

# THE INSIDE BIMODAL SYSTEM FOR RANGE MONITORING IN PARTICLE THERAPY TOWARD CLINICAL VALIDATION

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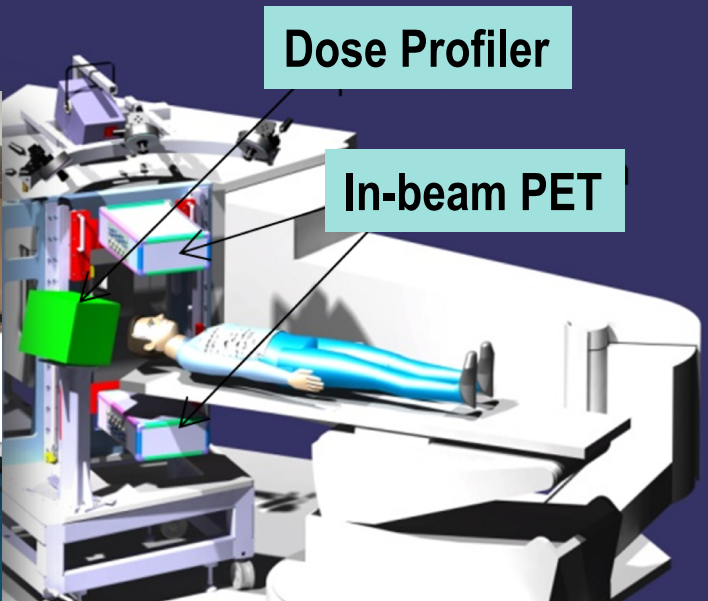
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## INSIDE

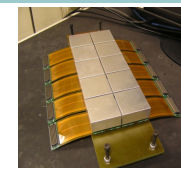


G. Giraudo, INFN Torino



Bi-modal imaging system for *in-situ* range monitoring in particle therapy

## In-beam PET

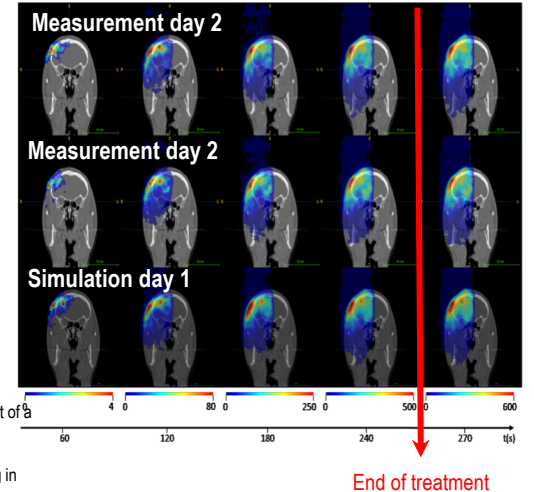
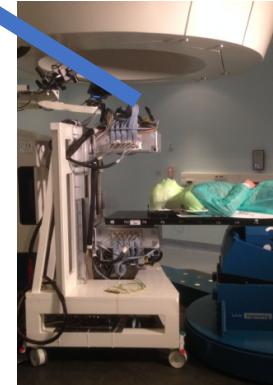


10+10 LFS + MPPC modules  
2560 acq chns/head  
Distance from the isocenter=30 cm

After 120 s average activity contour distance < 1 mm

### CLINICAL TEST

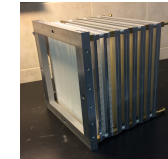
First clinical test patient suffering of a carcinoma of the lacrimal gland. Treated with  $3.7 \cdot 10^{10}$  protons [66.3, 144.4] MeV/u (28-29)/30 fractions, 2.2 GyE Monitored for two consecutive days (1 and 2 /12/2016) Compared with FLUKA simulations



Ferrero V, Fiorina E, Morrocchi M, Pennazio F, et al. Online proton therapy monitoring: clinical test of a silicon-photodetector-based in-beam pet. Scientific Reports 2018;8(1):4100.

Fiorina E, Ferrero V, Pennazio F, et al. Monte Carlo simulation tool for online treatment monitoring in hadrontherapy with in-beam PET: A patient study. Physica Medica EJMP 2018; in press, DOI: <https://doi.org/10.1016/j.ejmp.2018.05.002>

## Dose Profiler



6 planes, each one composed of 2 orthogonally oriented scintillating fibres layers  
G. Traini et al., Physica Medica 34 (2017) 18–27

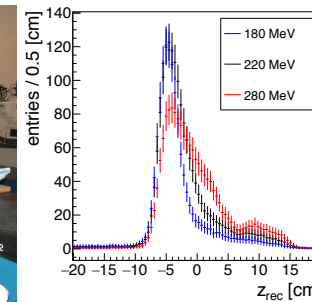
### CNAO TEST BEAM

Single 12C pencil beam (PB) shot inside rando phantom (centre) at different ranges (energies).

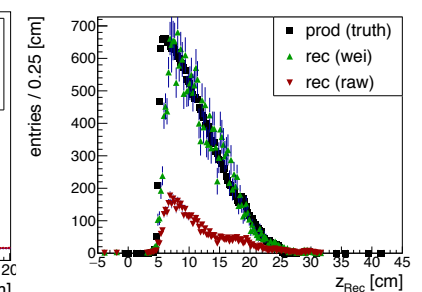


Statistics:  $10^6$  ions  $\sim 1\text{cm}^2$  area. 10-20 PB summed up

A. Sarti, University Sapienza and INFN Roma1



Reconstructed spectrum only: no matter effect accounted for



Matter effect studies performed against full FLUKA simulation of 300 MeV  $^{12}\text{C}$  ions