

# Simple Organics in Comets: Formaldehyde, Methyl Cyanide, and Methanol

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**Abstract.** Millimeter observations of simple organic molecules have been conducted towards comets Hale-Bopp, T7/Linear, and Q4/Neat with the Arizona Radio Observatory 12 m telescope on Kitt Peak, AZ. Formaldehyde (H<sub>2</sub>CO) was detected in all three comets with column densities on the order of  $\sim 2 \times 10^{12} \text{ cm}^{-2}$ . The production rate (Q) of H<sub>2</sub>CO in Hale-Bopp is  $\sim 10^{28} \text{ s}^{-1}$ , while Q  $\sim 10^{27} \text{ s}^{-1}$  for Q4/Neat and Q  $\sim 7 \times 10^{26} \text{ s}^{-1}$  for T7/Linear. Methyl cyanide (CH<sub>3</sub>CN) and methanol (CH<sub>3</sub>OH) were both observed towards Hale-Bopp in March 1997. The total column density derived for CH<sub>3</sub>CN from a rotational diagram analysis was  $2.01 \times 10^{12} \text{ cm}^{-2}$  with a rotational temperature of  $\sim 200 \text{ K}$  and Q =  $7 \times 10^{26} \text{ s}^{-1}$ . Five transitions of methanol were observed over the period from March 10-21, 1997 with  $N_{tot} \sim 4 \times 10^{14} \text{ cm}^{-2}$  and Q  $\sim 3 \times 10^{29} \text{ s}^{-1}$ . Comparisons have been made between observed abundances in comets and in molecular clouds. For example, in Hale-Bopp the ratio of CH<sub>3</sub>OH/H<sub>2</sub>CO is  $\sim 200$ , CH<sub>3</sub>CN/H<sub>2</sub>CO  $\sim 1$ , and CH<sub>3</sub>OH/CH<sub>3</sub>CN  $\sim 200$ , while for Orion-KL CH<sub>3</sub>OH/H<sub>2</sub>CO is  $\sim 2$ -21, CH<sub>3</sub>CN/H<sub>2</sub>CO  $\sim 25$ -271, and CH<sub>3</sub>OH/CH<sub>3</sub>CN  $\sim 12$  (i.e. Lee et al. 2001). The variations in abundances between comets and molecular clouds will be discussed.

**Keywords.** line: identification, astrochemistry, comets: individual(C/1995 O1(Hale-Bopp), C/2001 Q4(NEAT), C/2002 T7(LINEAR), submillimeter

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