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Strategies for Rapid Implementation of Interstellar Missions: Precursors and Beyond (4)

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SPACE ARKS FOR THE NEAREST STARS: A FEASIBILITY EVALUATION

Abstract

Since the first discovery of an exoplanet we realized that a large number of stars have a planetary system and now, that we are able to discover planets smaller than Jupiter size, we know for sure what before we just expected (and what science fiction writers are saying since almost one century): terrestrial planets are common and a number of them lie in the habitable zone of their star. We discovered that even our closest star has a terrestrial planet. In the next years we expect to start the process leading us to become a multiplanetary species, by first exploring and then colonizing the Moon and Mars and other bodies of the solar system. Plans to lunch precursor interstellar probes are also being studied and also true interstellar robotic spacecraft are being designed, even if for now we speak of microprobes performing a fast flyby mission like that of the Starshot Project. Microprobes, performing a flyby and later remaining in the destination planetary system require just moderate and predictable advances in technology and are a required step toward human interstellar exploration and colonization. The aim of the present paper is to study the possibility of performing true interstellar human missions of the simplest type in a predictable timeframe. Such simple interstellar missions are based either on space arks (or generation ships) or slow interstellar ships carrying a hibernated crew. In both cases a nuclear propulsion system – either an advanced fission or a fusion thruster is assumed – which does not require advances in basic science, but only the development of technologies which are already under study, can be used. Since fusion thrusters must be considered low thrust engines, both cases of constant ejection velocity and limited variable ejection velocity are considered and the optimal specific impulse is sought for. The study concentrates on the design of what is usually referred to as a 'slow boat', i.e an ark of small size travelling at a small percentage of the speed of light, to reach the extrasolar planet Proxima Centauri b in less than 450 years. The habitat – assumed to be similar to a space settlement of a relatively small size – and of the thruster are mainly considered, since these elements are assumed to be the most critical ones to assess the feasibility of such an interstellar exploration and colonization mission.