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High voltage conditioning of the electrostatic deflector of MARA

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A new vacuum-mode recoil spectrometer MARA (Mass Analyzing Recoil Apparatus) [1] has been built in JYFL. The spectrometer has a designed first-order m/q resolving power of 250. What sets this FMA-like [2] device apart from its siblings is the single-deflector ion-optical configuration QQQEM. Collimators and slit systems are used to reduce the background components caused by scattered beam and recoils with unwanted m/q. The deflector is designed for a maximum electric rigidity of 14 MV, achievable with 500 kV across the gap. The primary beam is dumped in a separate beam dump, the anode is split to facilitate this.

The geometry, materials and their finishing are of utmost importance when constructing a device used in such high voltages. A cylindrical vacuum chamber is used in MARA because of its mechanical simplicity and clearance from the electrodes and the large vacuum volume is pumped with cryo- and turbomolecular pumps. The electropolished titanium electrodes are oversized to achieve a uniform field with a simple electrode geometry.

The high voltage conditioning process of such a device is a time-consuming process and has therefore been automated. The conditioning logic is heavily influenced by the systems in use at CARP [3] and SHIP [4] and follows a three-limit approach.

The factory conditioning, as well as the first conditioning at JYFL, were prime opportunities to tune the conditioning parameters. The conditioning proceeded well when pre-breakdown currents in the order of tens of microamperes were seen. These currents were accompanied with increases in radiation and vacuum levels, indicating that the voltage was indeed reaching the electrodes and field emission was taking place. The results got and the parameters used in the first conditioning are reported.

References:
[1] J. Saren, doctoral thesis
[2] C. N. Davids et al., NIM B 70 (1992) 358-365
[3] M. Morinobu et al., NIM B 70 (1992) 331-342
[4] G. Munzenberg et al., NIM 166 (1979) 391-395

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