Special issue on transport in B −fields in low-temperature plasmas

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EDITORIAL

Special issue on transport in *B*-fields in low-temperature plasmas

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From immense scale galactic plasmas down to micro-discharges, the details of the diffusion of particles have been the most problematic and challenging in the field of plasma physics. In solar physics, the diffusion of plasmas across magnetic fields determines the dynamics of the corona, the solar wind and hence space weather at the earth [1]. Terrestrial thermo-nuclear fusion experiments have been particularly hampered by a lack of data, understanding and theory for decades [2, 3]. Cross-field diffusion is particularly important in the formation and transport of beams of charged particles [4, 5]. This can be seen in research on magnetized plasma sources and plasma thrusters for space applications [6, 7]. In low temperature plasmas weak magnetic field can be applied for better coupling of external power to the plasma or control of plasma profiles. Unfortunately, control of plasma profiles by applied magnetic field may be severely limited by complicated anomalous transport [8], short-circuit and sheath effects [9, 10] or plasma self-magnetic field [11].
Negative ion extraction from plasmas is very poorly understood at the moment [12, 13]. It is the basis of a fundamental heating mechanism for ITER, a very large toroidal fusion experiment [2]. More immediate uses are made in the surface analysis industry of negative ions for Secondary Ion Mass Spectroscopy and other methods of surface analysis [14]. These involve creating a plasma of negative ions, hydrogen in the former and oxygen in the latter, then extracting them using a set of grids or holes. To minimize the effects of co-extracted electrons, a magnetic field is generated normal to the extraction axis with the hope that the electrons, having a smaller gyro radius than the heavy negative ions, will be removed from the extracted beam by impacting one or more of the extraction electrodes. Unfortunately, these fields create $E \times B$ drifts in the plasma resulting in unwanted anisotropies and major problems in beam forming [15].
With this background, a workshop was held at the Austin GEC in 2012 in order to assemble as many of the researchers in this area as possible in the one room and hope for synergy [16]. The one day 'Workshop on Cross Field Diffusion' attracted more than a dozen presentations and 50 to 100 participants. This special edition of *Plasma Sources Science and Technology* (PSST) assembles a number of those presentations allowing the reader easy access to the field. The abstracts of the remaining presentations, mainly industrial-related, can be found on the GEC2012 website [16].

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