

## Performance analysis of in-beam PET range verification system for carbon ion beams

*Monday, 20 May 2024 18:15 (5 minutes)*

The SIG (Superconducting Ion Gantry) project focuses on enhancing online monitoring performances of in-beam PET during ion treatments, developing new image reconstruction algorithms and analyses that consider fast-decaying isotope signals. In this study we presented the performance evaluation of an in-beam PET system for carbon ion irradiations. The Range Verification System prototype under investigation is based on state-of-the-art PET modules featuring segmented Lutetium Fine Silicate crystals coupled to Silicon Photomultiplier matrices. It was tested on carbon ion beams at two energies (144 MeV/u and 213 MeV/u) at the CNAO facility. The beams were impinging on homogeneous PMMA phantoms and data were acquired during the irradiation. The performance analysis was designed to evaluate the stability of range difference estimation considering several consecutive subsets of coincidence events with different event amounts. The range difference values were calculated between the two irradiated energies for each pair of images of the two energies from the subset lists. Our result indicates that the performance of the PET system appears to be minimally affected by the statistics included in the PET images and the average experimental range difference is compatible with the expected value. The obtained results are valuable for the ongoing design and implementation of a customized image reconstruction method focused on highlighting fast isotopes.

### Field

Software and quantification

**Primary authors:** RANJBAR, Sahar (Istituto Nazionale di Fisica Nucleare, University of Turin, Department of Physics, Torino, Italy); Dr FIORINA, Elisa (Istituto Nazionale di Fisica Nucleare, torino); Dr PENNAZIO, Francesco (Istituto Nazionale di Fisica Nucleare Torino, Italy); Dr MAS MILLAN, Felix (Istituto Nazionale di Fisica Nucleare, State University of Santa Cruz, Ilhéus, BA, Brazil)

**Co-authors:** VIGNATI, Anna (Istituto Nazionale di Fisica Nucleare, University of Turin, Department of Physics, Torino, Italy); BERSANI, Davide (Istituto Nazionale di Fisica Nucleare); Dr MONTALVAN OLIVARES, Diango Manuel (Istituto Nazionale di Fisica Nucleare, University of Turin, Department of Physics, Torino, Italy); Mr DATA, Emanuele Maria (Istituto Nazionale di Fisica Nucleare, University of Turin, Department of Physics, Torino, Italy); Mr WERNER, Julius Friedemann (Institute of Medical Engineering, Universität zu Lübeck, Germany); DONETTI, Marco (Fondazione CNAO); PULLIA, Marco (CNAO); Dr FADAVI MAZINANI, Mohammad Adel (Istituto Nazionale di Fisica Nucleare Torino, Italy); Dr HOSSEINI, Mohammad Amin (Istituto Nazionale di Fisica Nucleare, University of Turin, Department of Physics, Torino, Italy); Dr CERELLO, Piergiorgio (Istituto Nazionale di Fisica Nucleare); Prof. CIRIO, Roberto (Istituto Nazionale di Fisica Nucleare, University of Turin, Department of Physics, Torino, Italy); Prof. SACCHI, Roberto (Istituto Nazionale di Fisica Nucleare, University of Turin, Department of Physics, Torino, Italy); Dr GIORDANENGO, Simona (Istituto Nazionale di Fisica Nucleare); Dr FERRERO, Veronica (Istituto Nazionale di Fisica Nucleare)

**Presenter:** RANJBAR, Sahar (Istituto Nazionale di Fisica Nucleare, University of Turin, Department of Physics, Torino, Italy)

**Session Classification:** Poster Session

**Track Classification:** Next-gen clinical PET/CT