TOKAMAK GOLEM FOR FUSION EDUCATION - CHAPTER 9
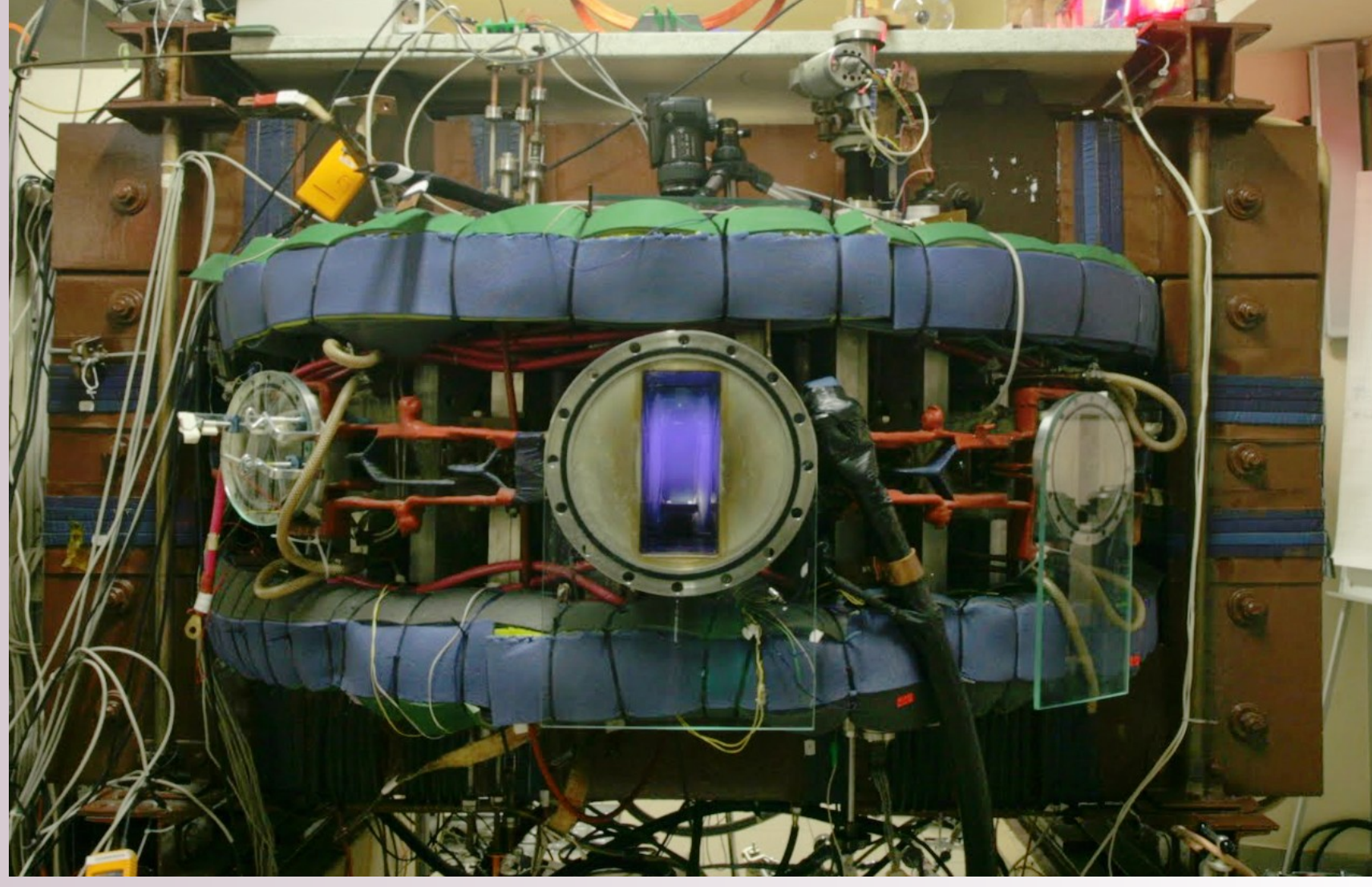
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The GOLEM Tokamak

- Parameters: $B_t < 0.5$ T, $I_p < 8$ kA, pulse length < 15 ms
- An educational device for domestic as well as for foreign students via remote participation/handling
- Students become familiar with probe measurements, data analysis and basic tokamak diagnostics.
- Subject of several Bachelor's degree projects and Master's degree theses each year
- At present used in an experimental laboratory course in the basic physics curriculum.

Electron density dependence

- Measurements of density dependence on other parameters of plasma.
- No influence of working gas preassure.
- Dependence on chamber temperature and plasma current was determined.
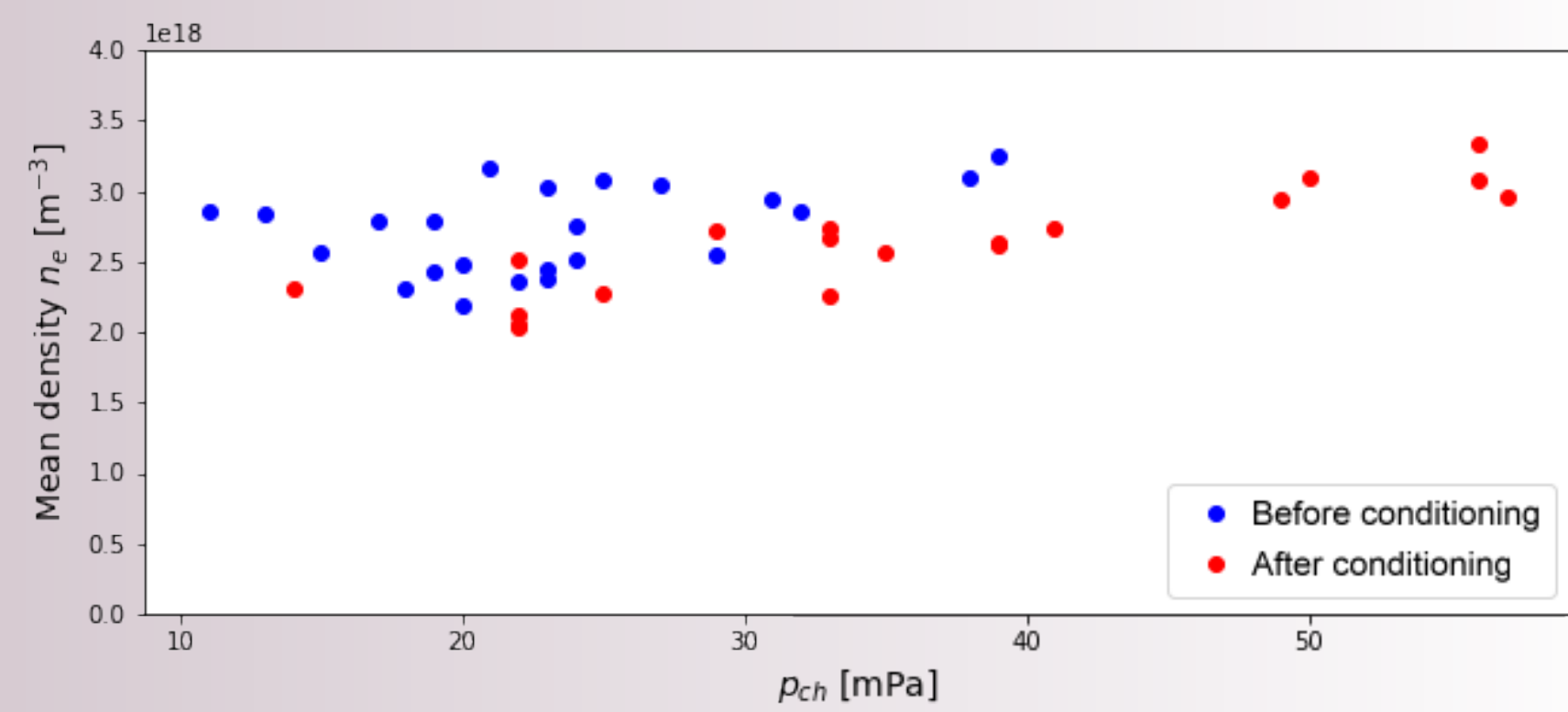
Electron density dependence on gas pressure before and after conditioning.

References

[1] V. V. Parail, O. P. Pogutse, Nuclear Fusion, **18**, 3(1978).

[2] J. Adamek et al, Contributions to Plasma Physics, **54**, 3, p. 279, (2013).

[3] J. Adamek, et al., Rev. Sci. Instr. **87**, 043510 (2016).

[4] R.S. Granetz et. al., Physics of plasmas, **21**,7: 072506 (2014).

[5] V. Svoboda, et al., Fus. Eng. and Des. **68**, 1310-1314 (2011).

Contact us

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Acknowledgment

The remote web control-room interface

- New wizard-like walk through remote control interface.
- Low risk of forgetting a setting, recommended setting available.
- All steps explained and accompanied by 3D model rendering.
- Access token further secures remote operation.

Right - Printscreen of the remote web control-room interface.
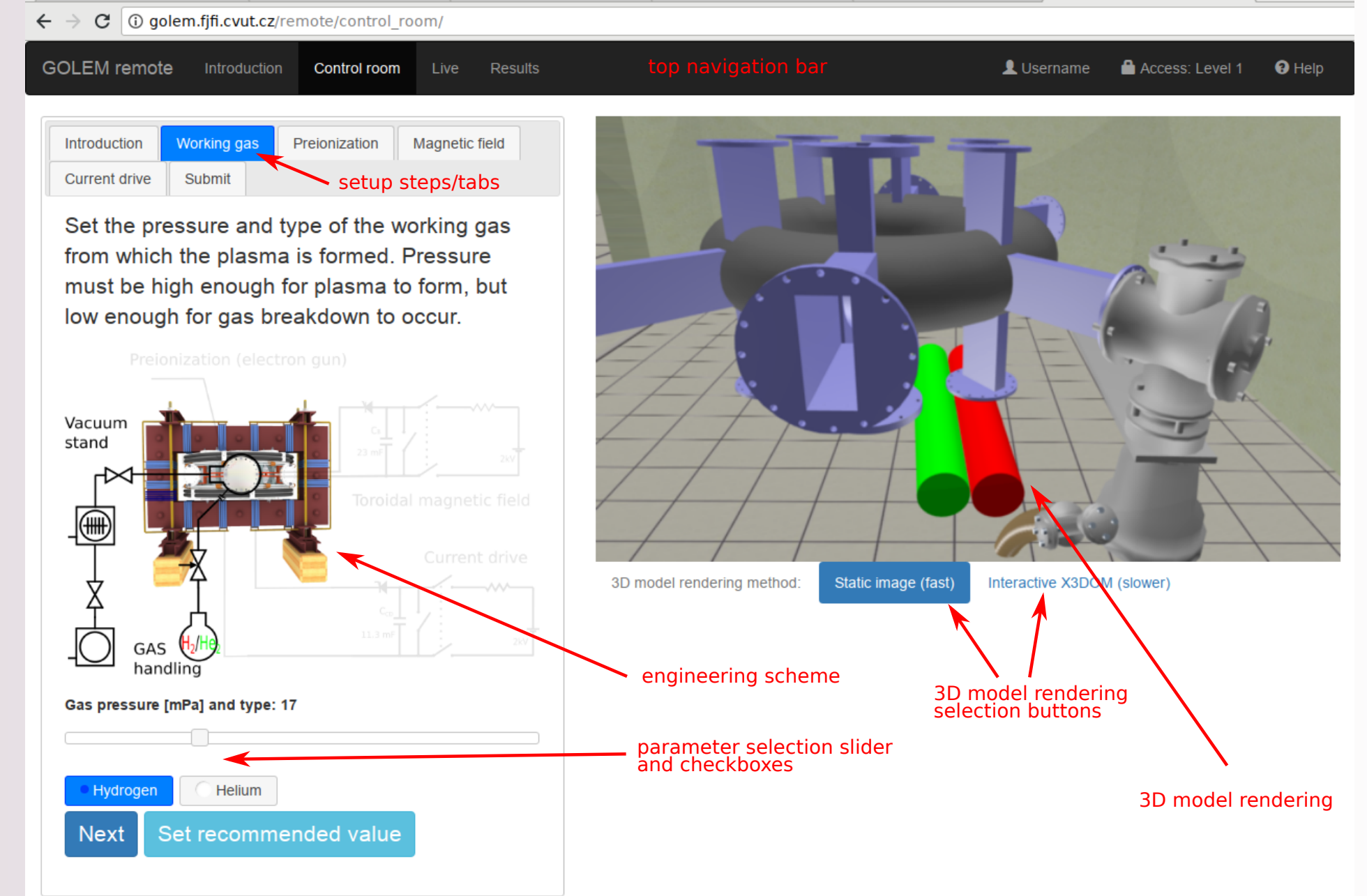
## Anomalous Doppler Instability observation by the Ball Pen Probe

- Low density discharges ($n_e \sim 10^{18}$ m^3) in GOLEM exhibit an ADI, which is:
  - manifested by 3 spikes of the U_{loop}
  - accompanied with an increase of HXR followed by an increase of the line average density $\rightarrow$ signature of an enhanced plasma wall interaction
- The edge plasma was analyzed by direct masurement of plasma potential with BPP.
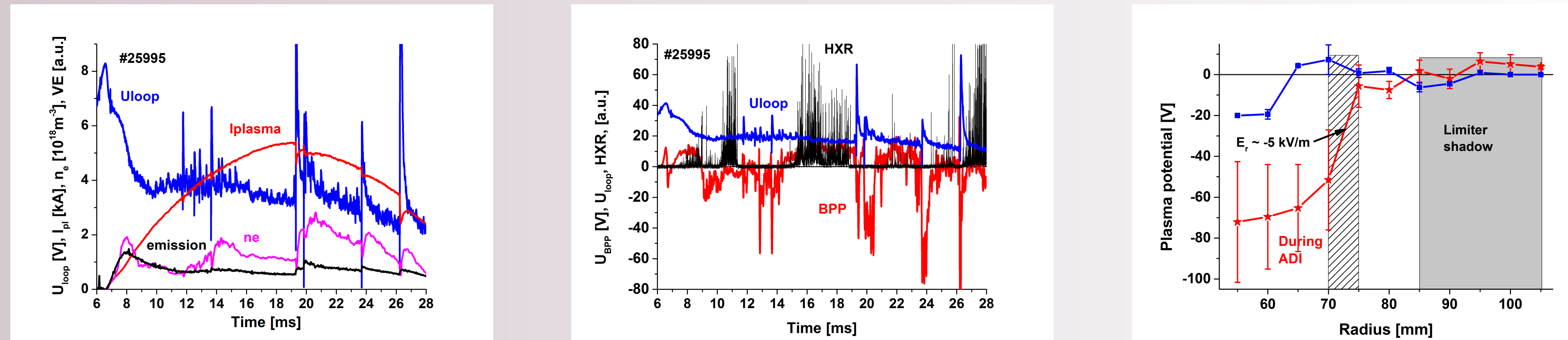
Temporal evolution of: left - a low density H discharge, mid - plasma potential at r = 70 mm and of the HXR emission. Right - Radial profiles of the plasma potential during appearance of the ADI.

Runaway electron studies

- Low electron density (4 - 6· 10^{18} m^{-3}) and relatively high loop voltage (4-6 V) $\rightarrow$ RE
- The improving plasma performance with the increasing number of discharges.
- Underestimation of the critical value of electric field E_{theor} by 3-10 times.
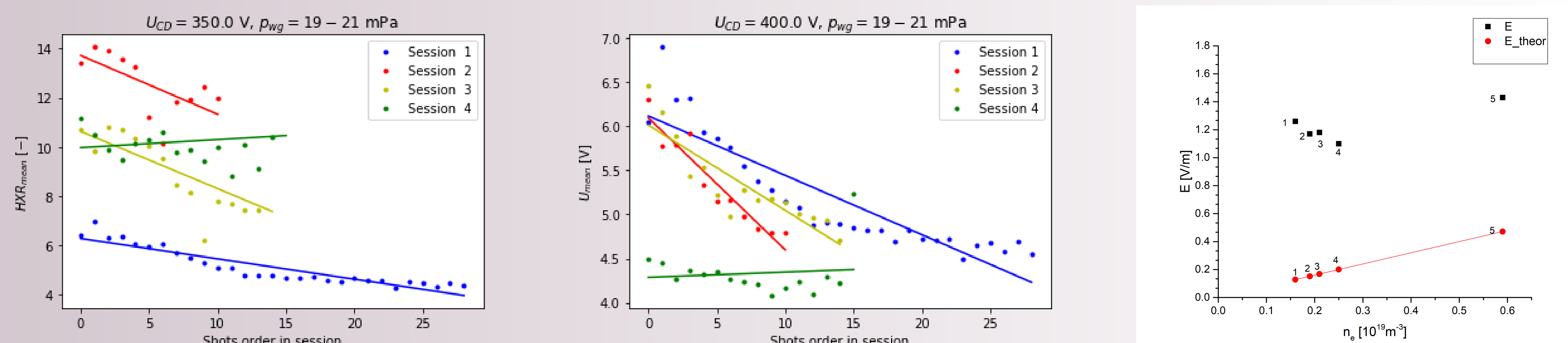
Left and Mid - Evolution of the mean intensity and mean U_{loop} during chosen sequence of discharges. Right - Comparison of theoretical and experimentally measured values of critical electric field 1: #25292, 2: #25508, 3: #25506, 4 :#25507, 5: #25505.

Plasma current control

- A numerical code for vacuum discharge modeling + table-top model developed to achieve a flat-top plasma-current regime.
- An algorithm for resistance shaping was implemented and tested on experimental data.
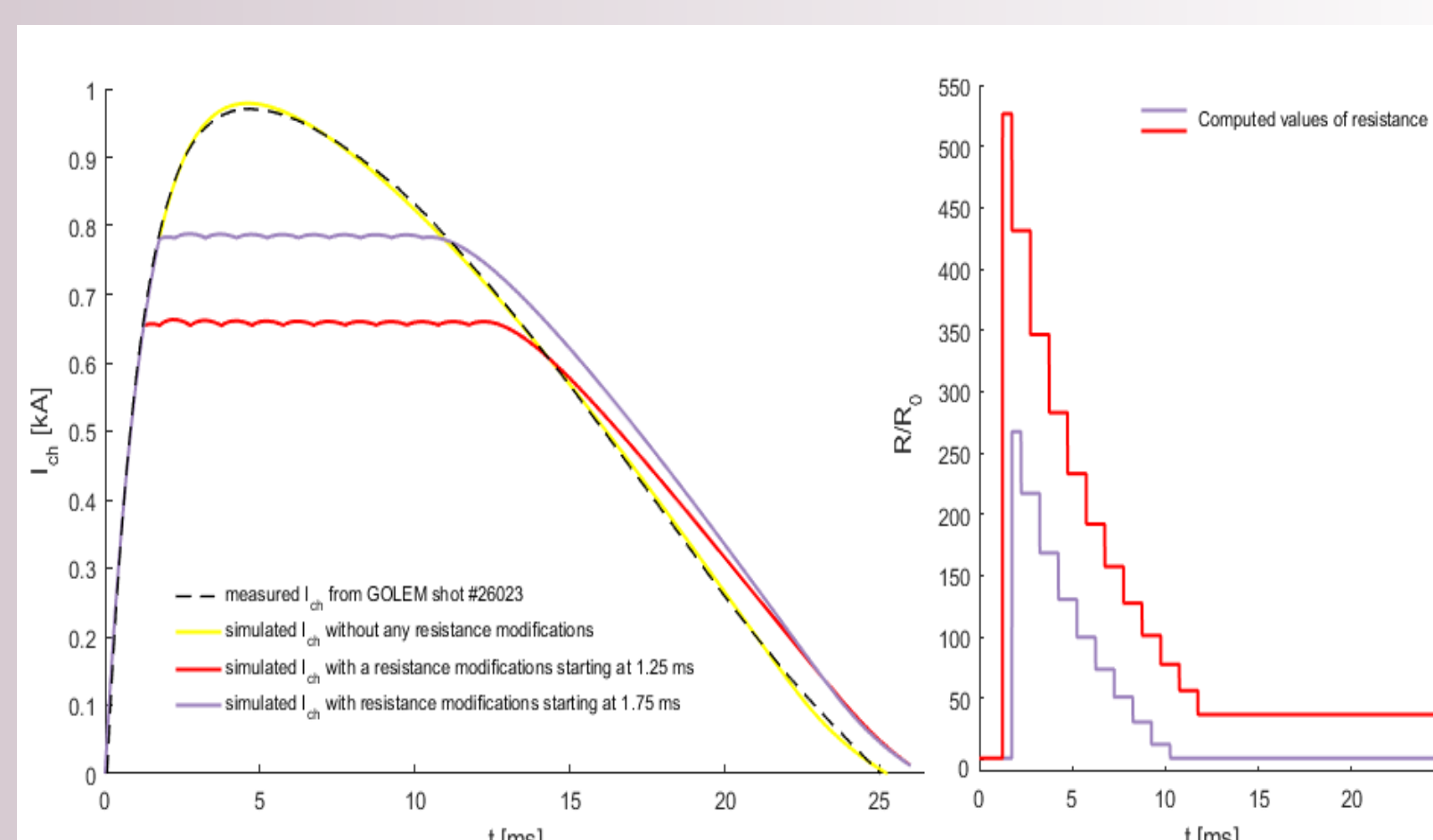
Simulated chamber current flat-top regimes and corresponding resistance values, experimental data from shot #26023 added for comparison.

Plasma radiation studies

- Comparing different methods of measuring electron temperature of helium plasma.
- Coronal-radiative model and isolines of two different ratios was applied.
- Helium spectral lines 668.00 nm, 706.76 nm and 728.33 nm were used.
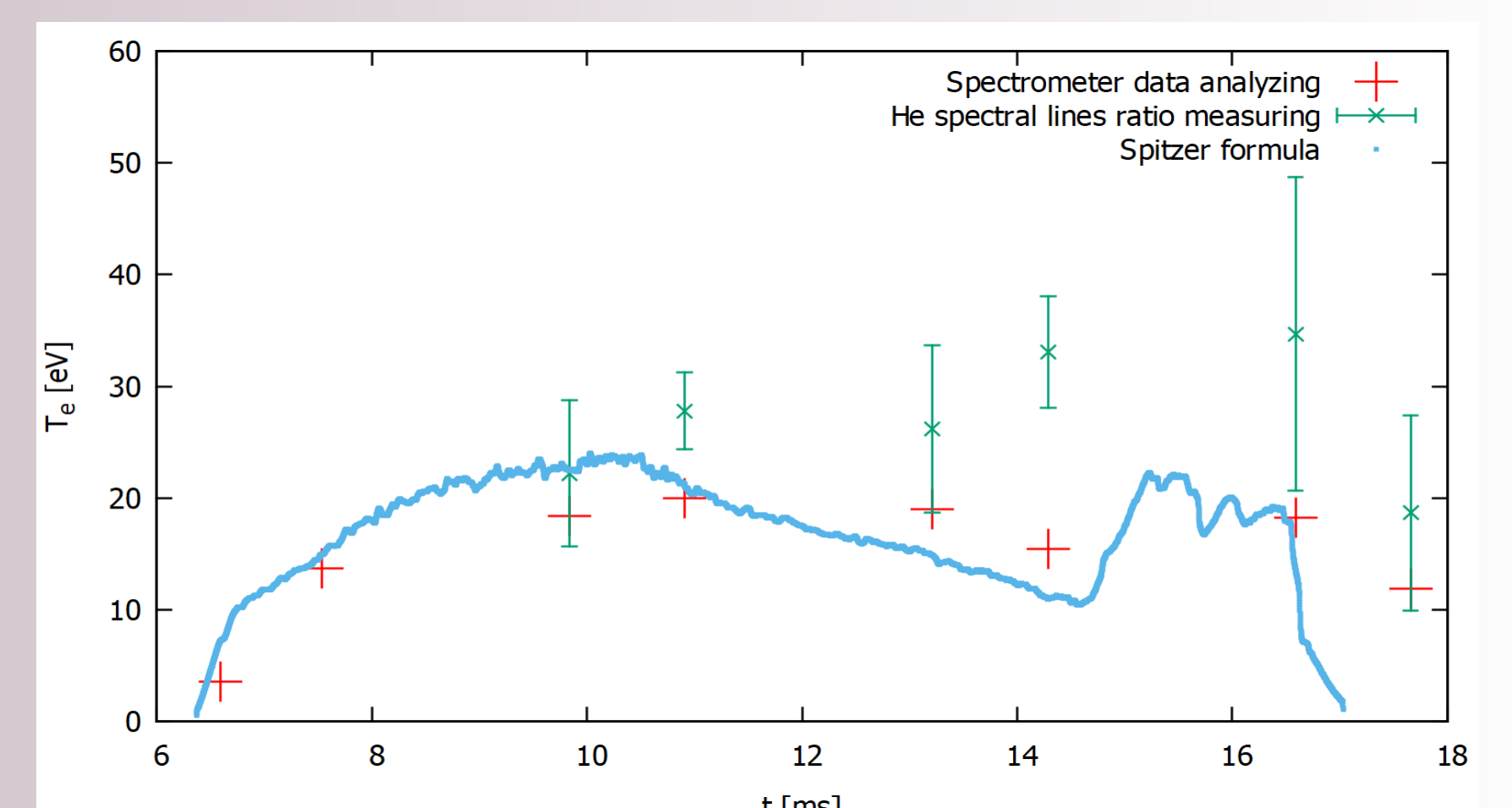
Electron temperature measuring in discharge #25611.