Observations of CH, NH, and NH_2 in Comets P/Hartley 2 (1991 XV) and Shoemaker-Levy ($1991a_1$) using the Hubble Space Telescope

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The study of minor species observed in cometary spectra is important as it may allow constraints to be set on the relative abundances of their progenitors in the cometary nucleus and thus, hopefully, provide information of cosmogonic significance. For example, it would be interesting to obtain meaningful values, or upper limits, for the CH_4/H_2O and NH_3/H_2O ratios, as these may give some insight into the processes and conditions prevailing in the regions where comets were formed. With this aim in mind, we have analysed a series of spectra obtained with the Faint Object Spectrograph (FOS) on the Hubble Space Telescope, showing, among others, the emissions due to the methyladyne radical, CH, some of which may come from methane, and the imidogen, NH, and amine, NH_2, radicals, both of which are probably produced mainly by the photolysis of ammonia. These spectra have the following particularly favorable characteristics : (1) they refer to two comets of different dynamical ages, P/Hartley 2 (1991 XV) and Shoemaker-Levy ($1991a_1$), (2) they were taken when these comets were at very similar distances from the sun and from the earth (R and Δ both near 0.9 AU), and (3) they were secured with the same instrument. Using the fluxes measured in the $\sim$ 1000 km $\times$ 3000 km aperture of the FOS and recently re-evaluated excitation rates for the CH A-X (0,0) band, the A-X (0-0) band of NH, and several bands of NH_2, we obtain average column densities for the radicals and derive production rates of their parents. These production rates are referred to that of H_2O, which itself is estimated using emissions from OH and [OI] that were recorded either simultaneously, or nearly so. Spectral synthesis is used to separate the forbidden oxygen line emissions from the superposed NH_2 features, while similarly, careful subtraction of the underlying continuum (using an appropriately convolved solar spectrum) is carried out in order to extract the relevant molecular fluxes. The influence of various model parameters (such as scale-lengths, time-scales, and velocities) on the derived relative abundances is discussed.

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