

## Ground-based characterization of 67P/Churyumov-Gerasimenko

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## Abstract

ESA's Rosetta spacecraft will rendezvous with the Jupiter family comet (JFC) 67P/Churyumov-Gerasimenko (67P/C-G) in 2014. The results we present here are based on the analysis of photometric and spectroscopic ground-based observations of 67P/C-G performed between 2004 and 2010. The aim of this study is to provide a characterization of the nucleus of the comet at large heliocentric distance and of the dust environment of 67P/C-G around its orbit. This information is essential for a good planning of the rendezvous of the Rosetta spacecraft with 67P/C-G, which will take place at  $\sim$  4 AU from the Sun. Moreover, this study will provide valuable information on the basic physical properties of the nuclei of JFCs and their dust environment far away from the Sun. The observations were carried out in April and June 2004, May and August 2006, July 2007 and March 2008 with the ESO Very Large Telescope (VLT), when 67P/C-G was moving from 4.6 AU post-perihelion to 3.7 AU pre-perihelion (last orbit). Three additional datasets were obtained in February 2010 with the ESO New Technology Telescope (NTT) and March and April 2010 with the SOAR telescope, when 67P/C-G was moving outbound from 3.5 to 3.8 AU. The comet appears point-like when it is at  $r \ge 4.6$  AU (pre- and post-aphelion), indicating that no significant coma is present around the nucleus at that heliocentric distance. Activity is detected, instead, starting at 3.7 AU pre-perihelion and it is still present at 3.8 AU post-perihelion. From 67P/C-G images taken in May

and August 2006 we determined a rotational period of 12.7047  $\pm$  0.0011 h and a linear phase coefficient  $\beta = 0.076 \pm 0.003$  mag/° [1], higher than the usual one adopted for cometary nuclei [2]. Thanks to the July 2007 dataset we determined that 67P/C-G does not show opposition effect at small phase angles (0.5° - 10°). We estimated the large-to-small axis ratio a/b > 1.45  $\pm$  0.09 and an effective nucleus radius of 2.38

 $\pm$  0.04 km, assuming an albedo of 0.04.

Based on broadband colour indices and reflectance spectra, the nucleus of 67P/C-G is slightly redder than the Sun with a constant reddening slope of  $\sim 11\%/100$  nm and it does not show colour variation with rotational phase. The reflectance spectra do not show any absorption or emission features.

In April and June 2004, May 2006, February, March and April 2010 we detected a tail-like structure of heavy grains associated with 67P/C-G. Our analysis and interpretation of the tail-like structure will be presented.

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 behaviour 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.

## References

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