Abstract Submitted
for the DPP12 Meeting of
The American Physical Society

Direct Measurements of the Ionization Fraction in Krypton Helicon Plasmas[1] RICHARD MAGEE, MATTHEW GALANTE, GREG LUSK, DUSTIN MCCARREN, EARL SCIME, West Virginia University, NJAL GULBRANDSEN, University of Tromso — Helicons are efficient plasma sources, capable of producing plasma densities of 10^{19} m^{-3} with only 1 kW of input RF power. But the ionization fraction in the core of a helicon is usually not well known, because the neutral density is typically inferred from indirect spectroscopic measurements or from edge pressure gauge measurements. We have developed a two photon absorption laser induced fluorescence (TALIF) diagnostic capable of directly measuring the local neutral density. We use TALIF in conjunction with a Langmuir probe to measure the neutral and ion density profiles as a function of driving frequency and magnetic field. We find that when the frequency of the driving wave is greater than the lower hybrid frequency (f_{LH}), the core ionization fraction is small (0.1 %) and the plasma density low (10^{17} m^{-3}). As the axial magnetic field is increased, or, equivalently, the driving frequency decreased, a transition is observed at RF = f_{LH}. The plasma density increases by a factor of 10 or more, the plasma density profile becomes strongly peaked, the neutral density profile becomes strongly hollow, and the ionization fraction in the core reaches ∼100%. The dramatic neutral depletion in the core is thought to be due to a combination of increased ionization and neutral pumping. The role of the latter is quantified by a comparison of flowing and static discharges.

[1]This work is funded by the US DoE through grant DE-SC0004736.

Richard Magee
West Virginia University

Date submitted: 19 Jul 2012 Electronic form version 1.4