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Diagnostic Neutral Beam and Beam-Based Diagnostic Development to Study Non-Inductive Startup Techniques[1]

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An 80 kV, 4 A, H^0 beam is being developed as a plasma diagnostic tool for studying non-inductive tokamak plasma startup methods in the URANIA experiment. The new diagnostics will provide measurements of equilibrium magnetic fields and possibly field fluctuations, ion temperatures, and plasma density profiles. These beam-based diagnostics will address important aspects of helicity injection startup and sustainment. These include examining dissipation mechanisms during helicity drive (*e.g.* anomalous ion heating through magnetic reconnection, anomalous resistivity, etc.), the role of impurities, and plasma magnetic field structures. A washer stack arc plasma source is implemented as the source of H^+ for the DNB. Its plasmas are characterized with a double tip Langmuir probe, a spectrometer, and measurements of the arc voltage and current. Initial results show that stable density plasmas ($n_e \approx 10^{17}\mathrm{m}^{-3}$) with steady electron temperatures of 0.5–4 eV can be generated by the source, which are expected to produce a full energy species fraction of greater than 80%. A novel 80 kV resonant DC-DC converter power supply has been constructed and is being optimized for minimal output voltage ripple. Initial tests have produced a 10 ms pulse at 40 kV.

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