Performance test of dual modulator polarimeters in two different configurations for magneto-optic measurement of fusion devices (P1-D-331)

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Accurate measurement of the magnetic field around plasma is indispensable for real-time control and data analysis on magnetic fusion devices such as tokamaks. Instead of commonly used pick-up loops, which have the problems of zero-point drifts, we proposed and tested a magneto-optic polarimeter based on the polarization modulation method using two photoelastic modulators (PEMs). Polarization detection using a pair of PEMs has been applied to the motional Stark effect (MSE) measurements in some tokamaks. The CO2 laser polarimeter for electron density measurement on JT-60U adopted this method and demonstrated long time stability for several hours. However, this method requires the same number of pairs of PEMs, which are delicate and expensive, as that of channels so that this method is not easy to apply to multi-point measurements of magnetic fields around tokamaks. To cope with this problem, the two PEMs, which are conventionally placed behind each magnetic sensor, are used to modulate the incident beam before split for each magneto-optic sensor. This configuration can reduce the number of PEMs drastically and the optical system becomes simple. In this new optical configuration, the polarization angle resolution comparable to the conventional optical configuration of 0.002° with response time of 10 ms was achieved at an incident polarization angle of about 0° while that at 21° was 0.07°. The resolution of 0.07° corresponds to 7 gauss when a 40-mm-long ZnSe sensing rod is used. Performance test between the two optical configurations were also made on the long-time stability and the accuracy with increasing numbers of beam splitters and/or mirrors for multi-point measurements.