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High Voltage Radio Frequency Test Facility for the characterization of the dielectric strength in vacuum of RF drivers for Neutral Beam Injectors Ion Sources

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PRIMA (Padova Research on ITER Megavolt Accelerator) is a large experimental facility under construction in Padova, Italy, aimed at the development and test of the full scale prototype of Neutral Beam Injectors (NBI), called MITICA, for ITER, the world's largest experiment to prove the feasibility of fusion as a source of energy.

MITICA is foreseen to accelerate a beam of 40 A of negative deuterium ions up to 1 MV, in order to deliver a power of about 17 MW to the plasma with a pulse length of one hour. All these requirements have never been reached before at the same time and this is the reason for PRIMA test facility and MITICA experiment.

The negative ions are produced by means of an ion source composed of 8 radio frequency (RF) drivers working at 1 MHz each generating a cold plasma at a pressure of 0.3 Pa with a power of 100 kW. A set of grids at different electrical potentials, extracts and accelerates the negative ions producing a negative ion beam which is then neutralized in order to enter and heat the plasma.
The production of the negative ions by means of RF driven ion source and their extraction is a feature which needs to be developed separately before MITICA operation, since these requirements are not satisfied in any of the existing NBI for fusion devices. Therefore a second experiment called SPIDER will be hosted in PRIMA and it is the full scale prototype of ion source for ITER NBI.

To fulfill the demanding operational condition of the RF drivers and the need to gain experience on the RF voltage holding in vacuum, a necessary experimental investigation is needed. Thus, the High Voltage Radio Frequency Test Facility (HVRFTF) is being built in Padova, at Consorzio RFX. The HVRFTF scope is to reproduce the operating conditions of the RF coils used in the ITER NBI ion source, in particular the voltage up to 15 kV at 1 MHz and the operating pressure in the range of 1E-3 –0.3 Pa.

The paper will present the specific features and issues related to the design, construction and first operation of the HVRFTF.

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