Panel Session IV - Creating a Tight Space Exploration Initiative

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President, The Mars Society

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Creating a **Tight**
Space Exploration Initiative

Dr. Robert Zubrin
President, Mars Society

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**Question:** How much rope is needed to connect two posts separated by a distance of 10 meters?

In principle, it can take any amount:

But it can be done with about 10 meters, if the rope is pulled tight.

It is the same with the Space Exploration Initiative.

The issue is whether you want to connect the posts, or whether your goal is to sell rope.

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**Rope Sale #1**

**The Lunar Tollbooth**

Even if Lunar refueling were free, it's easier to go direct to Mars!

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**Rope Sale #2**

**Nuclear Electric Propulsion**

<table>
<thead>
<tr>
<th><strong>One-way Transit Time</strong></th>
<th><strong>Claim</strong></th>
<th><strong>Reality</strong></th>
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</thead>
<tbody>
<tr>
<td>60 days</td>
<td>1460 days</td>
<td></td>
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<tr>
<td>3000 W/kg</td>
<td>16 W/kg</td>
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**Cumulative Radiation Doses Received in Space**

The cumulative radiation dose of a human roundtrip mission to Mars using current propulsion technology has already been experienced by numerous astronauts.

No radiation-induced health effects have been observed.
Mars Direct Transfer and Surface Habitation Layout

- Exercise/Health Room
- SR-1
- SR-2
- SR-3
- SR-4
- Library

Mars Direct Tether Application for Artificial Gravity

- Mars Gravity Achieved with 1300-m Long Tether at Only One RPM
- One RPM and Reduced Wear on Design Antennas, Solar Panels, etc.
- Mission Continues if Tether Fails
- Spins Tether & Counter-Balance (Receives Provide Initial Spin-Up)
- No Despin Required. Tether (and TMU) Slowly Released near Mars
- Total Tether System Mass is 600 kg based on Torque and 2 Safety Factor
- Zero Burn of TMU Reduces Tether System Mass

Mars Direct Mission Sequence

Year 1
- Automated

Year 2
- Automated
- Piloted

Year 3
- Automated
- Piloted

Year 4
- Automated

Year 5
- Automated

In-Site Propellant Provides the Mobility Needed to Explore Mars
Lunar/Mars Direct Exploration Vehicles

- Common Systems Defined to Explore and Colonize the Moon and Mars
- MELEO is the SAME for either Mars or Lunar Missions
- No LEO Assembly Required: Launch Direct to Moon or Mars
- ETO Vehicle is Inline Shuttle-C with Earth-Escape 2nd Stage on Top
- ETG Configuration Optimized not to LEO but to Earth Escape
- Mars Mission has Simple Tether Application to Achieve 3/4 Gravity
- Mars Mission Combines Earth Hydrogen with Martian CO₂ to Create Methane and Oxygen (One kg of H₂ Creates 8 kg of Propellant)
- Surface Habitation and Crew Return Vehicles are Reusable
- No Orbital Vehicles at Mars or Moon: All Elements go to Surfaces

"This proposition being made public and opening to the weighing of all, it raised many variable opinions amongst men, and caused many friends & deniers amongst themselves. Some from their reasons & hope conceived, inclined to stir up & encourage the rest to undertake and prosecute the same; others, again, out of their fears, objected against it, as sought to divert from it, suggesting many things, and these either unreasonable or unanswerable; so that it was a great design, and subjects to many unanswerable germs & dangers..."

"It was ascertained that all great & honorable actions are accompanied with great difficulties, and must be both unforeseen and overcome with unanswerable answers."

-Governor William Bradford, "Of Plimoth Plantation," 1621