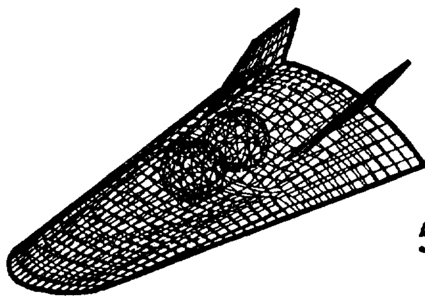
FUSION PROPULSION AND POWER FOR FUTURE FLIGHT



H. D. Froning, Jr.
Flight Unlimited
5450 Country Club Drive
Flagstaff, Arizona

NASA Langley Advanced Transportation Workshop
"Transportation Beyond 2000"

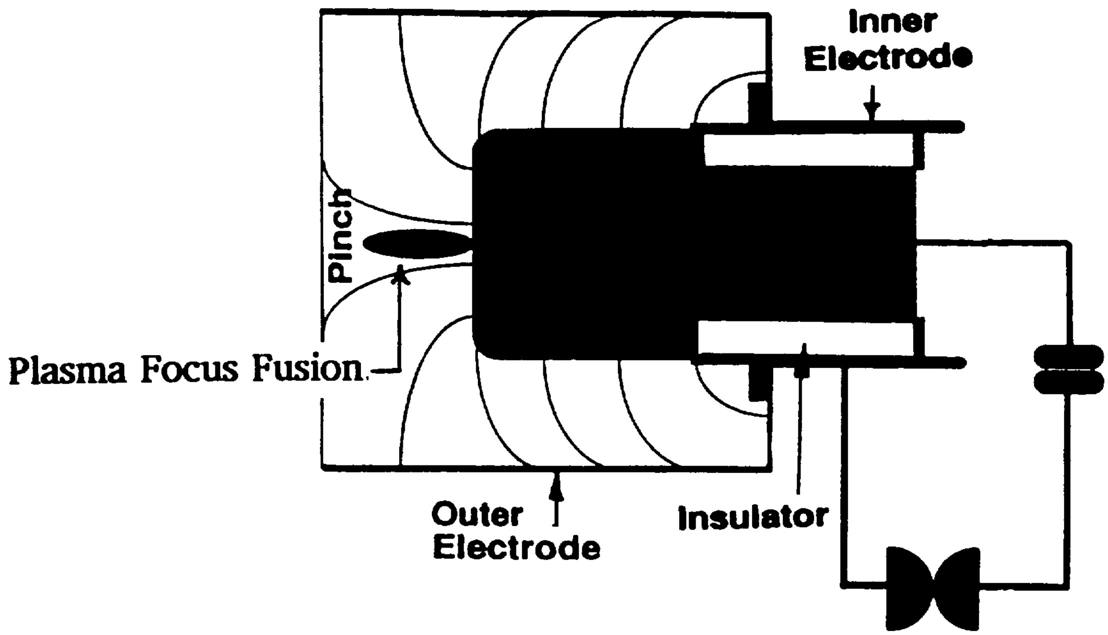
September 26-28, 1995

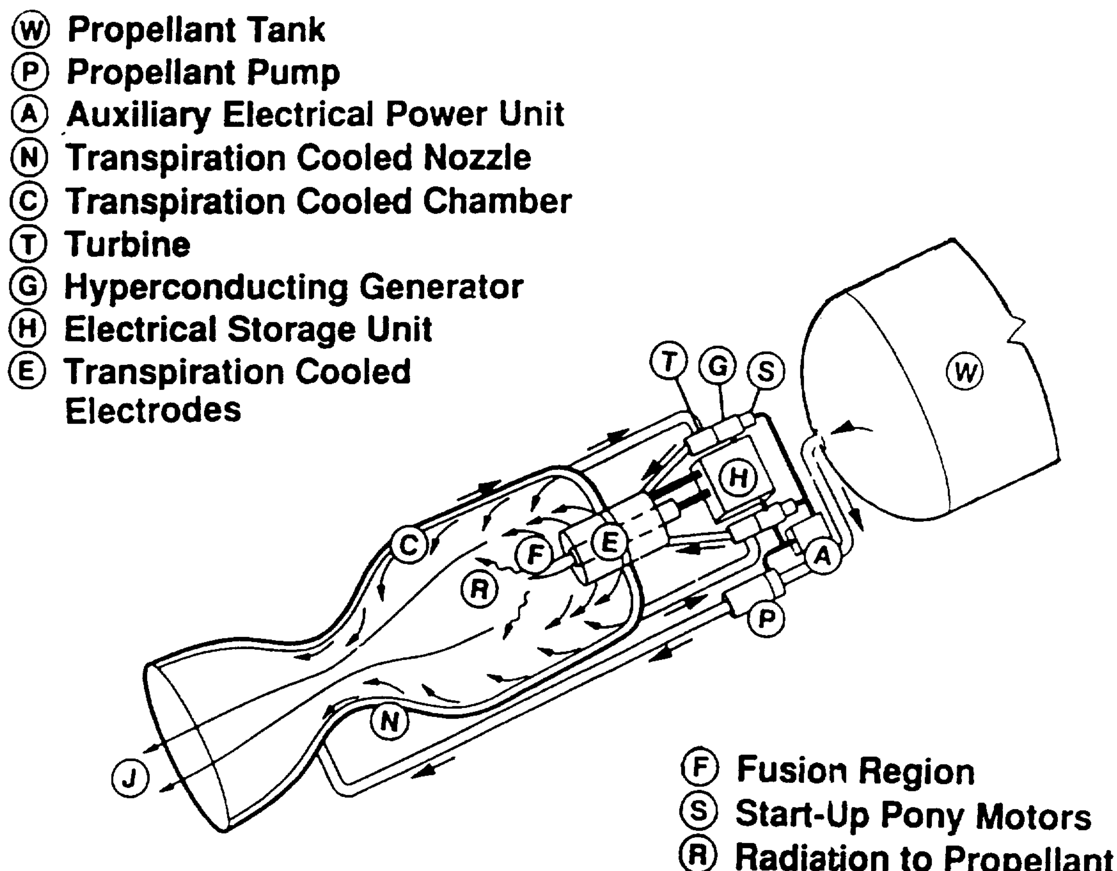
Flight Unlimited

There are innovative magnetic and electric confinement fusion power and propulsion system designs with potential for:

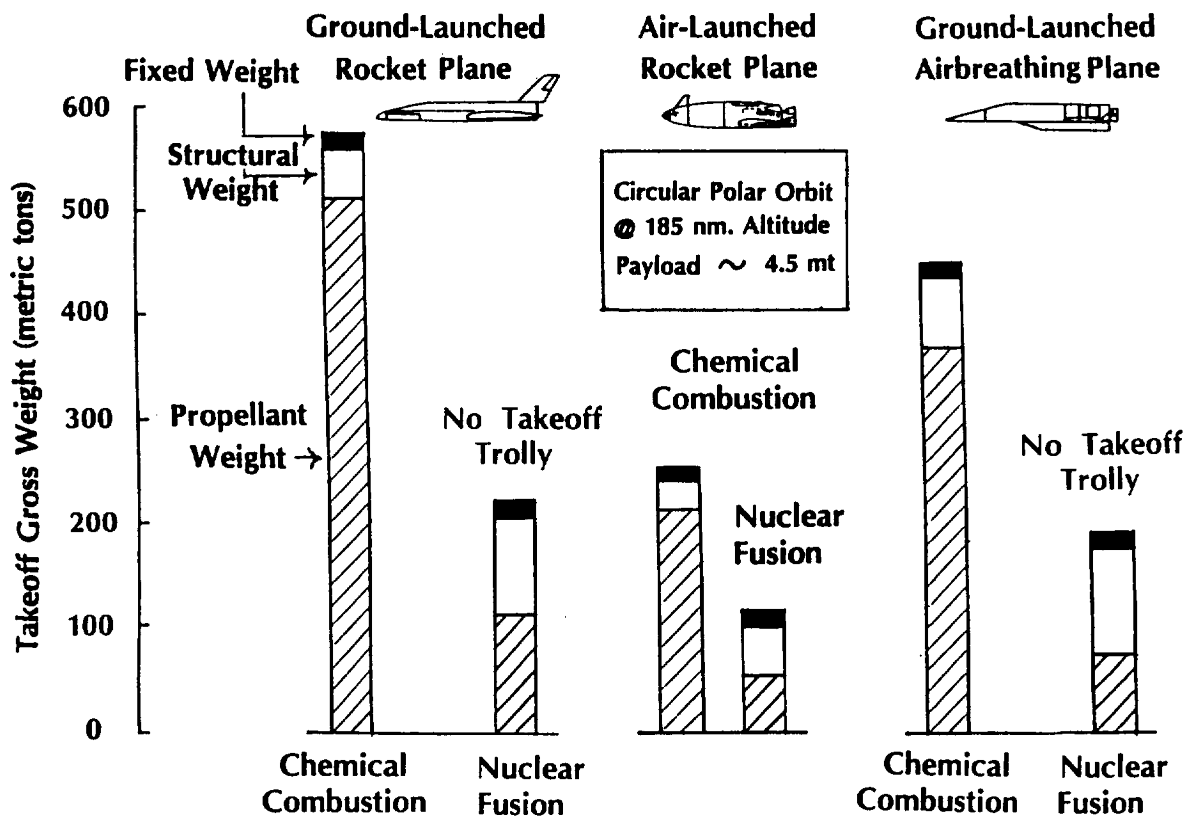
- **Vacuum specific impulses of 1500-2000 seconds with rocket engine thrust/mass ratios of 5-10 g's**
- **Environmentally favorable exhaust emissions if aneutronic fusion propellants can be used**
- **A 2 to 3-fold reduction in the mass of hypersonic airliners and SSTO aerospace planes**
- **A 10 to 20 fold reduction in Mars expedition mass and cost (if propellant from planetary atmospheres is used)**

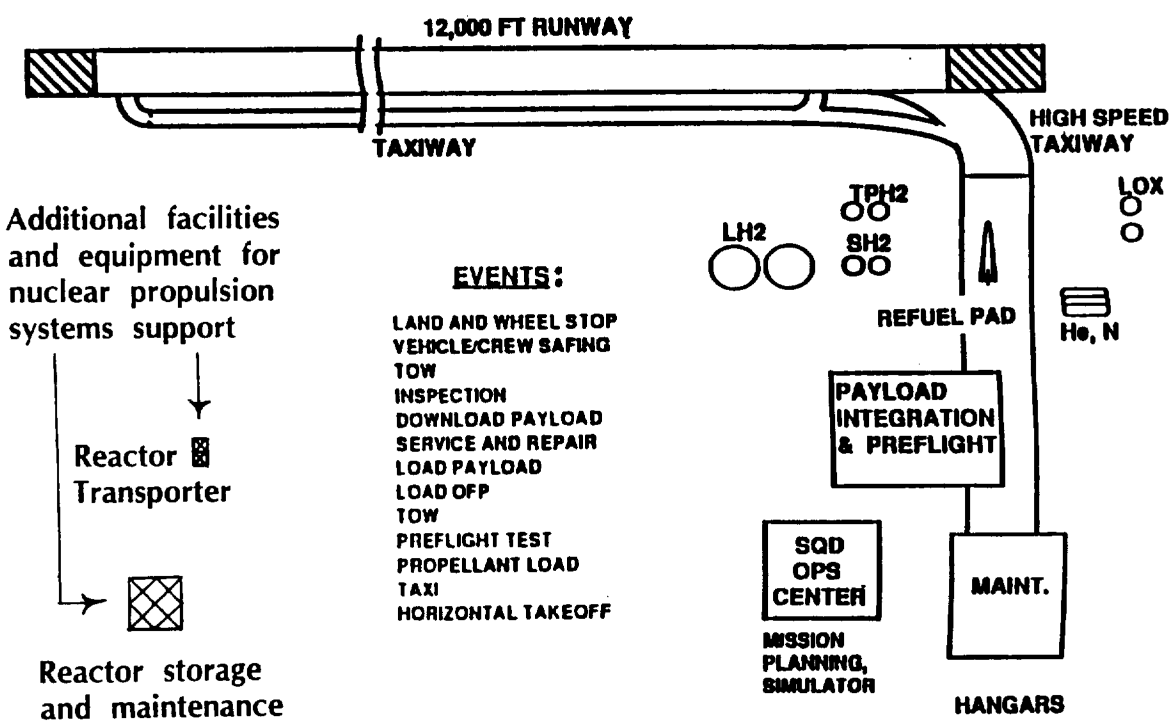
And feasibility or in-feasibility of these systems could be confirmed with a modest applied research and exploratory development cost





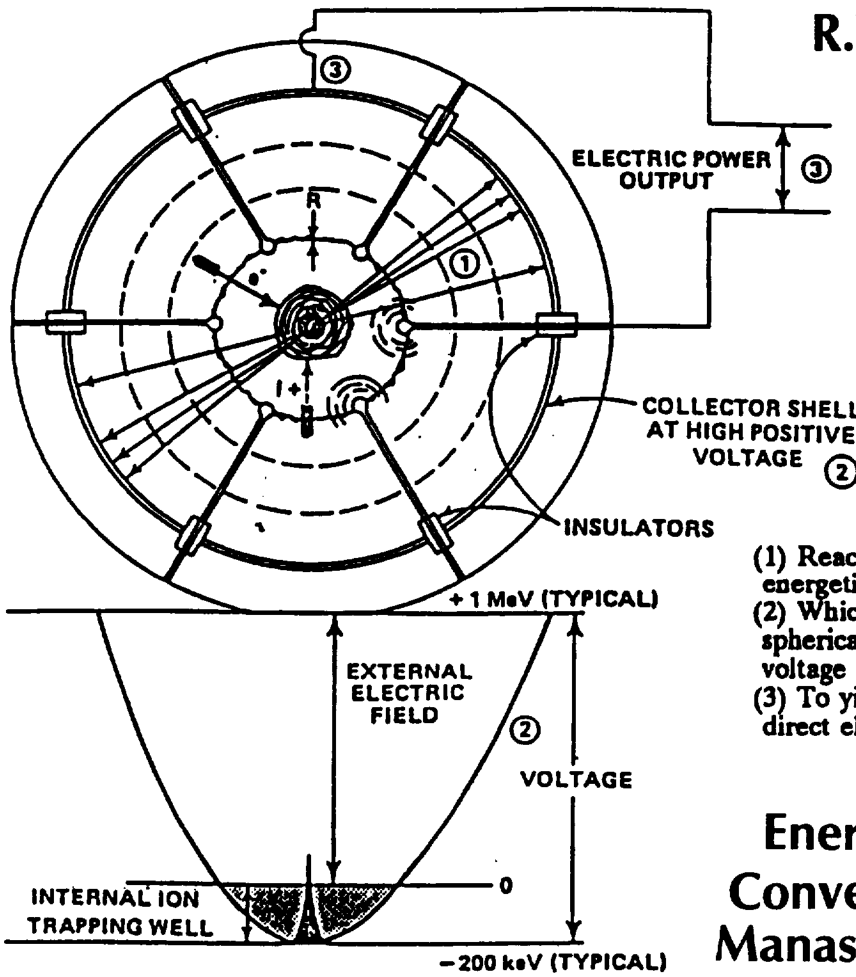
Plasma focus Engine





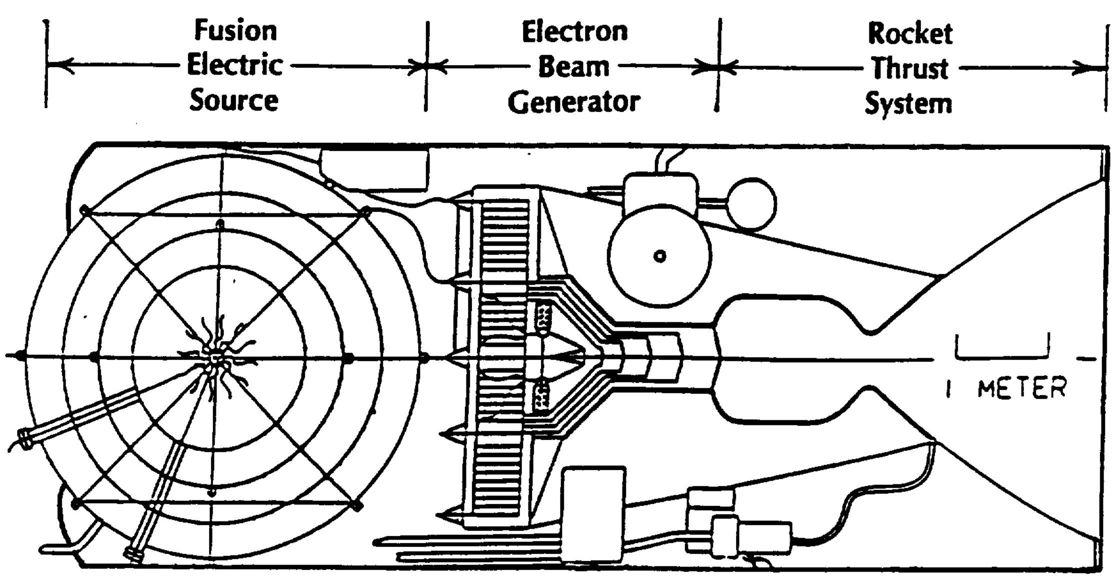
Facility, Operation, and Support

R.W. Bussard



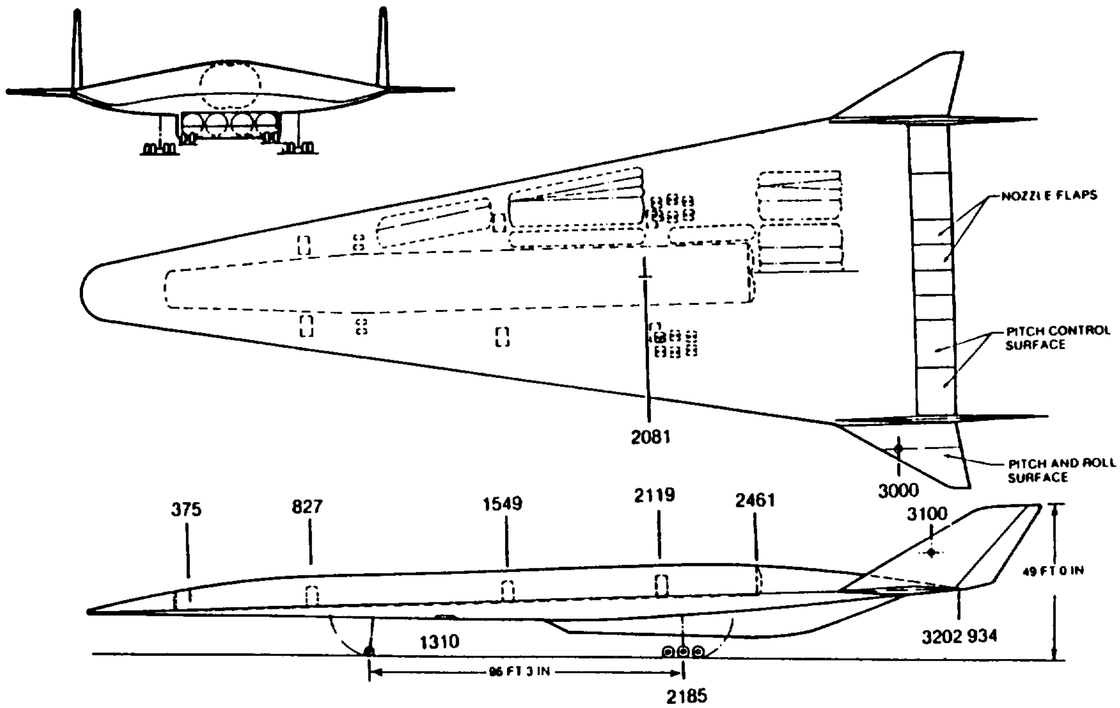
(1) Reaction products are energetic charged particles,
(2) Which escape against spherically symmetric radial voltage gradient,
(3) To yield radiation-free direct electric power output

Energy/Matter Conversion Corp. Manassas, Virginia

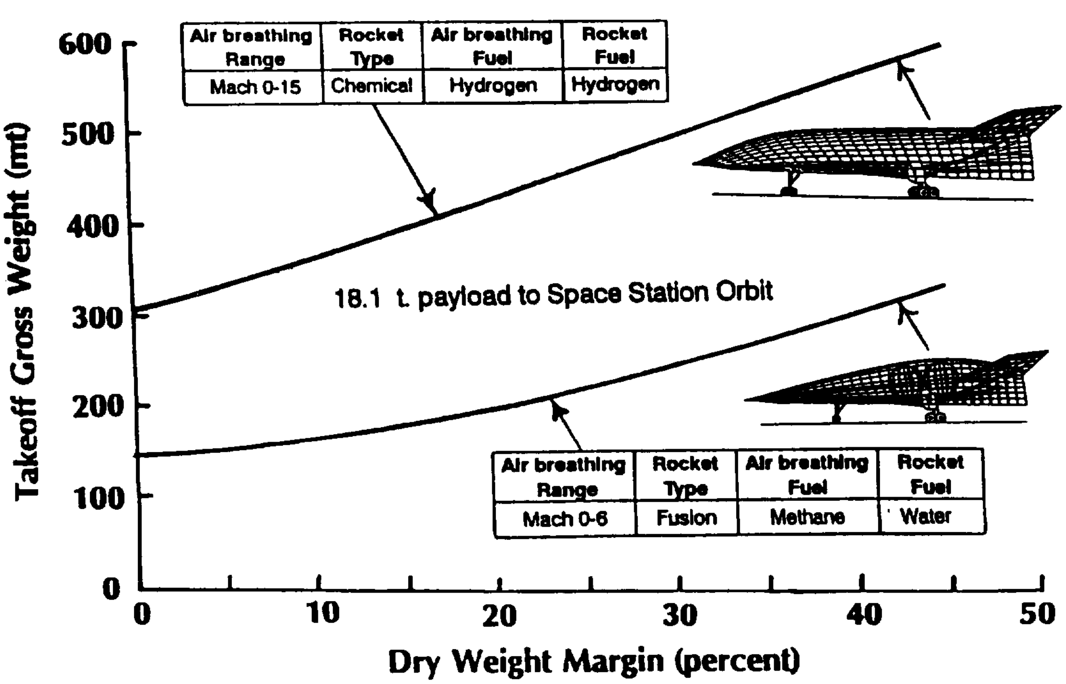


Typical Integration of Subsystems for Fusion-Electric Rocket

A 2 to 3-Fold Reduction in Hypersonic Airliner Mass is Possible if Fusion-Electric Propulsion is Used For the Long Cruise Phase of Flight



Effect of Design Margin on Weight



Air breathing Range	Rocket Type	Air breathing Fuel	Rocket Fuel
Mach 0-15	Chemical	Hydrogen	Hydrogen

Air breathing Range	Rocket Type	Air breathing Fuel	Rocket Fuel
Mach 0-6	Fusion	Methane	Water

IAF-92-0569

WORLD SPACE CONGRESS 1992™

USE OF PLANETARY ATMOSPHERES FOR CHEMICAL AND FUSION PROPULSION FLIGHT

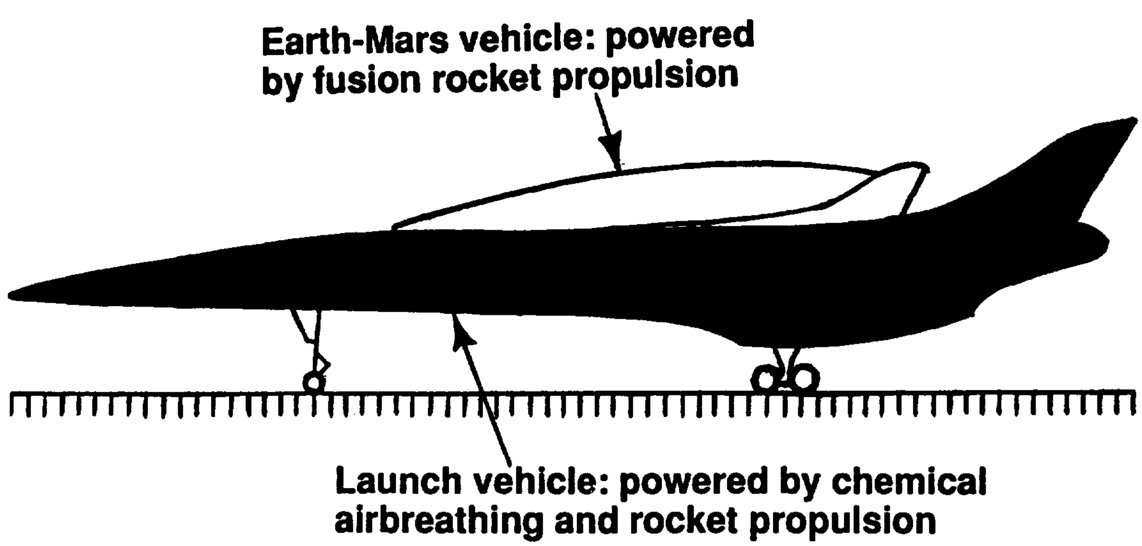
H.D. Froning Jr.
McDonnell Douglas

F.B. Mead
Phillips Laboratory

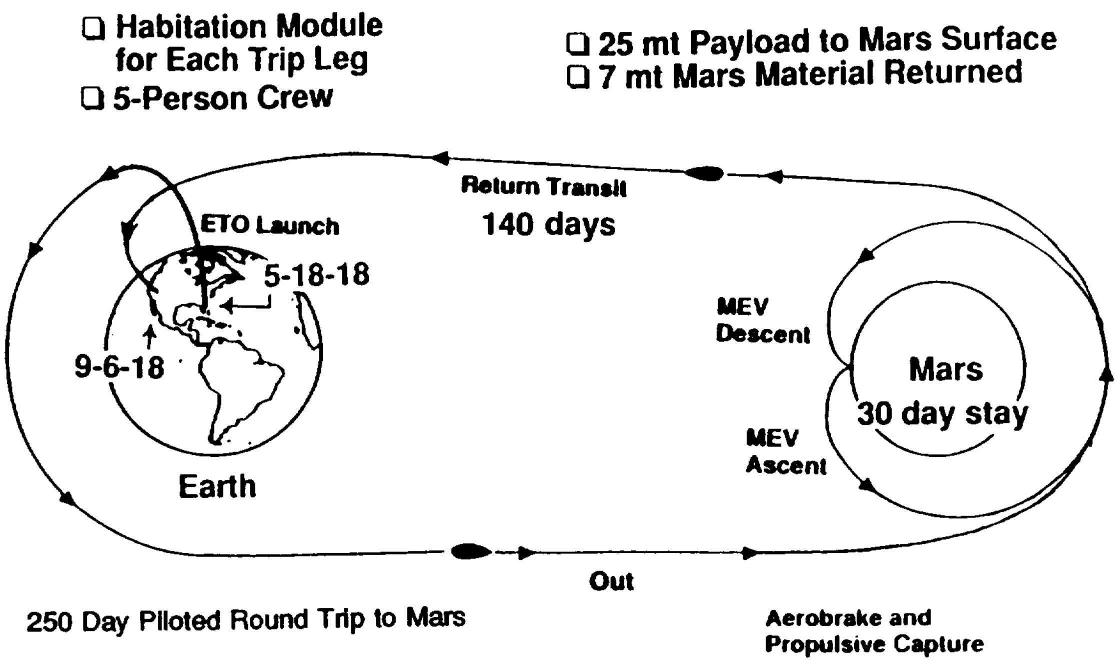
J.L. Leingang
Wright Laboratory

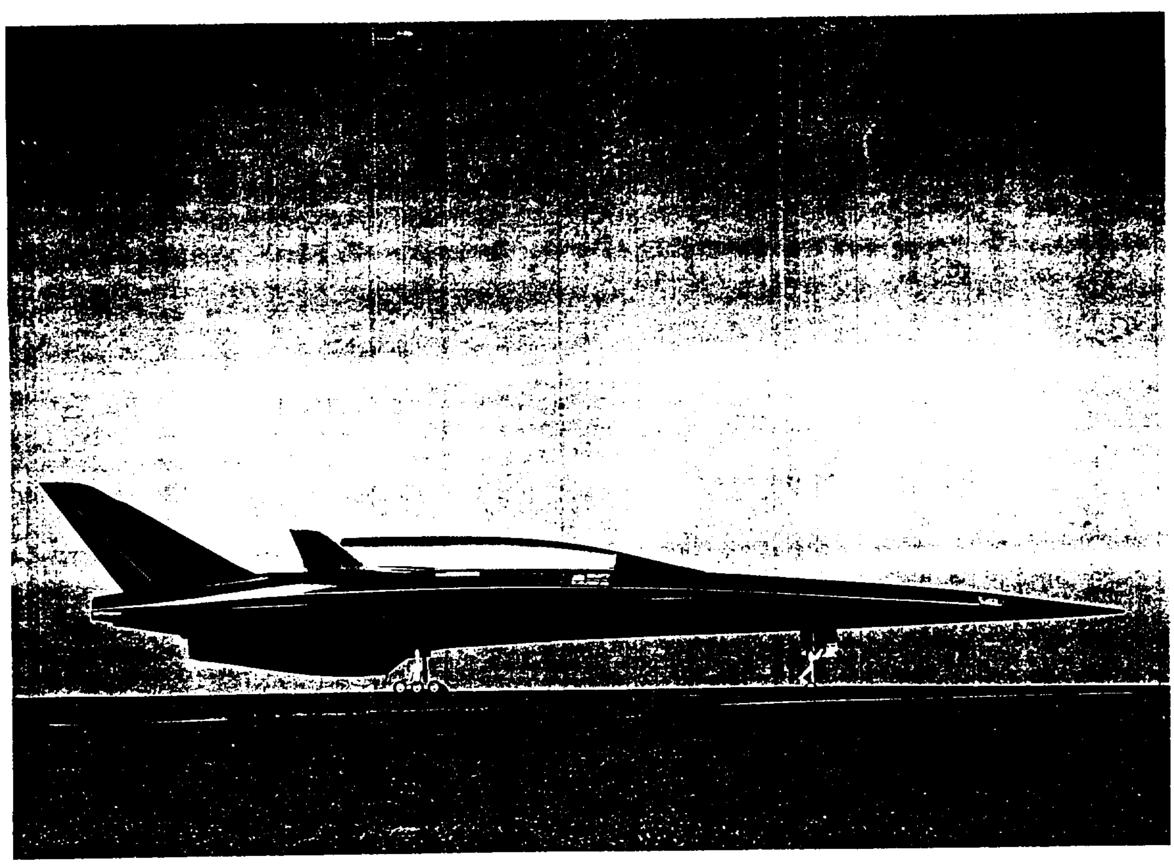
S.N.B. Murthy
Purdue University

- Oxygen and nitrogen obtained from Earth's atmosphere for propulsion from Earth to Mars



- Carbon dioxide obtained from Mars's atmosphere for propulsion for return to Earth





A Mars Expedition Takeoff Mass of 2.5 to 5 Million Pounds is Possible – Depending upon the Fusion Propulsion Efficiency Achieved During the Trip