The New Vacuum Mode Recoil Separator MARA at JYFL

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The gas-filled recoil separator RITU [1] has been used extensively for nuclear structure studies near the proton-drip line employing fusion evaporation reactions. RITU is designed for studies of heavier elements and to extend research to lighter masses (A = 50 – 150) a new electromagnetic mass-separator project called MARA (Mass Analysing Recoil Apparatus) has been started. Its ion-optical layout will be QQQEM – a quadrupole triplet followed by an electric deflector and a magnetic dipole. First order cancellation of energy dispersion at fixed focal plane position is obtained by the combination of electric and magnetic fields. At the focal plane the energy, position and incoming angle of the arriving recoils will be measured. The incoming angle in the dispersive plane (x') can be used to correct second and higher order aberrations to improve mass resolving power. Recoil counting rates at the focal plane can be reduced by a flexible slit system. First order resolving power is calculated to be 250 for 2 mm beam-spot diameter. Most electromagnetic separators, such as the FMA [2], have two electromagnetic deflectors and one magnetic dipole between giving continuous energy focus. The new separator will have a similar mass resolving power to these EME type spectrometers but it will be shorter and simpler. To improve primary beam suppression the electrostatic anode will be split and the direct beam will be collected with an appropriate beam dump behind the anode. In addition, special baffle structures in the vacuum chambers will be used to reduce the scattered beam component. A careful simulation of feasibility, carried out for fusion evaporation reaction ^{58}Ni(^{54}Fe,2n)^{110}Xe, shows that MARA will be superior when compared to RITU in the lower mass region where symmetric reactions or inverse kinematics are used.

[1] M. Leino *et al.*, Nucl. Instr. and Meth. **B 99**, 653 (1995).
[2] C. N. Davids *et al.*, Nucl. Instr. and Meth. **B 70**, 358 (1989).