SIMULATION OF ION BEAM NEUTRALIZATION PROCESSES

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While the ease of neutralizing ion beams is commonly known, yet the process of neutralization remains unknown. As electric propulsion becomes more prevalent in space missions, this question is of significant importance. While currently described through an "effective collision frequency" that binds electrons to the beam, this fudge factor does not allow for a full description of the effect. Explanation of the effective collision frequency also has bearing on space instrument calibration, electrodynamic tethers, and ionospheric research. A review of the present state of knowledge on the topic is presented as well as results from initial computational modeling using two- and three-dimensional Particle in Cell/Direct Simulation Monte Carlo codes. The codes are used to simulate an ion beam operating in LEO, GEO and vacuum environments. The simulations show electrons moving to neutralize the beam from background and neutralizer sources. The simulations show perturbations in the background electrons and beam/background coupling phenomena. The results are compared favorably with previous computations and experimental observations.