Molecular diversity of five comets observed in the submillimetre range in 2013

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The year 2013 was a prolific one for submillimetre observations of comets. In the context of the large international observation campaigns of comets C/2011 L4 (PanSTARRS) and C/2012 S1 (ISON), we observed five comets at submillimetre wavelengths with the IRAM-30m and APEX radio telescopes. These comets were also monitored with the Nançay radio telescope at the 18-cm wavelength, providing OH production rates.

Comet C/2011 L4 (PanSTARRS) is a dynamically new Oort-cloud comet that passed perihelion at 0.30 au from the Sun on 10 March 2013. We observed it on 14–18 March and 5–8 April, as it receded from the Sun and its total outgassing rate dropped from $\sim 5 \times 10^{29}$ to $\sim 7 \times 10^{28}$ molec./s (Combi et al. 2014). We observed C/2012 F6 (Lemmon) contemporaneously with comet PanSTARRS, and also during 13-16 February 2013. This old long-period comet displayed a much larger gas- to-dust ratio, with a peak outgassing rate around 10^{30} molec./s, when we observed it in March–April. It reached perihelion at 0.73 au on 24 March 2013. During the period of 8 November to 16 December 2013, we observed 3 comets at IRAM-30m over 21 different days. The dynamically new sungrazing comet C/2012 S1 (ISON) was the prime target and we detected it from 8 November until two days before perihelion (28.8 November at 0.012 au from the Sun), when it completely disintegrated. We intensively observed comet ISON during its first large outburst on 14 November (Biver et al. 2013, Crovisier et al. 2013, Agundez et al. 2014). Comet C/2013 R1 (Lovejoy) is another old long-period comet that was discovered late, in September 2013, and observed during the whole period. We monitored its activity as it approached the Sun (perihelion at 0.83 au on 22 December 2013) with a peak outgassing rate around 1.5×10^{29} molec./s. Another long period comet, C/2012 X1 (LINEAR) was observed in Nov.–Dec. 2013. It had a strong outburst in early October 2013 and passed perihelion on 21 Feb. 2014 at 1.6 au from the Sun.

We will report observations of 18 different molecular species and concentrate on the main molecules (e.g., HCN, CH_3OH, CS, H_2CO, HNC, CO, H_2S, CH_3CN, HC_3N, HNCO), which have been detected in a majority of these comets. We will compare the chemical composition of these comets and also investigate the variation with time and heliocentric distance observed in comets C/2011 L4 (PanSTARRS), C/2012 S1 (ISON), and C/2013 R1 (Lovejoy) as they receded from or approached the Sun.

References: Agundez, M., Biver, N., Santos-Sanz, P. et al. 2014, A&A 564, L2; Biver, N., Agunez, M., Santos-Sanz, P. et al. 2013, CBET 3711; Biver, N., Bockelée-Morvan, D., Debout, V., et al. 2014, A&A submitted; Combi M., Bertaux, J.-L., Quémerais, E. et al. 2014, AJ, in press; Crovisier, J., Colom, P., Biver, N., et al. 2013, CBET 3711.