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Modelling 1-D quasi-static potential structures at Jupiter

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Quasi-static potentials have long thought to be one of the significant drivers of the main ultraviolet emission associated with Jupiter's auroral oval. The magnetic field lines connecting to the auroral zone extend into Jupiter's middle magnetosphere, at radii of $20R_J$ – 50 R_J. Such quasi-static potential structures are capable of accelerating charged particles into the planetary ionosphere and generating aurora, with the Juno JEDI instrument observing inverted-V potential structures on the order of megavolts. However, Juno's observation of quasi-static potentials has not been as ubiquitous as was initially theorised. Juno has observed more frequent instances of bi-directional electron beams on the same field line, indicating the presence of dynamic processes occurring at different altitudes. In addition, this suggests that quasi-static potentials may not be a significant driver for the main UV emission.

In this paper, we present new results from a 1-D Vlasov model of the high-latitude magnetic field lines in the Jovian mid-magnetosphere. Our model is time-dependent and features a non-uniform mesh close to the ionosphere, allowing us to examine the formation of quasi-static potential structures in the upward current region over the course of a simulation. We will also present simulations showing the collapse and reformation of these potential structures, with the collapse showing the propagation of electron beams in both directions along the modelled field line.