# The activity cycle of 67P/Churyumov-Gerasimenko

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We present ground-based observations of comet 67P/Churyumov-Gerasimenko, target of the Rosetta mission, and an assessment on its activity levels. Based on imaging in the R-band, we measure the brightness of the coma within various apertures and use this to assess the amount of dust in the coma. We find that the comet begins to show detectable activity at a pre-perihelion distance from the Sun of 4.3 au, and then shows a smooth increase in production to a peak around one month after perihelion passage. The behaviour of the comet is consistent from one orbit to another, based on archival images taken over three apparitions, and we therefore use the heliocentric lightcurve to make predictions for the 2014/5 period while Rosetta is operating at the comet. We find that the $Af\rho$ parameter, measured within an aperture of radius 10,000 km at the comet, is proportional to $r^{-3.2}$, pre-perihelion [1].

We also attempt to make predictions on the gas production rate by fitting a model to the observed brightness values. This is done by assuming various parameters about the nucleus and dust, many of which are reasonably well constrained for 67P, and solving an energy balance equation that gives the sublimation rate of various ices as a function of solar illumination [2]. The model then links the gas production rate to the total amount of dust in the coma, and its brightness. We find that only a small fraction of the surface area (1.4 %) needs to be active for water sublimation, with an extra peak (up to 4 %) for a month either side of perihelion, while an even smaller area is producing $CO_2$ (0.04–0.09 %) [1].

The predictions can now be tested against new observations, and we will present the latest results from our 2014 monitoring of 67P. We are performing regular R-band imaging on the comet using the VLT, and early indications in March 2014 indicate that the comet does appear to have returned to activity as expected. By the time of the ACM meeting we will have around 4 months of imaging to make a clear assessment of the trend between 4.4 and 3.8 au, which will allow a comparison with our model and therefore predictions to be made of how well 67P appears to be following its previous activity pattern.

By July, we will also have obtained the first of a series of VLT/FORS visible wavelength spectra, to make a direct search for gas emission lines. These will represent some of the most distant spectroscopic observations of a Jupiter family comet coma. Preliminary results will be shown from these spectra, which will also constrain the expected evolution of activity as Rosetta approaches the comet.

**References:** [1] Snodgrass, C., et al. 2013, A&A 557, A33. [2] Meech, K., et al. 1986, Icarus 66, 561.