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PROJECT ICARUS: OPTIMIZATION OF NUCLEAR FUSION PROPULSION FOR INTERSTELLAR MISSIONS

Abstract

The historical Daedalus spacecraft design was a two-stage configuration carrying 50,000tonnes of DHe3 propellant. Daedalus was powered by electron driven Inertial Confinement Fusion (ICF) to implode the pellets at a frequency of 250Hz. The mission target was to Barnard's Star 5.9light years away in a duration of around 50years. This paper is related to the successor Project Icarus, a theoretical engineering design study that began on 30th September 2009 and is a joint initiative between the Tau Zero Foundation and The British Interplanetary Society. In the first part of this paper we explore 'flyby' variations on the Daedalus propellant utilization for two different mission targets; Barnard's Star and Epsilon Eridani, 10.7light years away. With a fixed propellant mass the number of stages (1-4) is optimized for maximum cruise velocity and minimum boost period. In the second part of this paper we re-examine the Daedalus ICF pellet design and consider alternative pellet designs for use in long duration space missions. This includes both DHe3 and DT within a Daedalus pellet geometry and DHe3 and DT within the geometry of typical pellets fielded at the National Ignition Facility (NIF). Some comparisons are made to the claimed performance of the historical Vista and Longshot fusion based propulsion designs. This is a submission of the Project Icarus Study Group.