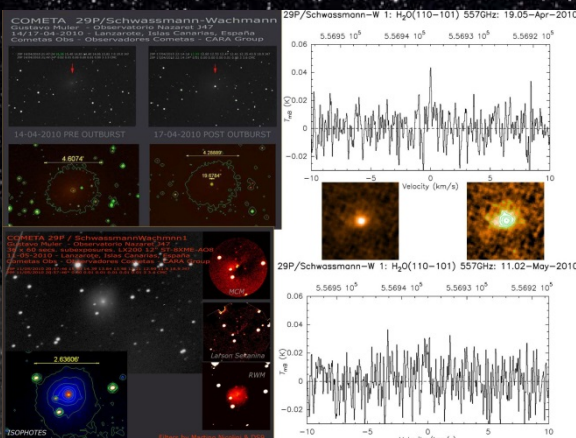


12 Years of Monitoring of Outbursting Comet 29P/Schwassmann-Wachmann 1

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Comet 29P/Schwassmann-Wachmann 1 (SW1) is a giant comet of 14.6 years period with a low-eccentricity orbit entirely between Jupiter and Saturn. It is best known for its remarkable outbursting activity in which it will, in an interval of a few hours, develop an intense, stellar nucleus and may increase in brightness by 1 magnitude per hour, with an amplitude of up to 7 magnitudes (a factor of 1000 in brightness).

Activity of the comet has been relatively low since 2010. Herschel observed SW1 at four epochs: three spectroscopic observations of the 110-101 water line with HIFI in 2010 and four epochs of imaging with PACS. Observations with HIFI in April 2010 show a weak water vapour detection during a major outburst, showing that superheating of grains must be present to permit water vapour sublimation at a heliocentric distance greater than 6AU. We show the archive of CCD monitoring of this comet obtained since 2001, which has almost 18 000 aperture photometry observations use it to place the Herschel observations in their context.

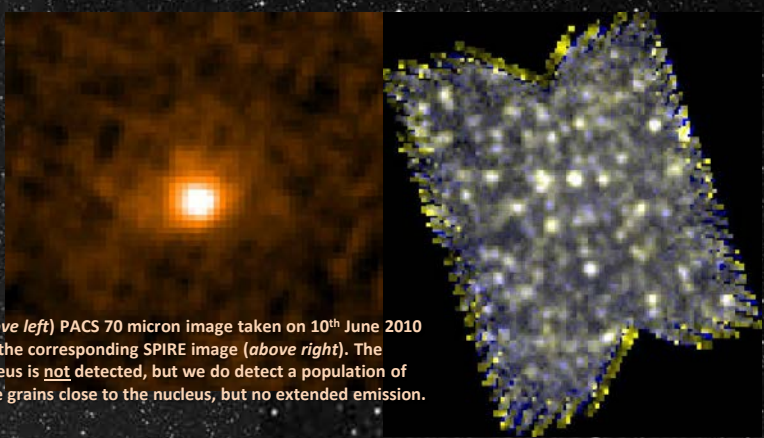


(Right) The observing log of Herschel observations of Comet 29P/Schwassmann-Wachmann 1

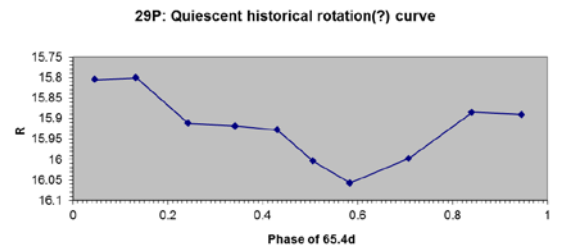
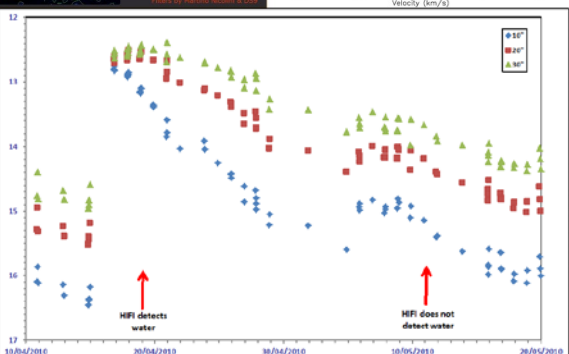
Date	OD	Instrument	Exposure
2010/04/19	340	HIFI	3487s
2010/05/11	362	HIFI	2883s
2010/06/10	392	PACS	1420s
2010/06/10	392	SPIRE	3353s
2010/12/30	595	HIFI	3035s
2011/01/02	599	PACS	5700s
2013/02/17	1375	PACS	14140s

Left HIFI spectra of 29P in outburst (top) showing the 110-101 line of water and in quiescence (bottom) where no line is detected.

Even though the comet is beyond the AU distance at which water sublimation is not expected, even for a slowly rotating nucleus such as 29P, super-heating of ice grains can occur in the coma when the grains are smaller than the wavelength of radiation.



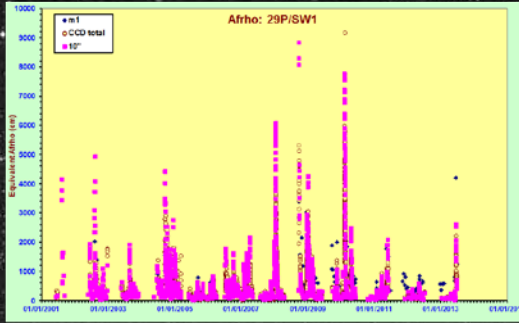
(Above left) PACS 70 micron image taken on 10th June 2010 and the corresponding SPIRE image (above right). The nucleus is not detected, but we do detect a population of large grains close to the nucleus, but no extended emission.



Spitzer observations suggest a best period for the rotation of the nucleus >60d. Photometry of the quiescent nucleus from a database of nearly 20 000 CCD observations between 2001 & 2013 suggests a very slow rotation period of 64.5 or 65.5d.

(Right) The full archive of 17 893 observations of 29P made by the Spanish Observadores_cometas Group between 03/06/2001 and 30/05/2013.

The measured mean outburst rate from this database is 14.2 per year.



Conclusions

- Comet 29P was monitored by Herschel at epochs of high and low activity during a period of generally low activity.
- Weak water vapour emission was seen during the April 2010 outburst of the comet. No water emission is seen 3 weeks later with the comet close to quiescence.
- The source of this emission can only be sublimation from super-heated grains emitted during the outburst.