ROSINA'S FIRST MEASUREMENTS FROM SPACE AND ANTICIPATED ANALYSES AT COMET CHURYUMOV-GERASIMENKO. A. Jäckel[1], K. Altwegg[1], P. Wurz[1], H. Balsiger[1], E. Arijs[2], J. J. Berthelier[3], S. Fuselier[4], F. Gliem[5], T. Gombosi[6], A. Korth[7], and H. Rème[8], [1]Physikalisches Institut, Universität Bern, Sidlerstr. 5, CH-3012 Bern (jaeckel@phim.unibe.ch), [2]Belgisch Instituut voor Ruimte-Aeronomie, B-1180 Brussel, [3]Institute Pierre Simon Laplace, F-94107 St.-Maur-des-Fossés, [4]Lockheed Martin Advanced Technology Center, Palo Alto, CA 94304, USA, [5]University of Michigan, Space Physics Research Laboratory, Ann Arbor, MI 48109, USA, [6]Max-Planck-Institut für Sonnensystemforschung, D-37191 Katlenburg-Lindau, [7]Centre d'Etude Spatiale des Rayonnements, F-31028 Toulouse.

Introduction: The Rosetta Orbiter Spectrometer for Ion and Neutral Analysis (ROSINA) is an orbiter payload instrument onboard the ROSETTA spacecraft that was successfully launched in March 2004 by the European Space Agency. The ROSINA instrument package is designed to determine the elemental, isotopic, and molecular composition of the atmosphere of comet 67P/Churyumov-Gerasimenko.

ROSINA Characteristics: The instrument package ROSINA consists of two mass spectrometers and one pressure sensor. The mass spectrometers are the Double Focussing Mass Spectrometer (DFMS) and the Reflectron Time-Of-Flight mass spectrometer (RTOF) that are both designed to analyze cometary neutral gases and cometary ions. The third sensor, the COmetary Pressure Sensor (COPS), consists of a pressure gauge assembly. These three sensors will measure the neutral gas and the ion composition in the cometary environment as a function of the heliocentric distance to the comet [1]. The Data Processing Unit (DPU) controls all three sensors and is fully redundant. The characteristic features of the three sensors are described in more detail below:

DFMS. The DFMS is a very compact state of the art high-resolution double-focussing mass spectrometer [2] realized in the Nier-Johnson configuration [3]. The sensor weights 16 kg and the power consumption averages 22 W. The DFMS is a high resolution mass spectrometer with a large dynamic range and good sensitivity. It covers a mass range of 12-140 amu/e and has a mass resolution of $m/\Delta m > 3000$ at the 1% peak height which corresponds to > 7000 at the 50% level. This allows separation of, e.g., ^{13}C and ^{12}CH. With an integration time of typically one second the recording of a whole mass spectrum measured with the Channel Electron Multiplier (CEM) detector from 12 to 140 amu/e takes approximately two hours. The mass resolution of the DFMS is high enough to measure interesting isotopic ratios of, e.g., the two nitrogen isotopes ($^{14}N^+$, $^{15}N^+$). This is of great importance in order to determine and explain the anomalous nitrogen isotopic ratios in comets.

RTOF. The RTOF is characterized by an extended mass range from 1 up to > 300 amu/e in order to identify organic material, e.g., polyaromatic hydrocarbons. The sensor weights 15 kg and consumes about 30 W. The high sensitivity of the RTOF sensor is essential with respect to the pressure range that is expected when Churyumov-Gerasimenko is at 3 AU where measurements are activated. The expected water production rates at perihelion, during peak activity, and at 3 AU at comet Churyumov-Gerasimenko are given in table 1.

Tab. 1: Expected water production rate and the corresponding pressure at 2 km from the nucleus for comet Churyumov-Gerasimenko [4].

Heliocentric distance	$Q(H_2O)$ [s^{-1}]	H_2O density [cm^{-3}] @ 2 km	Pressure [mbar]
Perihelion (1.3 AU)	4.1×10^{27}	2.0×10^{11}	6.0×10^{-6}
Peak activity	1.0×10^{28}	8.0×10^{11}	2.5×10^{-5}
3 AU	1.0×10^{23}	1.0×10^{7}	1.0×10^{-10}

An advantage of the RTOF sensor is that a full mass spectrum of the entire mass range (1-300 amu/e) that is only limited by the signal accumulation memory is recorded within 100 µs. The mass resolution in the triple reflection mode is $m/\Delta m > 4500$ at the 50% peak height. DFMS and RTOF complement one another.

COPS. The COPS weights 1.7 kg and consumes 7 W. It consists of two ionization gauges to determine the gas dynamics of the comet. One gauge is a nude hot filament extractor type Bayard Alpert ionization gauge [5]. It measures the total particle density with a nitrogen sensitivity of about 20 $mbar^{-1}$ at 100 µA. The other gauge, a closed ionization gauge, with its opening facing towards the comet, measures the molecular flow from the comet. Combining the results from both gauges and the known spacecraft orientation relative to the nucleus of the comet, the velocity and the density of the cometary gas can be calculated. In addition, this sensor serves as a safety instrument for Rosetta in case of pressure increases.

Anticipated Analyses: During the increasing activity of the comet from aphelion to perihelion more and more cometary material like dust particles as well as ice will evaporate. The evaporation products can easily be measured by the ROSINA mass spectrometers. Together with other instruments onboard Rosetta that are specialized on dust measurements it will be possible to determine the dust composition due to the capability of ROSINA to measure in an extended mass range (> 300 amu/e) with a high sensitivity and a large dynamic range. Therefore, the two ROSINA mass spectrometers support the dust analyses performed by the dust specialized instruments.

Conclusions: The ROSINA instrument package was designed to measure relevant elemental, isotopic, and molecular abundances from the onset of activity through perihelion. It will easily cope with the activity of Churyumov-Gerasimenko at 4 AU as well as at perihelion. Finally, it will analyze the composition of the volatile material over a large mass range with a large dynamic range, and it will significantly contribute to our understanding of the dynamics of this comet.

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