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67P/Churyumov-Gerasimenko: start of activity and heliocentric light curve

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Comets are believed to be widely unmodified remnants from the formation of the solar system; their study can give important insights into the conditions prevailing at the time of the planetary system formation. After the success of the Giotto mission to comet 1P/Halley, the European Space Agency (ESA) approved in the early nineties a new space mission with a comet as main target: Rosetta, which will rendezvous with come 67P/Churyumov-Gerasimenko (67P/C-G) in 2014.

67P/C-G is a Jupiter family comet with orbital period of 6.56 years. Due to repeated encounters with Jupiter, the orbital evolution of 67P/C-G is chaotic. The last encounter in February 1959 occurred at a distance of only 0.0518 AU and produced drastic changes in perihelion distance, eccentricity, inclination, orbital period and possibly led to its discovery in 1969. After 67P/C-G was selected as target comet of Rosetta mission, observational campaigns and theoretical investigations were performed in order to establish a detailed portrait of 67P/C-G in preparation of the rendezvous with the spacecraft ([1], [2], [3], [4]).

Here we present ground-based observations of 67P/C-G obtained between July 2007 and March 2008 at ESO VLT using the FORS2 instrument. The comet was moving inbound, from 4.6 AU to 3.4 AU. The orbital arc covered by our observation is the same where 67P/C-G will be in 2014 when the rendezvous with the Rosetta spacecraft will take place, thus of highly interest for mission planning. Since the comet's activity around perihelion has shown similar behaviour during the last three orbital passages, it is fair to assume that the comet's behavior at large heliocentric distance has not changed from one orbital revolution to the other, leading us to expect that during its approach to 67P/C-G, Rosetta will find the same conditions detected during our observations.

A considerable difficulty in observing 67P/C-G during the past years has been its position against crowded fields towards the galactic centre for much of this time (Fig. 1 - top). The 2007/8 data presented here was particularly difficult, and the comet will once again be badly placed for Earth based observations in 2014/5. We made use of the technique of Difference Image Analysis (as implemented in the DanDIA software, [5]), which is commonly used in variable star and exoplanet research, to remove background sources and extract images of the comet (Fig. 1 - bottom).

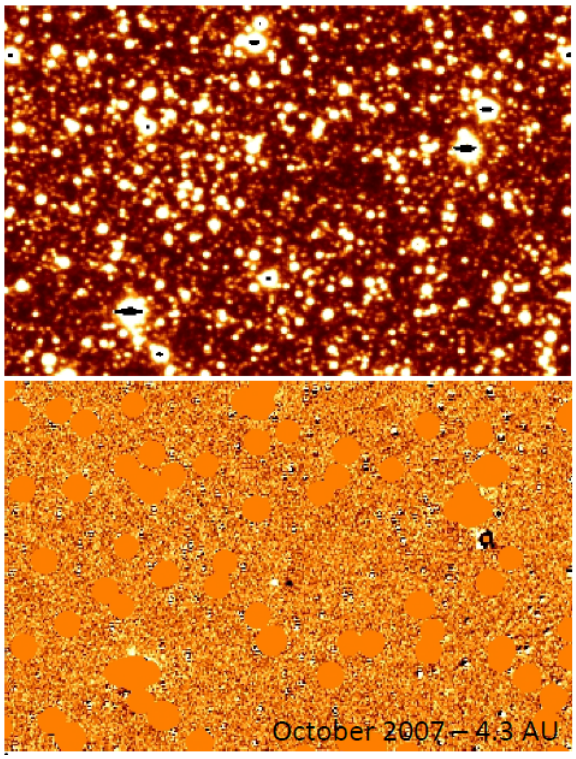

Figure 1: Image of 67P/C-G obtained in October 2007 at 4.3 AU. Top: original image, showing the very crowded star background. Bottom: image processes make use of the technique of Difference Image Analysis. The comet is the white dot close the centre of the image.

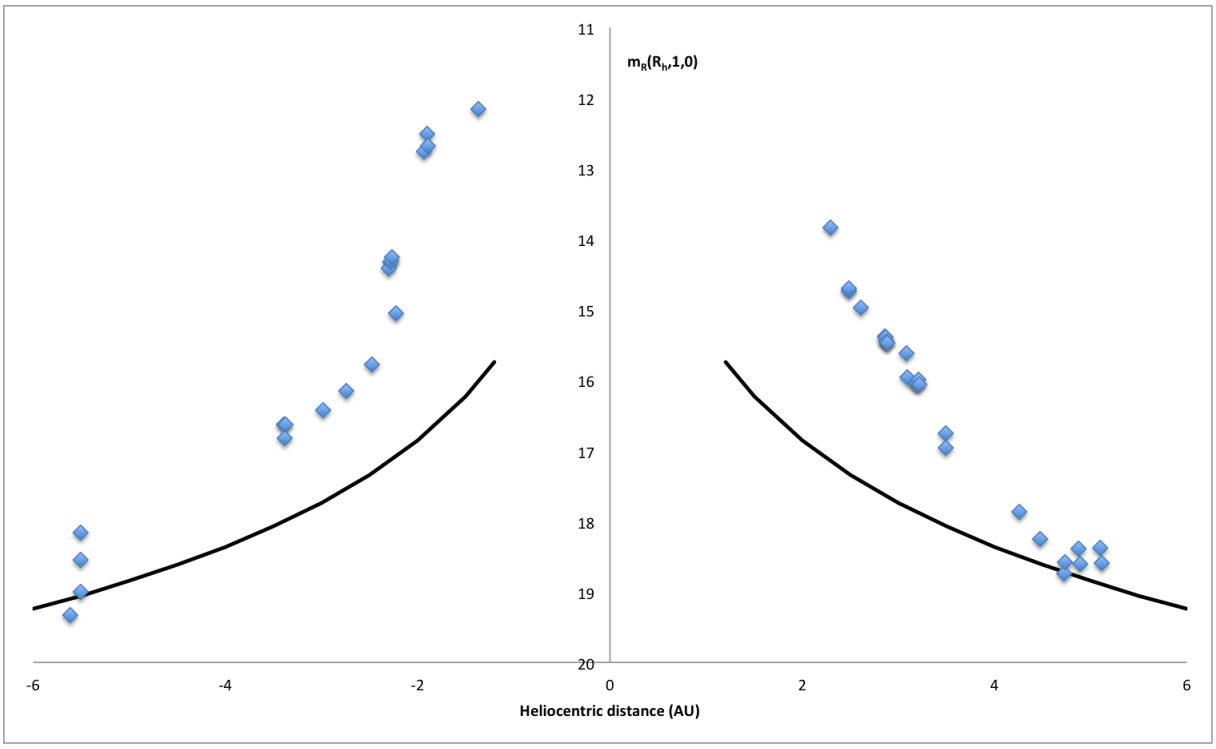

Figure 2: Preliminary heliocentric light curve from archival data, with R band magnitudes corrected for geocentric distance and phase angle. The magnitudes are measured within a fixed aperture equivalent to 10,000 km at the comet at each point, and a median value for each night is plotted. The line shows the predicted magnitude of the bare nucleus [4].

We determined that the comet became active during the period November 2007 - March 2008, at a distance of 4.1-3.4 AU from the Sun. The comet will reach this distance, and probably become active again, in April-September 2014.
To investigate the longer period activity cycle of the comet we compiled the heliocentric light curve of the comet, making use of images of 67P/C-G taken during the last three apparitions taken from the ESO archive. A preliminary light curve is shown in 2. This information will be used for planning observing campaigns, both from the ground and using OSIRIS on board Rosetta.

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