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An original model for the simulation of the stopping power of negative hadrons

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An original model is presented for the simulation of the energy loss of negatively charged hadrons: it calculates the stopping power by regarding the target atoms as an ensemble of quantum harmonic oscillators.
This approach allows to account for charge dependent effects in the stopping power, which are relevant at low energy: the differences between the stopping powers of positive and negative charged hadrons may amount to approximately a factor two, which is significant when high precision is required for the evaluation of energy deposit distributions. Related use case are the tails of energy distributions in the development of showers, the environment of radiation background monitors, experiments for antimatter searches, and the recent interest demonstrated for the possible therapeutic applications of antiproton beams.

The resulting antiproton stopping powers for different elements are compared against measurements at CERN antiproton experiments and are shown to be in satisfactory agreement with experimental data.
The model described is implemented in the Low Energy Electromagnetic package of the Geant4 Toolkit; it represents a significant improvement for the accurate simulation of low energy negative hadrons with respect to previously available models.

Primary authors: Dr PIA, Maria Grazia (INFN GENOVA); CHAUVIE, Stephane (INFN Genova)

Presenter: CHAUVIE, Stephane (INFN Genova)

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