SPACE EXPLORATION SYMPOSIUM (A3)
Solar System Exploration (5)

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ONE MISSION FOR SUN EXPLORATION

Abstract

Sun studying is one of the major directions of the basic researches which are being carried out by spacecrafts. Effective research of Sun is possible with use of spacecrafts inserted into the heliocentric orbits. These spacecrafts allow observing Sun's areas, which are invisible from the Earth, including polar areas. These spacecrafts allow to investigate thin structure of a solar atmosphere and to execute other researches which cannot be spent with using of spacecrafts located in Earth's vicinity. We propose to use the system of three working heliocentric orbits. On each of these orbits, spacecraft makes three revolutions with respect to the Sun. These orbits are characterized by a small radius of perihelion (50...70 solar radii) and by a large inclination, allowing exploring the polar regions of the Sun. The aphelion radius of the working orbit is located inside Earth's orbit. The orbital period of the working orbit is about 150 days. Venus's swingby is used for spacecraft transfer from one working orbit to another. All the working orbits (except the last selected orbit) have resonance with the Venus orbit (e.g. the resonance is equal to two thirds). Space transportation system is based on the Soyuz-2 launcher. Transportation system includes a chemical installation of upper stage "Fregat" and electric propulsion with two "RIT-22". Chemical installation provides hyperbolic excess of velocity relative to Earth at the spacecraft start from Earth (the optimal value of hyperbolic excess of velocity is approximately equal to 1100 m/sec). Then chemical installation is separated. RIT-22 provides flight along heliocentric Earth – Earth trajectory and Earth's swingby. The required mass of xenon for Earth - Earth trajectory is less than 230 kg. The hyperbolic excess of velocity is 9.462 km/sec when SC approaches to the Earth. Earth's swingby provides a further coasting flight to Venus. The spacecraft mass at this time is 1910 kg. When SC approaches to Venus the hyperbolic excess of velocity is a little more than 17 km/sec. Then three gravitational maneuvers at Venus are used. Each maneuver inserts the spacecraft into a sequence of three working heliocentric orbits. The estimation of mass of systems of spacecraft (electric propulsion, solar power system, on-board control complex, on-board radio system, telemetry system and other service systems of spacecraft) gives an opportunity to estimate the mass of scientific complex. This mass is sufficiently large (over 250 kg). Therefore a wide range of studies of the Sun is possible.