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Fluctuations and Transport in Hall devices with ExB drift

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Devices with stationary, externally applied, electric field which is perpendicular to a moderate amplitude magnetic field B_0, are now a common example of magnetically controlled plasmas. High interest applications involve Penning type plasma sources, magnetrons for plasma processing, magnetic filters for ion separation, and electric space propulsion devices such as Hall thrusters. One common characteristic of these numerous applications are plasma parameters conditions in which electrons are magnetized so the electron Larmor radius is much smaller than the characteristic lengths scale of the devices, while ions have large Larmor radius and do not feel the magnetic field and thus can be easily controlled by the electric field. The latter is a basis of various useful applications for ions extraction, separation and acceleration. Similar conditions also occur in some ionospheric plasmas as well as in some laboratory experiments on magnetic reconnection. The proposed talk reviews physics basis of such Hall plasma discharges. Application of the external electric field perpendicular to the magnetic field, as well as gradients of plasma density, temperature and magnetic field, naturally present in such discharges, result in plasma fluctuations and instabilities that make plasma turbulent and electron transport anomalous. Specific conditions of such plasmas precludes existence of standard drift waves, however other modes, the so called anti-drift modes become possible and unstable. The open magnetic field lines (terminated by the wall) also result in new instabilities, the so called sheath impedance modes. This talk provides physics based description of various modes and instabilities pertinent to such Hall plasmas and resulting anomalous electron transport due to these modes.

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