Scattering properties of the dust in distant comet C/2014 A4 (SONEAR).

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Cometary dust preserves the materials left from the early stages of the solar system formation. In the comets that reach close distances to the Sun, the dust does not represent the pristine materials due to sublimation of its volatiles and other changes caused by the solar radiation. However, there are some comets whose orbits keep them far away from the Sun. Some of them exhibit considerable activity at heliocentric distances much larger than 4 au and, thus, allow us to study the dust not notably modified by solar radiation. Since 2011, we are conducting a comprehensive program of polarimetric, photometric, and spectral investigations of active distant comets with the 6-m telescope BTA (SAO RAS) with multi-mode focal reducer SCORPIO-2 (Afanasiev & Moiseev, 2011, Baltic Astron., 20, 363).

We present continuum polarization measurements for unique distant comet C/2014 A4 (SONEAR) with perihelion distance more than 4 au. The comet showed significant activity at large heliocentric distances. Since no emission lines could be detected with our spectroscopic observations, all this activity can be attributed to the dust Polarization map of this comet, obtained at phase angle 3.8 deg., shows spatial variations of polarization over the coma from about –2% near the nucleus to –8% at the heliocentric distance r=4.2 au (the polarization images of the comet were taken in the g-sdss (λ4650/650 Å) and r-sdss (λ6200/600 Å) filters). Thus, the negative polarization is significantly greater than the typical polarization (~ -1%) observed at the same phase angles for the dust in the comets close to the Sun. Possible explanation of the unusual polarimetric properties of the dust in this comet is provided. It is based on the computer modeling of the dust as a polydisperse ensemble of rough multishaped spheroids, which change their size and composition with the distance from the nucleus.