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Author: Dr. Irina Kovalenko
Space Research Institute (IKI), Russian Academy of Sciences (RAS), Russian Federation

Dr. Natan Eismont
IKI RAS, Russian Federation
Dr. Ludmila V. Zasova
IKI RAS, Russian Federation
Mr. Dmitry Gorinov
Space Research Institute (IKI), Russian Academy of Sciences (RAS), Russian Federation
Prof. Lev M. Zelenyi
Russian Academy of Sciences, Russian Federation

VENERA-D MISSION DESIGN

Abstract

Venera-D is a project of future mission to Venus, led by the cooperation of the Russian Academy of Sciences, Roscosmos and NASA. The scientific objectives of the mission include complexanalysis of the atmosphere, surface and plasma environment of Venus. The baseline mission implies a landing module and an orbiter. The landing module includes a main lander, with expected lifetime of about 2 hours on the Venus surface, and a smaller long-lived station which will operate about 2 months. The orbiter is planned to operate at least 3 years in a near-polar 1-day period elliptical Venus orbit, and is aimed at atmospheric studies and data relay between the Earth and landers. Potential mission augmentations, such as aerial platforms, a balloon, a few additional small long-lived surface stations, are under consideration to be included in the project. In addition, a small satellite operating in the vicinity of collinear Lagrangian points of the Sun-Venus system has been proposed.

The main goal of the mission trajectory and scenario design is to deliver all the elements to the different destinations. The prior tasks are deployment of the main lander and insertion of the orbiter into operational orbit, while maximising the duration of mutual visibility and ensuring collection of data from the main lander to the orbiter in the very limited life-time of the first. All the mission elements, including both landing and orbital modules, are planned to be launched by Proton-M or Angara-5 vehicle with DM-3 upper stage. Launch windows in 2026, 2028, 2029 and 2031 are selected so that to maximise the payload mass. The upper stage inserts all the elements into a transfer orbit toward Venus, and separates afterwards. The separation of the landing capsule from the orbital part, containing the main orbiter and a small satellite to Lagrangian point orbit (if included), is planned to carry out 3 days or more before the Venus arrival. The landing module continues the incoming trajectory to an uncontrollable entry into the atmosphere, while the orbital part performs a manoeuvre to be inserted into a Venus flyby trajectory, counter to the lander's one, and then a manoeuvre at the pericentre of the arrival hyperbola. The main orbiter is inserted into the operational orbit, while inserting the small satellite towards the vicinity of the L1 point. Then, the small satellite might perform a free (or small-manoeuvre) transfer to an L2 point orbit.