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LAUNCH SYSTEM SOLUTIONS FOR INTERSTELLAR TRAVEL

Abstract

Building on the experience gained from several successful high launch energy NASA exploration missions, a NASA funded study focused on developing a launch system capable of Interstellar travel in the near term is discussed. The NASA funded Interstellar Probe study managed by Johns Hopkins applied Physics Lab focused on the development a set of launch vehicle and upper stage system solution concepts. The configurations discussed are designed to achieve launch energies significantly above the two previous record setting missions, New Horizons and Parker Solar Probe. The launch system configurations discussed will document of several the very high launch energy solutions explored. With the advent of the NASA Space Launch System (SLS) and its significant lift mass capabilities, coupled to the significant volume available inside the fairing, the SLS system is demonstrated to be particularly well suited to the stacking of one or more upper stages in order to improve and minimize space travel mission durations. The system solutions presented are designed to increase the ultimate launch energies, by a factor of 2-3 times above those achieved for the New Horizons (wet mass = 478 kg, C3 =157.75 km**2/s**2) and Parker Solar Probe (wet mass = 643 kg, C3=154 km**2/s**2) missions. While these two separated Spacecraft launch energy examples were significant engineering achievements, incorporating the Atlas V, 551 and Delta IV Heavy launch systems with unique upper stages, the SLS lift capability configurations presented will be coupled to several Oberth maneuvers and passive and gravity assist trajectories studied. These study cases are discussed, from an engineering perspective, and will demonstrate, with current and emerging technologies, that even higher launch energies are achievable in the very near, mid to late 2020's time frame. The engineering based ground rules applied to the NASA funded study, the methodology applied and system solutions explored, will be examined. The focus on technologies and systems currently funded as well as near term emerging launch system solutions are presented. The illustrations and accompanying tables will supplement the written words and include many of the launch system configurations studied. The paper concludes with a comparison between the Parker Solar Probe launch system 10+ year development history, and includes a candidate development schedule for executing an Interstellar Probe mission.