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A novel comb-based multi-channel microwave Doppler backward scattering diagnostic on the HL-3 tokamak

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A novel multichannel Doppler backscattering (DBS) system based on a comb generator has been designed and tested for application on the HL-3 tokamak. DBS diagnostic is widely used to measure the localized density fluctuations and the propagation velocity of turbulent structures[1-4]. Microwave is launched at a frequency that approaches a cutoff layer in the plasma and at an angle that is oblique to the cutoff layer. Bragg backscattering occurs near the cutoff layer for fluctuations with k⊥=-2ki, where ki is the incident probe wave vector at the scattering location. The turbulence propagation velocity can also be determined from the Doppler shift in the return signal together with the knowledge of the scattering wavenumber. With the comb generator and heterodyne scheme, the stability and flexibility of the DBS system are greatly improved. The turbulence information can be obtained with high temporal and spatial resolution. This article introduces the system design, laboratory test results, and initial experimental results from HL-3.

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