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Fine structure of Balmer-α line of atomic hydrogen measured by saturation spectroscopy SHUSUKE NISHIYAMA, Hokkaido University, Japan, GOTO MOTOSHI, National Institute for Fusion Science, Japan, KOICHI SASAKI, Hokkaido University, Japan — Saturation spectroscopy is a widely used technique to obtain Doppler-free resolution in fundamental spectroscopy. This technique, however, is not used commonly for plasma diagnostics. In this work, we developed a system of saturation spectroscopy at the Balmer-α line of atomic hydrogen with the intention of applying it to diagnostics of the Large Helical Device at the National Institute for Fusion Science. A weak probe beam and a intense pump beam were injected into a linear magnetized plasma source on the chord of the cylindrical axis of the plasma from the counter directions. The frequency of the probe and pump beams was scanned simultaneously over the whole range of the Doppler-broadened Balmer-α line. In the condition of a weak magnetic field (60 Gauss), we obtained a saturation spectrum with many obvious peaks without Zeeman splitting. Most of the other peaks were assigned to fine-structure components of the Balmer-α line and their cross-over signals, which arose at the midpoint frequency of two transition peaks with a common lower or upper level. We also found anomalous cross-over signals at the midpoint of the peaks which had $2s$ and $2p$ as their lower levels. These signals suggest that the populations of $2s$ and $2p$ are exchanged significantly.

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