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8.49 High Resolution Magnetic Field Measurements in Hydrogen and Helium Plasmas using Active Laser Spectroscopy

Tuesday, 17 April 2018 16:01 (120)

Passive spectroscopic measurements of Zeeman splitting has been reliably used to measure magnetic fields in plasmas for decades. However, a requirement is that the field must be high enough to be resolved over Doppler and instrument broadening (typically >1 T). A synthetic diagnostic capable of measuring low magnetic fields (<5 mT) with high sensitivity (+/- 0.5 mT) is currently under development at Oak Ridge National Laboratory. The diagnostic relies on Doppler-free saturation spectroscopy (DFSS), an active, laser-based technique that greatly reduces Doppler and instrument broadening. To date, diagnostic has been successfully employed to measure the magnetic field in a magnetized (55-90 mT), low-temperature (5-20 eV), low-density (5e16-3e18 mˆ-3), hydrogen and helium plasma in the 5-200 mTorr pressure range using a low power (25 mW) diode laser. These measurements are presented and shown to be accurate within 0.5 mT. Crossover resonances (CR's) (an artifact of the diagnostic) are also observed within the measured spectra. Parametric response of the CR's to the magnetic field and gas temperature will be presented. A quantitative model, developed from these measurements, to accurately predict the CR's behavior will also be given.

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