The VINETA device: fundamental studies with stallarator applications

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The VINETA device is a linear magnetized helicon discharge (magnetic field $B_0 \leq 0.1$T). The Argon plasma (column 4m length, 0.1m diameter) can achieve densities up to $n=10^{19}m^{-3}$ and temperatures $T_e=3$eV and $T_i=0.2$eV at moderate radiofrequency (RF) powers ≤ 6kW. The VINETA device is used for basic experiments on drift wave turbulence, helicon waves and ion dynamics in wave fields. Drift waves are investigated with high-resolution poloidal probe arrays, providing space-time data for detailed statistical analysis. Of particular current interest is the role of the collisionality on the drift wave dynamics. To achieve independent control of the electron temperature, the helicon target plasma is additionally heated by a 7kW electron-cyclotron resonance system, under construction. The kinetics and drift dynamics of Argon ions in the presence of wave fields, e.g. kinetic Alfvén waves and drift waves, is studied by means of diode laser-induced flourescence (DLIF). This versatile diagnostic tool provides both ion temperatures, ion densities, mean ion drifts as well as perturbed velocity distribution functions. Of particular interest is the application of time-resolved DLIF to measure wave fields and drift mode structures. Finally, helicon modes are used for non-resonant wave heating of plasmas. The helicon discharge mechanism is known to be extremely efficient, even though the understanding is still far from being complete. It is planned to use helicon wave heating in the small l=2 stellarator WEGA as well. All these recently started basic plasma physics studies and diagnostics developments are seen to be of relevance for stellarator edge physics, where the plasma is not confined and a variety of pressure gradient driven instabilities lead to anomalous transport behavior, in particular far-SOL profiles.