Experimental results from the Cadarache 1 MV test bed with SINGAP accelerators

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An "ITER-like" accelerator, which is a scaled down version of the ITER SINGAP (SINgle GAP, SINGle Aperture) accelerator, has been build and installed on the Cadarache 1 MV test bed. The objective is to demonstrate reliable D^- beam acceleration as close as possible to 1 MeV with an accelerated D^- current density, JD^-, of ≈ 200 A/m^2 with the parameters and beam optics required for ITER.

Encouraging results have been obtained previously with a proof-of-principle SINGAP accelerator, which had the disadvantage of an essentially un-cooled ion source and a pre-accelerator significantly different from that designed for ITER. With that prototype good agreement between simulations and experimental results has been demonstrated. The highest obtained beam energy was 911 keV with $JD^- = 50$ A/m^2 for 2 s. At 498 keV a current density of 120 A/m^2 was reached.

The new "ITER-like" accelerator has a maximum of 25 apertures arranged in a square 5 x 5 array, each aperture being identical to those foreseen for ITER. However different plasma grids, each with a limited number of apertures, are used for the experiments at Cadarache so as not to exceed the 1 MV power supply current limit of 100 mA: 3 apertures are used for beam extraction at $JD^- \approx 200$ A/m^2 and either a vertical column or a horizontal row of five apertures are to be used to verify the modelling of the beam optics. The full 25 apertures can only be tested on a test bed with a higher current capability. The main acceleration grid can be moved either vertically or horizontally, or both, to test off-axis steering.

This paper will describe the layout of the test bed with the new accelerator, and the results so far obtained from high voltage holding tests, beam extraction and acceleration. A detailed comparison between the simulations and the measurements of the optics of the beams will also be given.