MOLECULAR COMPOSITION OF COMET 8P/TUTTLE FROM RADIO OBSERVATIONS WITH THE IRAM AND CSO TELESCOPES. Nicolas Biver[1], Darek Lis[2], Nicolas Fray[3], Dominique Bockelée-Morvan[1], Jacques Crovisier[1], Jérémie Boissier[4], Pierre Colom[1], Neil Dello-Russo[5], Rapahël Moreno[1], Ron Vervack[5] and Harold Weaver[5], [1]LESIA, Observatoire de Paris, 5 place Jules Janssen, F-92190 Meudon, France (Nicolas.biver@obspm.fr), [2]Caltech, Pasadena, California, USA, [3]LISA, Créteil, France, [4]IRAM, Grenoble, France, [5]APL, Johns Hopkins University, Maryland, USA.

Comet 8P/Tuttle, with an orbital inclination of 55° and period of 13.6 years, belongs to the Halley-type category of comets. It made a close approach to the Earth at 0.253 AU on 2 January 2008. It reached the limit of naked eye visibility and its total water outgassing rate was around 2.5×10^{28} molec./s [1] at the end of December. We took advantage of this favourable return to undertake a detailed study of the chemical composition of comet 8P/Tuttle at radio wavelengths with the Institut de RadioAstronomie Millimétrique 30–m and Caltech Submillimeter Observatory 10.4–m radio telescopes.

The comet was observed daily with the IRAM 30-m (Spain) from 28.8 December to 1.8 January UT and from 4.3 to 9.3 January UT at the CSO on top of Mauna Kea, Hawaii. HCN, HNC (Figure), CH_3OH, CS, H_2S, H_2CO and CH_3CN were detected. Preliminary determinations of abundances relative to water suggest that this comet belongs to the methanol and formaldehyde rich comets [2] while the HCN, H_2S and especially CS are towards the relatively low end of molecular abundances in comets. Significant upper limits on the abundances of CO (<2.5% relative to water), HNCO, HCOOH, SO, HC_3N and OCS were also obtained. We have measured the HNC/HCN ratio to be around 8% (Figure). This ratio is significantly higher than in the Jupiter-family comet 73P observed at a similar heliocentric distance of 1.1 AU [3]. The HERA heterodyne array on IRAM-30m was used on 30 Dec. to map HCN and H_2CO emissions. This suggests that 90% of H_2CO comes from an extended source in the coma with a Haser-equivalent parent scalelength around 1.2 times that of H_2CO destruction length.

Simultaneous observations of several lines of methanol at 157 or 304/307 GHz suggest a gas temperature around 40 K. The average expansion velocity is estimated to 0.85 km/s from the line shapes. All line shapes (see Figure) are asymmetric with a mean blueshift of -0.25 km/s. This suggests preferential outgassing in a jet on the observer side (50° from the sunward side) with higher velocity (~1 km/s). Modulations with time of the HCN outgassing rate and the line Doppler shift was searched for. No significant variation is found in the data, but some possible periodicities found by the PDM (variance ratio) method are 6.1 h and 8.2 h, comparable with periods found from CN jets [4] or radar imaging [5].

References:

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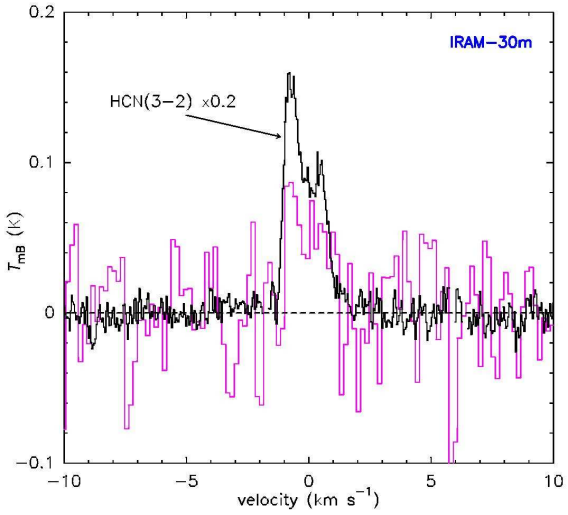

Figure: HCN *J*=3–2 (black, intensity divided by 5) and HNC *J*=3–2 (pink) lines observed in comet 8P/Tuttle with the 30-m IRAM radio telescope on 28–31 Dec. 2007. Velocities are with respect to the nucleus of the comet. Both lines show a strong blueshifted peak suggesting asymmetric outgassing.