

Chemistry and Compositions of Cometary Coma

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The study of cometary compositions has been the subject of great interest since 1986 when High Intensity Ion Mass Spectrometer (HIS-IMS), Neutral Mass Spectrometer (NMS) and Positive Ion Cluster Composition Analyzer of Reme Plasma Analyzer (PICCA-RPA) onboard Giotto spacecraft measured a large number of peaks between 12 and 120 amu in mass spectrum of comet Halley. Several theoretical models have been constructed describing the chemistry of cometary coma. But most of these models were limited to the chemistry of only few ions. This paper describes the chemistry of cometary compounds in the inner coma of comet Halley using a chemical coupled transport model for ion-neutral, electron-neutral, photon-neutral and electron-ion reactions. In this model 600 chemical reactions are used. The primary ionization sources are taken as solar EUV, photoelectron and auroral electron of solar wind origin. The production rates, loss rates and density of 46 ions for masses up to 40 amu are calculated. The chemistry of these ions is discussed in this paper. The calculated ion mass densities are compared with Giotto IMS and NMS data at radial distances 1500 km, 3500 km and 6000 km. We have found good agreement between model calculation and Giotto measurements. The nine major peaks in IMS spectrum between masses 10 and 40 amu are reproduced fairly well within a factor of two inside the ionosphere. The simple formulae for calculating densities of nine major peak ions of IMS spectra are reported. These formulae will be useful in estimating their densities without running the complex chemical model.