# Numerical simulations for the radiation emitted from the dust and molecules in the inner coma of comet 67P/Churyumov-Gerasimenko

M. Błęcka[1], F. Capaccioni[2], U. Fink[3], G. Rinaldi[2], and G. Tozzi[4]

[1]Space Research Center PAS, Bartycka 18a, 00-716 Warsaw, Poland
[2]IAPS-INAF, via del Fosso del Cavaliere, 100, 00133, Roma, Italy
[3]Lunar and Planetary Laboratory, University of Arizona, Tucson, AZ 85721, United States
[4]INAF, Osservatorio Astrofisico di Arcetri, Largo E. Fermi 5, I-50, 125 Firenze, Italy

The work we present deals with the spectrometric measurements of the VIRTIS instrument part of the payload of the Rosetta mission to the comet 67P/Churyumov-Gerasimenko (C-G). The interpretation of the measurements require modeling the radiance from the nucleus and from the dusty/gaseous environment of the comet. The dust is an important constituent of comets, and is always present on the surface of the nucleus and in the coma. The cometary spectra are strongly affected by the processes taking place in the coma and by the structure, composition, and spatial distribution of cometary materials. The particles of the dust, illuminated by sunlight, scatter, absorb, and emit radiation. The radiation is transmitted through the coma region before being collected by instruments such as the VIRTIS/Rosetta spectrometer. First of all, the results of modeling the thermal radiance from dust and molecules in coma are presented. This radiation forms an especially important part of the signal in the 2.5–6.0-µm spectral range. The emission processes depend on the thermal state of the nucleus and dust composition (i.e., optical parameters of dust/ices), density distribution, shape, and size of dust grains around the nucleus. The number density distribution of the dust grains around the coma and their size distribution are drawn from the recent theoretical simulations and Inner Coma Environment Simulation tools (ICES). For our analysis, the equation of radiative transfer through the assembly of dust grains and various gases is solved. The applied codes are similar to the models used some time before for the analysis of the signals from the dust torus around Mars, Martian atmosphere, and comet 46P/Wirtanen. The modeled levels of the thermal radiances were compared with the total radiance calculated for the same geometry. But the main purpose of the paper is the detailed discussion of the influence of the state of the comet and the parameters of dust on the thermally emitted signal to be measured by the VIRTIS spectrometer.

**Acknowledgements:** The work was supported by the grant: 2011/01/B/ST9/05442.

**References:** Agarwal,J; M.Müller, G.Eberhard, Dust Environment Modelling of Comet 67P/Churyumov-Gerasimenko; Space Science Reviews, 128,1–4,2007 and references therein; Błęcka M.I. "A Study of the Influence of the Surface Emittance and Extinction by Dust on Martian IR Spectra" Adv. in Space Research Vol. 23, No.9, pp.1613–1622, 1999; Blecka , M.I., S. Erard "Numerical simulation of the influence of scattering on the dust in the Martian atmosphere on radiance spectra" Adv. Sp. Research Volume 34, ISSUE 8, 2004; Błęcka, M.I, G. Rinaldi , U. Fink , F.Capacioni , G.P. Tozzi Numerical simulations of the radiance from the limb measurements of dusty coma of the Comet 67P/Churyumov Gerasimenko; EPSC Abstracts, Vol. 8, EPSC2013–969, 2013; Blecka, M.I., M.T. Capria, A. Coradini, M.C. De Sanctis; Numerical simulations of the radiance from the Comet46P/Wirtanen in the various configuration of the measurements during "Rosetta" Mission Adv. SpaceRes. 31, 12, 2501–2510, 2003; Bockel´ee-Morvan, et al. in ASSL Vol.311: The New Rosetta Targets. Observations, Simulations and Instrument Performances, ed. by L. Colangeli, E.Mazzotta Epifani, P.Palumbo (2004); De Sanctis, M.C., J. Lasue , M.T. Capria, Simulationof 67P/Churyumov- Gerasimenko during the Rosetta mission phases ; EPSC Abstracts; Vol. 6, EPSC-DPS2011–157, 2011; Fonti,S., A.Jurewicz, A.Blanco, M.I. Blecka, V.Orofino "Presence and detection of carbonates on the Martian surface" JGR ,VOL 106,No. E11, pp 27, 815–27, 822, November, 2001; Hanner, M.S. (1983) The nature of cometary dust from remote sensing. In Cometary Exploration (T.I. Gombosi Ed.), Vol. 2, pp. 1–22; Kolokolova, L. and K. Jockers, Composition of cometary dust from polarization spectra, Planet. Space., vol. 45, No. 12, pp. 1543–1550, 1997; Zakharov V.V. , A.V. Rodionov , J.-F. Crifo , M. Fulle A numerical study of the dusty-gas atmosphere of comet67P/Churyumov-Gerasimenko; EPSC Abstracts 6, EPSCDPS 2011-126-1, 2011 EPSC-DPS Joint Meeting 2011.