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# Rosetta at comet 67P/Churyumov-Gerasimenko: Spacecraft orbit modeling

**M. Hahn (1)**, M. Pätzold (1), S. Tellmann (1), B. Häusler (2) and T. Andert (2)
(1) Rheinisches Institut für Umweltforschung, Abteilung Planetenforschung, Cologne, Germany (Matthias.Hahn@uni-koeln.de)
(2) Institut für Raumfahrttechnik, Universität der Bundeswehr, Munich, Germany

## Abstract

The Rosetta spacecraft is on its way to its target comet 67P/Churyumov-Gerasimenko. The science objectives of the Radio Science Investigation (RSI) experiment addresses fundamental aspects of cometary science such as the determinations of the nucleus mass and bulk density, its size and shape and its gravity field and internal structure.
The radio carrier links transmitted by the spacecraft and received on Earth will be used for these investigations. The perturbed motion of the spacecraft near the comet nucleus leads to perturbed Doppler frequency shifts of the transmitted radio signal recorded on Earth. The forces acting on the spacecraft are the nucleus gravity field, third body perturbations, the solar radiation pressure, the solar wind pressure and the cometary outgassing pressure.
First studies using a complex force model for spacecraft orbit simulations were carried out. An analysis of Doppler frequency shifts caused by cometary gravitational forces shall be presented. A detailed shape model of the comet nucleus is used. Different modelled internal density distributions yield different coefficients of degree and order $\geq 2$ in the expansion in spherical harmonics of the gravitational potential. The sensitivity of the radio science method to density inhomogeneities within the cometary nucleus will be shown. The sensitivity is limited by the observation geometry, lack of knowledge about the outgassing pressure force and solar radiation pressure force, and by the combined thermal noise and solar plasma noise.