

ION CHEMISTRY OF TITAN

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The Cassini voyager has recently passed through the ionosphere of Titan where the Ion and Neutral Mass Spectrometer (INMS) monitored the ionic and neutral species present. It was apparent from an analysis of the Cassini data that the neutral molecules so far identified in the atmosphere of Titan were not sufficient to explain the observations of the mass spectrometer.

The ion density at m/z 30 was higher than could be accounted for by the models. It has been proposed that methylenimine (CH_2NH) is also present and that protonated methylenimine (CH_2NH_2^+) contributes significantly to the ion density at m/z 30. Methylenimine has been positively identified in the interstellar medium and is likely to be a significant product of the neutral chemistry occurring in Titan's upper atmosphere. The high proton affinity of methylenimine (853 kJ mol^{-1}) makes proton transfer with protonated neutral species present in Titan's ionosphere a likely reaction pathway.

The ion-molecule chemistry of methylenimine (CH_2NH) was examined for the first time. Neutral methylenimine is not a stable compound under laboratory conditions. It can be generated by the pyrolysis of methylamine (CH_3NH_2) and survives sufficiently long in a flow tube for its kinetic parameters to be established. Using a flowing afterglow-selected ion flow tube (FA-SIFT), the kinetics for the reactions of O_2^+ , HCNH^+ , CH_3NH^+ , $\text{C}_2\text{H}_3\text{CNH}^+$, HC_3NH^+ , C_2H_5^+ and C_3H_5^+ with methylenimine were established. As anticipated, rapid reactions of these ions with methylenimine were observed.