Unusual Polarization during Outburst of Comet 17P/Holmes. N. Kiselev[1] (kiselev@mao.kiev.ua), V. Rosenbush[1], S. Velichko[2], F. Velichko[2], L. Kolokolova[3], and K. Antoniuk[4], [1]Main Astronomical Observatory of National Academy of Sciences of Ukraine, Kyiv, Ukraine, [2]Institute of Astronomy of Kharkiv National University, Kharkiv, Ukraine, [3]University of Maryland, College Park, USA, [4]Crimean Astrophysical Observatory, Nauchnyj, Ukraine.

Introduction: We present results of polarimetric observations of comet 17P/Holmes during the outburst. Even though the comet showed typical for the small phase angles negative polarization, its absolute values were very low and had a pronounced negative spectral gradient. Both these results are atypical for comets. The reasons of such unusual behavior of the comet polarization are discussed.

Observations and results: The polarimetric observations of comet Holmes were carried out with a photoelectric photometer-polarimeter mounted at the 0.7-m reflector of Chuguev Observational Station (Ukraine) on October 27–November 5, 2007. The filters BC (4845/65 Å) and WRC (7228/1140 Å) and 88, 33, and 20″ diaphragms were used. On November 8–22, 2007 the comet was also observed at the 1.25-m telescope of the Crimean Astrophysical Observatory (Ukraine) with a photoelectric photometer-polarimeter. The wide-band filters R (6860/1080 Å) and I (7660/550 Å) and 12″ diaphragm were used. Diaphragm was centered at a photometric nucleus and two regions of coma at the distance 6 arcmin to the north and the south of photometric nucleus. The comet was observed within the range of phase angle of 16.1–11.3°.

Figure 1 summarizes the observations described above. The typical phase-angle dependence of polarization for comets [1] is also shown there. Figure 1 reveals the following peculiarities for comet Holmes: i) the degree of polarization depends on the position of measured area in the coma; ii) the degree of polarization is substantially smaller than that for typical comets; iii) the comet demonstrates a strong negative spectral gradient of polarization (polarization diminishes with the wavelength).

Amazingly, all comets show very similar characteristics of negative polarization branch: position of the minimum at $\alpha_{min} \approx 10°$ with the value $P_{min} \approx -1.5\%$, and inversion angle at $\alpha_{inv} \approx 22°$. However, it is evident from Fig. 1 that the polarimetric properties of comet Holmes are very different. For it, the degree of polarization near the minimum is ~–1.1% in the R filter and about –0.5% in the I filter. According to the data in the red bands (red symbols), the expected inversion angle should be about 18° that is also the value unusually low for comets.

The other peculiarity of the Holmes' polarization is its spectral trend. Even though there is not enough data to draw a firm conclusion about the typical spectral behavior of comet polarization at small phase angles, none of the previously observed comets showed such a pronounced negative spectral gradient. Comet Holmes is the first one for which it reached –0.77% / 1000 Å near the polarization minimum.

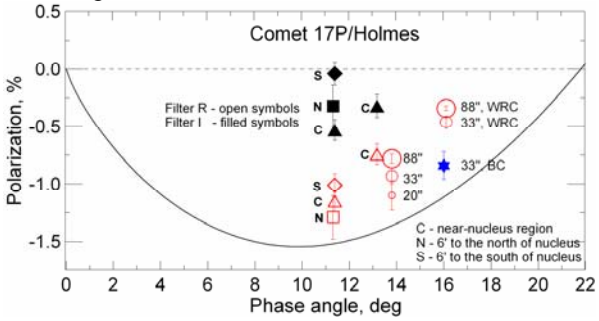

Fig. 1 Phase-angle dependence of polarization for comet Holmes in different filters and diaphragms. The typical curve of polarization for comets in red continuum is shown by solid line.

Discussion: It is believed that the negative polarization at small phase angles is a result of the light scattering by aggregated dust particles in comet atmospheres. Theoretical modeling of light scattering by aggregates shows [2] that the depth of the negative polarization branch strongly depends on the aggregate size (the number of monomers) and gets the values typical for comets only if the aggregates are larger than 0.6 μm. This may support the idea that the dust in the comet Holmes outburst was dominated by smaller particles than those typical for the regular comet dust. The other factor that may influence the negative polarization is composition of the particles: the negative polarization is usually more pronounced for silicate-rich particles. Finally, some unusual combination of aggregated and compact particles in the dust may be the reason of the comet Holmes peculiarities since the ratio of aggregate/compact particles in the dust influences the degree of negative polarization as well as its spectral trend [3]. To select between these reasons for unusual polarimetric properties of the comet, more detailed modeling as well as more information about the outburst dust from other observations, especially photometric and thermal, are necessary.

References: [1] Kiselev N., and Rosenbush V. (2004) in: Videen et al. (eds.), Photopolarimetry in Remote Sensing. Kluwer AP, 411-430. [2] Kimura H. et al. (2006) *A&A, 449*, 1243-1254. [3] Kolokolova L. et al. (2007) *DPS meeting #39*, #54.06.