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Electron impact ionization in Saturn's magnetosphere: Direct calculations using observed, nonthermal electron distributions

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The primary source of ions in Saturn's magnetosphere is electron impact ionizaton of neutral water molecules from Enceladus. Charge exchange does not produce a net increase in ion density. Photoionization, at a rate of less than 5x10^{-9} s^{-1}, is believed to be less significant than electron impact. Existing estimates of the electron impact ionization rate have either been based on observed electron temperatures (much less than 10 eV near L=6) or models of physical chemistry. The later require a hot electron component to produce an ionization rate sufficient to match other data. Since the threshold for ionizationion is 13 eV and the cross section peaks around 100 eV, essentially all ionization is a result of the non-thermal tail on the electron distribtion. To fully account for this, we numerically integrate the full electron spectrum observed by the Cassini/CAPS-ELS instrument and the ionization cross section. The resulting ionization rates, as a function of spacecraft L shell, latitude and local time are compared with previous estimates and models.