PHOTOELECTRIC MONITORING OF COMET C/1995 O1 (HALE-BOPP) IN LISNYKY

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We present results of the narrowband electrophotometric observations of Comet Hale-Bopp near perihelion which were made with the AZT-14 telescope at the Lisnyky station of Astronomical Observatory of the Taras Shevchenko National University of Kyiv. The standard set of IHW cometary filters was used. The comet's nucleus gas production rates Q of C_2 and C_3 were calculated on the basis of the stellar magnitudes of the comet for these filters. We used the Haser model for neutral cometary atmosphere for calculations. The values $Af\rho$, which are the characteristics of the dust nuclear production rate, were estimated too. Comet Hale-Bopp reached the maximum of gas (C_2 and C_3 molecules) and dust $Af\rho$(BC) production close to perihelion.

1. INTRODUCTION

One of the most informative methods of comet exploration is the photoelectric observation with narrow band filters. These data (the absolute fluxes both in emission bands and the continuum, gas and dust sublimation rate and their variations as a result of changes in heliocentric distances, nucleus rotation and comet activity, comparative chemical composition, outbursts of brightness, periods of rotation of nuclei and space orientation of rotation axes *etc.*) are obtained, as early as 1976 for more than 85 comets (A'Hearn *et al.*, 1995). The Astronomical Observatory of the Taras Shevchenko National University of Kyiv (AO KU) obtained a set of narrow band interference filters from M. A'Hearn (A'Hearn, 1982), one of the coordinators of the International Halley Watch photometric net, and joined the international cooperative work on creating the observational base of narrow band photoelectric photometry of comets. During 1982–1995 the collaborators of the AO KU participated in narrowband and UBVR electrophotometric and polarymetric observations of 9 comets: Austin (C/1982 M1), Churyumov-Gerasimenko (67P), Halley (1P), Hartley-Good (C/1985 R1), Giacobini-Zinner (21P), Thiele (C/1985 T1), Brorsen-Metcalf (23P), Levy (C/1990 K1) and Hale-Bopp (C/1995 O1) (Churyumov *et al.*, 1990; Churyumov and Rosenbush, 1991). The data on narrow band photometric and polarymetric observations of Comet Halley and Giacobini-Zinner were sent to the International Archives of these comets (both comets were the first to have been explored with space probes).

2. OBSERVATIONS AND PROCESSING

Electrophotometric observations of Comet Hale-Bopp (C/1995 O1) were made by the authors at the Lisnyky observing station of the AO KU with an electrophotometer installed at the AZT-14 reflector, which has a 50-cm diameter of the mirror. During observations the standard narrowband interference filters of the IHW, except the CN-filter (its bandpass shifted noticeably for the last 12 years) were used.

Altogether more than 500 observations of Comet Hale-Bopp were obtained for the period March 13 – April 27, 1997. The comet's nucleus gas production rates Q of C_2 and C_3 were calculated on the basis of the stellar calibration of these filters. The calculations were made by using the Haser model for neutral cometary atmosphere (Haser, 1957). The values $Af\rho$, which characterize the dust nucleus production rate (A'Hearn, 1991; A'Hearn *et al.*, 1995), were estimated too. Comet Hale-Bopp reached the maximum of gas (C_2 and C_3 molecules) and dust $Af\rho$(BC) production near the perihelion. The mean values of the production rates in the vicinity of the perihelion are $\log Q(C_2) = 28.4$; $Q(C_3) = 27.2$; $Af\rho(\mathrm{BC}) = 6.0$. These values are close to those obtained by other observers, *i.e.*, T. Farnham *et al.*, 1997. Discrepancies between $Af\rho$ values for the BC and RC filters show that the cometary continuum is more red than the Sun and increases with time according to the law

$$\log(Af\rho(\mathrm{BC})/Af\rho(\mathrm{RC})) = -0.00066(\Delta t - 0.061),$$

where Δt is the time (in days) from perihelion. This dependence is evidence for the presence of a dust in the near nucleus region of the comet that is more red than the Sun. It is possible to describe similar discrepancy for UC and BC filters as $\log(Af\rho(\mathrm{UC})/(Af\rho(\mathrm{BC})) = 0.0045(\Delta t - 0.0055)$.

This dependence indicates that a cometary dust which is more blue than the Sun is present near the nucleus. The maximum near perihelion in $\log(Af\rho)$ is absent. The variation of phase angle φ of the comet cannot explain the observed dependences because in the beginning of the observations on March 13, 1997, $\varphi = 47.^\circ2$, and the maximum of $\varphi = 49.^\circ1$ was on March 23, 1997 and in the end of observations on April 30, 1997. In both cases the sum of mean-square errors is approximately 1.5 times smaller for the temporal law than for a linear dependence with phase. Probably, the observed dependences are explained by changing color characteristics and sizes of the dust particles in the shells constantly being formed in the nucleus region of the comet. The both large dark particles being more red than the Sun occur in the shells simultaneously, as well as small light particles, which are more blue than the Sun. This fact, probably, is seen under the question (Churyumov *et al.*, 1999; Churyumov *et al.*, 2000).

3. CONCLUSION

1. Altogether more than 500 narrowband photoelectric observations of Comet Hale-Bopp were obtained at the Lisnyky observing station of the AO KU for the period March 13 – April 27, 1997.

2. Mean values of the gas and dust production rates near perihelion are $\log Q(\mathrm{C_2}) = 28.4$; $Q(\mathrm{C_3}) = 27.2$; $Af\rho(\mathrm{BC}) = 6.0$.

3. In the dust shells simultaneously occur both large dark particles, more red than the Sun, and small light particles more blue than the Sun.

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