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ASSESSING THE FEASIBILITY RANGE OF SOLAR POWERED PLANETESIMALS REDIRECTION OPERATIONS FOR TERRAFORMING

Abstract

The work aims assessing principal physical and technical constraints of technological concept for achieving maximal carrying capacity and expansive potential of Planetary Systems (PSs). Most potential Biosphere Substrates (BSs) chemical composition is generally very far from optimal for life. To cover all surface of a BS with dense photosynthesising layer during most of the remaining PS lifecycle for maximal carrying capacity thus workforce and productivity enabling further biosphere's expansion to new substrates - importing significant amounts of limiting chemical elements by Planetesimals Redirection is ubiquitously inevitable. Although its expensive - the value of a BS maximal population and productivity during remaining PS lifecycle is orders of magnitude higher. According to laws of orbital mechanics, the farther a planetesimal orbits a star, the more time but less energy required for its delivery. Also, the more distant - the more rich in volatiles planetesimals are. The most technically detailed and feasible scheme to date of Planetesimals Redirection was proposed in 1999 based on thermonuclear engines. Although, nuclear fuel is extremely scarce, and probably limiting for final stages of interstellar colonisation missions. We investigate possibilities and principal limitations of using concentrated beamed solar power for Planetesimals Redirection operations, which can increase such operations' possible scale to orders of magnitude. Such missions might consist of solar power harvesting concentrator system tracking "planetesimal tug" spacecraft with beam powering it. When the "tug" spacecraft reaches and mounts on targeted planetesimal, covering the planetesimal with photoreceivers decreases evaporation. The propulsion system might evolve from steam rocket to ion thrusters, then to relativistic particle accelerators, increasing technical complexity and efficiency - consuming less fraction of planetesimals as propellant. The power harvesting concentrator might be based on momentum dempher (Mercury) - quite a limited surface. Or, on orbital Fresnel lens with optic fiber flexible collimator, which might operate as arrays, allowing to increase surface collecting solar power to orders of magnitude. The power harvesting system mostly passive orbit maintenance and tracking the "tug" spacecraft during the whole mission is very complex astrodynamical task, that we are proposing and estimating solutions for. The estimated principal limitations for such operations include pointing / tracking accuracy, with respect to increasingly delayed feedback, beam divergence, and more, increasing with distance. Deeper fundamental understanding and technical solutions development increasing feasible distances of solar powered Planetesimals Redirection operations can make Terraforming research much more feasible and attractive, accelerating works for future generations sustainable cosmic expansion.