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Derivation of physical properties of the subsurface of 67P from Rosetta/MIRO observations

Johanna Bürger, Anthony Lethuillier, Jürgen Blum, Bastian Gundlach and Yuri Skorov
Institute of Geophysics and extraterrestrial Physics (IGeP), TU Braunschweig, Mendelsohnstraße 3, D-38106 Braunschweig
(j.buerger@tu-bs.de)

1. Introduction

MIRO [3], as one of the instruments on board the ESA's mission Rosetta, measured the near surface thermal radiation of comet 67P/Churyumov-Gerasimenko (hereafter 67P). With its two continuum channels the microwave radiometer measures the thermal emission arising from depths of approximately 1 cm and 4 cm at wavelengths of 0.5 mm and 1.6 mm, respectively [4]. The two channels are referred to as the SUBMM and MM channels.

Our aim is to derive from these observations physical properties of the subsurface of 67P. To achieve this we fit the measurements made close to perihelion on the southern hemisphere of the comet with a one-dimensional thermal model of the subsurface.

2. Thermal Model

This thermal model, developed by B. Gundlach et al., takes into account thermal conductivity, infrared radiation, solar illumination and volatile sublimation. The output of the model is a temperature profile that serves as input to a radiative transfer model whose output is in turn a brightness temperature that can be compared to MIRO measurements. The thermal model used will be described in more detail by B. Gundlach in the presentation during EPSC entitled "Thermophysical Modelling of Cometary Activity".

3. MIRO data

On the 13th August 2015 comet 67P reached perihelion. Around this time the southern hemisphere of 67P experienced polar day, during which the surface was constantly illuminated. By looking at the temperature data measured by the two continuum channels of MIRO one month before and after perihelion we found a region and time where the temperature is independent of local solar time, simplifying the thermophysical model of the subsurface. For this study we decided to focus on the Wosret region. It is characterized by a relatively flat surface [2] and located on the southern hemisphere of the small lobe of 67P as illustrated in Figure 1.

The data acquired by MIRO over Wosret need to be filtered as not all measurements can be used in this study. We selected measurements that were made when Rosetta was less than 200 km from the surface of the nucleus and when the emission angle was lower than 60°. Additionally, as the orbiter was located far from the surface at the time, some of the MIRO measurements include a non-negligible contribution from the background space. We correct the temperatures by calculating the percentage of observed sky for each measurement and then deriving the actual surface temperature.

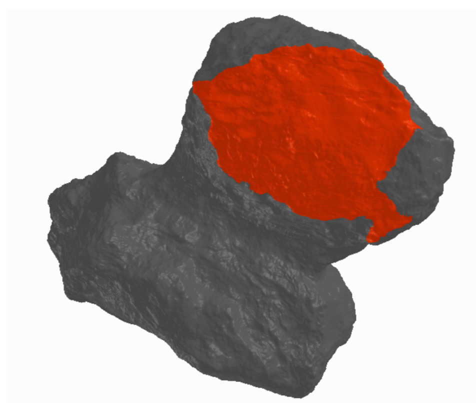

Figure 1: The Wosret region (highlighted in red) is located on the southern hemisphere of the small lobe of 67P.

4. Perspectives

The southern hemisphere of 67P has been investigated by MIRO after the Rosetta rendezvous maneuver in August 2014 in polar night and thermal properties have been derived by Choukroun et al. [1]. These can be further improved by analysing the acquired data at polar day knowing the shape of 67P in more detail.

Acknowledgements

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