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3D-localized, high-resolution, non-perturbing, vectorizable magnetic field diagnostic using two-photon Doppler-free laser-induced fluorescence YOUNG DAE YOON, PAUL M. BELLAN, Caltech — A detailed description of a new plasma magnetic field diagnostic using Doppler-free two-photon laser-induced fluorescence is presented. The diagnostic is based on a method previously developed in the context of rubidium vapor experiments. Two counter-propagating diode laser beams at ∼394nm are directed into an argon plasma to excite Ar-II ions from the metastable level $3s^2 3p^4 4p\ ^4D_{7/2} \longrightarrow 3s^2 3p^4 4p\ ^4D^o_{5/2} \longrightarrow 3s^2 3p^4 5s\ ^2P_{3/2}$. The levels involve two similar (394.43nm and 393.31nm) transition wavelengths, so the two counter-propagating beams effectively cancel out the Doppler effect. The excited ions then decay to the $3s^2 3p^4 4p\ ^2D^o_{5/2}$ level, emitting a 410.38nm line which is to be detected by a photomultiplier tube. The Zeeman splitting – normally unobservable because of the large Doppler broadening – of the resultant fluorescence is then to be analyzed, yielding the magnetic field of the particular location. This method is expected to provide 3D localized, non-perturbing vector measurements of the magnetic field. The resolution of the diagnostic is only limited by the cross-section of the laser beam, which can easily be as small as hundreds of microns wide. An experimental implementation is currently in progress.

Young Dae Yoon
Caltech

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