

SPACE PROPULSION SYMPOSIUM (C4)  
Missions Enabled by new Propulsion Technology and Systems (6)

Author: Prof. Mikhail S. Konstantinov  
Moscow Aviation Institute, Russian Federation, mkonst@bk.ru

Dr. Viacheslav Petukhov  
Russian Federation, petukhov@mail.ru

ONE VERSION OF A SPACE TRANSPORT SYSTEM FOR RESEARCH OF THE SUN

**Abstract**

Space transport system on the basis: of launcher "Soyuz - 2"; of the engine installation of chemical upper stage "Fregat"; and of electric propulsion - are investigated. Opportunities of this transport system for SC insertion into a heliocentric orbit for Sun research are researched. The flight including one gravitational maneuver at the Earth and some Venus's swingbys is analyzed. The chemical upper stage "Fregat" engine is used only in Earth vicinity. It provides SC leaving of Earth's vicinity with some magnitude of hyperbolic excess of velocity (the magnitude of this hyperbolic excess of velocity is being optimized). Then the upper stage "Fregat" engine is being separated from SC. Electric propulsion is used on a trajectory of the heliocentric flight Earth-Earth. The opportunity of use of electric propulsion such as SPT-140 or RIT-22) is researched. The opportunity of work of this electric propulsion and at the following stages of flight is supposed. SC makes up to 7 Venus's swingbys on these stages of flight. We were giving the preference to such variants for which work of propulsion system is not used on the flight trajectories: Venus-Venus. The trajectory, from which spacecraft explores the Sun, (assigning orbit) is being characterized by a perihelion radius, an aphelion radius and an orbit inclination to the ecliptic plane. Requirements of decreasing of perihelion radius and of increase of an orbit inclination are in a particular inconsistency. Influence on mass characteristics of space vehicle of magnitudes of perihelion radius and an orbit inclination of assigning is analyzed. It is shown, that for version when the electric propulsion is used only on a flight site the Earth - the Earth (for implementation of Earth's swingby) and 5-6 Venus's swingbys, SC mass after switching-off of electric propulsion more than 1900 kg; the scientific instrumentation unit mass can reach 800 kg and a little more. It is shown that use of the ionic engine RIT-22 has advantage before version of SPT-140 use: 1) a scoring in spacecraft mass is more than 80 kg, 2) the economies of fuel - 110 kg. On the considered mission profile it was possible to receive a maximum inclination of target orbit of equal 30 degrees. Unfortunately thus the radius of a perihelion was much more than 60 radiuses of the Sun (frequently this magnitude is considered as the requirement on the part of developers of scientific instrumentation of the project).