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Electric double layers and their applications to astrophysical objects and electric propulsion

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Electric double layers, abrupt potential drops within a plasma, exist in the plasma environment of the Earth and the stars, can cause phenomena as diverse as aurorae, or electromagnetic radiation from rotating neutron stars and may also play an important role in supplying and accelerating plasma in coronal funnels at the surface of the Sun. In the laboratory, both current-driven and current-free double layers have been generated and studied in a variety of experimental devices. The class of current-free double layers which form in low pressure magnetically expanding plasmas (e.g. from Helicon sources) for a variety of gases and geometries exhibit interesting electron and ions dynamics properties. The latter are also observed in particle-in-cell simulations. Application of expanding plasmas to the field of electric propulsion is receiving increasing interest: in addition to thruster performance assessment and optimisation, direct measurements of thrust combined with spatial mapping of the expanding plasma provides some information on momentum flux imparted from an expanding plasma and on plasma detachment from a magnetic field.