TRAPPIST production rates of multi outbursts comet 12P/Pons-Brooks

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The authors report that they obtained from the TRAPPIST-North robotic telescope (Jehin et al. 2011) recent observations under clear skies using broad band and cometary HB narrowband filters (Farnham et al. 2000) of the Halley type comet 12/Pons-Brooks and computed preliminary production rates at 10^5 km using a Haser Model (Vp=Vd=0.5km/s) (Haser 1957; Cochran & Schleicher 1993). A Haser model could not be fit at 10^4 km due to the very strong dust contamination. The dust production rates proxy A(0)f(rho) were estimated by profile fitting at 10^4 km (A'Hearn et al. 1984) and corrected for the phase angle (Schleicher 2007).

Observations with TRAPPIST-North just before and after the newly reported 12P/Pons-Brooks outburst on October 4.75 +/- 0.43 UT (Atel #16270), indicate a 2.2 Rmag increase in a 5 arcsec aperture from 15.6 +/- 0.02 (on Oct 4.96 UT) to 13.41 +/- 0.01 (on Oct 7.80 UT) from a set of 4 R band images each night while the comet was at 3.05 au from the Sun. Preliminary analysis indicates a large increase of Afrho by a factor of 6 in the RC band (with a typical coma dust shape similar to the outburst seen on July 20.82) was measured but only a small increase of less than a factor 2 for the CN and C2 gas production rates at 10^5 km resulting in an unusual high dust/gas ratio compared to outbursts observed in other comets where both increases at same rate (ATel #15673 for 73P; ATel #15189 for C/2021 A1). OH was not detected.

12P/Pons-Brooks
Date UT=2023-10-07, r_h=3.03 au, Delta=3.06 au, DT=-196 days
Q(OH) < 1.09 E28 s-1
Q(CN) = 1.91 +/- 0.22 E25 s-1
Q(C2) = 2.47 +/- 0.40 E25 s-1
A(0)fp(RC) = 6715 +/- 15 cm
A(0)fp(BC) = 6142 +/- 77 cm

Date UT=2023-10-03, r_h=3.08 au, Delta=3.09 au, DT=-200 days
Q(OH) < 2.87 E28 s-1
Q(CN) = 1.50 +/- 0.23 E25 s-1
Q(C2) = 1.27 +/- 0.46 E25 s-1
A(0)fp(RC) = 1285 +/- 7 cm
A(0)fp(BC) = 1153 +/- 20 cm

Another outburst of 0.63 Rmag in a 5 arcsec aperture was detected earlier in our monitoring between Sept 22.93 (Rmag = 16.04 +/- 0.02) and Sept 25.85 (Rmag = 15.41 +/- 0.02) from a set of 4 R band images on each night. No special coma feature was noted in the nights

following. The value of Afrho nearly doubled while the production rates of CN and C2 did not change.

12P/Pons-Brooks
Date UT=2023-09-25, r_h=3.16 au, Delta=3.14 au, DT=-208 days
Q(OH) < 0.98 E28 s-1
Q(CN) = 1.20 +/- 0.33 E25 s-1
Q(C2) = 0.87 +/- 0.55 E25 s-1
A(0)fp(R) = 1305 +/- 4 cm
A(0)fp(BC) = 1189 +/- 20 cm

Date UT=2023-09-22, r_h=3.2 au, Delta=3.15 au, DT=-211 days
Q(OH) < 1.27 E28 s-1
Q(CN) = 1.18 +/- 0.22 E25 s-1
Q(C2) = 0.84 +/- 0.48 E25 s-1
A(0)fp(R) = 798 +/- 3 cm
A(0)fp(BC) = 759 +/- 10 cm

Notations: rh= heliocentric distance (in au), Delta=geocentric distance (in au), DT= Time to perihelion. OH, NH, C3, CN, C2 are the HB gaseous narrowband filters for the corresponding species, and BC, GC, RC are the blue, green and red dust continuum filters (Farnham et al. 2000).

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