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Ion Optical Modeling of In-Flight Separators

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Realistic ion optical models are a critical component in the design and operation of the next generation of in-flight, heavy ion separators for the production and study of exotic nuclei. Current methods for detailed optical modeling of large acceptance, in-flight separators will be presented in the context of the design efforts for ARIS (the Advanced Rare Isotope Separator, to be constructed at FRIB), S3 (the Super Separator Spectrometer, being developed as part of Spiral2 at GANIL) and ISLA (the Isochronous Separator with Large Acceptance, being developed for use with re-accelerated FRIB beams from ReA). Transport, purification and focusing of secondary beams require particularly detailed consideration of the ion optical system because of the high power of the primary beams and the large phase space of the reaction products, both of which make the understanding of higher order aberrations important. Models based on either Taylor expansion methods (e.g. COSY Infinity) or ray tracing methods (e.g. Zgoubi) are used to study the detailed performance of proposed ion optical separator designs. Methods to be discussed include: the excitation-dependent modeling of magnetic dipole and multipole elements, parallel optimization techniques to speed the discovery of optimized magnet settings and design requirements for the reduction of optical aberrations, and Monte Carlo methods to simulate full beam cocktails to verify system performance for benchmark experimental cases.

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