Accelerator design for the Neutral Beam Injector for ITER

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In order to deliver a total of 33 MW of auxiliary heating power, each of the two Neutral Beam Injectors (NBI) foreseen for ITER is designed [1] to provide acceleration up to 1MV of a 40 A current of Deuterium negative ions. In the NBI baseline design the Accelerator is a Multi Aperture Multi Grid (MAMuG) system. In the framework of the EU activities oriented to the revision of the NBI design and to the construction in Padova of the Neutral Beam Test Facility aimed to assemble and test the first NBI, the designs of four Accelerators have been revised or carried out:
The five-grids 1MV accelerator of the reference design, the alternative two-grids 1MV SINGAP type accelerator, the new three-grids 500kV accelerator for the initial low energy operation in ITER, the new single grid 100kV accelerator to study low energy extraction of the ITER negative Ion Source. For all accelerators, the grids must withstand the power load allowing limited bending and therefore limited impact on the optics. To fulfil this requirement , the grids have to be actively cooled and the channels have to be carefully designed in order to be accommodated in a relatively narrow space. Depending on the different acceleration voltages and parameter range, the different physical processes involved in the acceleration (namely stripping losses, back-streaming ions and secondary electrons released by particles impinging on the surfaces) will result in different thermal loads to the grids. In this contribution the main characteristics of the four accelerators will be reviewed with emphasis on the physics and related impact on the grid design.

[1] DDD 5.3 ITER documentation