Tokamak GOLEM for fusion education – chapter 16: plasma edge, transport barrier, fast ion temperature, spectroscopy, magnetic islands, MHD stability

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This contribution is devoted to current student's projects at the GOLEM tokamak at the Czech Technical University in Prague with support of the Institute of Plasma Physics (IPP CAS). This device is the oldest operational tokamak in the world and is focused on the education of future fusion specialists. Uniquely, GOLEM tokamak features a full remote-control system which extends its reach worldwide. This is the first part of two contributions on this subject.

A new **combined Langmuir-Ball-pen electric probe** equipped with two Langmuir and two ball-pen probes has been installed, calibrated, and used for **advanced studies of the plasma edge**. **Spectral calibration of three compact spectrometers for visible light and near spectral ranges** was performed by students of the SUMTRAIC & EMTRAIC 2024 events. Surprisingly, several chlorine emission lines were identified in the measured spectra on GOLEM, **revealing erosion of the in-vessel diagnostics wiring**. Building on previous work [1], the formation of a **spontaneous transport barrier was studied in helium plasma**. Scaling laws were derived to explain the dependence of the electron temperature gradient on plasma input power and density. **Ion temperature was measured** with an **ultra-fast temporal resolution of 5 µs using a swept ball-pen probe** in hydrogen and helium plasmas. The study of MHD activity on GOLEM includes the **detection of magnetic islands using Mirnov coil signals**. A user interface was developed to enhance manual signal processing and visualization, with future plans for automation using AI. The **MHD stability of plasma** was also **investigated** by varying the plasma current intensity, pressure, and toroidal magnetic field. The **CAD geometry of the Golem tokamak** was converted to a suitable format to be **displayed via Google AR**. The attendees of the poster session will have a chance to look at the oldest working tokamak in the surrounding environment through their mobile device.

References

[1] P. Macha et al 2023 Nucl. Fusion 63 104003, DOI: 10.1088/1741-4326/acf1af