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# FTP/1-2: Acceleration of 1 MeV H- Ion Beams at ITER NB-relevant High Current Density

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ITER neutral beam (NB) system requires deuterium negative ion beams of 1 MeV, 40 A at the current density of 200 A/m^2 from a single large negative ion source and an accelerator. This paper summarizes progress in R&D with a reduced size accelerator, so-called "the MeV accelerator"at Japan Atomic Energy Agency (JAEA). In the last Fusion Energy Conference, we reported achievement of 1 MV voltage holding in vacuum for more than one hour. Physics of beamlet deflections due to their own space charges and magnetic field was also reported utilizing a sophisticated three dimensional beam trajectory analyses. The improved voltage holding and a trajectory compensation technique have been applied to the MeV accelerator.

Many discharge burn marks have been observed inside the accelerator after long pulse operation reported in the last conference. It was turned out that such discharge marks were observed at positions facing to high local electric field, such as edges, corners, and steps between grid and its support. In the present MeV accelerator, such positions have been modified, for example, by increasing radii of corners around grid supports, and increasing gap length between grids to lower the local electric concentrations to about 3 ~ 4 kV/mm.

For compensation of magnetic deflection, aperture offset was applied at the bottom of the EXG. Magnetic field is formed by small permanent magnets embedded in EXG between aperture lines. Since the polarities are arranged so as to be alternative in each line between apertures, aperture offset of 0.8 mm was defined in the direction against the magnetic deflection. To counteract the beamlet deflection by space charge repulsion, a field shaping plate, a metal plate to deform electric field, were installed around the aperture area for deflection of outermost beamlet inward. Position and thickness of the plate was designed by the analyses.

It should be highlighted that reduction of beam direct interception at grids has brought substantial improvement in voltage holding during beam acceleration at around 1 MV. By the improved voltage holding even under beam acceleration, H^- ion beams of 185 A/m^2 (430 mA in total) have been successfully accelerated up to 0.98 MeV. This is a world first demonstration of negative ion beams at high current, high current density and high energy close to the ITER requirements.

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