OBSERVATIONS OF COMETS C/2002 T7 (LINEAR) AND 2P/ENCKE AT ANDRUSHIVKA

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Photometric and spectral observations of C/2002 T7 (LINEAR) and 2P/Encke were made with the Zeiss-600 telescope at the Andrushivka Astronomical Observatory in November 2003. CCD imaging of the comets was carried out with narrowband HB filters CN, RC, and BC. The total number of CN molecules, gas production rate for CN, and $Af\rho$ value for the dust coma were obtained. The optical spectra of Comet C/2002 T7 (LINEAR) were obtained and reduced for the wavelength range 4200–7300 Å. The reddening gradient is derived for the spectra. Its value agrees with similar results for other comets at a heliocentric distance of 2.6 AU.

SPECTROSCOPY

Observations of Comet C/2002 T7 (LINEAR) were made with the Zeiss-600 telescope at the Andrushivka Astronomical Observatory in November 2003. A S1C CCD camera attached to the spectrograph at Cassegrain focus of the telescope was used in the observations. The nucleus of the comet was centered on the slit. More details on the observed data can be found in Table 1. The original CCD frames were flatfielded and cleaned of cosmic events. The cometary counts were converted to the absolute intensity scale using observations of the star HD 74280. Its flux was taken from [5]. To provide wavelengths calibration, the $Ne - Ar - N_2^+$ lamp was exposed as well. To calculate the flux from the comet, we used the formula:

$$F_{com}(\lambda) = F_{star}(\lambda)\frac{I_{com}(\lambda)}{I_{star}(\lambda)}P^{-\Delta M}(\lambda), \tag{1}$$

where F_{com} and F_{star} are extra-atmospheric fluxes from a comet and standard star, $I_{com}(\lambda)$ and $I_{star}(\lambda)$ denote the observed fluxes from the comet and standard star, $P^{-\Delta M(\lambda)}$ is spectral transparency coefficient, $\Delta M = M_{star} - M_{com}$ is difference of air masses for the star and comet. For our observations, the difference of air masses does not exceed 0.1. The spectra cover the spectral region of 4200 to 7300 Å.

Table 1. Log of spectral observations

Object	Date, November 2003	Exposure, s	Dispersion, Å/mm	Δ, AU	r, AU
C/2002 T7 LINEAR	24.0996	5×300	3.02	1.68	2.64
HD 74280	24.9622	3×60	3.02		
HD 74280	24.9653	3×60	3.02		
HD 74280	24.9683	3×60	3.02		

For aftertreatment, the one-dimensional spectra of the comet were extracted from the two-dimensional spectral images. To analyse the one-dimensional spectra of the comet, we used the SPE reduction software package developed at the Crimean Astrophysical Observatory. Emission lines of molecules were not detected in these spectra. Some of night-sky spectral lines ([O I], [Na], [Hg I]) were identified. As we detected only the cometary continuum, the normalized gradient for our spectra was derived (Fig. 1). The normalized gradient is written as:

$$r_\lambda = \frac{F_{com}(\lambda_2) - F_{com}(\lambda_1)}{\lambda_2 - \lambda_1} \cdot 1000\ \text{Å} \cdot 100, \qquad (2)$$

where F_{com} and F_{sun} are extra-atmospheric fluxes for a comet and the Sun, $\lambda_1 = 5500$ Å, $\lambda_2 = 6500$ Å. Value of normalized gradient equals about 0.07. The value is in agreement with the data obtained earlier by Jewitt *et al.* [4].

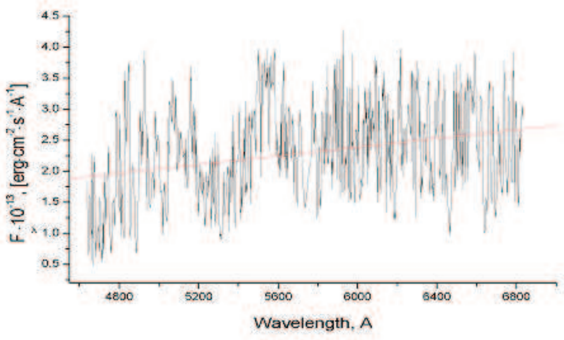

Figure 1. The normalized gradient of continuum for Comet C/2002 T7 (LINEAR)

PHOTOMETRY

Photometry observations of C/2002 T7 (LINEAR) and 2/P Encke were derived in November 2003. CCD imaging of comets was carried out with narrow-band HB filters *CN*, *RC*, and *BC* at Cassegrain focus. Narrow-band photometry was performed to determine the total number of the CN molecules observed in the cometary atmospheres, gas production rate for CN, and $Af\rho$ product. The exposure time was 300 s for each frame (Table 2). Preliminary processing of all data was made with the use of standard procedure [2]. Figure 2 shows CN images for comets 2/P Encke (a) and C/2002 T7 (LINEAR) (b).

Table 2. Log of photometric observations

Object	Date, November 2003	Exposure, s	Frame size	Pixel size	Filter
C/2002 T7 (LINEAR)	21.9980	10×300			*CN*
	22.0611	10×300			*BC*
2/P Encke	21.7663	3×300			*CN*
	21.7785	2×300	8×8	1.68	*BC*
	21.8344	2×300			*RC*
HD 25680	22.9622	8×2			*CN*
	22.9653	10×2			*BC*
	22.9690	10×2			*RC*

a) b)

Figure 2. CN images of comets

The total number of observed molecules was calculated by the formula:

$$N_{obs} = \frac{4\pi\Delta^2 F_{obs}}{g}\,. \tag{3}$$

Here, Δ [cm] is the geocentric distance of a comet, F_{obs} [erg cm^{-2} s^{-1}] is the total flux in the observed molecular emission, and g [erg s^{-1} mol^{-1}] is the fluorescence efficiency factor (g-factor) of the observed band. We used $g = 3.55 \cdot 10^{-13}$ for heliocentric velocity of Comet 2P/Encke $\dot{r} = -15.4$ km/s at the observation moment and $g = 3.39 \cdot 10^{-13}$ ($\dot{r} = -19.1$ km/s) for Comet C/2002 T7 (LINEAR) [1, 3]. All fluorescence efficiency factors are scaled by r^2, lifetime for CN is scaled by r^{-2}. We obtained $Af\rho$ product for characterization of the dust coma of the comet. This value is proportional to the dust production rate and is independent of the projected distance from the cometary nucleus if the cometary continuum brightness follows the ρ^{-1} law. The product $Af\rho$ (where ρ is the filling factor) is defined as

$$Af\rho = \frac{(2r\Delta)^2}{\rho}\frac{F_{com}}{F_{sun}}\,. \tag{4}$$

Here, r [AU] is the comet's heliocentric distance, Δ [cm] denotes the comet's geocentric distance, ρ [cm] is the aperture radius of the comet's image, F_{com} [erg cm^{-2} s^{-1}] is the measured cometary flux in continuum, and F_{sun} [erg cm^{-2} s^{-1}] is the solar flux at 1 AU. The results of calculations are presented in Table 3. M. Kidger (2003) obtained $Af\rho$ value of about 800 for Comet C/2002 T7 (LINEAR) through the R filter at 3.8 AU.

Table 3. Results of photometric observations

Object	r, AU	Δ, AU	N(CN)	Q(CN)	$Af\rho$
C/2002 T7 (LINEAR)	2.691	1.733	4.62×10^{28}	3.04×10^{22}	845.74
2/P Encke	0.944	0.265	2.05×10^{28}	1.10×10^{23}	–

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