Retrieval of the cometary crust properties with radio transmission experiment: numerical modeling.

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The comets are thought to be the less evolved bodies in the Solar System. They are now considered as documents of solar system formation. It is supposed now that nuclei consist of easy sublimating volatiles such as water ice (mostly), carbon monoxide and dioxide, and also contain some fraction of mineral non-volatiles, mainly silicates.

On the surface of the nucleus and the nearest subsurface layers complicated phenomena take place, such as heat transfer, volatile sublimation, condensation etc. These processes must change the physical and chemical properties of the topmost layer of the cometary nucleus, such as temperature, porosity, chemical composition and so on. Heat and mass flow simulations suggest that significant temperature gradients occur in the subsurface layer about a few tens meter thick. Thus, we expect the physical properties of the surface layer to differ significantly from the ones of the bulk of the nucleus. The peculiarities of the surface layer and its electrical properties can provide useful information about physical and chemical properties of the comet as a whole. A technique, appropriate for investigating of the cometary interior, is through radio wave propagation. The CONSERT experiment[1], planned to be carried on board the ROSETTA mission, is an instrument of this kind. However, the primary objective of this instrument is the investigation of deep cometary interior.

The key question addressed in the paper is: to what extent is the CONSERT experiment able to infer information on the topmost layer of the nucleus? If so, which technique of data interpretation is required? The results we present give a positive answer to this question and propose a possible approach to the data interpretation.

Preliminary qualitative investigation of this question has been given in the recent paper [2] for spherical geometry of cometary nucleus. In the present study, these results are further developed. Full vectorial treatment of the problem is given. Wave propagation between Orbiter and Lander is modeled for arbitrary polarization of sounding wave. We have studied main features of wave field and their relation to dielectrical parameters of the cometary nucleus. The results obtained by us suggest that several meters thick surface layer can be reliably detected by means of the CONSERT equipment.

References.

1. Kofman, W. et al., 1998. Comet Nucleus Sounding Experiment by RadioWave Transmission. *Advances in Space Research* **21** , 1589-1598.

2. Ilyushin, Y. A., T. Hagfors, V.E. Kunitsyn. Cometary surface layer properties: Possible approaches to radio sounding retrieval during the CONSERT experiment-Numerical simulation and discussion. *Radio Science*,**38** No. 1 P.1008 doi 10.1029/2001RS002487 February 2003