A Novel Approach to Exploring the Mars Polar Caps

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A Quote from a famous American . .

Von Braun picture from John Brophy - 40446

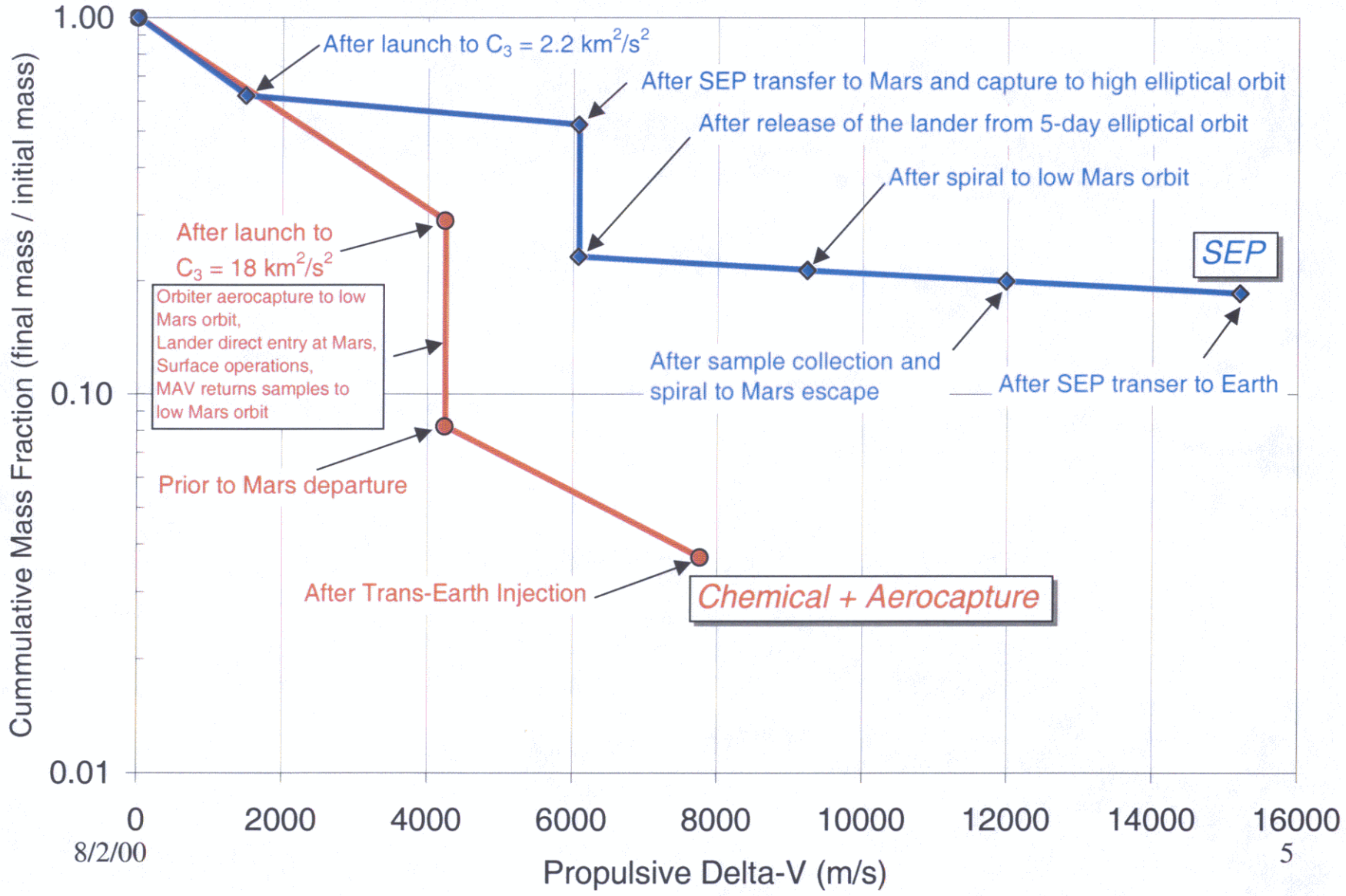
Electric Propulsion

- Twelve (12) times higher specific impulse than chemical
- Space solar array development has progressed to >100W/kg
- Over forty (40) ion engines are currently flying - DS1 is enroute to a comet
- Mass, Cost & Risk have been reduced to the point that Solar Electric Propulsion (SEP) is a viable alternate
- Current SEP capability is enabling for high ΔV Missions - such as those to Mars, especially Sample Return (SR).

Novel Aspects of Proposed Approach

- Use SEP for all aspects of travel to/from Mars - major mass fraction improvement (insert MSR mass fraction chart)
- "Rendezvous with Mars" to enable placement in elliptical orbit of arbitrary phase and periapse - all trajectory issues resolved with this approach (need Ted Sweetser traj)
- Landers descend to surface from 5 day elliptical orbit
- Orbiter provides lander support and can change plane for next phase of mission

Mars Transfer Physics - mass ratios



Why this is Important

- Global Access to Mars at every opportunity
  - Poles (Polar Picture)
  - Areas of Interest (Water signs)
- Improved Landing accuracy & ability to "wait out" dust storms or to change targets
- The Interactive Mission

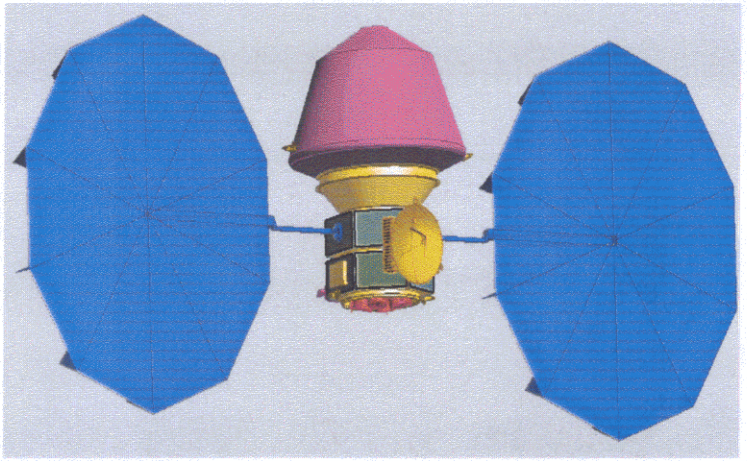
What is the payload, how long does it take?

- 400kg on a Delta II, 2250kg on the next generation US medium LV (Delta IV, Atlas 5 series)
- ~15 to 36 months each way, depending on mass transported
- Multiple payloads to multiple locations are possible:
  - Landers
  - Science Orbiters
  - Telecom Orbiters (~400kg each)
  - A mix of the above
- Launch windows are several months long

Mars Sample Return - an example

- Can be accomplished using a single medium class launch vehicle
- Mission duration is 2.8 to 5.9 years depending on payload and SEP capacity
- Simplified MAV requirements
- Sample from any point on the Martian Surface
- Low entry velocities at Earth minimize Planetary Protection issues
- Flight proven technologies throughout

Sample Return using SEP



- Add pic of vehicle in flight config.

Summary

- SEP changes the paradigm for Mars Exploration:
  - Go where you want, when you want . . .
  - Multiple payloads are straightforward
  - Vehicle designs are reusable
  - Enables high rate (10Mb/sec)
  - Tested technology - low risk
  - Relaxation of Launch periods a programmatic plus!
  - And more!!