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Investigating the physical properties of outbursts on comet 67P/Churyumov-Gerasimenko

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Abstract

Cometary outbursts have been observed on several comets by ground-based telescopes and in situ instruments of spacecraft. However, the mechanism and physical properties for these phenomena are still unclear. The OSIRIS camera onboard the Rosetta spacecraft provided first-hand information on the transient events (outbursts) of comet 67P/Churyumov-Gerasimenko during its perihelion passage in 2015. The physical properties of the outbursts can be therefore investigated via time-series images with high-resolution images.

1. Introduction

Unlike the "snap shots" from the previous flyby observations, the OSIRIS measurements can provide precise information on the timing and location of the outbursts via time-series images with high-resolution images. After the first detection in March, 2015, the OSIRIS wide-angle camera (WAC) and narrow-angle camera (NAC) captured another outburst in mid-July, 2015. Since then, many more outbursts from the nightside and sunslit regions have been detected ([1, 2]), with most of their source regions were located at the southern hemisphere of comet 67P ([3]). The detected outburst events show a variety of morphological features that have been classified into three different types: broad fans, narrow jets and complex plumes. In this work, we investigate the morphology of these events and characterize their physical properties in detail, including the surface brightness profiles, ejected mass and speed if there are two or more sequential images acquired by the same filter in short duration during the outburst timeframe.

2 Observations

The data sets used in the present investigation consist of pairs of consecutive images obtained in short time interval of ∼6 s to ∼20 s from July 29 to September 30, 2015, with the NAC orange filter (center wavelength =6486 Å, FWHM =852.4 Å). All images listed in Table 1 were acquired in 1x1 binning mode which results in a pixel scale of ∼3 m to ∼26 m depending on the changing distances between the Rosetta spacecraft and the nucleus. Fig. 1 shows an example of an outburst event can be easily detected without any image enhancement technique or high lighting the image with a particular display scale (i.e. log-log scale).

Fig. 2 shows the case when additional image processing must be applied to find the outburst events directly from the consecutive images. These low contrast mini-outbursts can be extracted through the difference images as the activity might become stronger or weaker with time. In this work, we used the positive detection method in the difference image to obtain the physical properties of outbursts.

Several data sets from both NAC and WAC were especially designed for monitoring the activity of the nucleus. The observed sequences ranged from 1 hour to one full rotation (∼12.4 hours). Starting in late-August 2015, the high cadence observations (every 5 minutes) in some sequences were designed to search for outburst events. Before then, normal cadences like 20 or 30 minutes in NAC and 1 hour in WAC had been scheduled.

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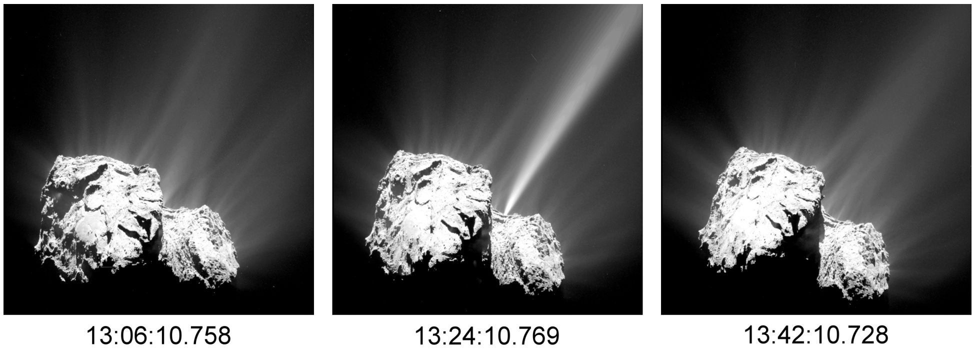

Figure 1: The time sequence of the coma structure on 29 July 2015 showing the sudden appearance of a dramatic outburst at 13:24 UT. The FOV is 7 km $\times$ 7 km. The Sun is coming from the top of the image.

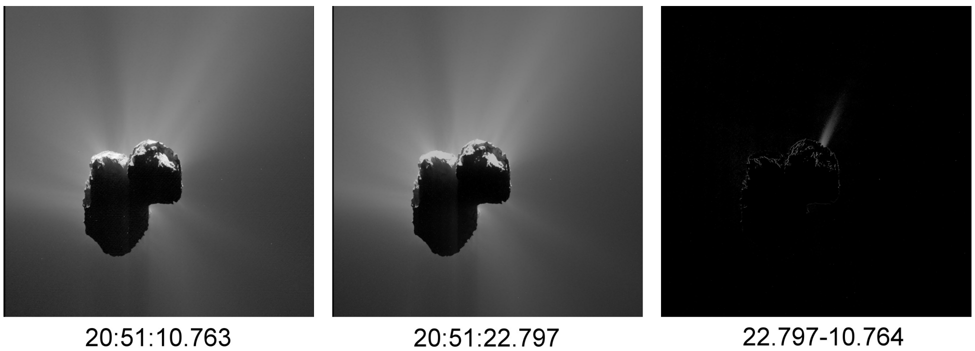

Figure 2: An example of how the difference image (right-panel, September 10, 2015) obtained by subtracting the brightness of two images with a time interval of 12 seconds can extract an outburst feature when there is no clear detection from the consecutive images. The frame is 12.02 km by 12.02 km. Sun is toward the top.

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References

[1] Grün, E. et al.: The 2016 Feb 19 outburst of comet 67P/CG: an ESA Rosetta multi-instrument study, MNRAS, 462, S220-S234, 2016

[2] Feldman, P.D. et al.: The Nature and Frequency of the Gas Outbursts in Comet 67P/Churyumov-Gerasimenko Observed by the Alice Far-ultraviolet Spectrograph on Rosetta, ApJL, 825, L8, 2016

[3] Vincent, J.-B. et al: Summer fireworks on comet 67P, , MNRAS, 462, S184-S194, 2016