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ISR 20/4 *Solar Sail Spacecraft* Title 402

Using the photon-wind from the Sun, analogous to terrestrial sailing, as a propelling force to sail a spacecraft from Earth on its mission, is neither new, nor science fiction, nor theoretically impossible, as the first experimental preparations have already shown. These were reported by Dr C.R. McInnes of the Aerospace Engineering Department of the University of Glasgow in a complete and up-to-date review of the subject which contained much that was new to me and I hoped also to my readers. I published it in December 1995.

The actual concept of solar sailing is due to the Soviet father of astronautics, Konstantin Tsiolkovsky who wrote in the 1920s about "using tremendous mirrors of very thin sheets to attain cosmic velocities". I first read about Solar Sailing in Arthur C. Clarke's exciting short story in which he described a thrilling international race to reach the Moon by solar sail spacecraft during which astronauts from different countries, by means fair and foul, tried to win the race. It was not mentioned by McInnes.

It was not until the early 1970s that the Space Shuttle, allowing the transport of bulky payloads and their deployment in space, suggested to NASA that solar sailing could be considered for certain missions. At their Jet Propulsion Laboratory in 1976, an initial design study was undertaken for a 800 × 800 meter square sail for the Comet Halley rendezvous mission. However, it had to be abandoned because of the high risk of its deployment. As an alternative, a spin stabilised heliogyro was considered which was to use 12 long blades, each 7.5 km long. Its advantage was that the blades could easily be deployed by simple unrolling. These NASA studies of solar sailing created worldwide interest and led to further experiments, particular of the solar sail material.

The JPL sail material was composed of a Kapton plastic film, 2 9 m [2 micro meter, or 2 millionth of one meter] thick on which a 0.1 μm layer of reflective aluminium is deposited, and backed, on its rear, with a layer of chromium of 0.175 μm thickness for thermal control. Such a sail, it was hoped, could be easily folded and deployed in space without difficulty. Cambridge Consultants Ltd of England, also developed a solar sail of a 276 m diameter disc, which was considered in 1995 the most advanced type.

McInnes discussed the great advantages of solar sail propulsion, as it needed no propellant and as it provided constant acceleration. It would prove very useful for inner solar system's missions, as for example a four-year round trip to Mars and back, or a mission with a 10 ton payload into orbit around Mercury in 900 days or 2½ years. Other solar system missions and advanced solar sail missions were described. No doubt, a great future awaits the solar sail.

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