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Production and manipulation of relativistic exotic nuclei

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Projectile fragmentation or fission in flight is a rich source of exotic nuclei. The production cross sections of the selected nuclides are crucial for a successful experiment, but also the production rates of all other nuclei is of importance as they define the level of separation that must be reached. With beam intensities exceeding 10^{10} primary beam ions a high reduction factor must be achieved.
The so called $B\rho - \Delta E - B\rho$ method has become the standard method for separation in fragment separators. World wide many dedicated devices have been built or existing beamlines have been modified to work in this technique. For new separators as BigRIPS or the planned Super-FRS a many stage separation scheme with more than only one degrader will be employed. This scheme can even be extended by an additional stage for bunching the energy-distribution for implantation into a gas catcher.
A formalism to calculate analytically the separation characteristics of these devices will be presented as well as numerical techniques of simulation. The description involves the combination of the ion-optical properties as well as the energy-loss of heavy ions in matter. The achievable resolution as well as limitations from ion-optical imperfections and the energy-loss and angular straggling in the degraders will be discussed.
The exact characteristics of separation depend on the velocity at which the separator is operated and strong differences even in the energy domain of 100-1000 MeV/u are the result. Ions of different charge states can confuse the particle identification and require special care for separation.
Another interesting possibility comes with the coupling to storage rings where after beam cooling much higher resolving powers can be achieved.

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