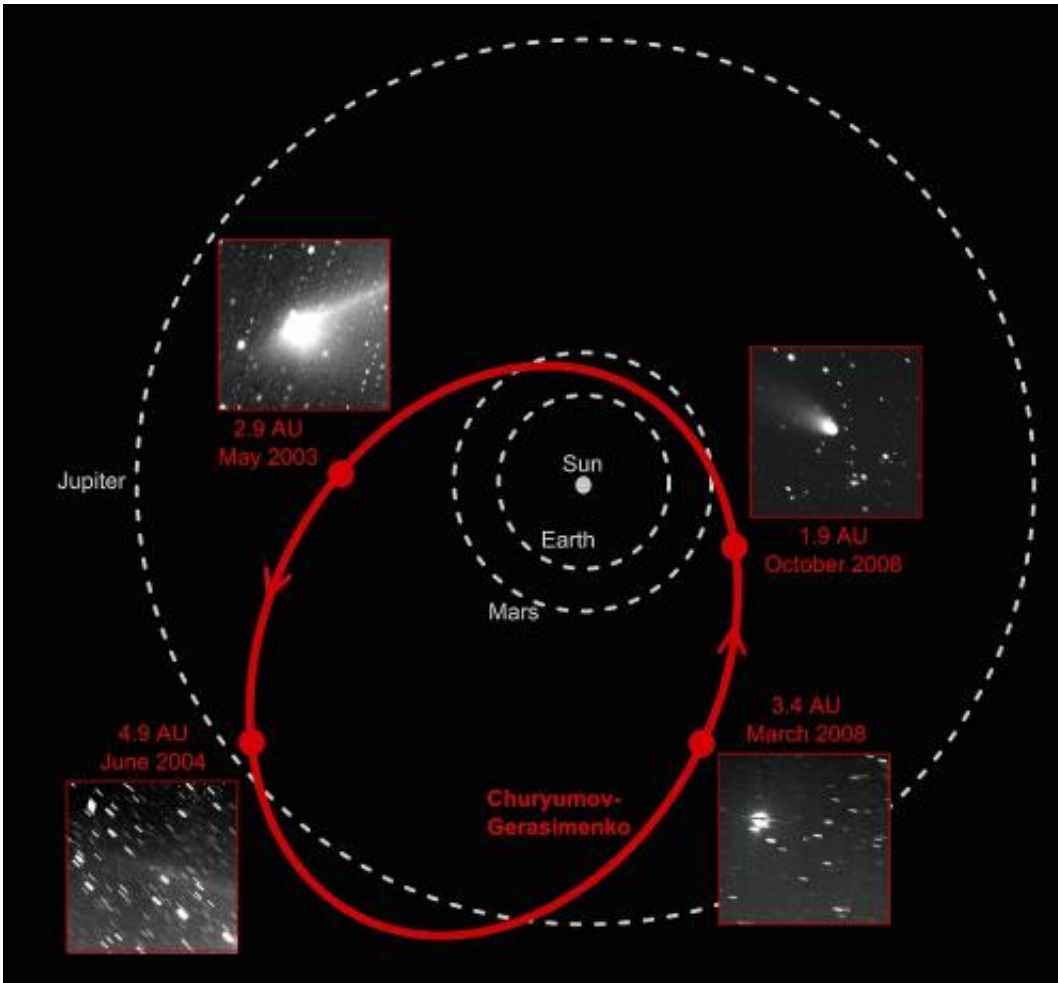


# Rosetta-comet will wake up early

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In the course of one orbit around the Sun, the comet Churyumov-Gerasimenko goes through different phases of activity. At a distance of 3.4 astronomical units (AU) a significant increase in brightness can be observed. Shortly before crossing the orbit of Mars the comet has developed its characteristic tail. Departing from the Sun, Churyumov-Gerasimenko is still very active and shows a dust trail, a structure composed of large dust particles emitted during the previous orbits of the comet. This trail can still be discerned at distances of 4.9

astronomical units from the Sun. Credit: MPS

(Phys.org) —On its way towards the Sun comet Churyumov-Gerasimenko, next year's destination of ESA's spacecraft Rosetta, will start emitting gas and dust earlier than previously expected. The comet's activity should be measurable from Earth by March 2014. This is one of the results of a new study performed by a group of researchers under the lead of the Max Planck Institute for Solar System Research (MPS) in Germany. The scientists analyzed numerous images from the comet's past three orbits around the Sun, obtained with ground based telescopes. For the first time, they were able to reconstruct the comet's activity in all phases of its orbit.

A [comet](#) spends the main part of its existence far from the Sun as an unchanged lump of ice and rock. When it approaches the Sun, however, a metamorphosis takes place: highly [volatile substances](#) vaporize from the nucleus carrying fountains of [dust particles](#) with them. These accumulate to form the comet's atmosphere, the coma, and are the origin of its tail, a comet's most characteristic feature. However, the principles governing these processes are still only poorly understood. What instances spark the ejection of gas and dust? How does this activity evolve? And which processes on the surface and within the comet's nucleus are decisive?

Next year, ESA's [spacecraft](#) Rosetta will try to answer these questions. The space probe is scheduled to rendezvous with comet Churyumov-Gerasimenko in spring, deposit a lander on its surface in the autumn of 2014, and accompany the comet on its way toward the Sun. The mission therefore offers the unique chance to study all phases of the onset of cometary activity from close-up. The new results presented by researchers from the MPS now suggest that Churyumov-Gerasimenko

could allow for exciting insights very early in the course of the mission.

"Churyumov-Gerasimenko could be active by March of next year", Dr. Colin Snodgrass from the MPS summarizes the new results. Two months prior to this, in January 2014, the space probe will be awakened from its hibernation phase.

The scientists base their predictions on 31 data sets recorded by them and other professional groups in the years between 1995 and 2010 with telescopes like the Very Large Telescope (VLT) at the European Southern Observatory (ESO). The images show the comet at different points during its orbit and thus in different phases of activity.

"We were able to analyze data from the entire activity-cycle of Churyumov-Gerasimenko with the same method. For the first time, this allows for a meaningful comparison of all data sets", says Snodgrass. "In this way we compiled a comprehensive picture of how the comet's activity develops during its journey around the Sun", his colleague Dr. Cecilia Tubiana from the MPS adds.

The researchers took an especially close look at the comet's past approach in 2007 and 2008. When ten years ago, ESA chose Churyumov-Gerasimenko as target of the Rosetta mission, this triggered a myriad of observational campaigns. "Most of the images taken in 2007, when the comet was far away from the Sun, present a significant difficulty", says Tubiana. During this time the comet could be seen from Earth only in front of the background of the Galactic center, the mass center of the Milky Way. In all images the faint comet only barely stands out from this crowd of stars. Next year, when Rosetta arrives at the comet, the observational situation will be similar. Many ground-based telescopes will then again be pointed towards Churyumov-Gerasimenko to complement the data obtained by Rosetta.

In their new study the researchers were able to analyze data that had been unusable before. Key to this success was a method usually employed to discover exoplanets in these crowded star fields. Images taken shortly after one another are subtracted making the crowded starry background disappear and revealing bodies that - like a comet - change their position. After using this technique to make the comet stand out from the camouflage of background stars, its brightness could be accurately measured. From the change of the brightness in the course of one [orbit](#) it is possible to reconstruct how active the comet was at which time. For the analysis of comet images this method was until now rather uncommon - and usually unnecessary, because rarely comets have been observed in front of the background of the Galactic center.

The elaborate calculations rendered astonishing news: to the researchers' surprise the comet's brightness increased distinctly at a distance of 4.3 astronomical units from the Sun. This is 4.3 times the distance between the Sun and Earth. Before, it had been thought a rule of thumb, that comets become active at a distance of approximately 3 astronomical units. At this distance the Sun heats the comet's surface enough for water ice to sublimate. "Some other gas must be responsible for the earlier activity that we observed", says Tubiana.

"Since Churyumov-Gerasimernko seems to have behaved much the same in the past orbits, we are optimistic that we can safely predict next year's events", says Dr. Hermann Böhnhardt from the MPS, lead scientist of Rosetta's landing mission, who was also part of the new study. After its awakening in March 2014, the researchers expect the comet to reach its peak activity in mid-September 2015 - almost one month after perihelion.

ESA's [space probe](#) Rosetta was launched in 2004 and is scheduled to reach its destination, the comet Churyumov-Gerasimenko, in 2014. In the autumn of 2014 the lander Philae will touch down on the comet's

surface. The MPS is the research institution with the largest contribution to this mission. The institute heads the teams of three instruments on board, contributed to five others and has developed and built important parts of the [lander](#).

**More information:** Snodgrass, C. Tubiana, D.M. Bramich, K. Meech, H. Bönhardt, and L. Barrera: Beginning of activity in 67P/Churyumov-Gerasimenko and predictions for 2014/5, *Astronomy & Astrophysics*, August 20, 2013. [dx.doi.org/10.1051/0004-6361/201322020](https://doi.org/10.1051/0004-6361/201322020)

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