Bull. Astr. Soc. India (1999) **27**, 79-80

CN and C_2 molecules in the coma of comet C/1995 O1 Hale-Bopp

B. B. Sanwal and Mahendra Singh

Uttar Pradesh State Observatory, Manora Peak, Naini Tal 263129, India

Abstract. The spectrophotometric observations of the Comet C/1995 O1 Hale-Bopp were taken through 104 cm telescope of the U.P. State Observatory, Naini Tal using EG & G Spectrograph coupled with an Optical Multi Channel Analyser and Reticon Array Detector in the optical region of the spectrum, during its closest approach (19-24 April 1997) for four nights. The molecular emission bands of CN at 3888 Å, and C_2 (Δv=+1, 0, −1) at 4690 Å, 5160 Å, and 5530 Å respectively, were detected. Column densities and production rates at different heliocentric and geocentric distances were also determined.

Key words : comet, production rates.

1. Introduction

Alan Hale and Thomas Bopp independently discovered this comet on July 23, 1995. A number of molecular species have been observed in this comet and production rates of molecular emission of various molecules at various heliocentric distances have been reported. We observed the comet spectrophotometrically at low dispersion to detect emission bands and to estimate the production rates.

2. Observations and data reduction

Comet C/1995 O1 Hale-Bopp was observed on four nights (19, 20, 23 and 24 April 1997) using the EG & G spectrograph with an optical multichannel analyser (OMA) mounted at the Cassegrain focus of the 104 cm telescope of U.P. State Observatory, Naini Tal. This spectrograph gives a dispersion of 2.5 Å/pixel. The complete instrumental details are given in an earlier paper (Sanwal et al. 1994). The S/N of the spectroscopic scans corresponds to ± 0.03 magnitudes above 4000 Å and ± 0.02 magnitudes below 4000 Å.

Along with the comet, the standard star α Leo was also observed for determining the nightly extinction coefficients and to find out the absolute flux of the comet. The geocentric distance (Δ), and the heliocentric distance (r) of the comet on different observing nights are given in Table 1.

3. Molecular emission

The prominent emission bands are of CN at 3888 Å, and C_2 (Δ v=+1, 0, −1) at 4690 Å, 5160 Å, and 5530 Å. For determining the column densities and production rates, area under the emission bands were measured after converting the measured intensities into flux.

4. Column densities and production rates

The number of molecules of each species, contained in a cylinder of radius defined by the diaphragm used, and extending entirely through the coma was evaluated using the formula given by Millis et al. (1982). These column densities were applied in the equation given by A'Hearn and Cowan (1975) to determine the production rates for CN and C_2 molecules. The estimated production rates at different heliocentric distances are shown in Table 1.

Farnham et al. (1997) reported the Haser model based logQ(CN) and logQ(C_2) at the heliocentric distance of 1.02 as 28.05 and 28.16 for this comet. Our estimates for comet Hale-Bopp are slightly less than these values for similar distances as seen in Table 1. In comet Hale-Bopp, three to five sharp, concentric shells or ripples in the lower coma on the sunward side were observed throughout April, 1997. The shells were formed by an especially active vent on the surface of the spinning nucleus spraying material. Our production rate estimates are based on the observations taken at the centre of the coma of the comet. The contribution of the shells or ripples is not taken into account. Therefore simple extrapolation of the production rates reported by Farnham et al. (1977) may not be valid for comparison with our estimates. This may be one of the possible reasons of getting slightly lower production rates though, comet Hale-Bopp had actually been much more active than comet Halley (Goraya et al. 1989) and comet Swift Tuttle (Sanwal et al. 1994) at similar heliocentric distances.

Table 1. Column densities(M) and production rates(Q).

Date	Δ(AU)	r(AU)	species	log(M)	log(Q)
Apr 19, 97	1.569	0.966	CN	32.46	28.19
			C_2	32.74	28.39
Apr 20, 97	1.582	0.970	CN	31.55	27.00
			C_2	32.35	28.00
Apr 23, 97	1.611	0.982	CN	32.15	27.57
			C_2	32.00	27.60
Apr 24, 97	1.624	0.986	CN	32.12	27.54
			C_2	32.00	27.57

References

A'Hearn M. F., Cowan J. J., 1975, AJ, 80, 852.

Goraya P. S., Sanwal B. B., Rautela B. S., Duggal H. K., Malhi J. S., 1989, EMP, 44, 243.

Farnham T., Schleicher D., Lederer S., 1997, IAU Cir. No. 6589.

Millis R. L., A'Hearn M. F., Thomson D. T., 1982, AJ, 87, 1310.

Sanwal B. B., Rautela B. S., Singh M., Srivastava J. B., 1994, EMP, 64, 139.