ENCELADUS' PLUMES REFLECTANCE. PARTICLE-IN-CELL MODEL PARAMETRIC STUDY. J. P. Kotlarz[1] and N. E. Zalewska[2], [1]Institute of Aviation, Al. Krakowska 110/114, 02-256 Warsaw, Poland, jan.kotlarz@ilot.edu.pl, [2]Institute of Aviation, Al. Krakowska 110/114, 02-256 Warsaw, Poland, natalia.zalewska@ilot.edu.pl & Space Research Center PAS, Bartycka 18A, 00-716 Warsaw, Poland.

Introduction: The mechanism that controls the Enceladus' cryo-volcanic eruptions is still not fully understand. One of the most important data sources is plume chemical composition or at least chemical signatures. I.e. chemical signatures like H_2 may prove water-rock interaction between the ocean and a rocky core [1]. Based on H_2 and methane (CH_4) detection in the plumes and theoretical predicted physical parameters of the subsurface ocean (i.e. pressure ~50 bar) we may assume that the presence of methanogenic archaeons like *Methanothermococcus okinawensis* near hydrothermal vents on Enceladus's ocean floor is possible [2].

In our work we are using kinetic numerical model to describe plumes curtain forms as a result of kinetic and thermodynamic processes a) in the ocean, b) inside Tiger Stripes icy forms and c) over moon's surface. This result data we are using to model potential, small changes in the plumes reflectance.

Methods: We applied EMMA particle-in-cell kinetic numerical code developed in Remote Sensing Division (Institute of Aviation) to model plume curtain form, density, and chemical composition depending on the different geological and biological scenarios in the ocean and rift 3D model types. Next we model interactions between plume particles and photons (UV, VIS and NIR, 1.7 – 10.2 eV including H Lyman-α spectral line).

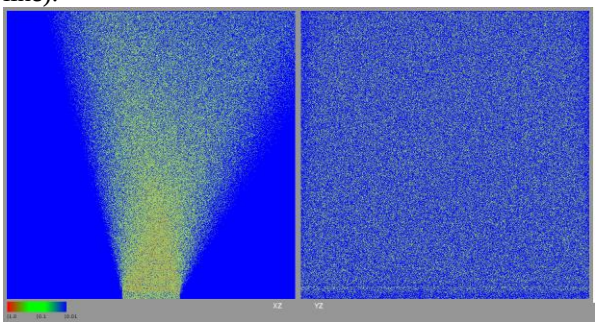

Figure 1. Relative density of water particles in the example Enceladus' plume particle-in-cell model.

As the result we will estimate reflectance spectra according to various geological scenarios, biotic activity and chemical composition. Also images acquisition angles will be taken into account. The results will be useful for spacecraft missions (i.e. proposed Enceladus Orbiter) and continuous monitoring using telescopes on the Earth or on the orbit.

The results will be compared with Cassini plumes images in the following spectral filters: BL1, IR2 and RED.

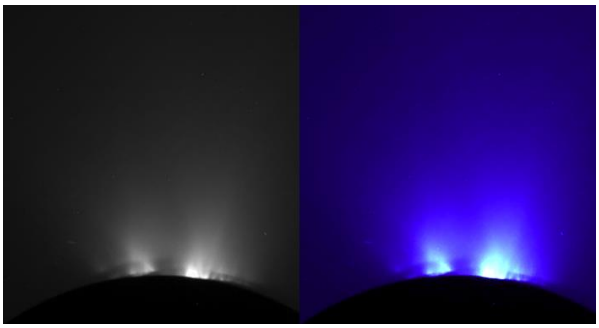

Figure 2. Original Cassini's plumes image in RED band (left) and the visualization of Cassini's data pre-processed for comparison with particle-in-cell model.

References: [1] Taubner, R. S., Pappenreiter, P., Zwicker, J., Smrzka, D., Pruckner, C., Kolar, P., ... & Peckmann, J. (2018). Biological methane production under putative Enceladus-like conditions. Nature communications, 9(1), 748. [2] Waite, J. H., Glein, C. R., Perryman, R. S., Teolis, B. D., Magee, B. A., Miller, G., ... & Lunine, J. I. (2017). Cassini finds molecular hydrogen in the Enceladus plume: evidence for hydrothermal processes. Science, 356(6334), 155-159.