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Development of 105 GHz Collective Thomson Scattering System on HL-2A

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A 105 GHz collective Thomson scattering (CTS) diagnostic for measurement of velocity distribution of fast ions has been developed on HL-2A tokamak. A high gain Cassegrain antenna installed below the gyrotron launcher is used to receive the scattering beam from the central chord inside the vacuum vessel. The transmission system and notch filters provide a suppression level >60 dB at 105 GHz, to protect the electronics in receiver system. The measured position is determined by the steerable gyrotron launcher, and the spatial resolution range varies from 70 mm at LFS to 260 mm at HFS1.

Positive linear relationships are found between the power of the CTS signal and Neutral Beam Injection (NBI) power or neutron count, indicating that the scattering signal contains a contribution from fast ions. Via signals with NBI dividing signals without NBI, a measured scattering spectrum consistent with simulation is obtained.

The high-frequency range of signals enhanced by NBI is slightly wider than the calculation, which may not come from accelerated fast ions. There could be a small heating effect of the modulated gyrotron since the gyrotron frequency is in the range of the third harmonic electron cyclotron frequency. The absorption of probe radiation in the plasma broadens measured spectra2.

A 140 GHz CTS system is under development on HL-3. Notch filters with larger attenuation can be adopted for better signal-to-noise ratio and thus clear scattering spectra. Furthermore, the full electromagnetic model for the simulation of scattering spectra could be utilized to extract projection velocity distribution from results.

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