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T-15MD GOAL

Further development of fusion research and fusion energy in the Russian Federation is associated with two areas: the fusion power plant (DEMO) and hybrid fusion-fission systems based on the tokamak as a neutron source (FNS). The goal of the scientific research on the T-15MD tokamak [1] is to establish the scientific basis in support of the creation of steady-state FNS as well as research activity in support of the ITER project.

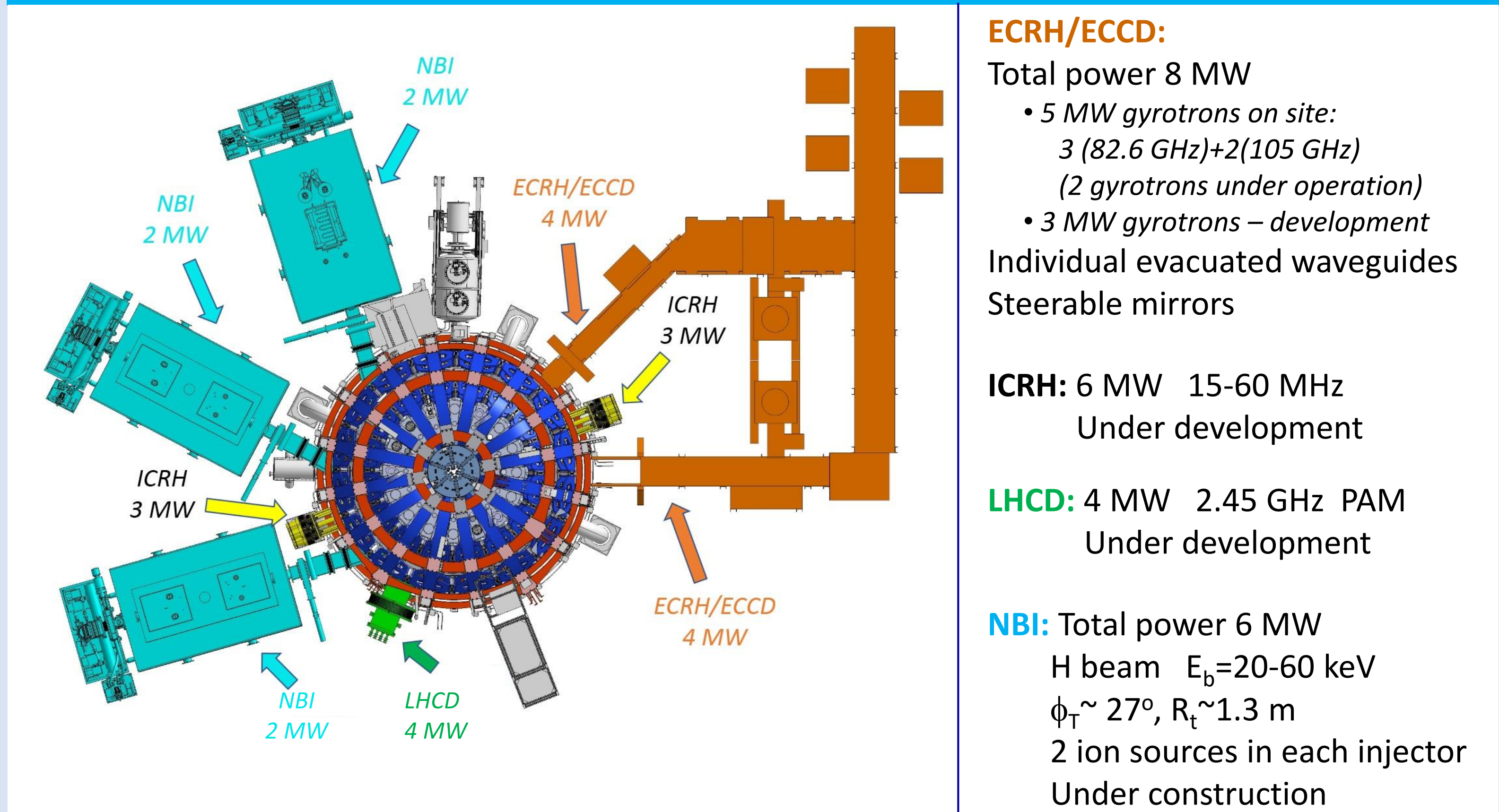
T-15MD research program will be aimed at solving of modern physical and engineering problems of tokamaks [2]:

- Noninductive scenario development, transport physics, MHD stability and control, plasma-wall interaction and divertor physics, physics of heating and CD, development of diagnostics etc.;
- Design of heating and CD systems, fuelling systems, development of first wall technologies, analysis of safety problem, development of remote handling systems etc.

T-15MD PROJECT PARAMETERS

	Major radius $R_0=1.48$ m Minor radius $a=0.67$ m Aspect ratio $A=2.2$ Elongation $k=1.8$ Triangularity $\delta=0.4$ Plasma current $I_p=2$ MA Toroidal field $B_T=2$ T Working gas H Pulse duration 10...30 s	MILESTONES 31.03.2023 First plasma Experimental campaigns: 2023 spring & autumn 2024 autumn 2025 spring
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AUXILIARY HEATING



DIAGNOSTICS

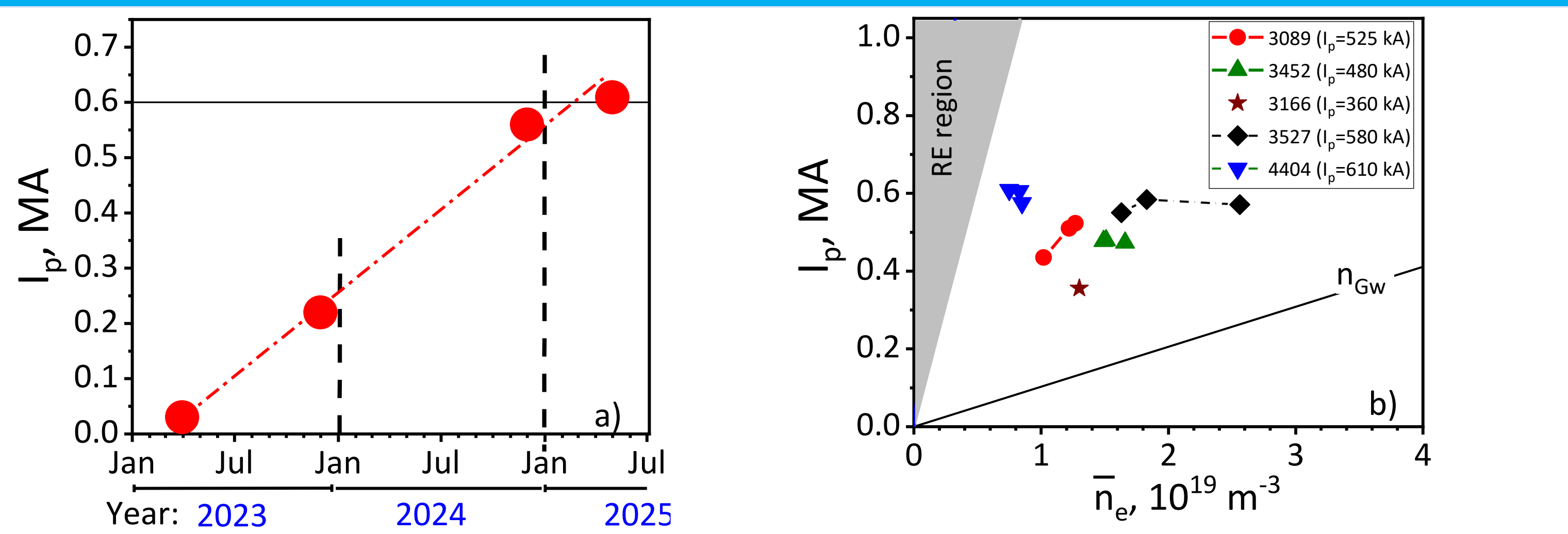
T-15MD tokamak diagnostics will be represented by more than 50 systems that allow measuring the plasma discharge parameters, as well as monitoring the state of technological systems. The set of diagnostics will include traditional systems and innovative ones designed to ensure plasma discharge control and control of facility state, measurement of basic parameters of plasma and an advanced set of characteristics

In Operation	Development
- Rogowskij coils - Poloidal Flux coils - Two-component magnetic probes - Loop voltage sensors - High-Res Visible Light Diagnostics - Pyroelectric bolometers - AXUV detectors - mm-wave interferometer (1 ch.) - Thomson scattering – tang. view - Multichannel SXR spectrometer - Visible Light Plasma Emission - Bremsstrahlung and linear emission - Diagnostics of plasma line emission spectra - SXR monitor - HXR monitor - HXR spectrometer - n⁰ emission monitor - Automatic radiation monitoring system - Fast cameras in visible light	- Fiber-optics current sensor - Saddle coils - Heavy Ion Beam Probe - MSE diagnostic - Heterodyne CO₂ laser interferometer - Two-color fiber laser interferometer - Sweeping (FMCW) reflectometry - Correlation reflectometry - Doppler reflectometry - Helium beam spectroscopy - Thomson scattering – vert. view - Divertor Thomson Scattering - ECE - Laser induced quenching
Commissioning	Planned
- Diamagnetic coils - Mirnov coils - Divertor Langmuir probes - CXRS - Neutral particle analyser	- Fast movable magnetic probe - BES - Fast reciprocating Langmuir probe - Diagnostics of ion temperature fluctuations on the heating beam - X-ray crystalline monochromator - Fast Ion diagnostics - Diagnostics of transient SXR disturbances - Suprathermal XR tomography - n⁰ emission tomography - n⁰ emission spectrometer - Fast cameras in IR light - Materials Science Station - Diagnostics of vibrations and deformations of tokamak components

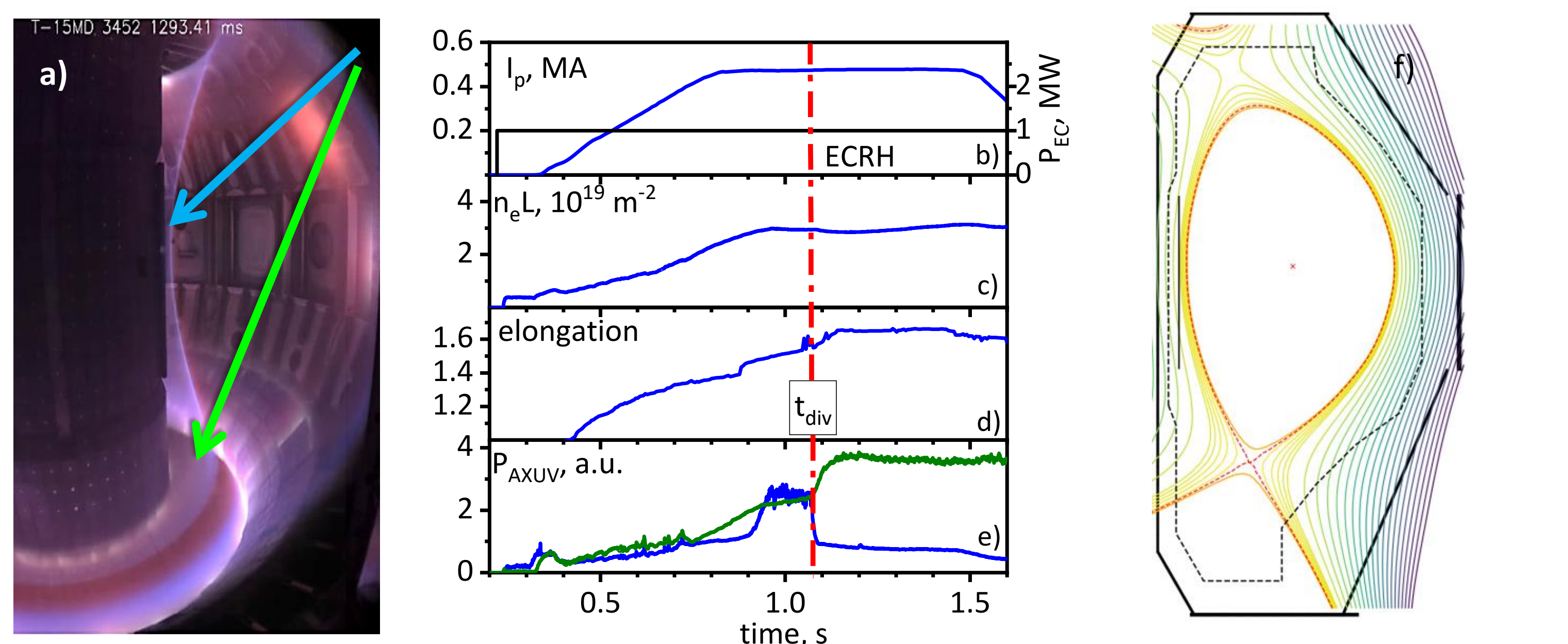
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- [2] Velikhov, E.P., Kovalchuk, M.V., Anashkin, I.O., et al., Physical research program on the T-15MD tokamak, Prob. of Atomic Science and Techn., ser. «Thermonuclear Fusion» **47** 4 (2024) 9-183 (in Russian).
- [3] de Vries, P.C., Mineev, A.B., et al, Nucl. Fusion **65** 5 (2025) 056001.
- [4] Ulasevich, D., et al, Submitted to Plasma Phys. Reports, 2025.

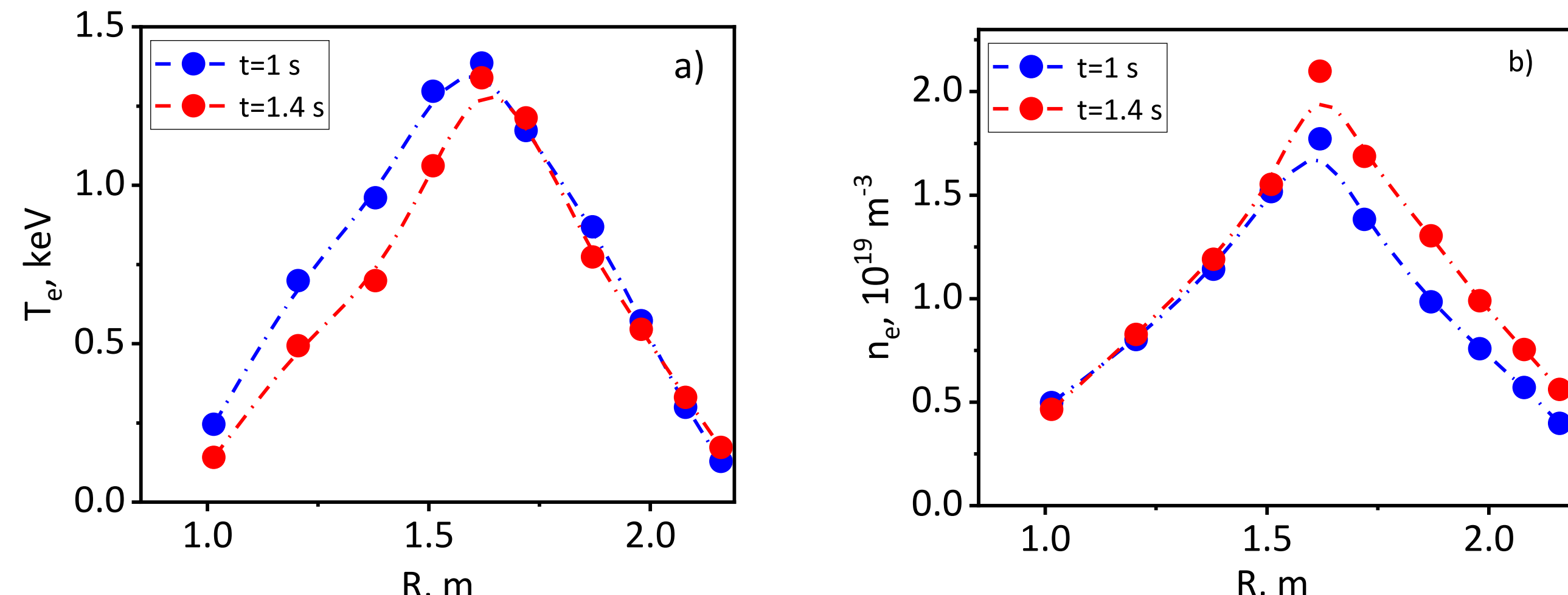
FIRST EXPERIMENTAL RESULTS



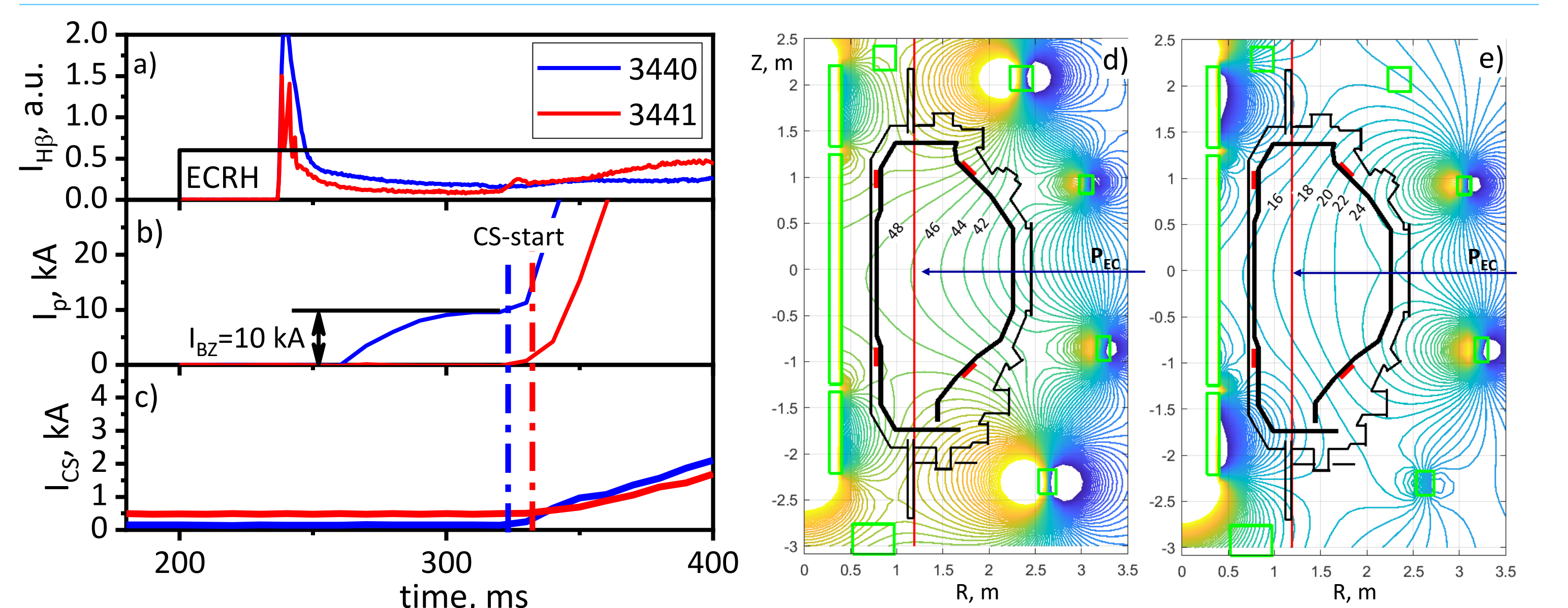
- Plasma current up to 0.6 MA is reached after 2 years of experiments.
- Simulations made using SCENPLINT code [3] for T-15MD shot #3089 showed that the current is carried by thermal plasmas.



- First discharges with divertor configuration formation were obtained at $I_p > 0.38$ MA and $k > 1.5$. Transition to the divertor configuration was registered by visible light imaging, AXUV, bolometers and Langmuir probes and was confirmed by equilibrium codes.



- Density and temperature profiles correspond to L-mode in both limiter and divertor configuration.
- Energy confinement time estimated as $\tau_E = W_{ec}/(P_{OH} + P_{EC})$ is in agreement with ITER L-mode scaling ITER-89P.



- T-15MD discharges were initiated using EC preionization.
- Optimization of magnetic configuration made it possible to get EC assisted plasma start-up in a wide range of $P_{EC} = 0.47-0.9$ MW. The value of initial current depends on the B_z value and was found to be independent on toroidal launch angles (observed in a whole range from $\phi_T = 0^\circ$ to $\phi_T = 18^\circ$).
- Dependence of I_{Bz} on magnetic configuration, p_{init} , P_{EC} etc. and its effect on discharge development are under investigation.

SUMMARY

- Plasma discharges with the current up to 0.6 MA have been obtained in T-15MD tokamak with ECR assisted start-up. The first discharges with divertor configuration were produced.
- Development of the heating systems and diagnostics continues.
- Upcoming work at the T-15MD facility will be focused on developing discharge scenarios with a divertor configuration, ECRH power increase (up to 5 MW), commissioning of the first neutral beam injector, and expanding the range of physical research.