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Current profile measured by the motional Stark effect polarimeter in the HL-2A tokamak

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The safety factor and current density profiles play a very important role in understanding magnetohydrodynamics and micro-instability. Motional Stark effect (MSE) is one of the most powerful tools to measure the current density. A 4-channel MSE polarimeter based on dual photo-elastic modulators (PEMs) has been developed in the HL-2A tokamak. For each channel, 6 1-millimeter silicon fibers are applied. And off-the-shelf avalanche photodiode detectors with frequency band of 250 kHz are adapted due to its quantum efficiency up to ~83% at 660 nm. The beam emission spectra are filtered by a monochromator; and the filter is controlled by an absolutely calibrated rotator, which can change the tilting angle of the filter with velocity of 720 degree/s, corresponding to the wavelength change of 288 nm/s with the filter. The rapid angle change of the monochromator enables the wavelength to be swept during the discharge. The accuracy of the MSE can be up to $\pm 0.15^\circ$ in the calibration experiments.

On HL-2A, the motional Stark effect is rather weak [1]. During the pilot experiment, the pitch angles of magnetic field are obtained for 3 spatial channels covering 10 cm along the major radius with time resolution of 5 ms. The profiles of current density and safety factor are obtained by the Current Profile Fitting (CPF) code, as shown in Figure 1. The q profile is monotonic, and the minimum q value is around 0.7. And the position of the q=1 surface consists with the sawtooth inversion radius measured by ECE.

[1] D. L. Yu et al., Rev. Sci. Instrum., 85, 053508 (2014).

Eligible for student paper award?

Yes

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