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Loop voltage, inductance, and impurity ion velocity in toroidal discharges D. H. MCNEILL, Consultant, 3955 Bigelow Blvd., Pittsburgh, PA 15213 — Strong co-current drift and substantial heating of impurity ions were reported in some early (∼1960) toroidal devices with low magnetic field B and high loop voltage, V_L (Sceptre and ZETA in Britain and Al'fa in Russia). High frequency spikes in V_L suggest rapid changes in the discharge inductance; V_L should be treated as the sum of resistive [IR] and inductive [d(LI)/dt] terms. Experimental data can be used to estimate the resistive and inductive contributions. High-energy electrons and (impurity and hydrogenic) ions were observed, but the average energies were a few tens of eV. Calculations using a 1-D momentum equation with a toroidal electric field as driver and slowing in Coulomb collisions and inelastic processes yield impurity ion (average) drift velocities and apparent temperature (drift driven by voltage spikes) that are consistent with spectroscopic observations on Al'fa. These early experiments contrast with modern tokamaks, which are comparatively quiescent and usually have relatively higher toroidal B and lower V_L. On the other hand, ZETA was a precursor of the reversed field pinch (RFP), some of whose characteristics seem related to their high V_L. Toroidal drift ("rotation") velocities for tokamaks and RFPs can be calculated in the same way.

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