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Electron and ion particle acceleration regimes observed by Juno over Jupiter's main aurora

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Abstract

Over Jupiter's most intense main aurora, the Juno spacecraft has identified up to four different particle acceleration regimes at energies above 30 keV (not counting the diffuse auroras generally observed equatorward of the main aurora). 1) In many main auroral regions there are both upward and downward accelerated electron angle-beam-like distributions with broadband electron spectral characteristics, extending to > 1 MeV energies, without any signatures of magnetic field-aligned electric potentials. Because the most intense beam-like angular distributions generally reside within the magnetically determined loss cones, there is clear evidence of stochastic-like electron acceleration both upward at positions below the spacecraft (0.5-1.0 RJ) and downward at positions above the spacecraft. These distributions are sometimes accompanied by upward and/or downward proton angular beams and sometimes not. 2) Juno sometimes observes downward electron "inverted-V-like" distributions with peaked electron distributions indicative of upward electric potentials (up to 400 kV inferred). Generally the downward electron energy fluxes associated with such potentials are less than those associated with the stochastically accelerated electron distributions observed nearby. 3) Several times Juno has observed clear transitions between the downward electron inverted-V distributions and downward broadband electron distributions. The difference between these broadband electron distributions and those identified as (1) above is that the apparent stochastic acceleration occurs primarily in the downward direction. 4) Finally, Juno sometimes observes strong downward ion inverted V's indicating the existence of downward electric potentials up to sometimes greater than 400 kV. The surprise here is that there also occurs simultaneously the upward and downward broadband acceleration of electrons such that the associated auroral emissions would be as intense as those observed in other regions. In this presentation we explore the characteristics of, and the relationships between, these different regimes with a particular focus on the relationship between electrons and ions. One of the surprises is that: A) downward ion inverted-V distributions are quite common within the main aurora with angular characteristic that suggest that they are accelerated downward at positions that are large distances upward away from the spacecraft, while B) downward ion inverted-V's have not been observed at radial positions greater than, say 4 RJ. This and other conundrums about the different auroral acceleration regimes are explored.