A review of Monte Carlo calculated f_Q factors for ionization chambers in clinical proton beams

K.-S. Baumann[1] C. Gomà[2], J. Wulff[3], J. Kretschmer[4], K. Zink[5]

[1]Department of Radiotherapy and Radiooncology, University Medical Center, Marburg, Germany
[2]Department of Radiation Oncology, Hospital Clínic de Barcelona, Barcelona, Spain
[3]West German Proton Therapy Center, Essen, Germany
[4]Medical Campus Pius Hospital, Carl-von-Ossietzky University, Oldenburg, Germany
[5]Marburg Ion-Beam Therapy Center, Marburg, Germany

Background: In recent years, the Monte Carlo (MC) codes PENH, Geant4 and FLUKA have been used to calculate f_Q factors - which are the basis of MC calculated beam quality correction factors k_Q - for air-filled ionization chambers in clinical proton beams. In this study, we present a review of these MC calculated quantities.

Material and Methods: A total of 196 MC calculated f_Q factors were incorporated in this study to derive average f_Q factors and to estimate the overall uncertainty.

Preliminary results: Fig. 1 shows MC calculated f_Q factors together with the average factors. The MC codes agree well for small energies but tend to diverge for high energies leading to an increasing overall uncertainty with increasing energy (fig. 2). Most likely, differences in the modelling of nuclear interactions lead to the discrepancies whereas the impact of these interactions increases with energy.

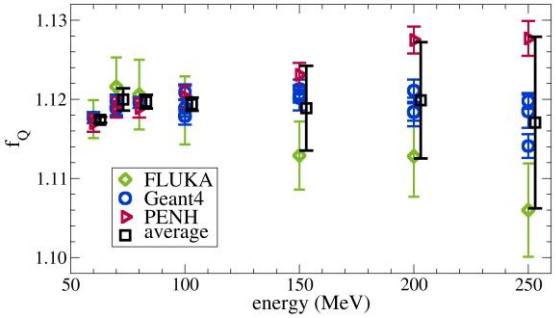

Figure 1: MC calculated and average f_Q factors for an exemplary ionization chamber.

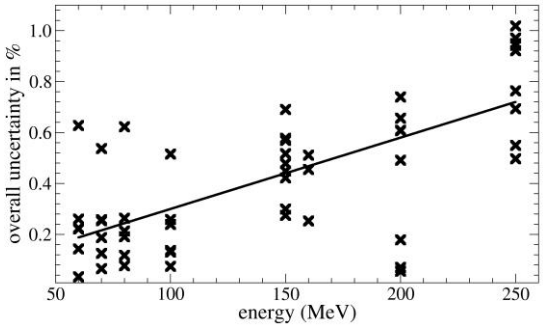

Figure 2: Overall uncertainties of MC calculated f_Q factors for each ionization chamber model and proton energy investigated, and a linear fit.