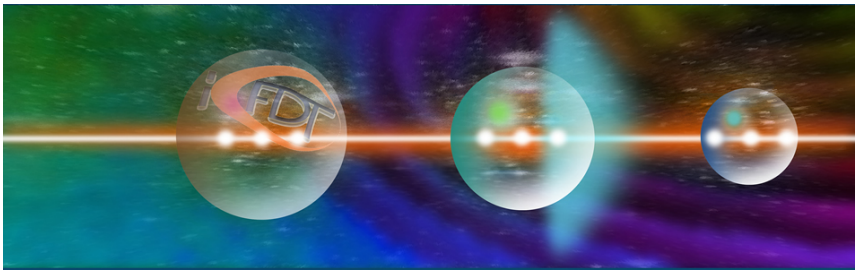

Contribution ID: **18** Type: **Poster**

Optical diagnostics applied on Proto-Sphera plasmas

Thursday, 4 October 2018 14:30 (1h 30m)

Proto-Sphera is an innovative plasma confinement concept based on the formation of a toroidal plasma around an axial screw pinch which provides the toroidal magnetic field. Optical emission (OE) from the Proto-Sphera device is detected by a compact spectrometer array covering the range 235-790 nm with the resolution from 0.09 nm in UV to 0.14 nm in IR. Plasmas formed in both Argon and Hydrogen gases are studied. The spectra are registered each 5 ms in order to study the time evolution of different species in the plasma that include H I, O I, Cu I and Cu II coming from the cathode erosion, C I present due to the wall erosion, and Ar I to Ar III in case of the discharge in argon environment. Simultaneously, the transmitted intensity of a collimated He-Ne laser beam, crossing the chamber towards the detection system, is also monitored. The optical system is equipped with a variable focusing in order to collect the signal mainly from the reactor's center (R = 0) or at distances from the center up to the plasma edge (R≈ -30 cm). In presence of the plasma, which is almost spherical around the reactor's center, the detected He-Ne line intensity increases, likely because of the radial distribution of the electron density, having a peak at the center, as confirmed by the spatially resolved OE spectroscopy. From the latter data, in case of H environment the central plasma column seems to be almost fully ionized after about 30 ms from the discharge ignition and has a rapid drop of the electron density beyond 10 cm from the center. Basing on the ionic to atomic line intensity ratios, the central plasma temperature is maximum shortly before turning off the discharge while the electron density in hydrogen decreases due to the plasma expansion, differently from the more compact Ar plasma. With the aim to reach the absolute values of the plasma parameters, the acquired temporally and spatially resolved spectroscopic data will be exploited to simulate the plasma (de)focusing effect and as an input for the interferometric measurements that presently considers an uniform electron density across the observation path and thus supplies only the average value.

Summary

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Session Classification: POSTER SESSION