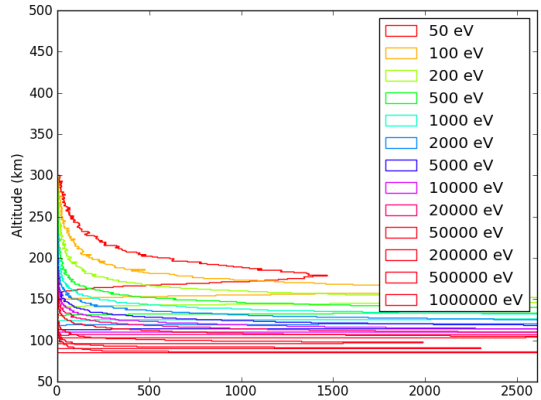
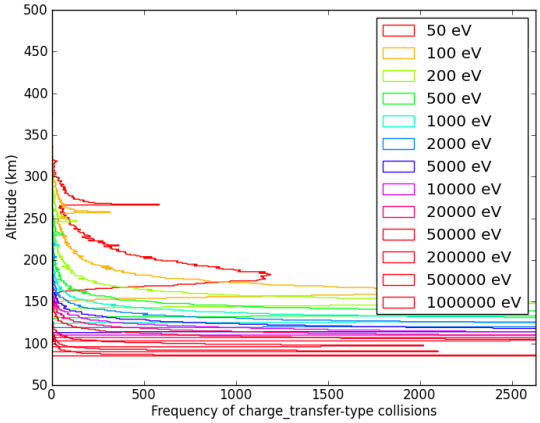
ENERGETIC PARTICLE PRECIPITATION IN THE MARTIAN ATMOSPHERE: EXPECTATIONS FOR MAVEN. R.D. Jolitz[1], R. Lillis[1], S. Curry[1], D. Larson[1] and B. Jakosky[2], [1]Space Sciences Laboratory, University of California Berkeley, [2]Laboratory for Atmospheric and Space Physics, University of Colorado.

Introduction: Energetic charged particle precipitation is an important process in the Martian upper atmosphere, particularly under extreme solar conditions. However, energetic particle effect measurements and models at Mars are scarce. Radar reflections from the Martian surface were seen to disappear [1,2] and derived total electron content was seen to increase [Lillis et al., 2010] at times of solar energetic particle (SEP) events. Increased ionization caused by SEP precipitation into the atmosphere can facilitate increased atmospheric escape, by an order of magnitude or more, as observed during an SEP event in 2006.and reported by Futaana et al. [Ergun et al., 2006. Ng et al., 2003].

We have developed a Monte Carlo code to track a population of energetic ions in an atmosphere to predict secondary electron production, atmospheric heating, energy deposition, proton aurora, etc. The model accounts for collisional processes such as ionization, excitation, dissociation, etc with major atmospheric constituents causing energy loss and scattering. The model framework is parallelized, open to multiple planetary-specific inputs (e.g. three-dimensional neutral densities, electric and magnetic fields) and uses an adaptive trace algorithm to accurately model collisions in dense or sparse atmospheric regions.





Using the predicted 3-D models of electric and magnetic fields from the Michigan Mars MHD code, 3-D neutral densities from the MTGCM, we simulate energetic ion precipitation in the Martian upper atmosphere. Secondary electrons are simulated using MarMCET [Lillis et al. 2009]. Preliminary results show charge exchange and ionization rates are shifted upwards as particle beam angle increases.

We will present three-dimensional ionization rates in areas of strong and weak crustal magnetic fields for typical isotropic and beamed solar energetic particle events. Ultimately this will form part of a comprehensive model of solar wind interactions with Mars and long-term Martian atmospheric erosion for comparison to results from the Mars Atmosphere Volatile EvolutioN (MAVEN) mission.

References:

[1] Morgan, D. D. et al. (2006) *Geophys. Rev. Lett.*, *33*. [2] Espley, J. R. et al. (2007) *Geophys. Rev. Lett.*, *34* L09101. [3] Author G. H. (1996) *LPS XXVII*, 1344–1345. [4] Author I. J. (2002) *LPS XXXIII*, Abstract #1402.