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The ISOLDE High Resolution Separator upgrade to a mass resolving power of 20000

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ISOLDE/CERN is one of the leading facilities in production of exotic beams. With its upgrade in the HIE-ISOLDE project an increase in primary beam intensity and energy is envisaged. Together with developments in target and ion source technology a significant increase in intensity of the exotic beam expected. Note, in the worst case after the ion source this is a cocktail beam containing radionuclides from all over the nuclide chart. The current magnetic separation with the high resolution separator (HRS) can suppress contaminations almost completely when the masses differ to the beam of interest by $/Delta$m/m > 1/2000 (ion-source emittance dependent). This will not be sufficient anymore for the user experiments and also because of radioprotection consideration; an increase of mass resolving power R = m/$/Delta$m to better than 20000 with a complete suppression of the contaminants is required, which is ion source independent.
Here we present a concept of a new separator, which consists of three stages; a magnetic pre-separator, a radio frequency quadrupole (RFQ) for improvement of the transversal emittance, and a magnetic HRS including its surrounding electrostatic optics. We will focus on the discussion of the magnet for the HRS. Here a 120 degree magnet with a bending radius of 1.25m has been chosen. The magnetic rigidity is 0.625T (B-field of 0.5T) to allow for separation of molecules of up to a mass of 300u. The magnet comprises a yoke in wedged H-type configuration for stability and precision. Pole face conductors are implemented to achieve the required inhomogeneous parameters for focussing and compensation of aberration. In a first step the concept has been derived analytically. It has been refined with the OPERA 2D software and been tested with the ray-tracing module of OPERA 3D using a conservative estimate of the radial emittance after the RFQ of 3 $/Pi$ mm mrad.

Primary author: Dr BREITENFELDT, Martin (CERN / University of Greifswald)

Co-authors: Dr SCHOERLING, Daniel (CERN); Dr TVETEN, Gry Merete (University of Oslo); Mr AUGUSTIN, Mathieu (CERN); Dr CATHERALL, Richard (CERN); Dr GILES, Tim (CERN)

Presenter: Dr BREITENFELDT, Martin (CERN / University of Greifswald)

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