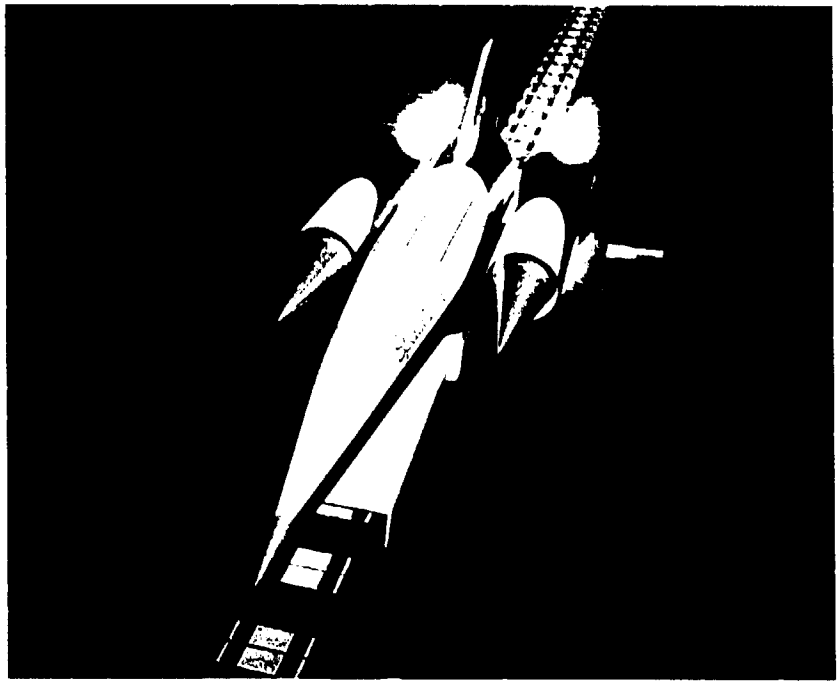
NASA MagLev Abstract for EML Symposium:

With the ever-increasing cost of getting to space and the need for safe, reliable, and inexpensive ways to access space, NASA is taking a look at technologies that will get us there. One of these technologies is Magnetic Launch Assist (MagLev). This is the concept of using both magnetic levitation and magnetic propulsion to provide an initial velocity by using electrical power from ground sources. The use of ground based power can significantly reduce operational costs over the consumables necessary to attain the same velocity. The technologies to accomplish this are both old and new. The concept of MagLev has been around for a longtime and several MagLev Trains have already been made. Where NASA's MagLev diverges from the traditional train is in the immense power required to propel this vehicle to 600 feet per second in less than 10 seconds. New technologies or the upgrade of existing technologies will need to be investigated in areas of energy storage and power switching. Plus the separation of a very large mass (the space vehicle) and the aerodynamics of that vehicle while on the carrier are also of great concern and require considerable study and testing. NASA's plan is to mature these technologies in the next 10 years to achieve our goal of launching a full sized space vehicle off a MagLev rail.

Magnetic Launch Assist



NASA's Vision for the Future

Magnetic Launch Assist

- The approach is to develop magnetic levitation, and linear motor technologies to investigate:
  - Scaled configurations more representative of the Future-X vehicle concepts (120 K lb. Vehicle, 2 g acceleration, 600 fps exit speed, approx. 1/2 mile of acceleration).
  - Stability and control over the operating range of the system.
  - Energy storage and distribution concepts over the operating range.
  - Integration and interaction between the thrust cradle and the vehicle.
  - Development of a full scale technology demonstrator.

Magnetic Launch Assist

NASA has contracted with three companies to produce magnetic levitation concepts:

Foster-Miller
Waltham, MA
POC: James Dill

Lawrence Livermore National Laboratory
Livermore, CA
POC: Louann Tung

PRT Advanced MagLev Systems, Inc
Park Forest, IL
POC: George Scelzo

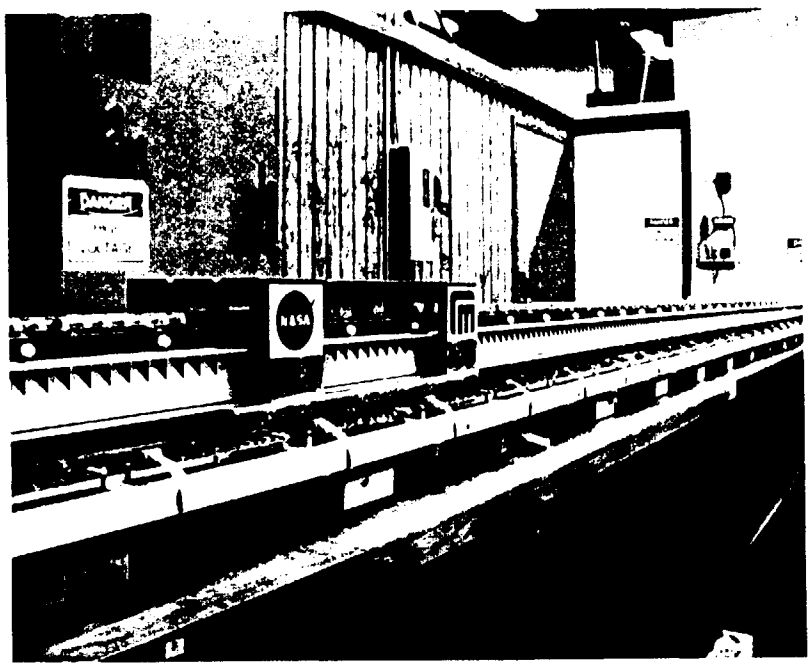
Magnetic Launch Assist

Foster-Miller

FM's design uses a Linear Synchronous Motor (LSM) for Propulsion and null flux coils reacting against a permanent magnetic field for levitation. The permanent magnetic field will be developed through the use of super conducting coils to reach higher flux densities than rare earth magnets.

Magnetic Launch Assist

Foster-Miller 40 ft. Magnetic Levitation Track that achieved 59 mph of a 6 Kg cradle. Propulsion during first 20 feet.



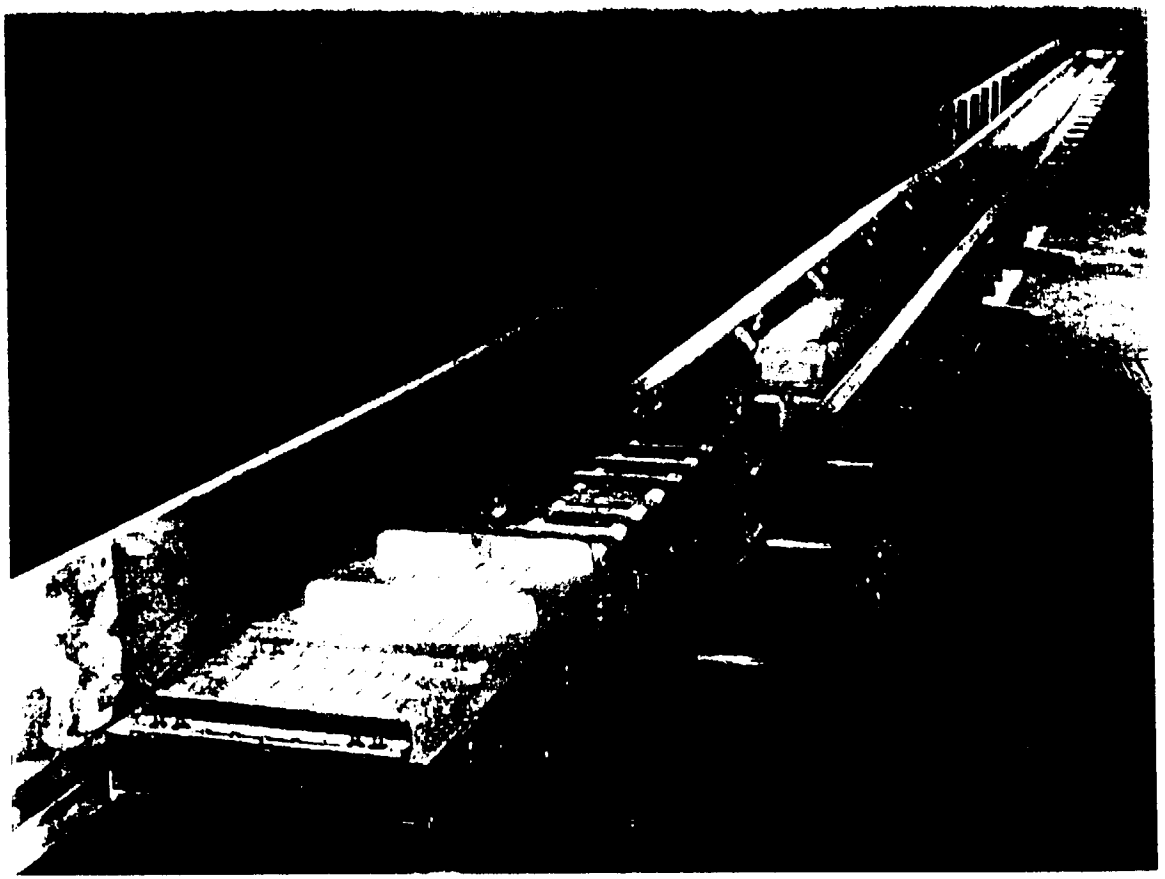
Magnetic Launch Assist

Lawrence Livermore National Laboratory (LLNL)

LLNL employs the use of Permanent Magnets in a Halbach array for levitation and uses a resonant charging capacitor bank to drive coils interleaved in the levitation coils for acceleration. The track has been named Inductrack.

Magnetic Launch Assist

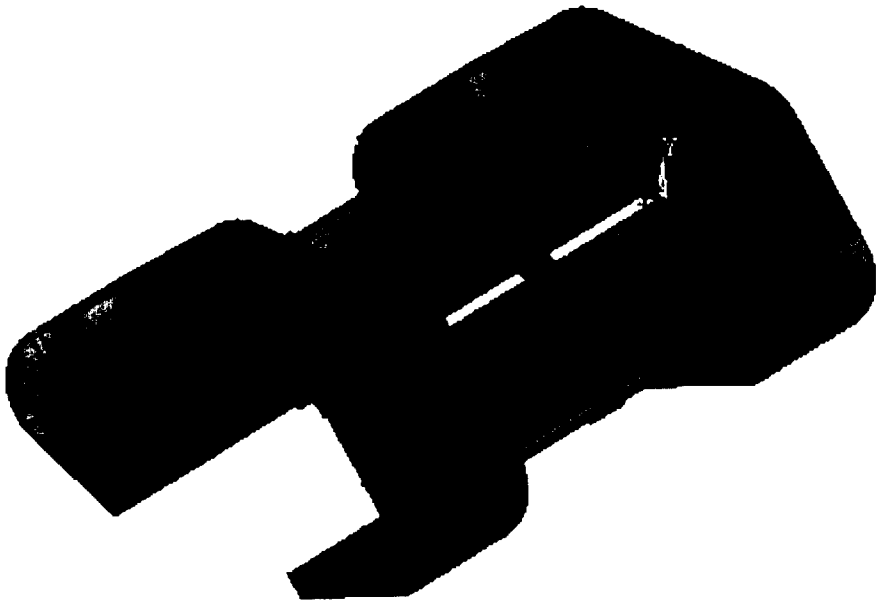
LLNL's 20 meter track that achieved 27 mph with a 20 kg cradle using separate sections for acceleration and levitation

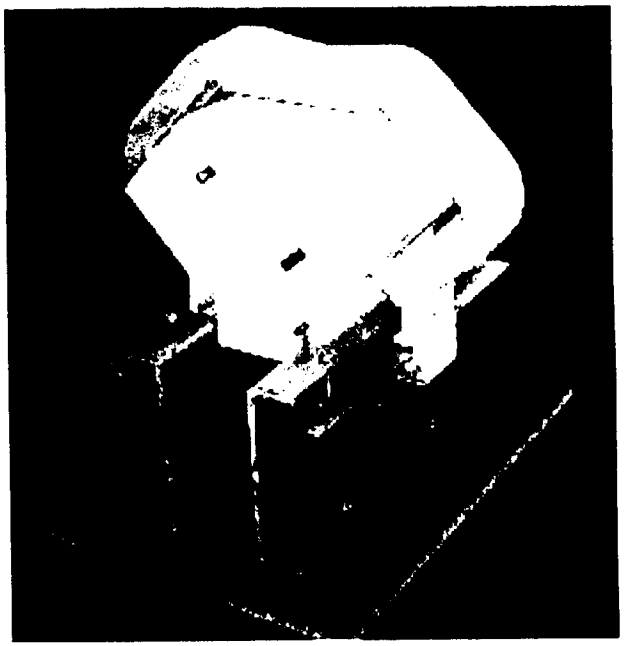


Magnetic Launch Assist

- LLNL Status
  - They are currently working on a 8 meter test track with a redesigned carrier to test the levitation stability at higher speeds and with interleaved acceleration. The 9 kg carrier will be accelerated at 10g's to achieve 60 mph.
  - The system is expected to be ready for testing by August 2000.

Magnetic Launch Assist

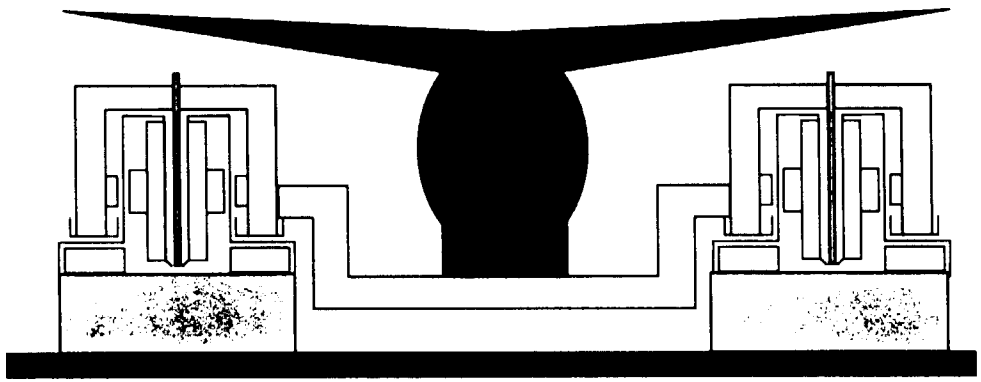




Cradle Design for LLNL's Inductrack

Magnetic Launch Assist

- PRT Status (Cont.)
  - Extend and test of a dual track concept by using two 200 ft. motors.



  - Should be accomplished in the Fourth quarter of FY2000.

Magnetic Launch Assist

	2000	2001 - 2002	2003 - 2004	2005 - 2006	2007 - 2008	2009 - 2010
Major Milestones & Decisions	Demo PRT Systems	RC Flight Test		Flight Demonstrator		Full-scale Prototype Demonstration
Key Issues						

- TRACK
- VEHICLE CARRIER
- LEVITATION
- PROPULSION
- STABILITY
- ENERGY STORAGE
- POWER DELIVERY
- SEPARATION DYNAMICS
- ABORT SCENARIOS
- SAFETY
- RELIABILITY
- MAINTAINABILITY
- OPERABILITY

Technology Research

- MagLev System
- Energy Storage System
- Partnerships
- Army, Navy, Air Force

MSFC Contracts

- PRT Advance MagLev Systems
- Lawrence Livermore Laboratory
- Foster-Miller

Track Development

Aero Dynamics Modeling - DFRC

- RC Test Vehicle Definition
- Modeling
- Separation Dynamics
- Safety scenarios

Flight Test DFRC

- System Integration
- System Activation

Prototype Technology

- Levitation / Propulsion
- Energy Storage (Flywheel)
- Power delivery
- System Controls
- Carrier Integration

KSC, Data Review

System Scaling to D-1 Vehicle

- Site Development
- Track Design / Construction
- Energy Storage System Construction
- Carrier Construction

Objectives

- $100/LB
- DESIGN AND BUILD FULL SYSTEM TO LAUNCH A FLIGHT DEMONSTRATOR BY 2010

Risk Level
TRL
1
4
7
9

Magnetic Launch Assist

The Magnetic Launch Assist program is under the management of Kennedy Space Center.

Program Manager: Jose Perez-Morales
Email: jose.perez-morales-1@kmail.ksc.nasa.gov