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Ion optical simulation for the NEXT solenoid separator

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The NEXT project aims to study **N**eutron-rich, **EX**otic, heavy nuclei produced in multi-nucleon **T**ransfer reactions[1]. Part of the NEXT setup is a 3T solenoid magnet with a 90-cm wide bore. The magnet will be used to focus the transfer products of interest and to separate those from unwanted by-products as well as from the unreacted primary beam.
Within this contribution, we present a Python code which we developed to simulate the paths of ions through the magnetic field of the solenoid. The goal of the simulation is to determine the optimal layout of the separator in order to achieve highest transmission efficiencies and strongest background suppression.
The simulation requires a realistic description of the magnetic field in- and outside the solenoid. For this purpose, we implemented an interpolated model. The trajectories of the ions through the magnetic field are determined through their emitting angles and magnetic rigidities. Therefore, we implemented the calculation of the charge state distribution in the code. As input data, our code requires the differential cross-section, the kinetic energies, and the emitting angels of the transfer products.
So far, we have investigated two reactions[2] in order to optimize the layout of the NEXT separator:

- ^{136}Xe+^{198}Pt at 6 MeV/u to produce nuclei around the N=126 shell closure
- ^{48}Ca+^{251}Cf at 6.1 MeV/u to produce nuclei in the transfermium region

We will present the results of the simulations.

References

[1] J. Even, et al., The NEXT project: A step to the neutron-rich side (2022), submitted to Atoms.

[2] Karpov, A.; Saiko, V., Phys. Part. Nucl. Lett 2019, 16, 667–670 & EPJ Web of Conf. 2017,163.