Quenching factor: simulation and measurement comparison

QF and profile calculation from SRIM

- SRIM output: IONIZ.TXT
  - Ionization (by primary ion and secondary recoils) as a function of the depth
- QF = Total ionization energy losses / Initial energy of ion
- This is done for different initial energies and then fitted with a function

$$fitQF = \frac{k(E + aE^b)}{1 + k(E + aE^b)}$$

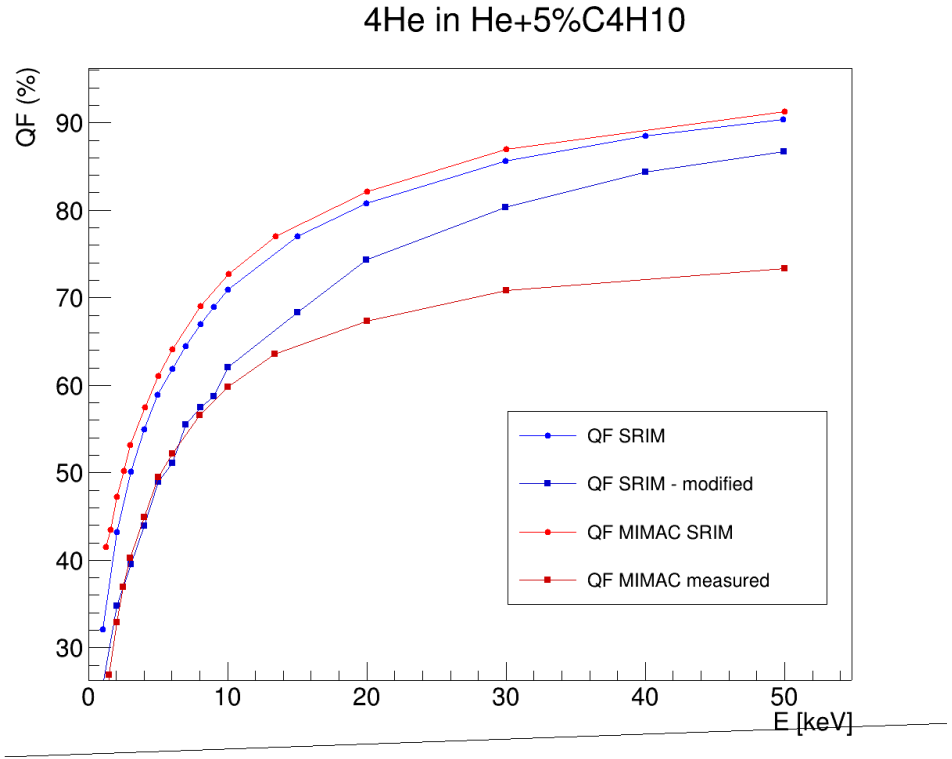
- The derivative of E*QF(E) is a function F(E) which is used as a conversion factor between the total energy and the ionization energy in each 3D hit of the track
  - We obtain the "ionization profiles"
- When summing all the ionization energy hits, one can retrieve the original QF
- *Note on ionization profiles*: the primary ion loses energy also through recoils with target atoms (which can then further ionize the medium or produce other recoils)
  - Different treatments of the ionization energy lost in these "cascades" were tested

QF comparison with MIMAC results

- The conversion factor F applied to the energy lost by the secondary recoils is the same as the one of the primary ion (this is the current approach)
- Alternative: for each secondary recoil, the F function corresponding to the recoiling atom is considered (instead of the one corresponding to the primary ion)

Last year I compared these two methods to the simulated and measured data from this paper: https://arxiv.org/pdf/0810.1137.pdf
(my presentation: https://agenda.infn.it/event/25553/contributions/128440/attachments/78416/101318/25-01-2021_sim_meeting.pdf)

The second methods seems in a better agreement with the measurement, while the first is more consistent with their SRIM simulation



QF comparison with NEWS-G

New measurement of QF from NEWS-G collaboration: https://arxiv.org/pdf/2201.09566.pdf
I simulated protons in methane at 100mbar to compare again the two methods

The modified approach is not consistent with the measurements, it does not explain the discrepancy

The discrepancy could be due to some misinterpretation of the ionizazion energy given by SRIM – is it worth to try different methods for describing the ionization profile?
Some ideas:

- Better handling of the cascades (they account for a significant fraction of the energy losses)
- What SRIM calls "ionization" includes other processes (excitation) - apply some correction?
- ?
- ...Or simply SRIM might not be accurate in calculating the ionization losses at such low energy