TOF-PET for Proton Therapy
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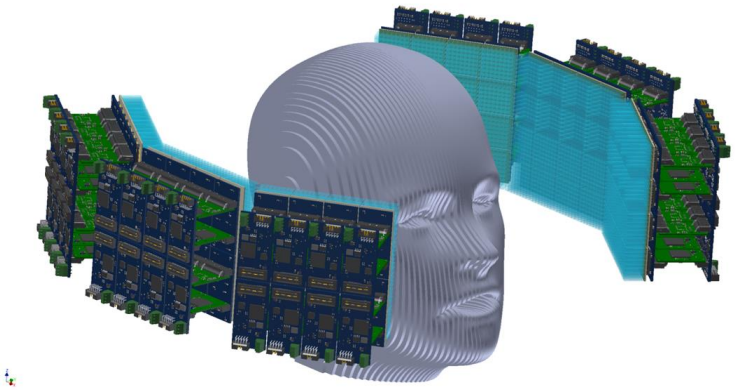
Researchers from the University of Texas at Austin, M.D. Anderson, the PETsys Electronics, University of Coimbra, the Laboratory of Instrumentation and Experimental Particle Physics (LIP), and the Center for nuclear sciences and technologies (C^2TN) in Lisbon -- a consortium of academic and commercial institutions in Texas and Portugal have been awarded a grant to build a novel diagnostic tool based on Positron Emission Tomography, or PET, to assist in proton cancer therapy. Funds in the amount of $2.5M (2.25 M€) come from a special development program run by the Government of Portugal and the UT System at Austin (UT Austin-Portugal Program)

Proton therapy is the most advanced type of radiation treatment of cancers of the prostate, lung, head and neck, liver, esophagus, and brain. The reason is simple -- unlike in a common *gamma* radiotherapy, the proton energy destroying the tumor can be delivered with much better accuracy (by using the well-known 'Bragg peak' of the energy loss in matter) thus minimizing the damage to the surrounding healthy tissue.

The proton therapy used in cancer therapy produces short-lived positron emitting radioisotopes, such as ^{15}O, ^{13}N and ^{11}C, that can be detected by PET imaging. The strength and time dependence of this image allows to assess the efficacy of the proton treatment *in-vivo.*

The aim of the project is to demonstrate the diagnostic value of the state-of-the-art Positron Emission Tomography scanner featuring excellent position resolution and Time-of-Flight (TOF) to register positron emitting radionuclides during and immediately after the proton irradiation. This is a multi-faceted collaboration led by Profs. Stefaan Tavernier and Joao Varela at PETSys Electronics in Lisbon, Dr. Narayan Sahoo of MD Anderson Cancer Center, Prof. Antero Abrunhosa of University of Coimbra, Prof. António Paulo of C^2TN, Prof. Paulo Crespo of LIP, and Prof. Karol Lang of the Department of Physics at UT.



Once the PET scanner is built, the researchers will use phantom head models to ascertain and verify isotope production maps by a proton beam at MD Anderson. Computer simulations will predict the distribution of the positron annihilation events that should be observed. Any mismatch with the observation will provide feedback to adjust the beam.

Due to geometrical constraints, the in-beam PET scanning in proton radiation therapy is very difficult since it is impossible to fully surround the patient with a ring of detectors as is normally required in PET scanning. The use of PET with very good TOF allows to obtain good PET images with partial angular coverage around the patient. In this project, we will build a prototype PET system that is suitable for radiation monitoring of the head and neck cancers. The project will allow testing the system with phantoms and small animals at the Proton Therapy Center at the M.D. Anderson Cancer Center. Patient studies are not part of the present application but will be part of a follow-up project after successful conclusion of the present project.

For further reading see:
https://www.mdanderson.org/patients-family/diagnosis-treatment/care-centers-clinics/proton-therapy-center.html
https://www.texascenterforprotontherapy.com
http://www.petsyselectronics.com