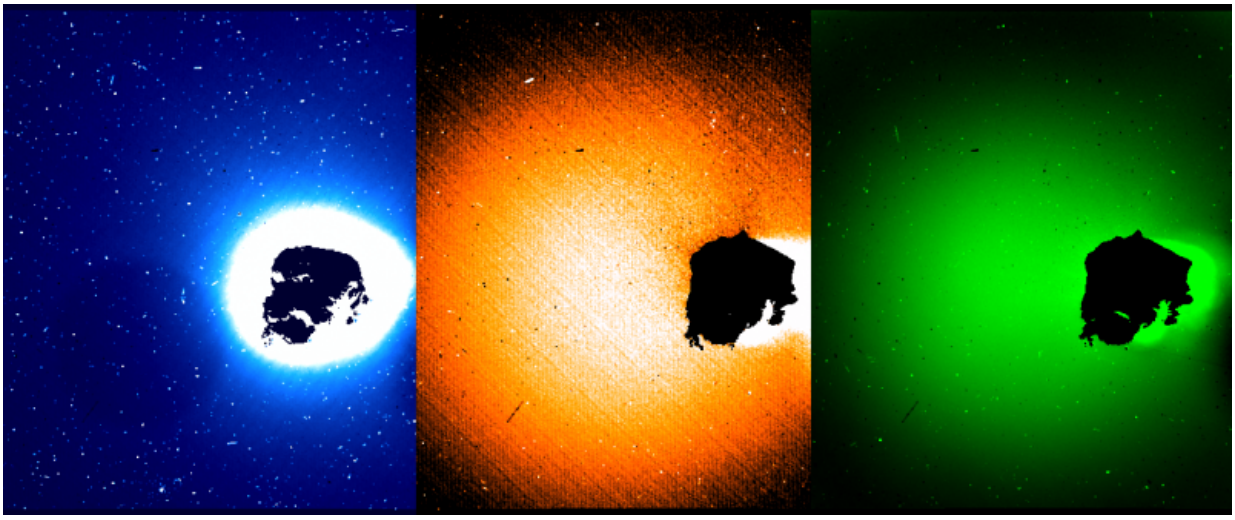
Team maps gas emissions from comet 67P/Churyumov-Gerasimenko

November 12 2015



These images, acquired with Rosetta's OSIRIS wide-angle camera using specific wavelength filters, map the emissions of three gases from the surface of comet 67P/Churyumov-Gerasimenko. From left to right, the panels show hydroxyl molecules (blue; 308nm filter), oxygen atoms (orange; 630nm), and cyanide molecules (green; 387nm). The OSIRIS instrument captured the images on March 12, 2015, when Rosetta was 80 km from the comet. Credit: OSIRIS Team

The European Space Agency's Rosetta spacecraft began orbiting comet 67P/Churyumov-Gerasimenko in August 2014, providing the closest and most detailed look at a comet to date. Now, a team led by astronomers at the University of Maryland has used data from Rosetta's Optical, Spectroscopic and Infrared Remote Imaging System (OSIRIS) cameras

to generate maps of multiple gas emissions just above the comet's surface.

The work has already revealed surprising physical and chemical processes never before seen up close. The researchers will present their findings at the 47th Annual Meeting of the American Astronomical Society's Division for Planetary Sciences, November 8-13, 2015, in National Harbor, Maryland.

The group focused on gases produced by the breakdown of water molecules (H2O) and hydrogen cyanide molecules (HCN). Both reactions are caused by ultraviolet radiation from the sun, and the gases produced by these reactions give off light at characteristic wavelengths that can help researchers identify where and when the specific gases are produced.

"Because Rosetta is very close to the comet, it can observe gas much closer to the nucleus than can be seen from Earth," said Dennis Bodewits, an assistant research scientist in astronomy at UMD who will present the group's findings. "This has already revealed unanticipated physical processes that are important both in breaking apart the original molecules of gas and in causing the fragments to shine."

When water (H2O) is broken down, it produces molecular hydrogen (H2) and a single oxygen atom. This oxygen remains in an excited state, which allows it to directly emit a photon instead of waiting to absorb a photon from the sun. This means that this excited oxygen can be used as a proxy to track the location and amount of water.

"Since we first arrived at the comet, the emissions have been far stronger than expected," Bodewits said. Early measurements of water by the Microwave Instrument for the Rosetta Orbiter (MIRO) camera provided a basis for these predictions. "However, these measurements came into

agreement when the comet drew closer to the sun."

The team was also surprised by the signature from cyanide gas (CN), produced as a byproduct of the breakdown of hydrogen cyanide (HCN). In early Earth-based observations, cyanide could be seen emitting light thousands of kilometers away from 67P's nucleus. However, when viewed up close as the comet approached the sun, the light emitted by cyanide fragments dropped off very sharply within about 10 kilometers.

"This indicates that, as with oxygen formed by the breakdown of water, cyanide also emits light immediately after it is formed," Bodewits explained. "As an interesting historical note, cyanide emission is very bright and was the first molecular emission identified in comets. This led to panicked news headlines in 1910, when both Halley's comet and the Daylight comet visited Earth. We now know that cyanide concentrations in comets are too low to be of any concern."

More information: The presentation, titled "Observed changes in the physical environment and chemistry in the inner coma of 67p/Churyumov-Gerasimenko," Dennis Bodewits et al., will be presented at 10:50am on Friday, November 13, 2015, at the at the 47th Annual Meeting of the American Astronomical Society's Division for Planetary Sciences. aas.org/meetings/dps47

Provided by University of Maryland