COMET 12P/PONS-BROOKS OUTBURST AND COMA EXPANSION RATE

Federico Manzini (Stazione Astronomica di Sozzago), Virginio Oldani (Stazione Astronomica di Sozzago), Andrea Reguitti (OAB-INAF), Paolo Ochner (University of Padova), Luigi R. Bedin (OAPD-INAF)

Comet 12P/Pons-Brooks, belonging to the Neptune family, has always been affected by very intense outbursts. The literature reports a sudden magnitude increase in the second half of September 1883 (r=2.1 AU from the Sun). During that apparition, two more minor outbursts were reported, on January 1 and January 19, 1884 (r=0.79 AU). Also, during the passage of 1954 several outbursts were observed that increased the brightness of the nucleus by 3 or 4 magnitudes: July 1 (r=1.06 AU), September 28 (r=2.22 AU) and again in December.

Following the recent outburst of comet 12P, which occurred between July 19 and 20 (r=3.89 AU), we measured the coma diameter on thirteen CCD images, publicly available, taken between July 21 and August 5, 2023, by the 2-m Faulkes North Telescope at the LCO-Haleakala Observatory (Maui, Hawaii, USA). The accuracy of these measurements was further assessed by making measurements on images taken with the 0.67-m Schmidt telescopes (July 23 and July 24) at the Asiago Astrophysical Observatory (INAF, Italy - MPC 098)

The measurements of the diameter of the coma were made by analyzing the photometric profile of a line drawn from E to W, inclined orthogonal to the axis of the expanding "wings", and passing through the optocenter on images previously processed in isophote, with a minimum threshold equal to the sky background and the isophote steps calculated proportionally to the difference between the max and min ADU value of the same photometric profile drawn on the unprocessed image (Fig.1). The coma diameter measured in pixels was then converted into km considering the resolution of the images (0.267 arcsec/pixel) and the distance Δ from the Earth on each day.

The coma, which measured about 48,000 km on July 21, expanded to reach a diameter of about 600,000 km on August 5, with a progression of about 38,000 km per day, at a computed average speed of 220 ± 38 m/s (projected on the plane of the sky). The expansion rate remained fairly constant during the observation period, as shown by the virtually linear progression of the expansion of the coma (Fig. 2). The wavefront of the outburst presumably developed approximately in the direction of the Earth, so the true expansion speed could be much greater than that measured on the sky plane. By calculating the intercept of the regression line of Fig. 2 with the x axis, it was also possible to estimate the approximate time of the beginning of the outburst on JD 60145.07278689 (July 19.55, 2023 ± 0.4 d).

The initially spherical coma gradually assumed an asymmetrical shape in the SE direction with respect to the position of the nucleus, as an effect of the radiation pressure on the emitted dust.

A numerical model of the expanding comet's coma was performed with our proprietary software (Fase 6) using the calculated expansion rate of 220 m/s. The software allowed to reproduce a day-by-day model of the coma almost exactly the size of that observed on each of the CCD images, as well as its asymmetric shape, and to derive a size of the dust particles in the expanding coma farthest from the nucleus between 1.5 and 2 microns.

Figures and extra material at https://web.oapd.inaf.it/bedin/files/PAPERs_eMATERIALs/ATel

We are grateful to the LCO-Haleakala Observatory for making the images of comet 12P publicly available, thus making this study possible.