Abstract Submitted
for the DPP15 Meeting of
The American Physical Society

Plasma magnetic field diagnostic using two-photon Doppler-free LIF YOUNG DAE YOON, PAUL BELLAN, Caltech — A detailed description of a new plasma B 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 393nm diode laser beams are directed into an argon plasma to excite Ar-II ions from $3s^2 3p^4 4s\ ^4P_{1/2} \longrightarrow 3s^2 3p^4 4p\ ^4S_{3/2} \longrightarrow 3s^2 3p^4 4d\ ^4P_{3/2}$. These levels involve two similar (392.86 and 393.25nm) transition wavelengths, so the two counter-propagating beams effectively cancel out the Doppler effect. The excited ions then decay to the $3s^2 3p^4 4p\ ^4P_{1/2}$ level, emitting a 324.98nm 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 a 3-D localized, non-perturbing measurement of magnetic fields. An experimental implementation is currently in progress.

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Date submitted: 23 Jul 2015 Electronic form version 1.4