Radio observations of comet C/2012 X1 LINEAR

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We obtained radio OH spectra of comet C/2012 X1 LINEAR between 03 November 2013 and 13 January 2014 with the 305-m Gordon Telescope at Arecibo Observatory. Spectra at 1667 and 1665 MHz (18-cm wavelength) were obtained with an on-sky beam size of 2.9′ and spectral resolution of 0.1 km s^{-1}, on most occasions mapping 7 positions of the OH coma within 4′ of the nucleus. The observation range spans heliocentric distances from 2.2 au down to 1.7 au pre-perihelion, and geocentric distances ranging from 2.8–2.2 au, yielding a resolution of 300-400,000 km at the comet. Radio OH spectra are seen via a Λ-doublet, with the excitation of the lines depending on the heliocentric velocity of the comet, changing the relative velocity of the cometary gas with respect to the UV spectrum of the Sun. We interpret the spectra via a vectorial Monte Carlo model, taking into account the OH inversion predictions of Despois *et al.* [1] as well as Schleicher & A'Hearn [2].

In highly productive comets, larger coma densities thermalize the line excitation, reducing the observed line strength near the nucleus. We treat this collisional quenching following that outlined by Schloerb [3] and Gérard [4]. Mapping observations can directly constrain the radius within which quenching is active, and thus yield a more accurate estimate of the gas production rate. Radio observations at high spectral resolution place excellent constraints on the gas outflow velocity in cometary comae. Best-fit models for these observations, processed based on spectra binned to a resolution of 0.34 km s^{-1}, yield gas outflow velocity of 0.78 ± 0.03 km s^{-1}, typical for comets outside 1 au heliocentric distance, and consistent with those of Tseng *et al.* [5]. Gas production rates differ by 20–30 percent for the two inversion models, but range between 2×10^{28} and 4×10^{28} mol s^{-1}, also similar to other comets observed at these heliocentric distances.

We will present spectral line maps for these observations, best-fit outflow velocities, gas production rates, and trends with heliocentric distance.

References: [1] Despois D. *et al.* (1981) *A&A*, **99**, 320–340. [2] Schleicher D.G. & A'Hearn M.F. (1988) *ApJ*, **331**, 1058–1077. [3] Schloerb, F.P. (1988) *ApJ*, **332**, 524–530. [4] Gérard E. (1990) *A&A*, **230**, 489–503. [5] Tseng W.-L. *et al.* (2007) *A&A*, **467**, 729–735.