Hypersonic Airplane Space Tether Orbital Launch (HASTOL) Study

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The Hypersonic Airplane Space Tether Orbital Launch (HASTOL) concept combines the best features of fully reusable jet airplanes and space tethers to move payloads from Earth to space. The hypersonic airplane flies a 15-ton payload in a ballistic arc that reaches Mach 10 to 12 at an altitude of 100 km. The airplane is met by a homing grapple at the end of a rotating 600-km-long tapered tether in a 700-km orbit. The grapple couples to the payload, and the tether rotation lifts the payload into space at a mild 2.5 g's.

In Phase I, Boeing and Tethers Unlimited, Inc. (TUI), found rendezvous conditions in which a space tether can reach the Boeing DF-9 hypersonic airplane without overheating its tip. DF-9 is similar to the X-43 research vehicle scheduled to fly in summer 2000 at Mach 10. It uses JP-fueled air-breathing turboramjets up to Mach 4.5, with slush-hydrogen and air/oxygen ram/scram engines above 4.5. The space tether uses Spectra polymer, and its zylon (PBO) tip warms only to 40°C during aeropass. The tether facility can restore its spin and orbit energy after each payload pickup by using electrodynamic propulsion and tether length pumping, which require solar energy but no propellant, while the grapple requires only a little propellant for each rendezvous.

In Phase II, we will study technology issues and identify solutions. Subsystem simulation models will be improved and coupled to find the combination that provides reliable payload transfer at low cost. We will identify potential users and upcoming flight mission opportunities, developing variations on the basic architecture to match the users and missions. This will result in a technology roadmap that shows how the HASTOL architecture can be developed through a series of technology and flight demonstrations.