (UHDR) and the production of the FLASH effect [2]. Promising results were obtained for irradiating cell cultures at dose rates exceeding 103 Gy/s with pulses of 250 μs and total irradiation times of the order of milliseconds.

To enhance the system's FLASH capability, TEKNIKER plans to incorporate a chopper to allow for the delivery of radiation in shorter pulses. This modification will permit to perform experiments with variations in pulse duration and frequency, crucial parameters in FLASH studies [3].

TEKNIKER's decision to specialize in FLASH technology for accelerators and biomedical research demonstrates its commitment to contributing to advancements in cancer treatment and radiobiological research. The focus on FLASH technology is driven by the potential benefits it may offer in terms of more effective and targeted cancer treatments, utilizing accelerated irradiation methods.
In summary, TEKNIKER aims to leverage its expertise and resources to advance in the field of FLASH technology, with the ultimate goal of making significant contributions to cancer treatment and radiobiological research.

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