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A ROSINA Perspective on the Organics in Comet 67P/Churyumov-Gerasimenko

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I. Abstract

The Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA) was sent onboard the Rosetta spacecraft to determine the chemical composition of comet 67P/Churyumov-Gerasimenko. ROSINA consists of three different instruments: the Comet Pressure Sensor (COPS), the Reflectron-type Time-Of-Flight mass spectrometer (RTOF), and Double Focusing Mass Spectrometer (DFMS).[1] The ROSINA instruments have investigated the coma of comet 67P for more than two years, performing measurements at various distances and angles between comet, Sun, and spacecraft. Thereby they proved the existence of a surprising amount of organics in the comet.[2] Some of these molecules were detected for the first time ever in comets. These results have been revealing an unexpected chemical complexity of comets and led to a more profound understanding of the origin of our Solar System.[3]

The study here presented is based on laboratory and space data from the ROSINA-DFMS. The instrument has the advantage of a high mass resolution (3000 at 1% peak height on mass/charge 28 u/e) and a high sensitivity. Furthermore, it allows measurements up till mass 180 u/e and can be operated in neutral gas- and ion mode.[1] Thus, the instrument is predestined to decipher the variety of organic molecules in the coma of comet 67P. The complexity of the study is increased by the unique DFMS ionization energy of 45 eV, leading to fragmentation different from databases like NIST. On the one hand this leads to potentially very complex fragmentation patterns, on the other hand it allows a clear identification of the molecules in the DFMS space data.

Thus, the results of the identification and quantification campaign of various organic compounds such as aliphatic and aromatic hydrocarbons, and alcohols in the cometary bulk will be shown. The presentation also focusses on the relative abundances of these compounds during various mission phases and conditions.

II. References

[1] Balsiger et al.: Rosina - Rosetta Orbiter Spectrometer for Ion and Neutral Analysis, Space Sci Rev, 128, pp. 745- 801, 2007.

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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, 469, pp. 130-141, 2017.