The ΔE-TOF detector of the FOOT experiment: experimental tests and Monte Carlo simulations

### The FOOT experiment
- **Identification** of the fragments produced in the human body during hadrontherapy and measurement of their production cross-section [1]
- **Radioprotection** in space

### ΔE-TOF detector
- Two layers of orthogonal plastic scintillator bars coupled to SiPMs at both ends
- Measures energy deposition in detector ΔE and Time of Flight TOF
- Contributes to provide velocity β and atomic number Z of the fragment
- The FOOT Monte Carlo simulation suggests a Z resolution of 2–6% for the ΔE-TOF detector

### Experimental setup
- Two Ej200 bars @ 11 cm relative distance (400 mm × 20 mm × 3 mm)
- Aluminum and black tape wrapping
- 4 Hamamatsu SiPMs coupled to each end
- WaveDREAM for bias & readout [3]
- Proton and carbon ion beams irradiations of different energy and position @ CNAO

### Monte Carlo simulations
- Proton energy deposition as input (FLUKA)
- Scintillation emission spectrum (Matlab)
- Geometry & optical transport (Geant4, [4])
- SiPM photon detection efficiency (Matlab)

### Results
- The Monte Carlo can predict the light attenuation in the bar and the number of detected photons

### References
- [3] Galli L. poster @ this conference

### Future MC applications
- Investigate the impact on the detector time and energy resolution of geometrical factors, such as:
  - the thickness of the plastic scintillator bar
  - different SiPM arrangements (number of SiPMs, micro-cell size)
  - uncertainties in the SiPM position wrt the plastic scintillator bar (e.g., angle, misalignment)
- Predict the energy and time resolution of the final ΔE-TOF detector