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Jets and sources of activity on comet 67P/Churyumov-Gerasimenko

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A major goal of the Rosetta mission is to study the evolution of a comet through activity. Understanding the physical processes reshaping the nucleus will help us to look back in time and reconstruct what pristine comet surface looked like at the time of its formation. A key question is how and why cometary activity is spatially distributed over the nucleus. We trace the manifestation of this activity in the coma, in the form of narrow dust features, hereafter called "jets", expanding straight for at least some distance from the source on the nucleus. We follow these jets down to the surface to constrain the location of active areas and better understand the physical processes underlying activity.

Jets are a type of highly localized activity. They appear as fuzzy streams of bright material arising from specific areas on the nucleus surface. They are typically detected against a dark background, which can be either empty space or casted shadows. Jets are seen at all scales, down to the resolution of the OSIRIS images. The smallest features detected so far are a few pixels across, which translates into a couple of meters at most. They have a typical column density a few percent higher than the ambient medium [1]. At the highest spatial resolution these jets appear as a combination of thinner features which can be traced directly to specific morphologic features on the surface.

By monitoring the activity and observing these jets from different angles we can reconstruct their three-dimensional structure and identify their source regions. We present here the first results of this inversion, covering the epoch from August to December 2014. We show how the spatial distribution of jet sources expands with time. While active areas were found mainly in the transition region between the two lobes in August 2014 (3.6 AU), they could be observed all over the Northern hemisphere in December 2014 (2.8 AU).

Jet sources are associated to different types of terrains: smooth areas, outcrops, cliffs, and pits. We will show that the latter case implies great heterogeneity in composition and structure not only on the surface but also at depths of several hundred meters inside the nucleus [2].

References:
[1] Sierks et al, On the nucleus structure and activity of comet 67P/Churyumov-Gerasimenko, Sience, in Press
[2] Vincent et al, A Glimpse into the Underworld: Active Pits on Comet 67P, Science, submitted