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Aliphatic Compounds in the Coma of Comet 67P/Churyumov-Gerasimenko

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1. Abstract

European Space Agency's Rosetta mission was one of the cornerstones in cometary space science. For the first time a spacecraft has accompanied a comet for an extended time period instead of short-time flybys as done before at other comets. Furthermore, it was the first time a soft landing on a comet was successfully performed. This combination allowed an in-depth investigation of the physical and chemical properties of the nucleus and coma.

Comets consist of rock, dust, water ice, and frozen gases. Furthermore, they contain various organic compounds including hydrocarbons. [1] Comets belong to the most pristine objects in our Solar System, which makes them a highly valuable target to study the elementary and molecular composition. Depending on the distance to the Sun, outgassing of frozen volatiles can be observed. This leads to the formation and evolution of the coma, which contains gaseous molecules as well as solid dust particles.

The Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA) [2] has observed the coma of comet 67P/Churyumov-Gerasimenko for more than two years. By now its instruments, DFMS (Double Focusing Mass Spectrometer) and RTOF (Reflectron Time-of-Flight), have identified many components never previously detected in comets. This applies to many organic molecules as well.

DFMS space data indicates the presence of hydrocarbons in the coma of 67P. [3] Therefore a closer investigation of aliphatic compounds like n-Heptane, n-Pentane, and n-Octane is essential. The first step for the investigation of these compounds in the coma of 67P is a precise calibration of the DFMS instrument. The calibration is performed under laboratory conditions with the DFMS flight spare model.

DFMS ionization energy by 45eV electrons causes the aliphatic molecule chains to break up into smaller fragments.[1] This results in a characteristic fragmentation pattern allowing an determination of the aliphatic compounds and thus a study of the relative abundances of these hydrocarbons in the coma of 67P.

2. References

[1] Le Roy et al.: Inventory of the volatiles on comet 67P/Churyumov-Gerasimenko from Rosetta/ROSINA, A&A 583, A1, 2015.

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[3] Altwegg et al.: Organics in comet 67P - a first comparative analysis of mass spectra from ROSINA-DFMS, COSAC and Ptolemy, MNRS, submitted, 2017.