Low statistics activity reconstruction methods with the DoPET system

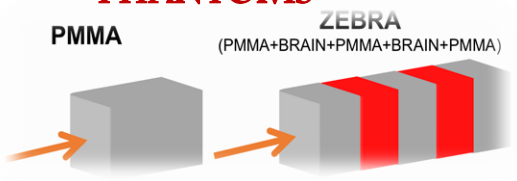
S. Muraro[a], N. Camarlinghi[a] , V. Rosso[a] et al.

a) Department of Physics, University of Pisa and INFN, Italy; b) INFN, Milano, Italy; c) Proton Therapy department, Trento Hospital, Trento, Italy; d) CERN, Geneva, Switzerland; e) TIFPA INFN,Trento, Italy; f) Department of Physical Sciences, Earth and Environment, University of Siena

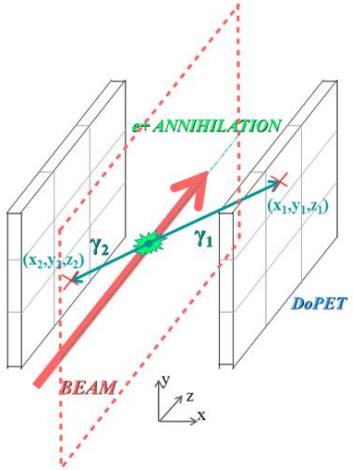
- A new reconstruction method for the monitoring of treatments in Proton Therapy is proposed: the *StraightForward Reconstruction* method
- Data were acquired using the DoPET prototype working at the Trento proton therapy centre
- Homogeneous and heterogeneous phantoms were irradiated using 130 MeV pencil beams
- The results are compared with the usually adopted MLEM method together with the Monte Carlo (FLUKA) expected results
- This study was focused on low statistic irradiations (down to 10^8 primary protons) where the reconstruction uncertainties became statistical relevant

DoPET @ Trento centre

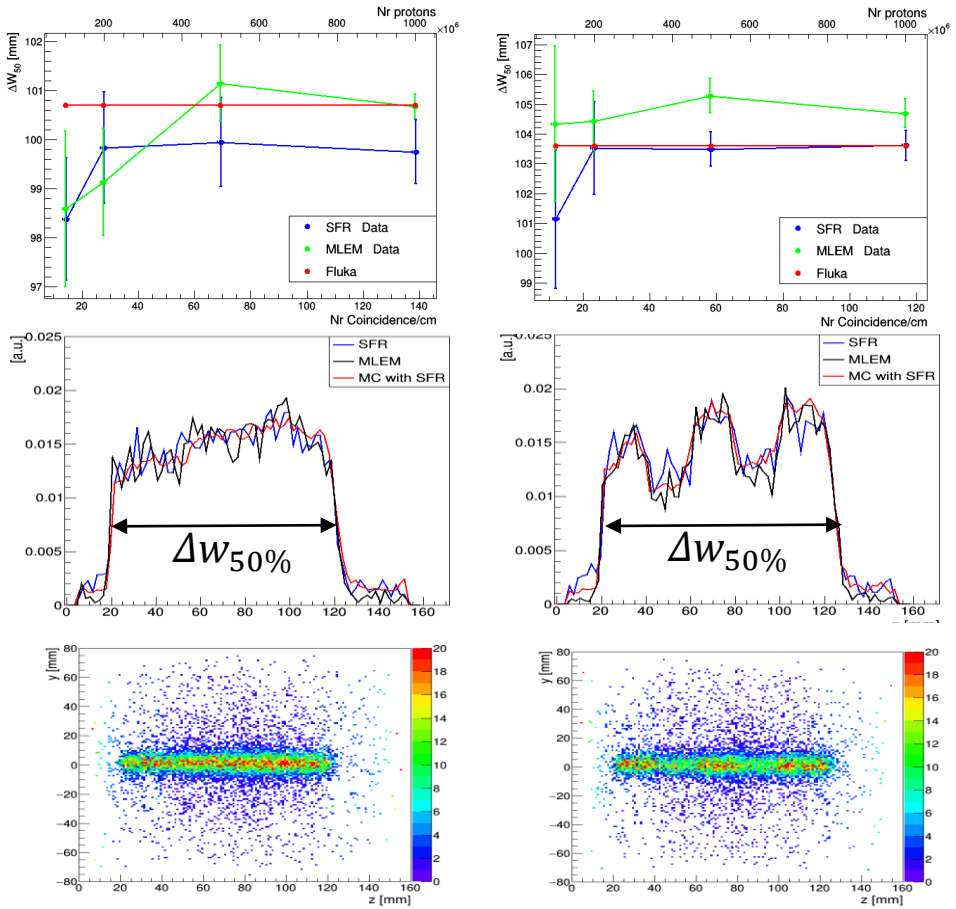
PHANTOMS



StraightForward Reconstruction method



The annihilation position of each event is reconstructed by evaluating the intersection between the beam axis position provided by the TPS and the coincidence line detected by the scanner. Each coincidence event is weighted to take into account for its detection geometrical probability.



RIGHT FIGURES -From top:

-$\Delta W_{50\%}$ reconstruction capability of the two methods

-Reconstructed longitudinal profiles (beam axis).

-Reconstruction of the (y,z) plain with the SFR method

Conclusions: A new reconstruction method for PET data was developed and gives comparable results with respect to FLUKA predictions, and to MLEM but taking less reconstruction time. Furthermore having two different procedure to evaluate the activity range allow us to be more confident on the results.

Thinking to reduction of safety margin and dose escalation, this approach open up the possibility to image guidance procedure with selected pencil beams extracted from TPS.