Science and Technology Facilities Council

Ada Lovelace Centre

Contribution ID: **6** Type: **not specified**

Engineering Highlight - A Particle-in-Cell Study of Space Charge Compensation for ISIS H- Ion Sources

Thursday, 19 June 2025 13:00 (20 minutes)

Speaker: Benzi John
 Join via Zoom: https://ukri.zoom.us/j/92256378528

Negative hydrogen ion sources are extensively used in particle accelerators worldwide for a variety of applications (e.g. for high-energy particle physics in CERN and in spallation neutron source facilities like ISIS) and also in magnetic fusion experiments utilising neutral beam injection for plasma heating and diagnosis. A typical problem encountered in the low energy beam transport (LEBT) region of particle accelerators is beam divergence and transport losses due to space charge effects. Space Charge Compensation (SCC) is a process that lowers the space charge of the ion beam and helps to minimise transport losses. The SCC occurs when the H- beam ionises the background gas and traps positive ions to the beam potential forming a peculiar low-density "beam-plasma". An experimental-simulation campaign is currently underway jointly with the ISIS Low Energy Beam Group to study the space charge compensation process to support operations and upgrades to the facility in the negative H- ion source region. High-fidelity particle-in-cell (PIC) simulations considering a multi-reaction framework have been used to investigate the SCC process for a range of operating conditions using the open-source PIC code, PICLas. The effect of key parameters, such as external magnetic fields, secondary electron emission, and boundary conditions on the space charge compensation time and degree, are being investigated. Simulation results will be compared to diagnostic data from experiments to correlate the beam transport and light emissions with the space charge compensation process.