Gateways to the Solar System: Innovative Advanced Magnet Lab Mass Driver Launch Platforms at L1 and L2

Cox, Clark, Vasant, Meinke

Lagrange points 1 and 2, each about 1.5 million kilometers from the Earth, are potential gateways to the solar system. From either point, many deep space destinations, including the Moon, Mars, or asteroids, would be accessible at much lower Delta-V than a direct transfer would require. At either gateway, an efficient, reusable launch platform, such as the Advanced Magnetics Lab mass driver discussed here, would provide further reduction in resources required to reach these destinations. The advanced magnet lab offers unique technology solution for a low mass launch tube driven by magnetic levitation, through the use of superconducting materials, 3D simulation and control of conductor placement and coil geometry, and automated manufacturing of multi-layered coils. This combination generates the highly stable double helix field with unprecedented robustness, reliability, and radiation tolerance, all of which lower production costs. L1 or L2 Gateways are reachable from a Geosynchronous Transfer Orbits (GTO) through a small hop. Although such weak stability transfers require more time, they require much less energy. Many Geosynchronous communications satellite insertions have unused "Launch Performance" such that as much as 5,000 pounds could ride along and be placed in a GTO at very low cost. Thus, from those gateways, many smallsats, including Interplanetary CubeSats or LunarCube-based missions could be sent to many destinations throughout the solar system. As an example, let's assume, conservatively, we have placed a 2,000 kg 'ride along' payload into a GTO as a ride along payload, where, conservatively, 1,000 kg represents the vehicle needed to get to the gateway, and 1,000 kg the remainder, including a 500 kg payload consisting of tens of 10 to 15 kg 2x2x2 or 2x2x3 U cubesats bound for another destination, and a reusable launch platform. The launch platform would be comprised of the spacecraft bus mass, solar arrays, long duration power storage, a rapid discharge power system and launch control electronics, all of which will support an Advanced Magnetics Lab Mass Driver launch tube with conventional or superconducting coils. Once the chemical or other conventional propulsion system has placed the Launch Platform near the L1 or L2 Gateway the approximately 50 free flying spacecraft would be transferred to the AML Mass Driver and launched, one at a time, to their final destinations throughout the solar system. To calculate the efficiency of this launch sequence you would divide the total mass at the gateway by the number of launches. The kinetic energy is being provided by the "massless " solar flux at 1 AU. This architecture could offer a very low cost, flexible, and thus effective mechanism for solar system exploration.