Investigation of the parameters of a dense, inductively generated stripping plasma for the FAIR-Project*

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As higher charge states are essential for short acceleration distances in modern facilities like FAIR, a screw-pinch plasma device is set up at the IAP Plasma physics group in the Goethe University Frankfurt. This screw-pinch device is set up as an alternative solution to the theta-pinch device[1] and as possible alternative solution to the established stripping foils.

The objective of the experiment is the investigation of a new coil configuration, and the generation and maintenance of dense plasmas with different ignition parameters.

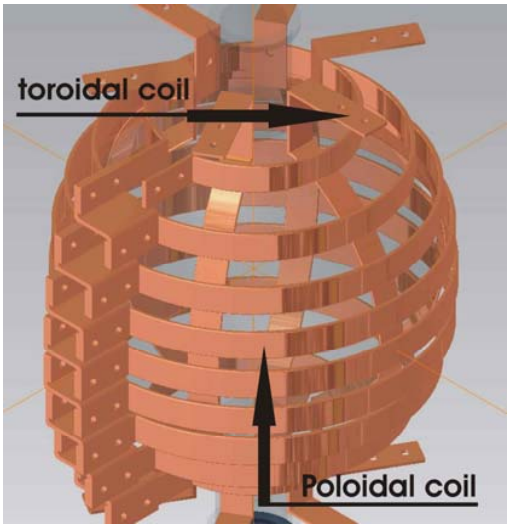

Figure 1: The construction of the coil

Figure 1 shows the configuration of the screw-pinch coils. This configuration consists of two coils, which are superimposed. The inner coil has 6 poloidal turns which are oriented along the Z-axis. The outer coil has 9 toroidal turns, which are in the XY-plane. The total inductance of the set up is L≈11 µH. The energy storage of the device consists of four capacitors with a capacitance of 25 µF each at a maximum charging voltage of 9300 V. The modular design of the capacitor bank can use capacitors single (25µF), parallel (50, 75, 100 µF) and in series (12,5 and 25 µF). A thyratron (TDI1-200k/25H) is used in order to switch the high voltage and current. The argon gas is used for the experiment.

Figure 2 shows a signal of the photodiode with a signal of a current curve. The photodiode signal is detected in the center of the recipient. The duration of the plasma discharge is about 500 µs, and is repeatedly compressed

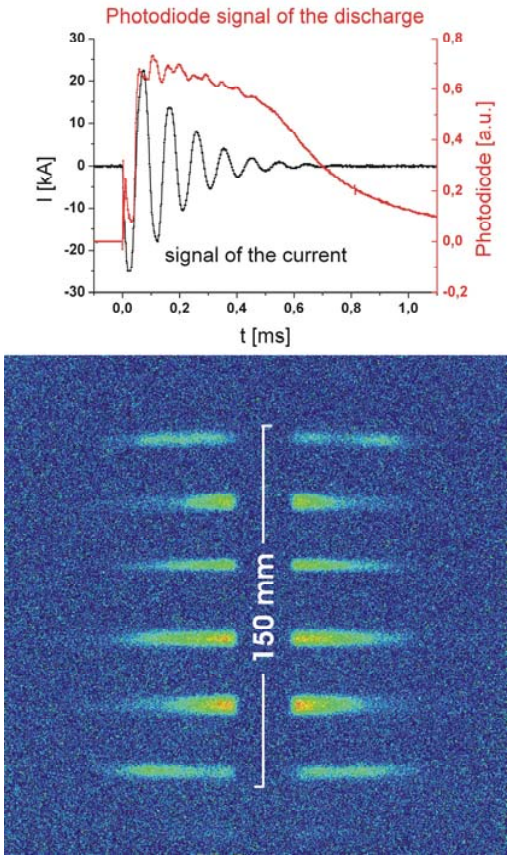

Figure 2: Above-the signal of the photodiode and current; below- plasma discharge at 74 µs

to a cylindrical shape. The duration of the compression phase is about 10 µs and the length of the discharge is 150mm. The achieved average electron density of the plasma is $1{,}6 \cdot 10^{16}$ cm^{-3}. The maximum efficiency of the structure is achieved at a pressure of about 140 ± 20 Pa and is approximately η = 70% for frequency of 10 kHz (Capacitance 25 µF) and charging voltage 18 kV.

References

[1] C. Teske, Y. Liu, S. Blaes and J. Jacoby, "Electron density and plasma dynamics of a spherical thete pinch", Phys. Plasmas 19, 033505 (2012)

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