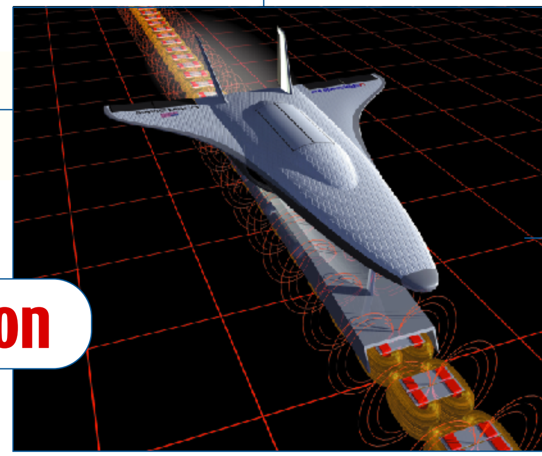
Advanced Space Transportation Technology Summary



Magnetic Levitation

Overcoming the grip of Earth's gravity is a supreme challenge for engineers who design rockets that leave the planet. One of the cutting-edge technologies being developed at NASA's Marshall Space Flight Center in Huntsville, Ala., would give launch vehicles a "running start" as they lift off to orbit.

Marshall engineers are testing magnetic levitation—or maglev—technologies that could levitate and accelerate a launch vehicle along a track at high speeds before it leaves the ground. Using electricity and magnetic fields, a maglev launch-assist system would drive a spacecraft along a horizontal track until it reaches desired speeds, and then the vehicle would shift to onboard engines for launch to orbit. A full-scale, operational track would be about 1.5 miles long and capable of accelerating a vehicle to 600 mph in 9.5 seconds.

Maglev technologies could dramatically reduce the cost of getting to space. Much of the expense of conventional rocket launches is traced to the weight of propellant. Since maglev-assisted vehicles use electricity—an off-board energy source, the spacecraft's weight at liftoff could be about 20 percent less than a typical rocket, resulting in significant cost savings. Each launch using a full-scale maglev track would consume only about $75 worth of electricity in today's market. Electricity is both inexpensive and environmentally safe.

The Marshall Center and industry partner PRT Advanced Maglev Systems Inc. of Park Forest, Ill., installed a 50-foot maglev track at Marshall in September and plan to extend it to 400 feet. Tests conducted with the experimental track help NASA learn more about aerodynamics, magnetic fields and energy storage devices associated with maglev. Experiments to validate the concept have been conducted successfully on a 20-foot electromagnetic track at the University of Sussex in Brighton, England.

The Marshall track is an advanced linear induction motor. Induction motors are common in fans, power drills and sewing machines, but instead of spinning in a circular motion to turn a shaft or gears, a linear induction motor produces thrust in a straight line. It's basically a rotary motor split in half and rolled out flat. When the coils of the linear induction motor are energized by alternating current, a magnetic field is created, providing thrust that pushes an aluminum carrier along the maglev track. A horseshoe-shaped carrier containing a 5-foot, 30-pound spacecraft model is levitated about one-half inch above the track as it accelerates from zero to 60 mph in less than one-half second.

The track—50 feet long, about 2 feet wide and about 1.5 feet high—is mounted on concrete pedestals. It consists of 10 identical, 5-foot-long segments that weigh about 500 pounds each. Most of the weight is iron used in the motor. The track is shrouded with nonmagnetic stainless steel.

Magnetic levitation of the carrier and its vehicle on the experimental track requires about 200 kilowatts of electricity—the equivalent of turning on 2,000 100-watt light bulbs at one time.

In addition to industry partner PRT, NASA is joining with Lawrence Livermore National Laboratory of Livermore, Calif., to develop maglev technologies. The Livermore team is building a track that uses permanent magnets and a linear motor that runs without superconductors or complex feedback circuits.

Maglev is one of many technologies being developed by the Marshall Center's Advanced Space Transportation Program to reduce the cost of getting to space from today's $10,000 per pound to only hundreds of dollars per pound.