

## Radiation Environment Estimates for Russian Project of Europa Lander

M. V. Podzolko (1), I. V. Getselev (1), Yu. I. Gubar (1), I. S. Veselovsky (1, 2), A. A. Sukhanov (2)

(1) Skobeltsyn Institute of Nuclear Physics, Moscow State University, Moscow, Russia, (2) Space Research Institute (IKI), Russian Academy of Sciences, Moscow, Russia

(The first author's e-mail: 404@newmail.ru)

### Abstract

In the current research the radiation environment during the space mission to Jupiter and Europa is studied, that is necessary to for estimating the radiation influence on spacecraft components and planning the mission.

The worst radiation impact during the mission, originated from the powerful Jupiter's radiation belts, will be encountered by the spacecraft in Europa orbit and on its surface: the dose during 2 months may amount up to several hundreds of kilorads. Thus the radiation hazard for the mission is very high. However, charged particle fluxes are not homogeneous everywhere in the vicinity of Europa, and furthermore, they differ for the low-altitude orbit ( $\approx 100$  km) and the surface. These flux variations are caused by peculiarities of the motion of charged particles in Jupiter's radiation belts crossing the orbit of Europa, the certain disturbance of the Jovian magnetic field near Europa and other factors, which are considered in our study. This analysis is necessary for choosing the optimal orbit around Europa and the landing site.

Also the dose of several tens of kilorads will be absorbed during the gravity assists near Jupiter. We conclude, that the optimal path, for the matter of minimizing both the power consumption and radiation dose, should consist of the first fly-by with a pericenter closer than  $\approx 150\,000$  km and relatively high possible inclination of about  $40^\circ$ , and several gravity assists using other Jovian moon Ganymede.

Additionally estimates of the radiation environment in near-Earth's and interplanetary parts of the trajectory are presented.

Finally proposals on the radiation environment monitoring during the mission and possible experiments for measuring the charged particle fluxes are made.