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Observations performed by the SESAME/Permittivity Probe during the descent and after the landing of Philae upon the nucleus of Comet Churyumov–Gerasimenko

Walter Schmidt (1), Alice Le Gall (2), Michel Hamelin (2), Sylvain Caujolle-Bert (2), Anthony Lethuillier (2), Valerie Ciarletti (2), and Réjean Grard (3)

(1) Finnish Meteorological Institute, Earth Observation, Helsinki, Finland (walter.schmidt@fmi.fi), (2) LATMOS, Paris, France, (3) ESA retiree

The Permittivity Probe (PP), a component of the SESAME instrument on board Rosetta's Lander Philae, was operated prior to the separation of Philae from Rosetta, during the descent and at the location of the final landing site. The working principle of PP consists in measuring, with a receiving dipole, the voltage induced in the medium by a current of known phase and amplitude injected by a transmitting antenna.

The primary objective of PP is to analyse the electrical properties of the comet surface material down to a depth of about 2 m, and to record their variations with temperature, solar illumination and heliocentric distance. These observations are particularly sensitive to the concentration of water ice at the landing site. The second objective of the instrument is to monitor the spectrum of the electromagnetic and electrostatic waves generated by the interaction between the comet and the solar wind at frequencies of up to 20 kHz.

The measurements performed during the descent were mainly devoted to the calibration of the instrument in its nominal configuration, with deployed landing gear
and away from the Rosetta spacecraft influence, in an environment of known permittivity, either a vacuum or a plasma whose density and temperature would have been derived from the LAP and MIP data. This approach is unfortunately invalidated owing to the fact the PP receiver was most of the time saturated by the operation of the CONSERT radar during the descent, an interference which seemed to have been minimized during in-flight interference tests, but which was significantly stronger after separation of Philae from Rosetta. Nevertheless, it was possible to recover some information about the instrument's transmitter and receiver performances then used during the analysis of the data measured on the cometary surface.

Undisturbed measurements were fortunately performed at the landing site, under various solar illuminations, using the three feet of Philae as transmitting and receiving electrodes. Alternative transmitting electrodes attached to the MUPUS PEN and the APX sensor could not be used because these appendages were not yet deployed during the initial PP measurements. After their deployment Philae's energy level was too low to allow additional PP measurements. Provided an improved model of the surface topology becomes available, a careful analysis of the PP data set might yield some information about the surface material's permittivity and the water ice concentration at the landing site. We shall review the progresses achieved so far in the analysis of the existing PP data set, and present any result obtained during a possible reactivation of Philae.