C_2, CN AND DUST IN COMET WILSON (1987VII); **R. Schulz, M. F. A'Hearn, Department of Astronomy, University of Maryland, P. V. Birch, C. Bowers, M. Kempin, R. Martin, Perth Observatory, Bickley, Western Australia**

Column density profiles in C_2, CN as well as in blue and red continuum (BC and RC) were constructed from two-dimensional images of the coma of Comet Wilson (1987VII). Our analysis showed that the continuum profiles decrease with the nuclear distance ρ as $1/\rho$. From the C_2 and CN profiles we determined the parent and the daughter lifetimes as well as the production rates in terms of the vectorial model.

The dynamically new comet Wilson (1987VII) was observed with the 24" Planetary Patrol Telescope at Perth Observatory, Australia, pre as well as post perihelion in April and May, 1987. Coma images were obtained with the University of Maryland's CCD camera system (field of view 9'.5 × 15', resolution 1".8) in several different spectral ranges using the photometric filter set of the International Halley Watch (IHW). Additionally, CCD images of selected standard stars for narrowband photometry of comets [1] were taken with the same filters. This is a report on the analysis of the post perihelion observations taken in C_2 and CN as well as blue and red continuum.

All images were bias subtracted, flat fielded, sky subtracted and normalized to counts per second. The standard stars were used to convert the cometary images into absolute fluxes by applying the calibration procedures and parameters, established for the IHW [2]. The underlying continuum in the emission band images was two-dimensionally approximated and subtracted, using the observations in blue and red continuum, which leads to a more accurate continuum correction with regard to spatial variations in the different components. For the conversion into column densities we assumed a constant g-factor for C_2 [3]. The g-factors for CN [4] were adapted to the actual heliocentric distances and velocities of the comet. The fluxes in the continuum images were converted into radiation powers (erg s^{-1} $Å^{-1}$), which are independent of the geocentric distance and therefore facilitate a comparison between the profiles observed on different dates.

The application of several well working structural enhancement techniques [5] to the images revealed no prominent features (e.g. jets) in the coma. Therefore, mean radial column density profiles, constructed by averaging around the nucleus, lead to a satisfactory representation of the intensity distribution as a function of nuclear distance ρ. Fig. 1 shows a typical example for the resulting mean radial profiles of the emission band and the continuum images. The radial continuum profiles (Fig. 1c and 1d) are in good agreement with the expected $1/\rho$ law for the decrease of brightness as a function of nuclear distance. In case of the C_2 and the CN (Fig. 1a and 1b) the circles reflect the column density profiles of the original images (no continuum subtraction), while the dots represent the column density profiles, constructed after a two-dimensional continuum subtraction. The continuum corrected profiles were used to determine lifetimes and production rates by fitting the Festou vectorial model [6] to them. The solid line in Fig. 1b shows the fit for the CN column density profile of May 4th, 1987. All post perihelion CN profiles could be well fitted under the assumption of steady state conditions for the CN production rate. With an adopted parent velocity of v_p = 1 km/s the best fits were obtained for a lifetime of the CN parent of τ_p = (30500 ± 1000) s and a lifetime of the CN radical of τ_d = (432000 ± 8000) s (r_H = 1 km/s). Tab. 1 gives the CN production rates corresponding to a CN velocity of v_d 1.2 km/s. The comparison with HCN production rates [7] shows that the CN production is significantly higher. Therefore, HCN cannot be the only parent molecule of the CN in Comet Wilson.

Tab. 1 CN production rates (v_d = 1.2 km/s) of Comet Wilson during its post perihelion phase.

Date / 1987	May 02	May 03	May 04	May 05	May 17
Q_{CN} / 10^{26} s^{-1}	3.5 ± 0.1	3.6 ± 0.1	2.6 ± 0.1	2.5 ± 0.1	2.2 ± 0.1

In case of C_2 the inner part of the column density profiles could not sufficiently be fitted by the conventional use of the vectorial model. The observed C_2 profile in Fig. 1a (dots) is much flatter in the inner part of the coma than the best fit of a steady state vectorial model (solid line 1). To compensate this flattening, we decreased the C_2 production rate in the vectorial model for the past 0.25 days by a factor of 1.5. This is a simple trick to easily simulate functions of the C_2 production rate, which are not known, but in any case different from those reflecting the production in conventional photolytic models. The best fit to the observed profile, using this trick to accomodate the flattening of the C_2 profiles, is shown in Fig. 1a as solid line 2. The parent and daughter velocities were set to $v_p = v_d$ = 1 km/s. The best fitting lifetimes τ (r_H = 1 AU) and production rates Q are listed in Tab. 2.

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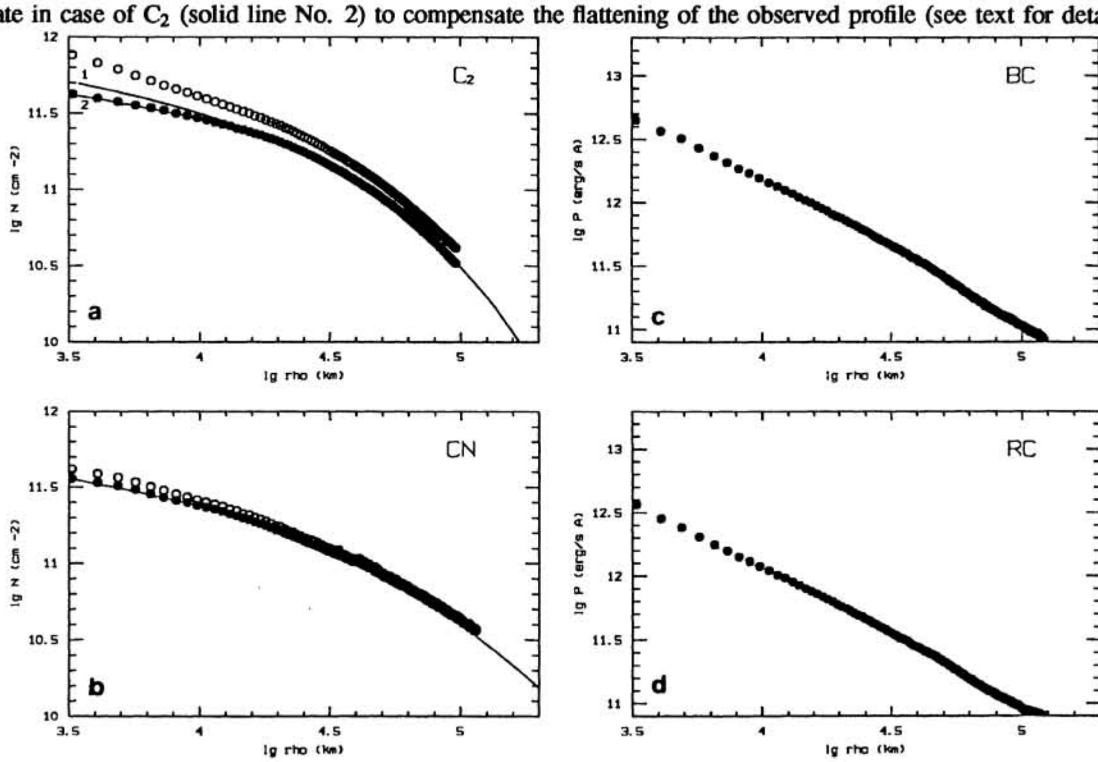
Tab. 2 The fitting parameters for the C_2 profiles. Q_1: production rate for steady state conditions; Q_2: values, to which Q_1 has to be reduced, Δt: time, for which this has to be done to compensate the profiles' flattening.

Date	τ_p / 10^3s	τ_d / 10^3s	Q_1 / 10^{26}s^{-1}	Q_2 / 10^{26}s^{-1} (Δt / days)
02.05.1987	35	65	4.3	3.2 (0.30)
03.05.1987	38	65	4.7	4.0 (0.25)
04.05.1987	35	65	4.8	3.2 (0.25)
06.05.1987	40	70	5.5	4.5 (0.15)
12.05.1987	39	80	5.0	2.8 (0.10)
14.05.1987	34	65	4.7	3.2 (0.30)
17.05.1987	41	65	4.8	3.7 (0.20)
Average	37.4 ± 2.9	67.9 ± 6.1	4.8 ± 0.4	3.5 ± 0.6 (0.22 ± 0.08)

Fig. 1 Mean radial profiles of Comet Wilson's coma in C_2, CN, BC and RC on May 4th, 1987. In case of C_2 and CN the circles represent the profiles of the original images, while the dots show the column density profiles after continuum correction. The CN and C_2 profiles were fitted by the vectorial model, assuming steady state conditions for the production rates (solid line for CN, solid line No. 1 for C_2), as well as a temporally altered production rate in case of C_2 (solid line No. 2) to compensate the flattening of the observed profile (see text for details).



The impossibility to fit the flat shape of the C_2 profiles in terms of a vectorial model indicates that the source function of C_2 is not sufficiently represented by an exponential law. On the other hand we find a C_2 profile resulting from modeling of chemical reactions [8], which is too flat to fit the observations. However, the knowledge of the source function of C_2 is totally necessary to draw conclusions on precursor molecules. We therefore need a coma model that combines both assumptions and allows to vary the contribution of each separately.

[1] Osborn,W.H. et al. (1990) Icarus 88, 228.
[2] A'Hearn, M.F. & Vanysek V. (1989) App. IHW-Archive of Obs. of Giacobini-Zinner, Ed. Z. Sekanina, JPL
[3] A'Hearn, M.F., Birch, P.D., Feldman, P.D., and Millis, R.L. (1985) Icarus 64, 1
[4] Schleicher, D.G. (1983) Thesis, Dep. of Physics and Astronomy, Univ. of Maryland, 108–110
[5] Schulz, R. (1991) Proc. 3rd ESO/ST-ECF Data Analysis Workshop, p. 73
[6] Festou, M.C. (1981) A&A 95, 69
[7] Crovisier, J. et al. (1990) A&A 234, 535
[8] Biermann, L., Giguere, P.T., and Huebner, W.F. (1982) A&A 108, 221