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First steps towards on-the-fly dose reconstruction from in-beam PET activation

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In-beam Positron Emission Tomography is a promising technique aimed to solve the problem of range verification in proton therapy. In this work we report the first results using a novel in-beam portable PET system that can detect and process on-the-fly the β+ activity produced during and after irradiation.
The specific PET setup consisted of 6 phoswich detector blocks with 338 pixels each, with of 1.55x1.55 x LYSO (7mm)+GSO (8mm) . The system was coupled to a fast data acquisition system able to sustain rates up to 10 Msingles/sec. Two different PMMA targets were irradiated with monoenergetic clinical proton beams at the Quirónsalud proton therapy center. The 3D maps of the activity were reconstructed on-the-fly every 0.5 seconds and with a 0.5 mm spatial resolution. We also assessed the system response to changes in the position and direction of the beam during irradiation.
This validates the experimental setup to be used for in-beam on-the-fly reconstruction of the 3D activity and provides a gold standard to obtain the deposited dose distribution when combined with a fast dose reconstruction method.

Primary author: Ms ESPINOSA RODRÍGUEZ, ANDREA (Grupo de Física Nuclear, EMFTEL & IPARCOS, Universidad Complutense de Madrid, CEI Moncloa, Madrid, Spain)

Co-authors: Mr ARIAS VALCAYO, Fernando (Grupo de Física Nuclear, EMFTEL & IPARCOS, Universidad Complutense de Madrid, CEI Moncloa, Madrid, Spain); Dr IBÁÑEZ, Paula (Grupo de Física Nuclear, EMFTEL & IPARCOS, Universidad Complutense de Madrid, CEI Moncloa, Madrid, Spain); Mr VALLADOLID ONECHA, VICTOR (Grupo de Fisica Nuclear (GFN) & IPARCOS, Universidad Complutense de Madrid (UCM)); Mr GARCÍA DÍEZ, Miguel (Grupo de Física Nuclear, EMFTEL & IPARCOS, Universidad Complutense de Madrid, CEI Moncloa, Madrid, Spain); Mr MARTÍNEZ NOUVILLAS, Victor (Grupo de Física Nuclear, EMFTEL & IPARCOS, Universidad Complutense de Madrid, CEI Moncloa, Madrid, Spain); ESPAÑA PALOMARES, Samuel (Universidad Complutense de Madrid); SANCHEZ PARCERISA, DANIEL (UCM); Dr VERA SANCHEZ, Juan Antonio (Centro de Protonterapia Quironsalud, Madrid, Spain.); Dr MAZAL, Alejandro (Centro de Protonterapia Quironsalud, Madrid, Spain.); Prof. FRAILE, Luis M (Universidad Complutense (ES)); MOINELO, Jose Manuel Udias

Presenter: Ms ESPINOSA RODRÍGUEZ, ANDREA (Grupo de Física Nuclear, EMFTEL & IPARCOS, Universidad Complutense de Madrid, CEI Moncloa, Madrid, Spain)

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