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ヘリウム線強度比分光を用いた電子密度、温度揺動およびその位相差の計測
Measurements of electron density and temperature power spectra and their cross phase by using thermal helium beam diagnostic

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Fast fluctuation measurements are essential to understand turbulent transport in hot magnetized plasmas. While a thermal helium beam diagnostic (THB) is capable of providing both electron density and temperature[1], achieving high time resolution has been difficult due to the photon noise. In this contribution, we introduce a new correlation analysis technique for THB. Instead of directly evaluating line ratios from fluctuating time series, we apply arithmetic operations to all available He I lines and construct time series with desired dependencies on the plasma parameters. By cross-correlating those quantities and by evaluating ensemble averages, uncorrelated noise contributions can be removed. Through the synthetic data analysis, we demonstrate that the proposed analysis technique is capable of providing the power spectral densities of meaningful plasma parameters, such as the electron density and the electron temperature, even under low-photon-count conditions. In addition, we have applied this analysis technique to the experimental THB data obtained at the ASDEX Upgrade tokamak and successfully resolved the electron density and temperature fluctuations up to 90 kHz in a reactor relevant high power scenario as shown in Fig. 1. This contribution is based on Ref[2].

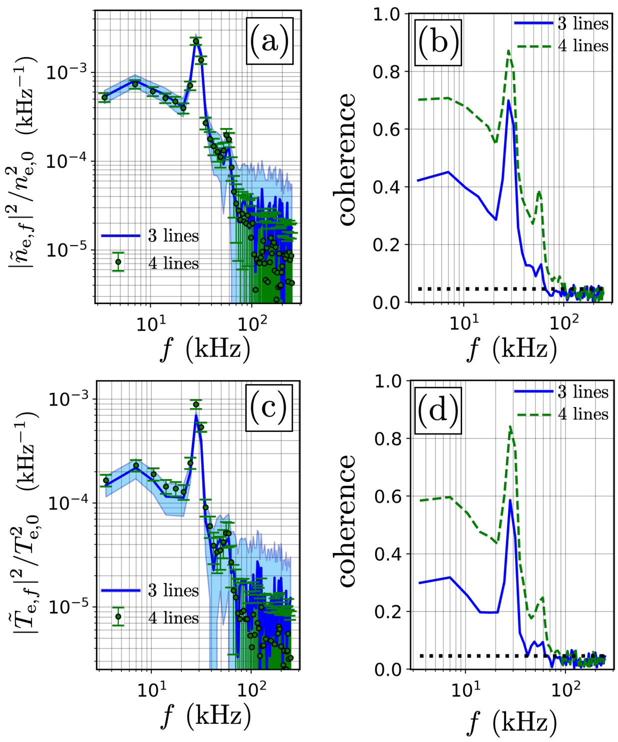

Fig. 1: Power spectral densities of n_e(a) and T_e(c) at $\rho_{pol} = 1.02$ for an EDA H-mode discharge #36124. The blue lines are calculated by using 667, 706, and 728 nm lines while the green dots are calculated by using 587 667, 706, and 728 nm lines.The coherence of (a) and (c) are shown in (b) and (d), respectively.

References

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