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Laser absorption velocimetry using an optical vortex beam[1] SHINJI YOSHIMURA, National Institute for Fusion Science, MITSUTOSHI ARAMAKI, Nihon University, NAOYA OZAWA, Nagoya University, KENICHIRO TERASAKA, MASAYOSHI TANAKA, Kyushu University, TOMOHIRO MORISAKI, National Institute for Fusion Science — A plain-wave-like beam, or a Hermite-Gaussian mode, has been used for conventional laser spectroscopy. Since the Doppler shift in frequency of light absorbed by a moving atom is given by the dot product of the wave vector of the light beam and an atomic velocity, it is essentially a one-dimensional measurement. It has a merit that the interpretation of the result is clear and straightforward; however, it simultaneously poses a limitation that the measurable velocity component is confined to the projection along the wave vector. This limitation may be overcome by using an optical vortex beam, or a Laguerre-Gaussian mode, which has helical phase fronts associated with orbital angular momentum of light. Due to its three-dimensional phase structure, the Doppler shift for an atom moving in the optical vortex beam has three components. Therefore, the laser measurement method that has a sensitivity even for transverse motion across the beam is possible to be achieved. We have performed laser absorption measurements using optical vortex beams as a proof-of-principle experiment, where an additional frequency shift in the absorption spectra of metastable argon neutrals in a plasma has been observed. The details of experimental results will be discussed in the conference.

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