

Development and first results of the edge Thomson scattering diagnostic with compact polychromators on the HL-2M Tokamak

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An edge Thomson scattering (ETS) diagnostic system on the HL-2M tokamak has been developed recently. A Nd: YAG laser (1064 nm, 2 J, 30 Hz, 15 ns) is used as the probe beam. The laser beam propagates vertically through the plasma region and the scattered light is observed horizontally. The combination of a half-wave plate and a polarizing beam splitter is used for stray light suppression. Characteristics of the non-ideal Gaussian laser beam is studied in detail. The laser beam waist and vertical spatial resolution are 2 mm and 10 mm, respectively. A set of collection lens is designed to image the 400 mm scattering region onto the rectangular fiber arrays. Scattered light is focused onto the 2.20×2.86 mm (10×13) fiber optic bundle. The collection optics is installed inside the vacuum chamber and the solid angle at central field of view is 0.018 sr. The 5-channel compact polychromator (Width 482 cm \times Height 8.8 cm) is developed to measure the scattered light. The noise level of each channel is less than 5 mV. The designed electron temperature measurement range is from 5 to 1000 eV and electron density measurement range is from 5×10^{18} to 1×10^{20} m⁻³. Measurements results of electron temperature and electron density by ETS are compared with that from the electron cyclotron emission (ECE) radiometer, the microwave interferometer, and the CO₂ dispersion interferometer. Combined with the data from the core Thomson scattering diagnostic system, the HL-2M plasma electron temperature profile is presented for the first time.

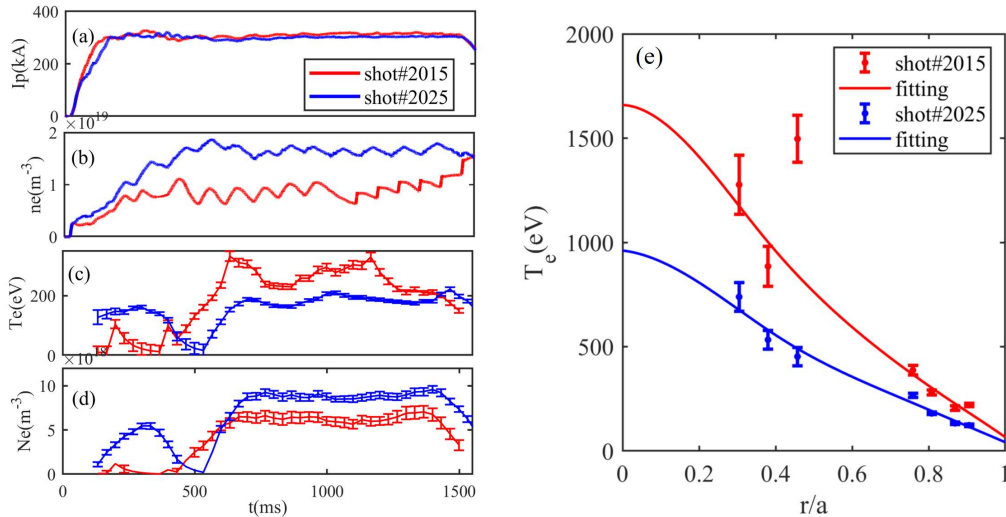


Figure 1. Comparison of plasma parameters of shot 2015 and shot 2025. (a): Plasma current. (b) Averaged electron density. (c) Electron temperature by EST. (d) Electron density by EST. (e) Plasma electron temperature profile.

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