Laser-induced quenching diagnostic of hydrogen atoms in ITER divertor [[1]](#footnote-1)\*)

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Laser-induced quenching (LIQ) diagnostic [1, 2] is proposed for measurement of hydrogen (deuterium, tritium) atoms density in ITER divertor. In opposite to other ITER diagnostics (Residual Gas Analyzers, H-alpha and visible spectroscopy) LIQ measures local concentrations. Therefore LIQ diagnostic will allow analyzing of main component density profiles (H, D, T) in divertor plasma along the probing laser beams [3]. Combining of LIQ and divertor Thomson scattering (DTS) diagnostics makes it possible to consider electron density and temperature measured by DTS in the similar spatial points during evaluation of hydrogen density from quenching signals [4]. Different spectral ranged of LIQ and DTS allow universal laser and collecting optics for both diagnostics.

Basics, benefits and applicability features under ITER conditions of the LIQ method for hydrogen density are described in the work. Developed dynamic collision-radiative model (CRM) of hydrogen atom allows calculating expected quenching signals and background intensity for DT scenarios of ITER. These calculations give an ability to assess measurement accuracy of the density in the observation points along the probing laser beam. The analysis was performed for two types of laser system: pulsed optical parametric oscillator (OPO) and time-modulated fiber laser. An optical layout and transmission of the collecting optical elements and fiber bundle were considered in the analysis as well as characteristics of the spectral device and photodetector (avalanche photodiode).

The calculations of signals and the performed analysis show that the laser system based on optical parametric oscillator can measure hydrogen density (deuterium, tritium) in ITER divertor with relative errors lower than 10% from *na*(H) ≈ 1017 m-3. The time-modulated fiber laser instead of pulsed OPO increases signal-to-noise ratio for more than ten times, therefore it decreases the sensitivity threshold of the diagnostic up to *na*(H) ≈ 1016 m-3.

References

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1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLVII/E/ru/IP-Gorbunov.docx) [↑](#footnote-ref-1)