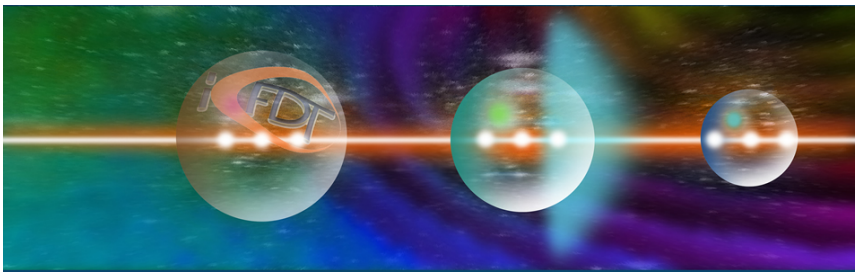

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Electron Density Measurement of PROTO-SPHERA Plasma by Second Harmonic Interferometer

Friday, 5 October 2018 17:00 (20 minutes)

The PROTO-SPHERA (PS) [1] experiment at Frascati ENEA Research Centre produce a Spherical Torus (ST) around a Plasma Centerpost (PC). The PC is an arc discharge driven by DC voltage between two annular electrodes.
This alternative and stable magnetic configuration is obtained without the internal toroidal coils and without the central ohmic transformer of a traditional tokamak. In fact, the PC, opportunely shaped by the PF Coils internal to the vessel, together with additional external poloidal field coils, forms the torus and is able to sustain its current through magnetic reconnections; moreover the torus is limited by two ordinary X-points with zero poloidal field, as in a double null divertor tokamak.

After resolving many issues, the device was capable to routinely operate with a 10 kA stable longitudinal current in the PC, and 5 kA in the Torus for 0.5 seconds. In order to measure the electron density inside PS, we selected a common-path Second Harmonic Interferometer (SHI) that fits well with the expected density range and construction constraints of the chamber. The SHI [2], developed by Pisa group and installed in several plasma devices along many years is insensitive-to-vibrations device, that has allowed an easy installation on the machine, thanks to a compact modular design.
In this work, we present the electron density measurements for different gases
(Ar and H) in various operating conditions and its correlation with other diagnostics.
In comparable plasma configurations, by using two filling gases,
the maximum line-averaged electron density through the machine midplane of PS was measured as 4 $/cdot10^{20}$ m^{-3} for Argon and as 1.5 $/cdot10^{20}$ m^{-3} for Hydrogen.

1) F. Alladio, P. Micozzi et al. -"Design of the PROTO-SPHERA experiment and of its first step (MULTI-PINCH)"- Nucl. Fusion 46 (2006) S613–S624
2) F. Brandi, F.Giammanco- "Versatile second-harmonic interferometer with high temporal resolution and high sensitivity based on a continuous-wave Nd: YAG laser"- Opt.Lett., 32, 2327-2329, (2007)

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