

Volatile composition and activity of comets C/2001 Q4 (NEAT) and C/2002 T7 (LINEAR)

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Comets C/2001 Q4 (NEAT) and C/2002 T7 (LINEAR) were observed on five consecutive nights, 7–11 May 2004, at heliocentric distances of 1.0 and 0.7 au, respectively, using the 1.3-mm receiver on the 10-m Submillimeter Telescope at the Arizona Radio Observatory. We carried out a search for six parent- and product-volatile species in both comets (de Val-Borro et al. 2013). Multi-line observations of the CH₃OH $J = 5-4$ series allow us to estimate the rotational temperature using the rotation diagram technique. The gas production rates are computed using the level distribution obtained with a spherically symmetric molecular excitation code that includes collisions between neutrals and electrons (see, e.g., Hartogh et al. 2010, 2011; Biver et al. 2012, Bockelée-Morvan et al. 2012). The effects of radiative pumping of the fundamental vibrational levels by infrared photons from the Sun are considered for the case of HCN. With systematically lower mixing ratios in comet C/2001 Q4, production rate ratios of the observed species with respect to H₂O lie within the typical ranges of dynamically new comets in both objects. We find a relatively low abundance of CO in C/2001 Q4 compared to the observed range in other comets based on millimeter/submillimeter observations, and a significant upper limit on the CO production in C/2002 T7 is derived. Depletion of CO suggests partial evaporation from the surface layers during previous visits to the outer Solar System and agrees with previous measurements of dynamically new comets. Rotational temperatures derived from CH₃OH rotational diagrams in both C/2001 Q4 and C/2002 T7 are roughly consistent with observations of other comets at similar distances from the Sun.

References: Biver, N., Crovisier, J., Bockelée-Morvan, D., et al. 2012, *A&A*, 539, A68; Bockelée-Morvan, D., Biver, N., Swinyard, B., et al. 2012, *A&A*, 544, L15; de Val-Borro, M., Küppers, M., Hartogh, P., et al. 2013, *A&A*, 559, A48; Hartogh, P., Crovisier, J., de Val-Borro, M., et al. 2010, *A&A*, 518, L150; Hartogh, P., Lis, D. C., Bockelée-Morvan, D., et al. 2011, *Nature*, 478, 218; Rezac, L., de Val-Borro, M., Hartogh, P., et al. 2014, *A&A*, 563, A4.