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Multi-dimensional PIC modelling of crossed-fields low temperature plasma devices

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Different plasma devices are based on the partial magnetisation of electrons in a ExB configuration. In Hall thrusters, a quasi-radial magnetic field creates a strong impedance to the axial electron transport, making a path from the external cathode to the internal anode-gas distributor longer. This increases the ionisation event chances and at the same time it creates a large electron azimuthal drift and virtual cathode for axial ion acceleration. In negative ion source, the tandem-magnetic barrier concept is often used and it consists of using a perpendicular to the flow magnetic field trapping electrons in order to reduce their density and temperature towards the extraction grid region. This reduces the negative ion destruction by electron detachment and the co-extracted electron current. In all the cases, a larger electron current across the magnetic field is measured and often ascribed to an anomalous (non-collisional) character of the transport. By means of multi-dimensional Particle-in-Cell / Monte Carlo Collision (PIC-MCC) models, we have shown how plasma uses all the different dimensions to create self-organised potential structures to increase the limited transport across B field lines. Results show the non-ambipolar character of the transport driven by electron magnetic drifts. Finally, the walls of the device play the role of short-circuiting the electron flow that exhibits a quite complex distribution.