Negative ions play crucial role in material processing in semiconductor industry, is used as a source in MeV range neutral beams required for magnetic confinement fusion experiments, plasma thrusters for space propulsion, in high power plasma switches and in pair-plasma generation, to name a few. While there are plethora of applications, basic plasma physics issues remain – for example, sheath physics in negative ion dominated plasma surface interaction, understanding issues in applying conventional diagnostics to negative ion dominated plasmas, physics understanding of such plasmas to expedite identification of novel plasma sources.

At the Institute for Plasma Research, India, a new experimental setup for studying Sheath Phenomena Involving Negative ions has been setup with focus on understanding: (1) the role of electron kinetics in negative ion production and transport across magnetic field; (2) Investigation of sheaths in the presence of negative ions; (3) Generating basic experimental data for validation of theoretical model on electronegative discharge; (4) Characterization and benchmarking of novel diagnostics; (5) To study basic phenomena in negative ion plasma due to wake introduced by external perturbation and (6) Numerical Modeling. The present topic aims to highlight some recent theoretical and experimental results on negative ion source, diagnostic and sheaths involving negative ions.

In fig-1, experimental setup for creating negative ion plasma in oxygen is shown. Negative ion formation takes place by two step process that involve electron impact excitation by fast energetic electrons, followed by dissociative electron attachment by slow electrons. However fast electrons also give rise to destruction of negative ions hence it reduces the efficiency of negative ion production in the bulk. To address the limitation, plasma sources having spatial distribution of electron temperature inside the discharge is created by interaction of dc/radio-frequency driven sheaths with an externally applied magnetic field. Negative ions are characterized using novel probing techniques based on floating Langmuir probe and dc biased hairpin probe [1].

References
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