Lunar Transportation Requirements

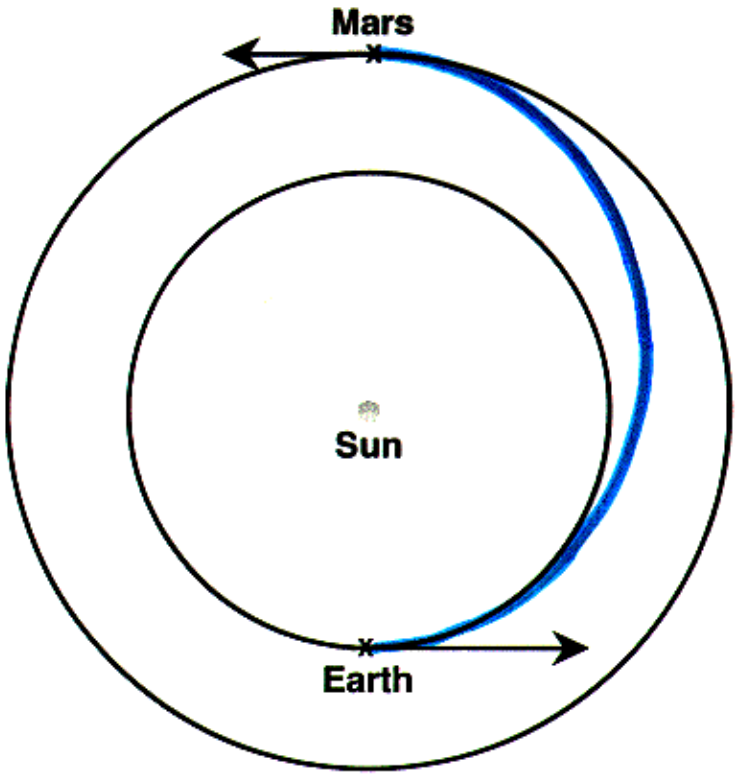
- **> 50 tonnes on lunar transfer trajectory**
  - **Apollo: 40 tonnes @ TLI for 2 men, 3 days on lunar surface.**
  - **Unlikely to be reduced significantly; can miniaturize components but not crew.**
  - **Maybe less if lunar oxygen is used for return propellant.**
  - **Note: 50 tonnes @ TLI implies 100 tonnes in LEO for 450 sec I_{sp} LOX/LH_2 upper stage.**
    - **70 tonnes if 850 sec nuclear thermal upper stage, but not likely in foreseeable political environment.**
- **Land anywhere on the Moon.**
- **Go any time of the month.**
- **Abort to Earth at any time.**

Lunar Transportation System Architectures

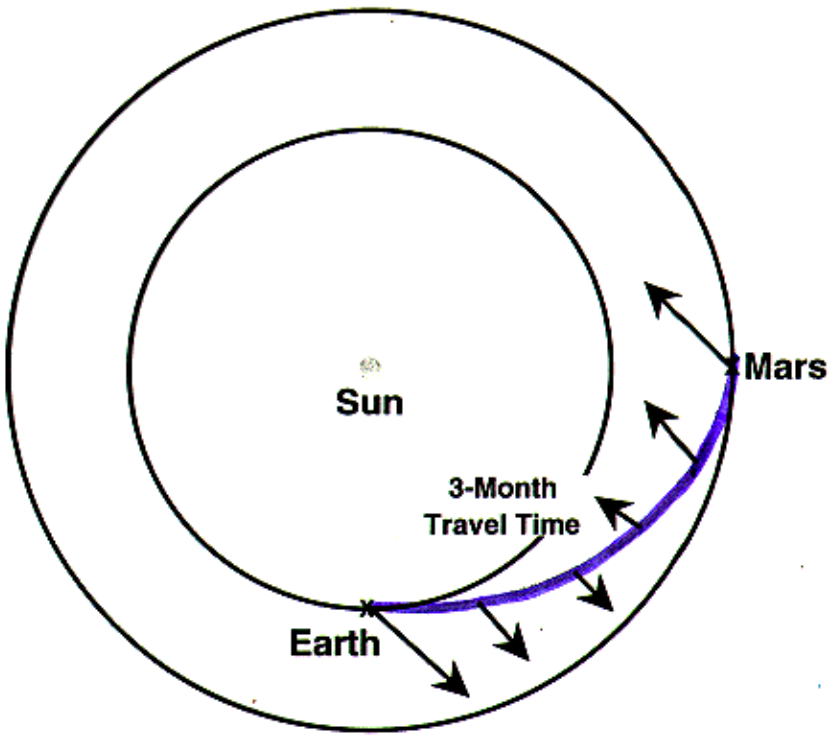
- Lunar Orbit Rendezvous (LOR)
- Earth Orbit Rendezvous (EOR)
- Lunar Surface Rendezvous (LSR)
- Lagrange Point Rendezvous (LPR)

Taking Full Advantage of High Exhaust Velocity Requires Optimizing Trajectories

Chemical Rocket Trajectory (Minimum Energy)



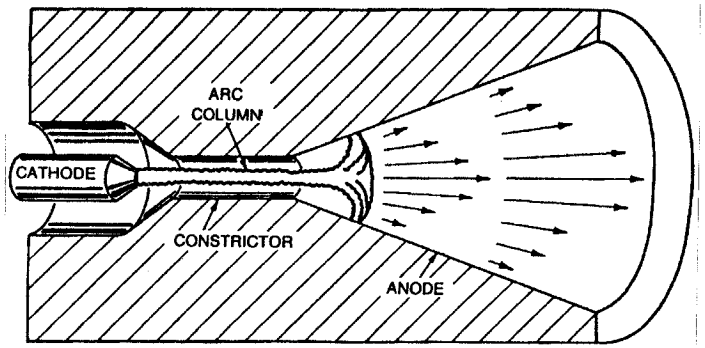
Fusion Rocket Trajectory (Variable Acceleration)



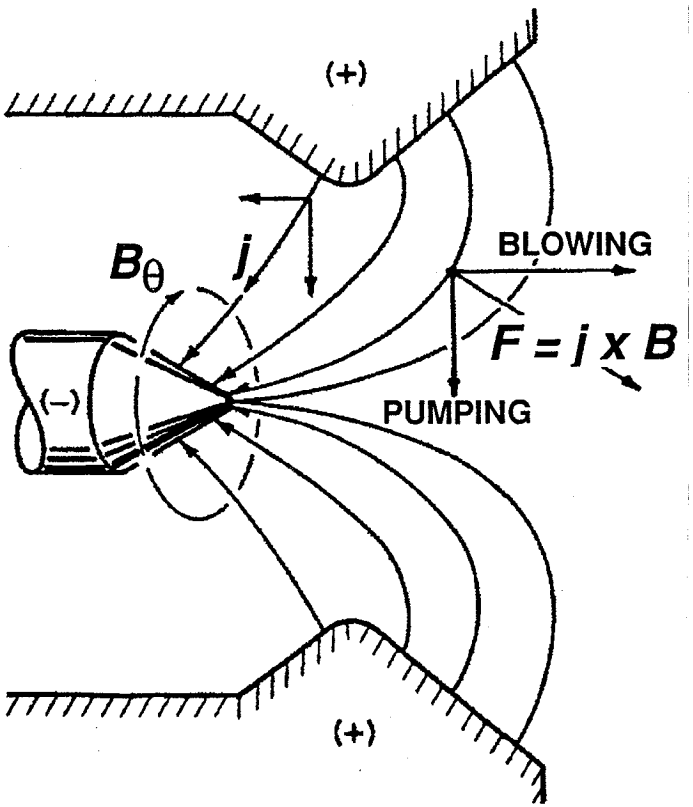
Plasma Thrusters

University of Wisconsin

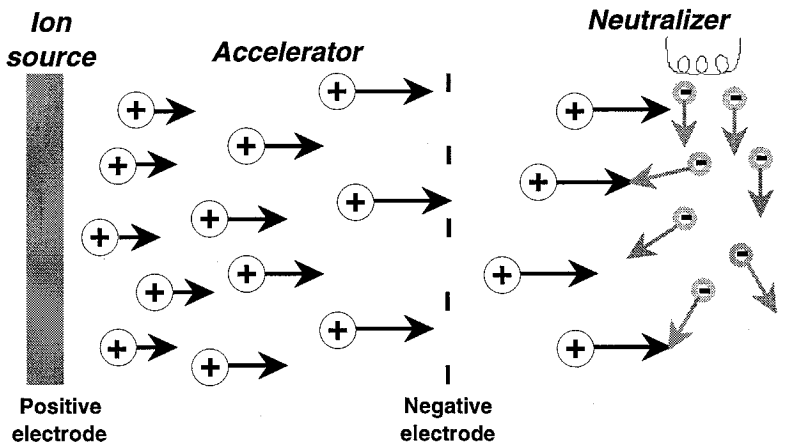
Electrothermal thruster



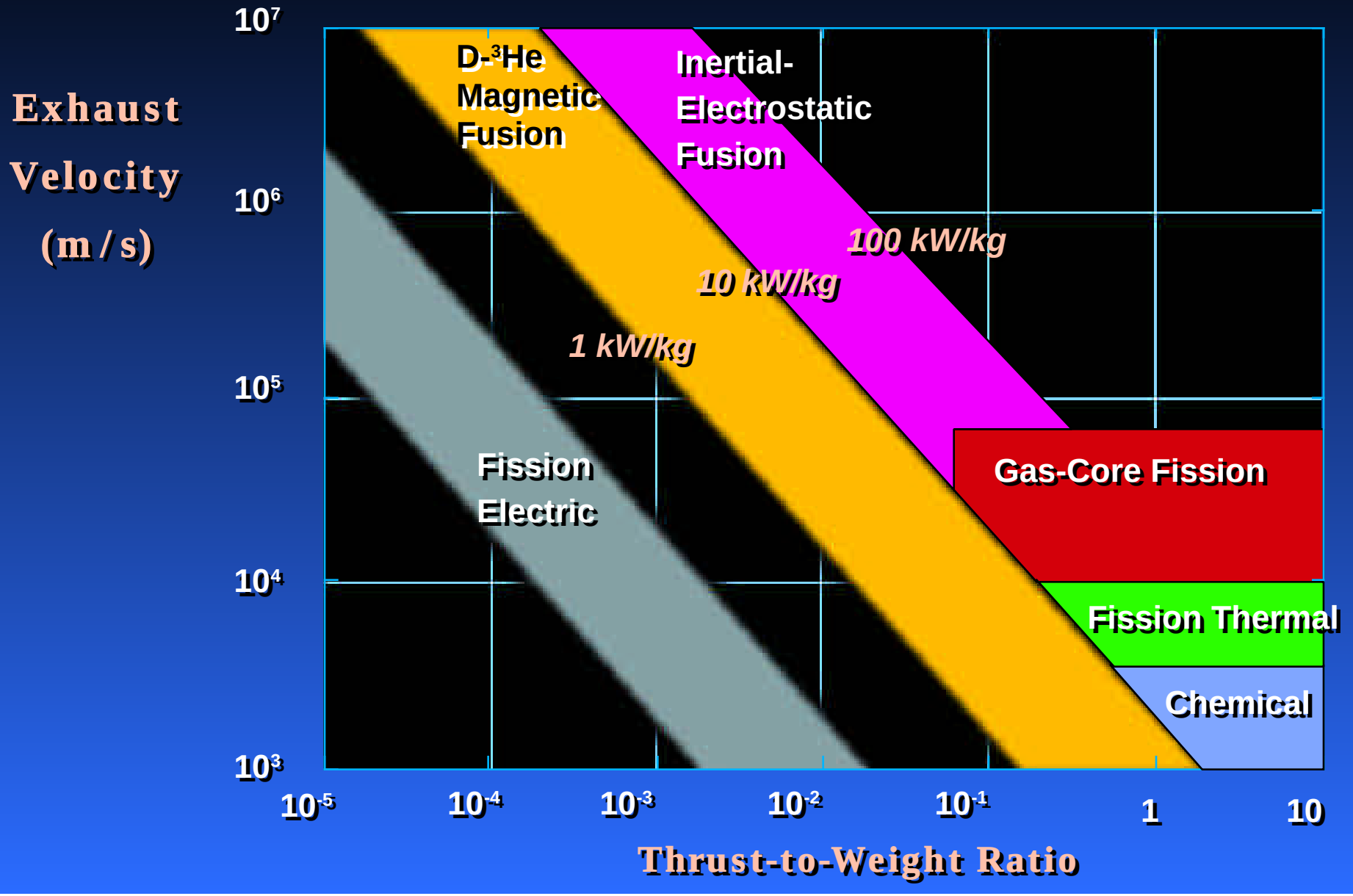
Electrodynamic thruster



Ion thruster



D-^{3}He Fusion Will Provide Capabilities Not Available from Other Propulsion Options



D-^{3}He is More Attractive for Space than D-T

- High charged-particle fraction allows efficient direct conversion to thrust or electricity.
  - ♦ Increases useful power.
  - ♦ Reduces heat rejection (radiator) mass.
  - ♦ Allows very flexible thrust and specific impulse tailoring.
- Low neutron fraction reduces radiation shielding.
- D-^{3}He eliminates the need for a tritium breeding blanket.