RADIO INTERFEROMETRIC OBSERVATIONS OF COMETARY MOLECULES

Patrick Palmer[1], Lewis E. Snyder[2], and Imke de Pater[3]

[1]Department of Astronomy & Astrophysics, University of Chicago; [2]Department of Astronomy, University of Illinois; [3]Department of Astronomy, University of California, Berkeley

ABSTRACT. A useful method for extracting cometary signals is demonstrated using VLA observations of Comet Brorsen-Metcalf (1989o).

1. Introduction

The VLA has detected the 1_{11}-1_{10} transition of H_2CO at 4829.659 MHz (6cm) from comets Halley, Machholz (1988j), and possibly Brorsen-Metcalf (1989o) (Snyder, Palmer, and de Pater, 1989; 1990). Using the Brorsen-Metcalf observations, we will demonstrate one of the advantages of interferometers over single-element radio telescopes for extracting weak spectral lines.

2. Observations and Discussion

The VLA D configuration was used to search Brorsen-Metcalf for H_2CO on 1989 Sept. 2, 3, and 7, with the spectrometer arrangement described by Snyder et al. (1989). The untapered beam was 20"x20", and the tapered 40"x40". Figure 1 depicts a data cube of H_2CO images for each velocity channel. By cutting through the cube along a pixel (which is at a fixed position relative to the comet), a spectrum of intensity versus cometocentric velocity for that position is obtained. Averaging over the appropriate pixels simulates the synthesized VLA beam. A pixel (shaded square) is 10"x10" in tapered, and 5"x5" in untapered data. Blocks of 3x3, 5x5, and 9x9 pixels were used for the data reductions. Within the field of view, different pixel clusters can be sampled to optimize the coupling of the synthesized beam to the gas distribution. Thus small pointing errors caused by ephemeris inaccuracies can be corrected after the observations have been made; this would be impossible to do with single-element telescope data. Gérard's (1987) SYMCOMET routine was applied to different pixel "cuts" through the Brorsen-Metcalf data cube, and the resulting symmetrical spectra are in Figure 2. Both the 5x5 tapered and untapered spectra show the best coupling of the beam to the H_2CO cloud, with a peak at channel 13 (cometocentric radial velocity = +0.76 km/s). This suggests that the boundaries of the coma gas best match the 5x5 pixel block.

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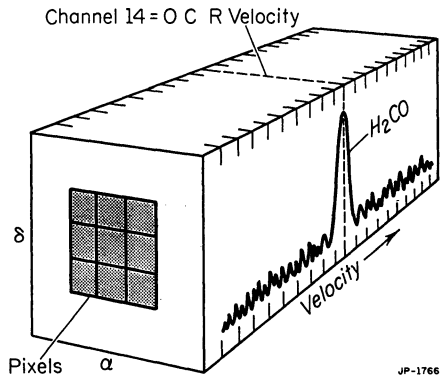

Figure 1. Representation of a data cube (images for each velocity channel as a function of α and δ). Here channel 14 is at 0 km/s cometocentric radial velocity.

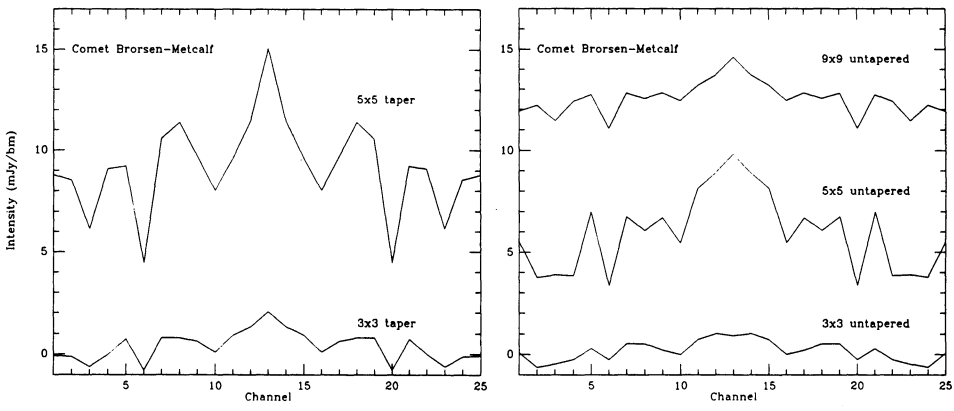

Figure 2. Spectra of the 6 cm H_2CO line obtained from applying SYMCOMET to different "cuts" through the Brorsen-Metcalf data cube. Ordinate: intensity in mJy/bm; abscissae: channel number (direction opposite to velocity). Channel 14 is 0 km/s and the channel width is 0.76 km/s.

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5. References

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