RESPONSE OF A SILICON TELESCOPE MICRODOSIMETER TO 400 MeV PER NUCLEON CARBON IONS

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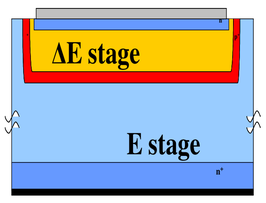
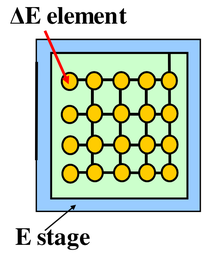
THE PROPOSED DEVICE



A monolithic silicon telescope consisting of a surface ΔE detector 2 μm in thickness coupled to an E detector about 500 μm in thickness made out of a single silicon wafer was recently proposed for the microdosimetric characterization of hadron beams.

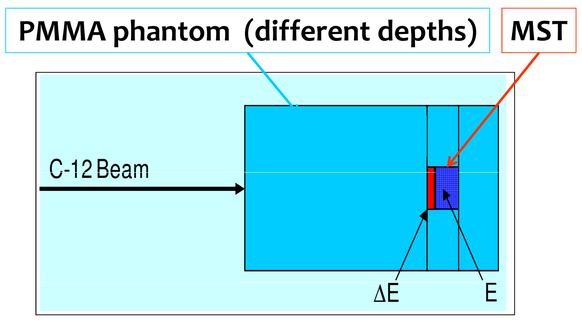
Two different devices, i.e. a single-diode ΔE detector 1 mm² in sensitive area (MST) and a ΔE detector geometrically segmented in micrometric cylinders 9 μm in diameter (SMST) were irradiated at different phantom depths with 62 AMeV carbon ions. Results of this preliminary irradiation were satisfactory [1].



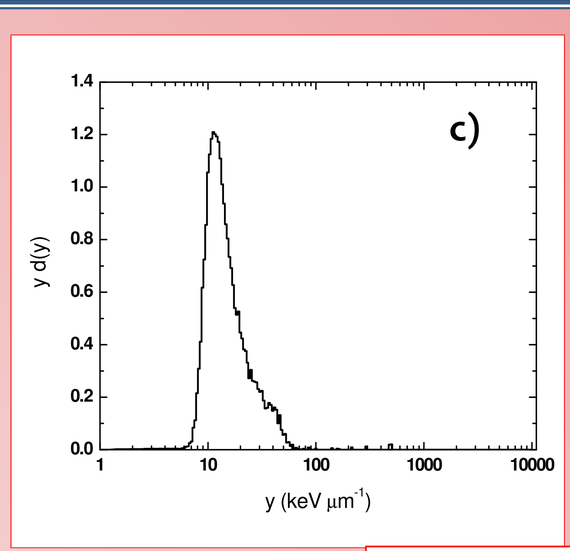
[1] S. Agosteo, G. A. P. Cirrone, G. D'Angelo, A. Fazzi, M.V. Introini, A. Pola, Feasibility study of radiation quality assessment with a monolithic silicon telescope: irradiations with 62 AMeV carbon ions at LNS-INFN, Radiat Meas 46 (2011) 1534-1538.

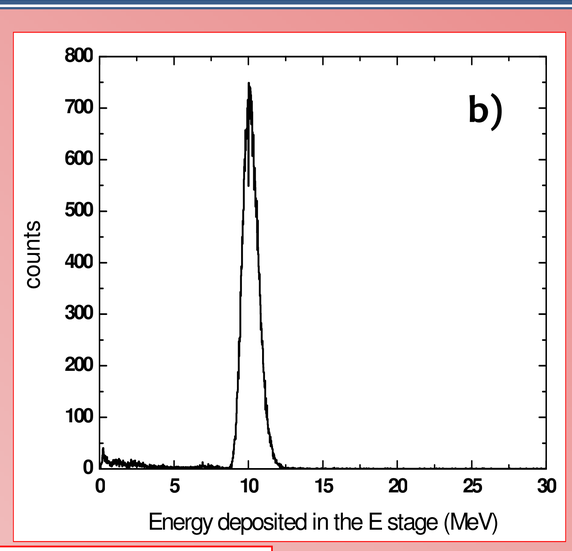
PRELIMINARY SIMULATIONS (FLUKA CODE)

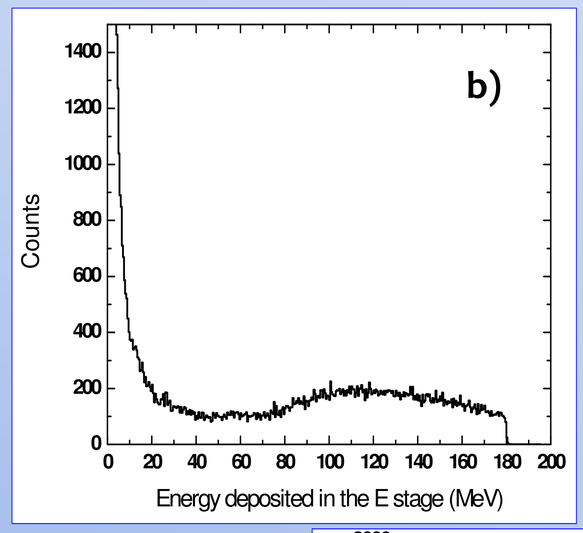
Simulations are under study in view of a measurement campaign that will be carried out at the Centro Nazionale di Adroterapia Oncologica (CNAO, National Centre for Oncological Hadrontherapy, Pavia, Italy), by irradiating the MST and SMST devices with 400 AMeV carbon ions.
At present preliminary results are available for the MST device.

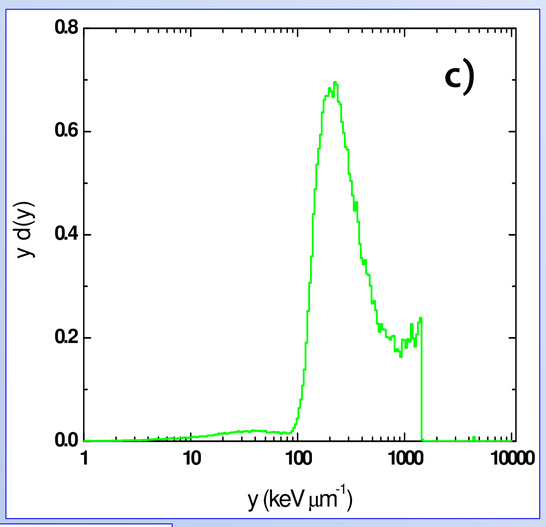


For saving computational time, the phantom was divided in two regions: 1) a "high precision" region 2cm upstream and 1 cm downstream of the detector, where the transport threshold of secondary electrons (card DELTARAY) was 10 keV and 2) the region including the rest of the phantom where the transport was turned off.



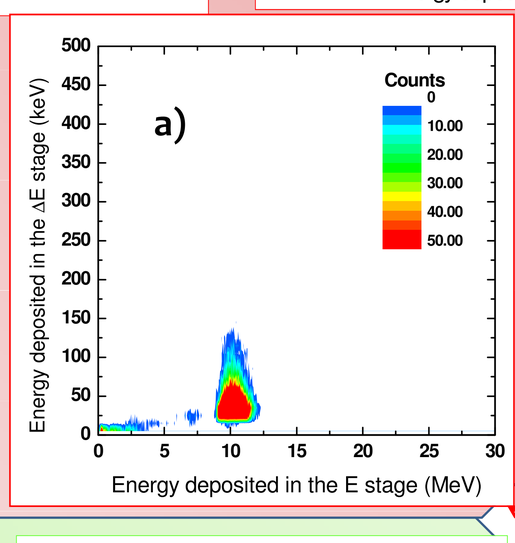


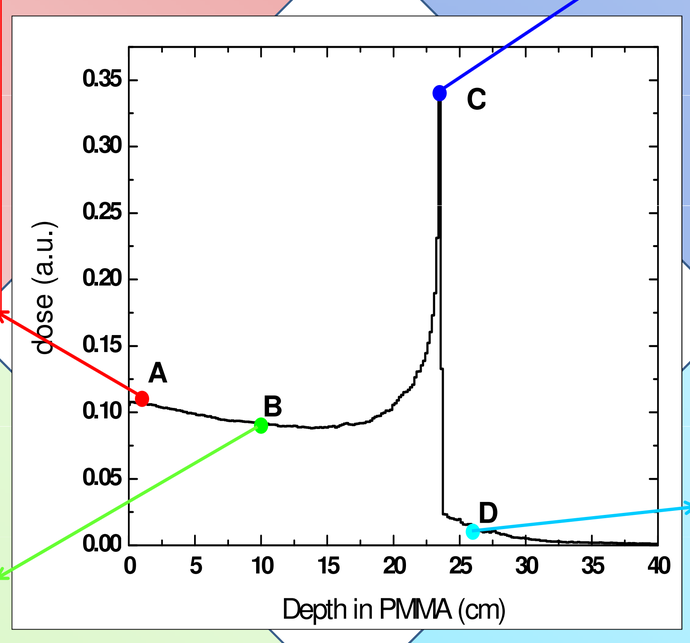


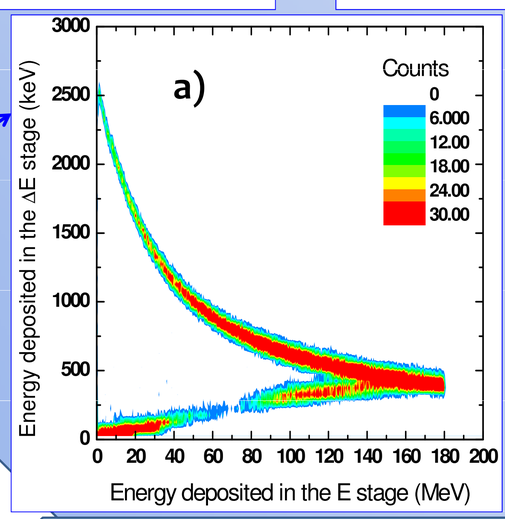


Simulated depth A = 1 cm

a) Scatter plot
b) Residual Energy spectrum (E stage)
c) Microdosimetric spectrum (ΔE stage)





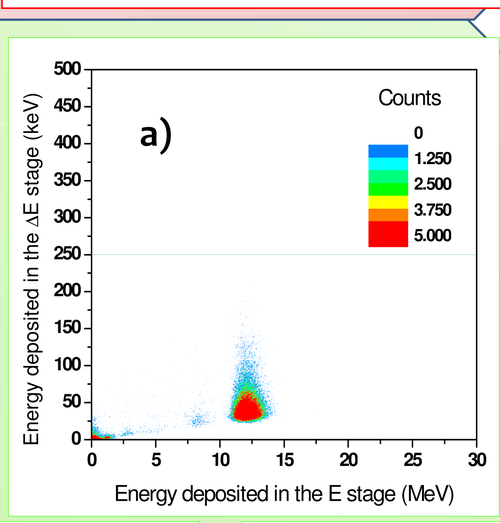


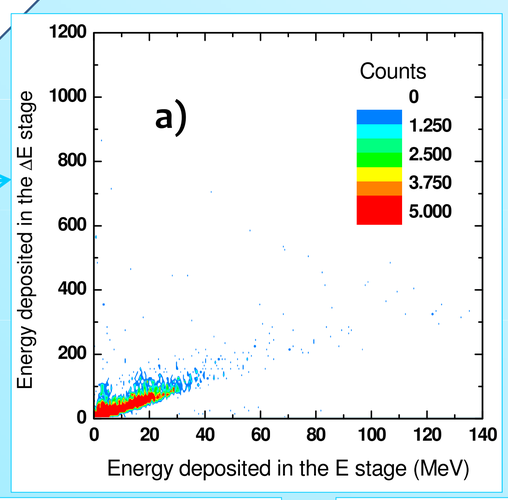
Simulated depth C= 23.5 cm

a) Scatter plot
b) Residual Energy spectrum (E stage)
c) Microdosimetric spectrum (ΔE stage)

Simulated depth B = 10 cm

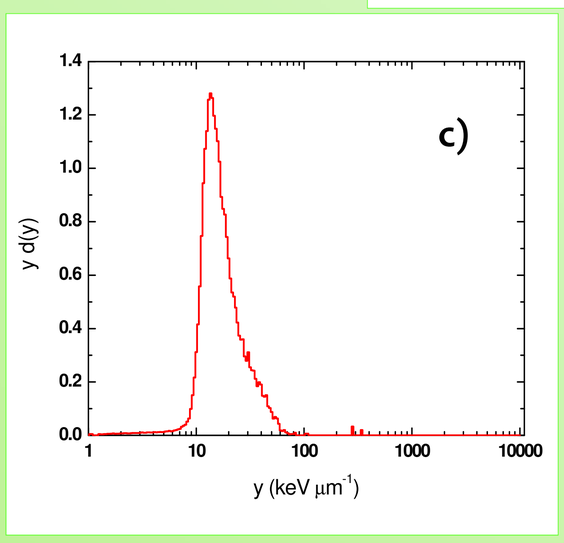
a) Scatter plot
b) Residual Energy spectrum (E stage)
c) Microdosimetric spectrum (ΔE stage)

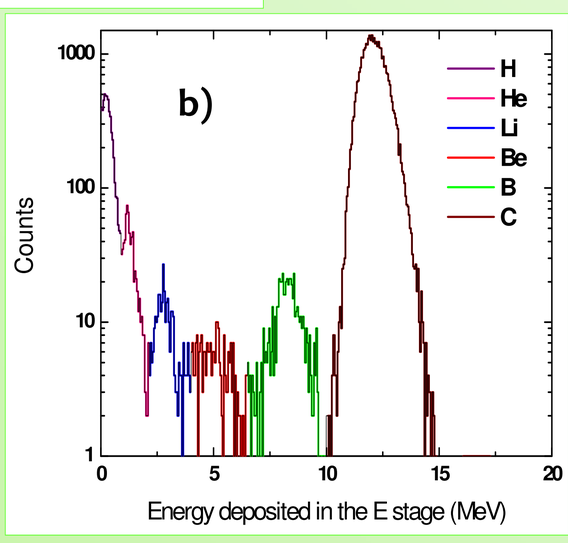


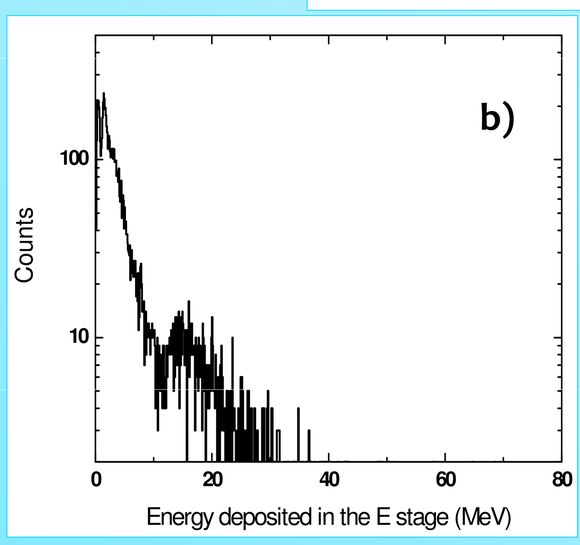


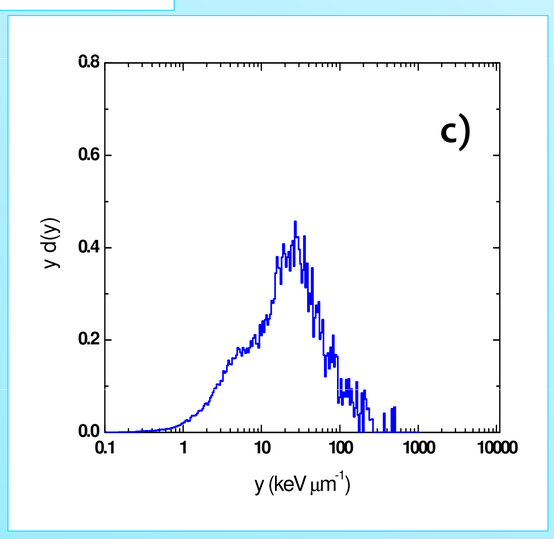
Simulated depth D= 26 cm

a) Scatter plot
b) Residual Energy spectrum (E stage)
c) Microdosimetric spectrum (ΔE stage)



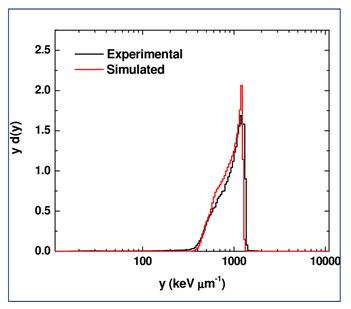






CONCLUSIONS

More detailed simulations are still in work for the SMST device and experimental measurements with both detectors will take place at the CNAO facility. A discussion about the accuracy of the simulation results will be given by referring to previous measurements[2] at the INFN-Laboratori Nazionali del Sud (Catania, Italy), perfomed by irradiating the MST and SMST at various PMMA depths with 62 AMeV carbon ions.



[2] S. Agosteo, G. D'Angelo, A. Fazzi, MV Introini, A. Pola, A monolithic silicon telescope for hadron beams: numerical and experimental study of the effect of ΔE detector geometry on microdosimetric distributions, submitted to Progress in Nuclear Science and Technology (ICRS12 Proceedings).

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