Mars Mission Architecture

You should (not) go

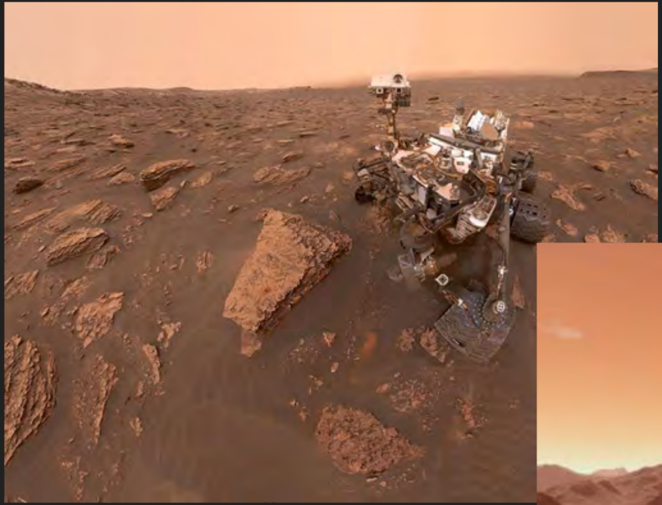
Today’s Outline

- The Psience -- Isaiah Tristan
- The Patchwork -- Brendon Bourgea
- The Pain -- Richard Archer
- The Politics -- Ryan Hofmann

Mars: A Case Study in Final Frontiers

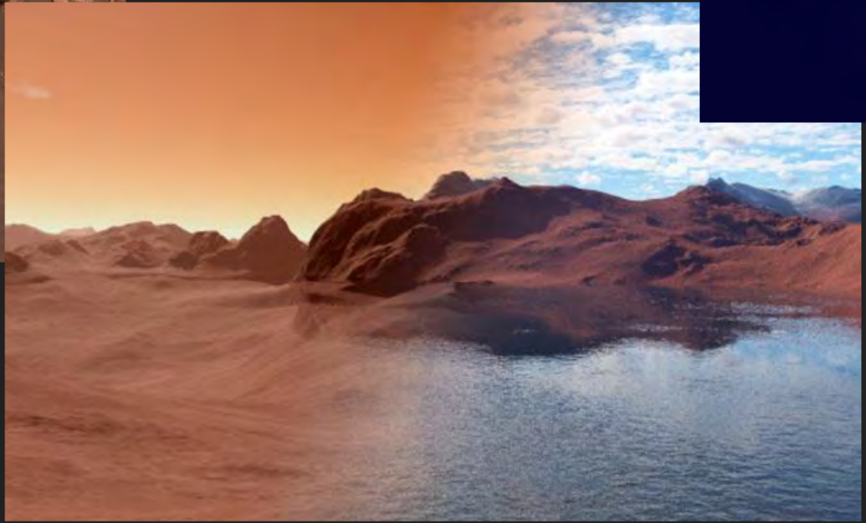
Dirt Sweet Dirt: What Else is There?

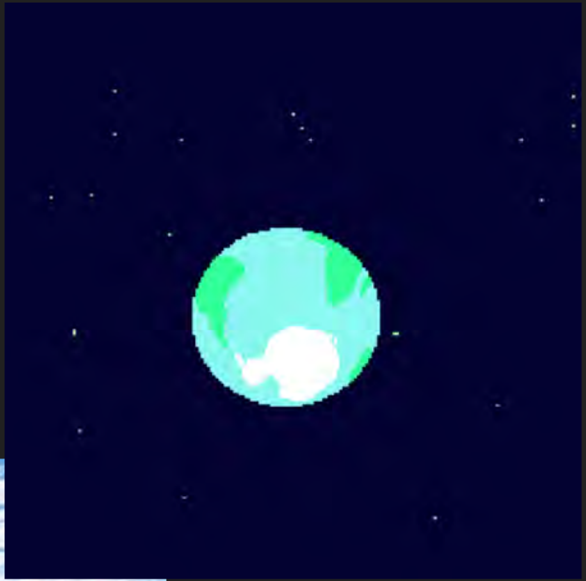
Baked Right into the Crust



By studying
what's left...

We can determine
how things were

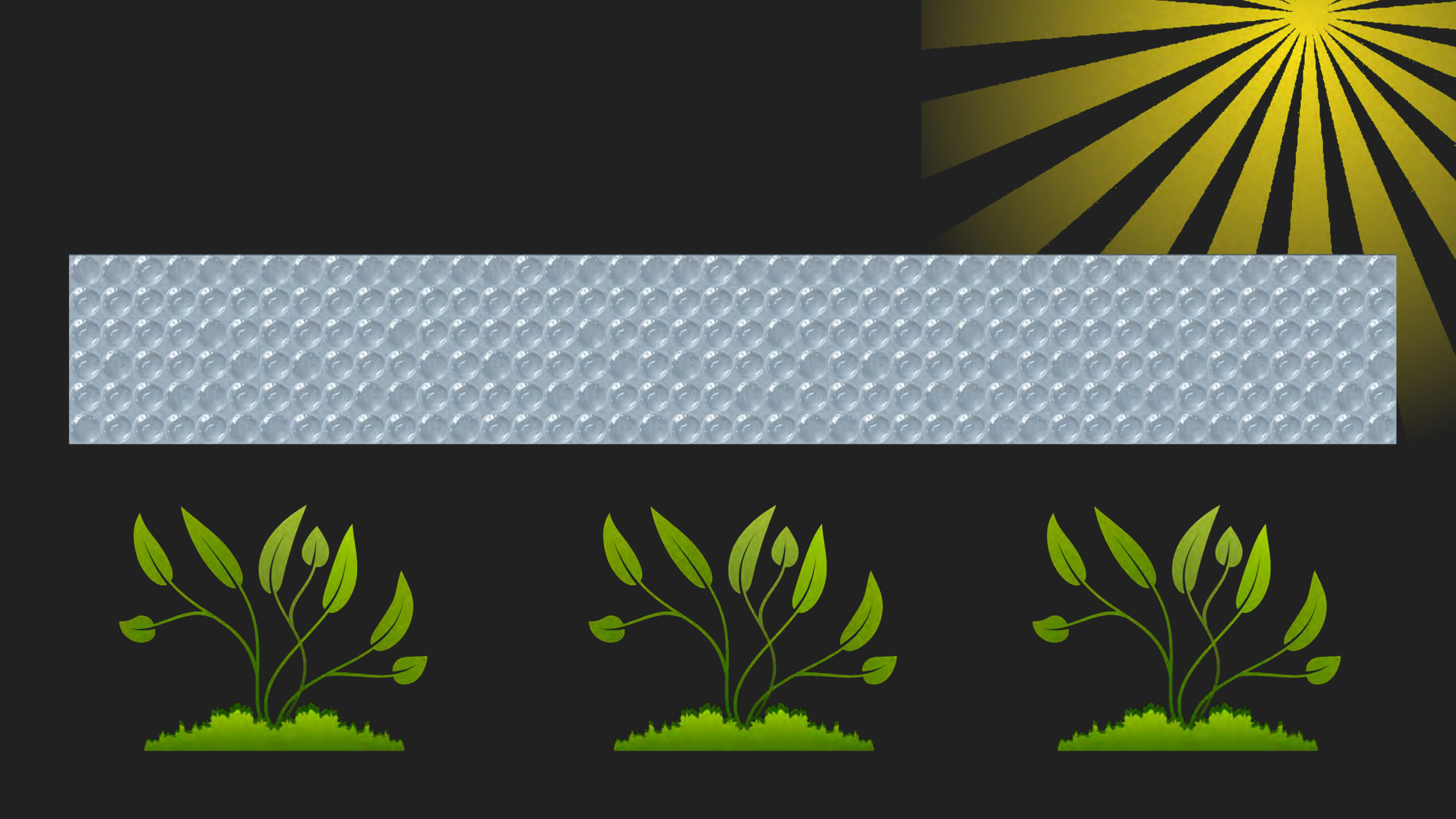




And what's
to come

A New Place to be Miserable

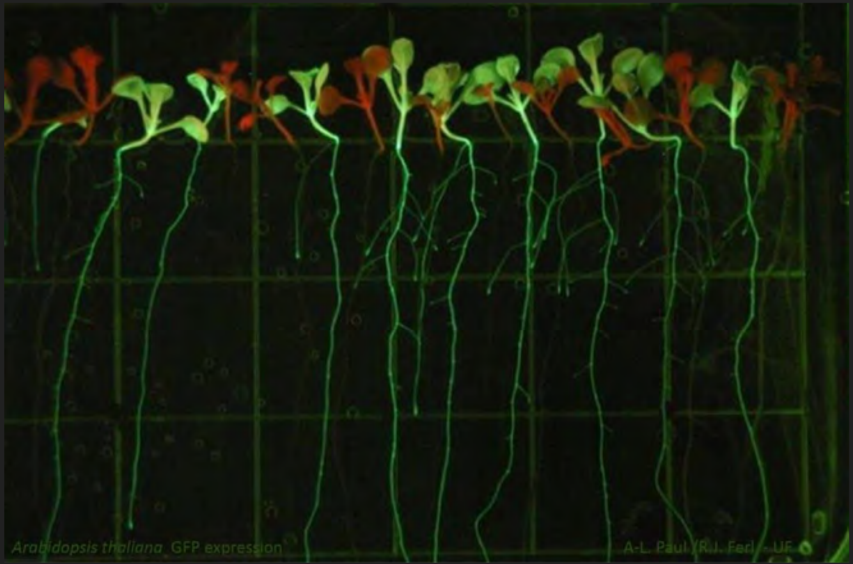
Do we need Martian settlements?



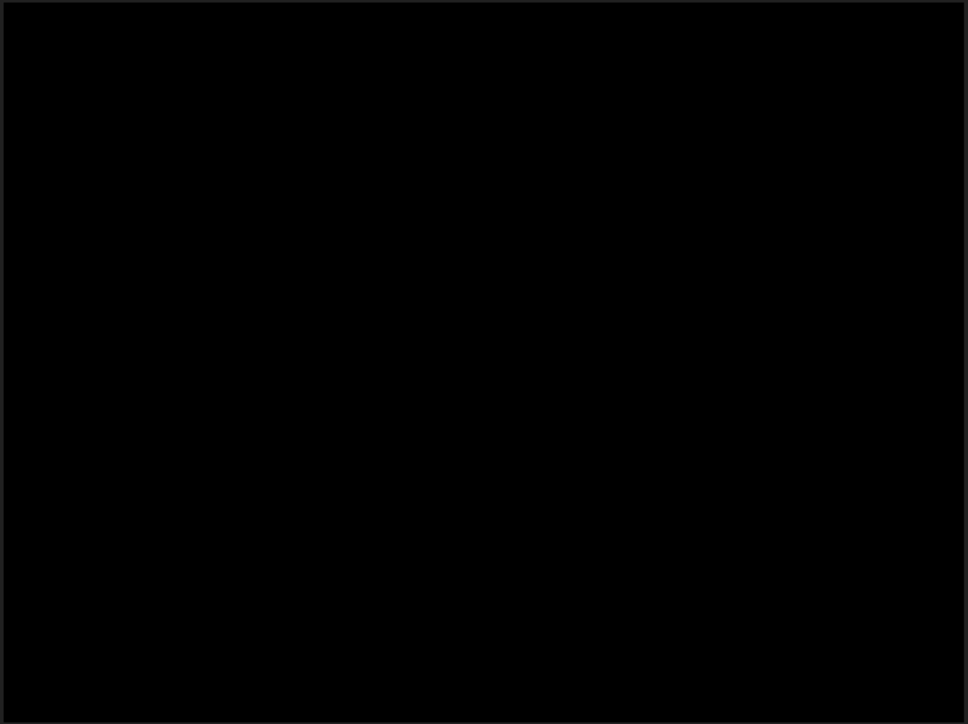
Certified Organic

Plants expressed certain genes differently in space.

Do we not understand their mechanisms well or do they have ways of dealing with space conditions?



What? STRAWBERRY is evolving!



Genetic mutations could quickly give us Martian versions of produce.

Terraforming!

Hardware Not Included

For a successful Mars mission, we need advancements in:

Recycling

Solar Energy

Sustainable Farming

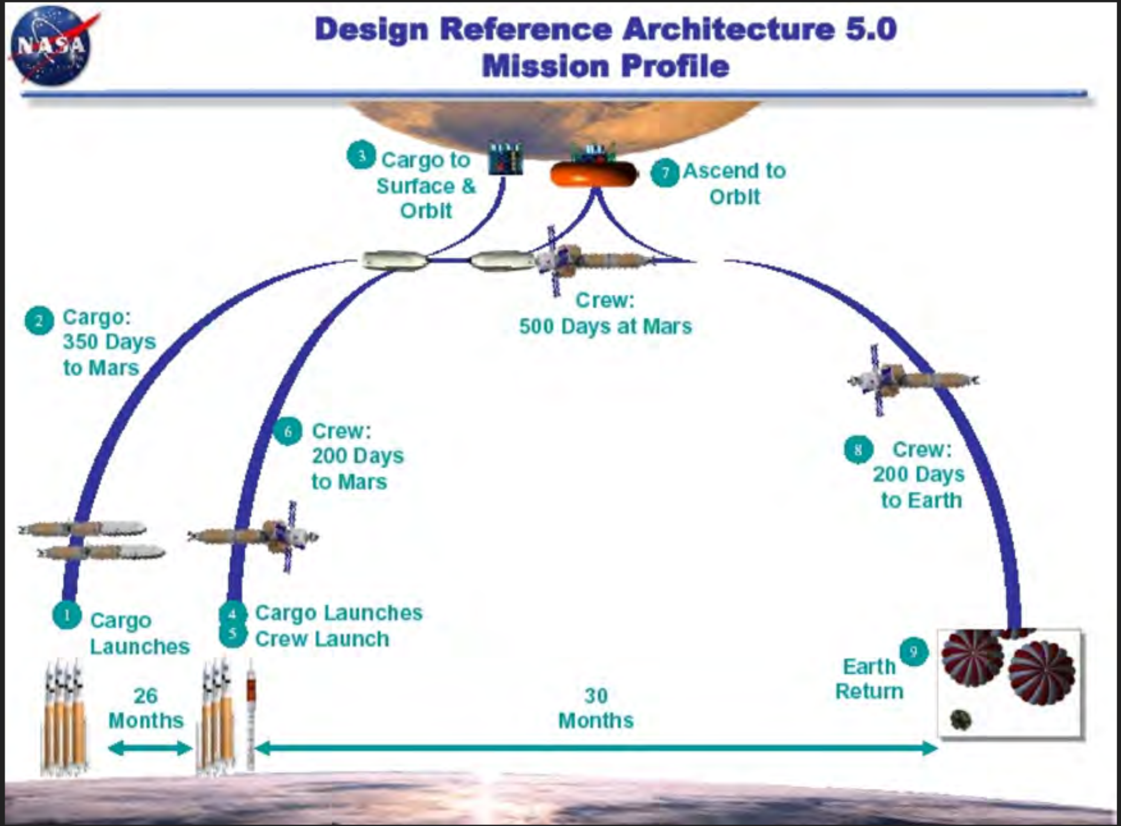
Going to Mars is Better for Earth

Mars Design Mission Architecture

- Mars is HARD! But not impossible
  - Orbital timing - only periodic launch windows
  - Conjunction vs. Opposition
    - Low Energy Long Stay, or High Energy Short Stay
  - Distance requires large Delta-V
    - Out of the well, into the well, out of the well, into the well

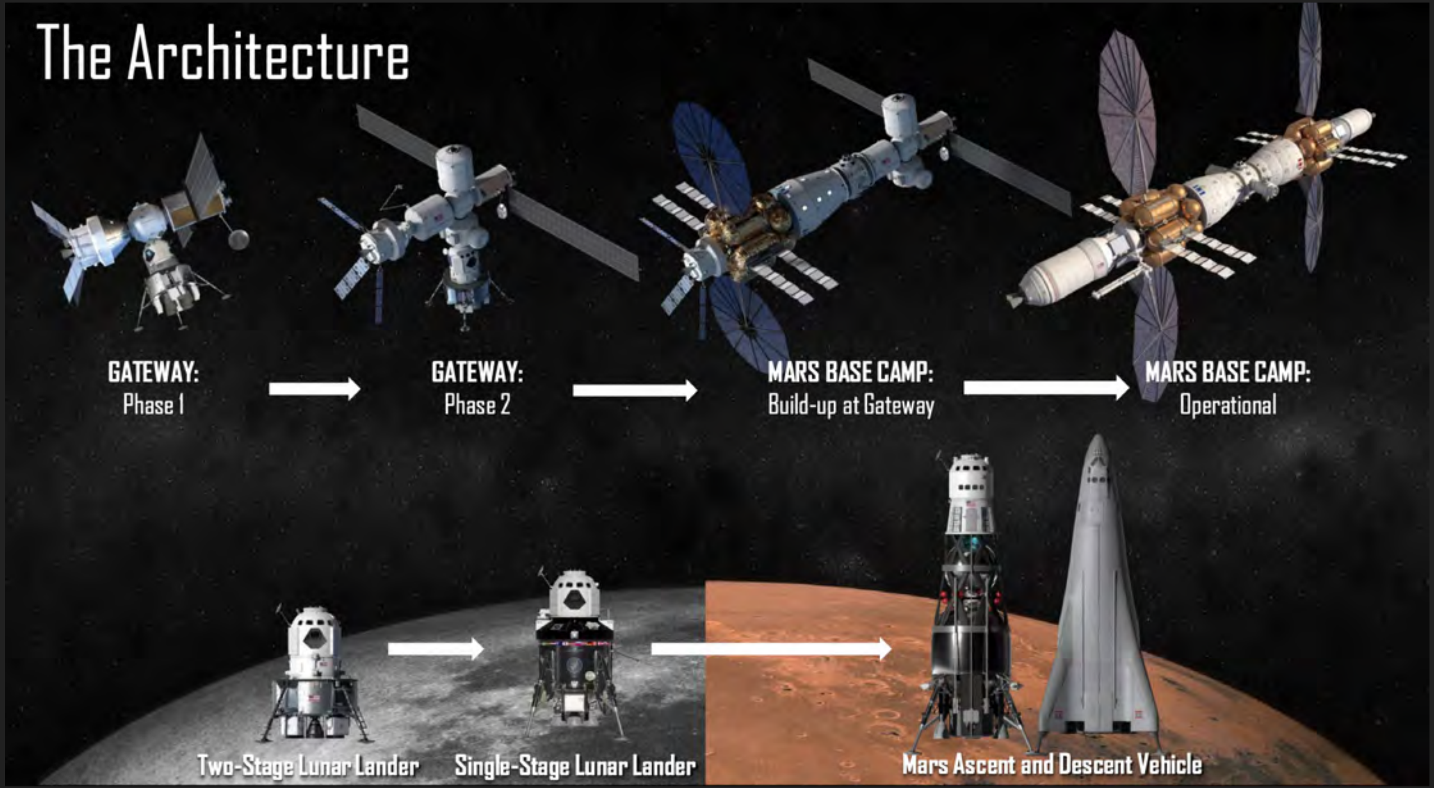
- Many different proposed architectures
  - NASA claims that the Lunar Gateway is necessary for Mars missions
  - Lockheed Martin wants to stage all necessary components
  - Mars Society believes we could go now with simple Mars Direct plan

NASA's Mars Design Mission Architecture



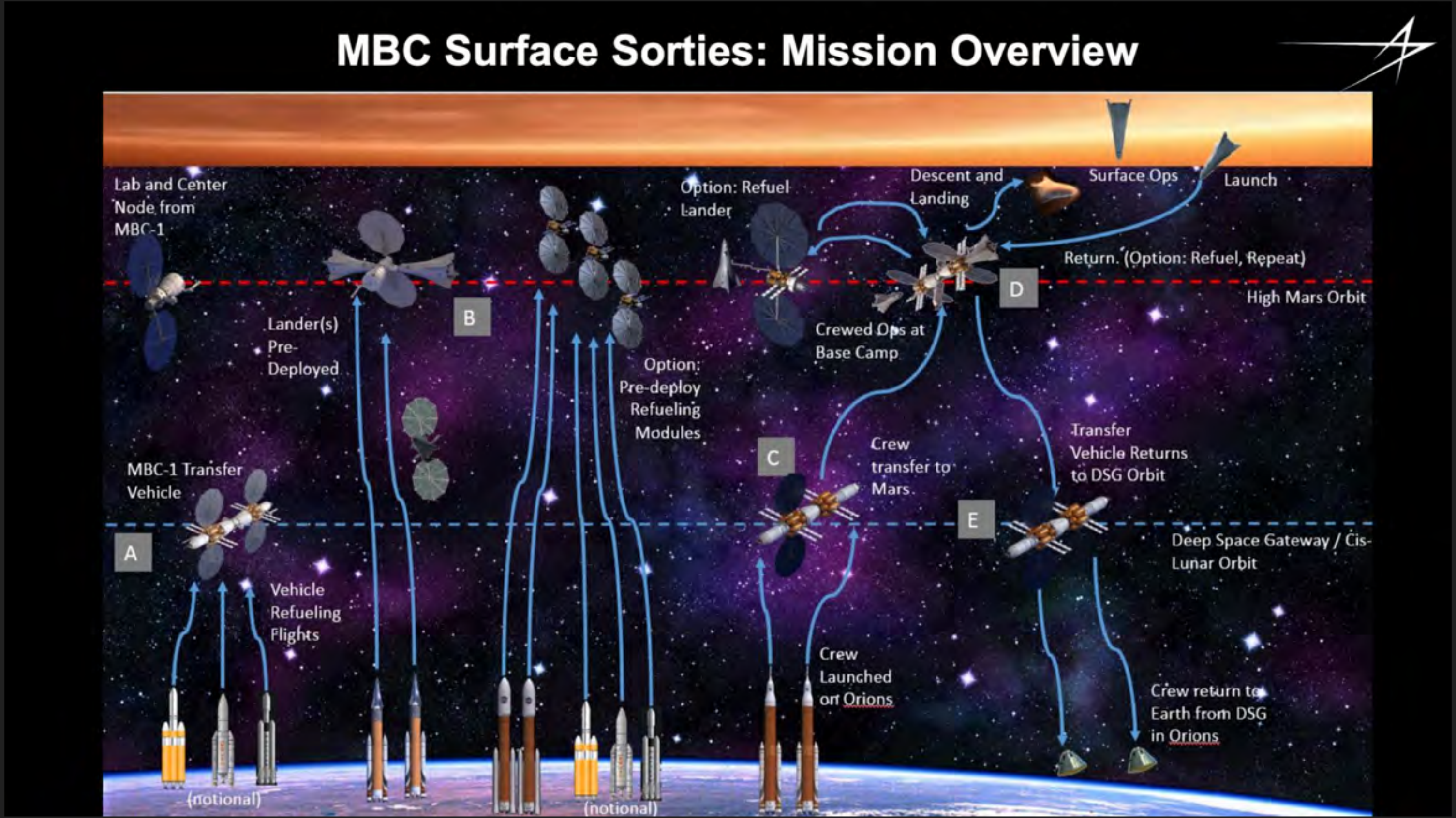
Human Exploration of Mars Design Reference Architecture 5.0 (NASA)

NASA's Mars Design Mission Architecture



(Jack Burns Presentation)

Lockheed Martin's Mars Design Mission Architecture



Crewed Missions to the Martian Surface via Mars Base Camp (Lockheed Martin)

Zubrin's Mars Direct Design Mission Architecture

Mars Direct:

- Do not need science fiction spaceships to go to Mars, Ruthless Minimalism
- In Situ propellant production allows the use of Saturn V class rocket to get to Mars
- Drop off ERV and Nuclear Reactor for methane and oxygen propellant production
- A more effective mission because of methane powered rover
- Use two ERV within one way driving distance of rover for added redundancy within range of the landing site of the next crew mission to Mars

Dr. Robert Zubrin

(Mars Society)

Zubrin’s Criticism of Other Architectures

On NASA’s Plan:

- It takes 10 meters of rope to tie together two posts 10 meters apart, but not if you’re trying to sell rope
- Same is happening with the Lunar Gateway. The Lunar “Toll Booth” is a vendor driven program and vendor driven programs will not get us to Mars.
- Don’t NEED a lunar base to go to Mars. Learn about going to Mars, by going to Mars..

On Lockheed’s Plan:

- The reason why we could go to the moon in the 60s and not the 90s is because in the 90s they wanted to use shuttle and stop at the ISS which added major complexities.
- Phobos Circular Equatorial Orbit restricts your operation
- Going to Phobos requires an extra 3.8 km/s deltaV than Mars does

Is Cis-Lunar Space A Hard Stop?

How Do We Progress to Mars and Beyond?

https://www.nasaspaceflight.com/2018/03/cislunar-station-new-name-presidents-budget/

How to Get to Mars? No More “Spam in a Can”

Budget/Time Crunch Workarounds = Innovation

Total Mercury	53h55’27”	(6 Flights)
Apollo 11	~192h	(1 Flight)
Mars Mission	~1.248E4h	(1 Flight)

http://www.bisbos.com/space_past_mercury.html

Human Bodies as Wet Engineering Challenges

Consider:

The Further We Move Beyond Cis-Lunar Space, the More Human Factors Make or Break an Expedition Architecture

What Are the Main Challenges?

IDEAS?

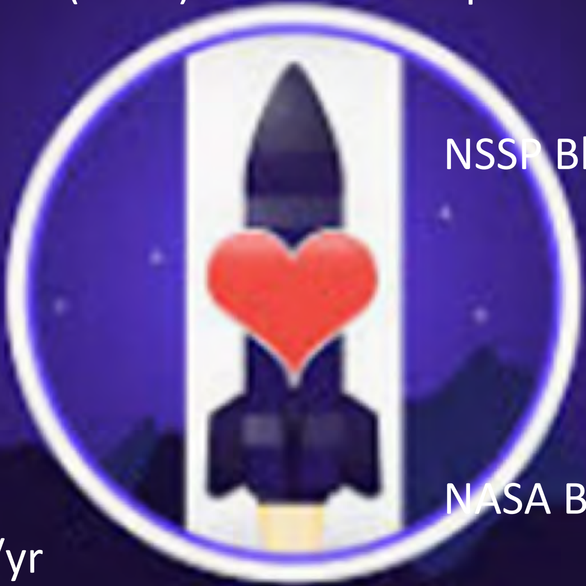
Dear Congress: “No Bucks, No Buck Rogers!”

Chinese Space Program (2016)
~12B/yr
NASA
~18.6 B/yr

Chinese Program
Opaque
Militarized
~67% US

NASA – Apollo ~80B/yr
(2019)

US NSSP



Space x Blows Up a Rocket:
“What a rebel!”

NSSP Blows Up a Rocket:
“What Rocket?”

NASA Blows Up a Rocket:
“What Budget?”

Radical Innovation In NASA Brings Economic Prosperity Through Revolution:

A New Generation, A New Paradigm

Highly Significant Projects (Civilization Disrupting) : $80 Direct /$1Inv.

[redacted]

Sustainable Profitability of Revolutionary Innovation

ABSTRACT

[redacted] million in annual budget which generates disproportionately positive direct and indirect economic impact[redacted] supports revolutionary innovation within NASA, leading future concepts and missions through pull-technology development are feasible and inherently necessary to the Nation, to NASA and to humanity. [redacted]ulfills this function. Success requires supporting TRL development from an alternate perspective [redacted]a [redacted]n, offering predictable success and highly profitable market return.

Draft Prepared for NASA

[redacted]

By Richard Archer

[redacted]

Dual Use Technology: Plowshare Initiative

GPS, Internet, Cell Phones, Lithium Batteries, Hubble, WST 50+ Year Redundant Tech

DARPA, CIA and NRO to NASA via MoA to Civilian Life

https://www.space.com/15892-hubble-space-telescope.html

Approximately -50yrs Behind NSSP

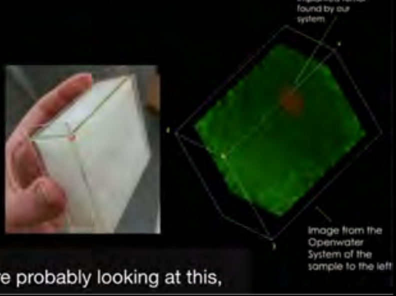
Horizon ~75yr – 100yr

- Project Starshot
  - Alpha-Centuri
    - Phillip Lubin
    - Sara Seager
    - NASA 100yr Plan
  - Recognizes Cybernetic Need
  - Recognizes Biomimicry Need
  - Recognizes AI/Nanotech Need

https://www.space.com/wfirst.html

NASA Has Been Accused of Becoming a Pork Barrel Job Mill Rather Than a Center of Innovation

A *New Generation* Is Rising Across the NASA Fence; Human Cybernetics



Openwater Technology, MIT, Mary Lou Jepsen,

NASA TRIAGE: Flexible Internal Sensors, Dagdeverin MIT, 2019

= Cybernetics/ Colonization Mars + at50 Year Horizon (TRIAGE)

Dava Newman (NASA/MIT) Biosuit

HZE Ionizing Radiation: A Daunting Barrier

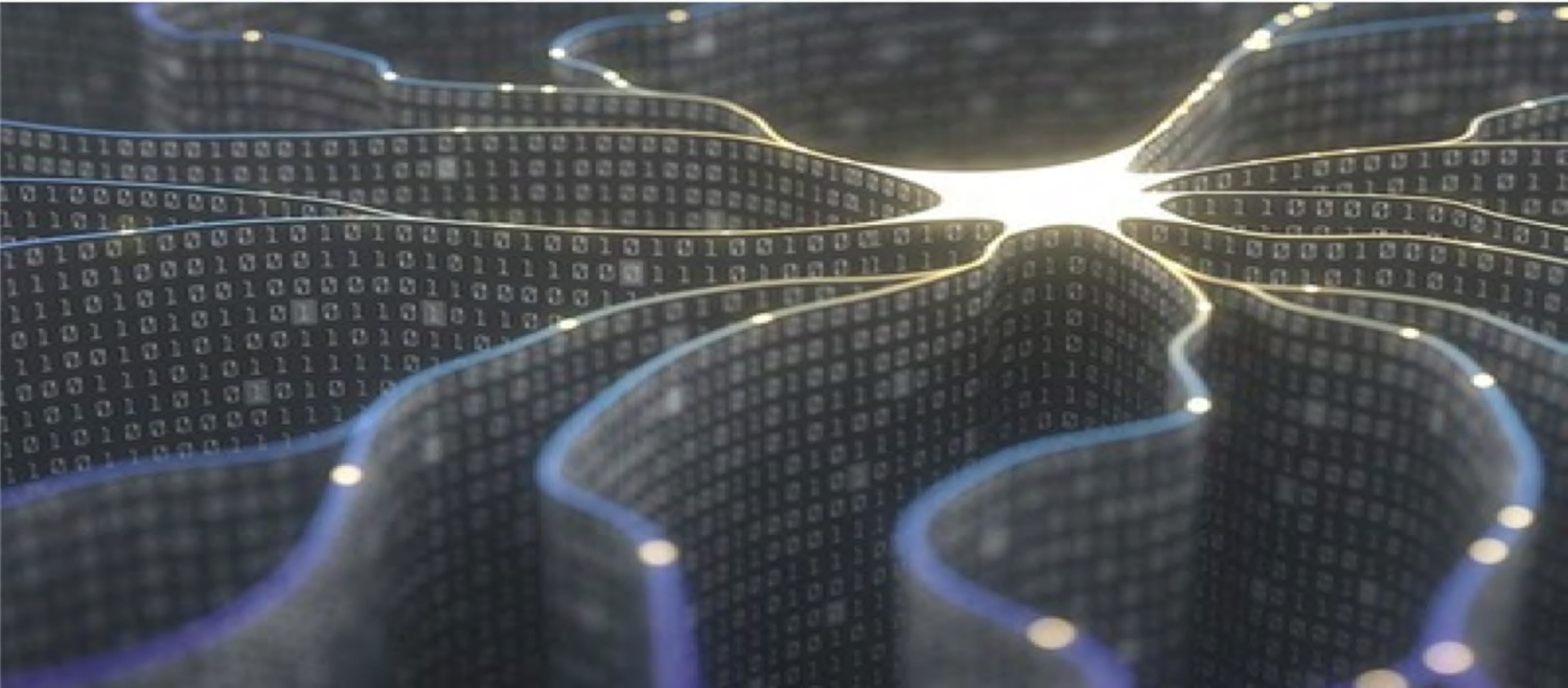
Dr. Zarana Patel
Current CO-I
Collaborating With MIT
Extremely Risk-Tolerant

TRIAGE AI
Human-Hab
Predictive
3rd Wave AI
NASA/TRISH/BRASH

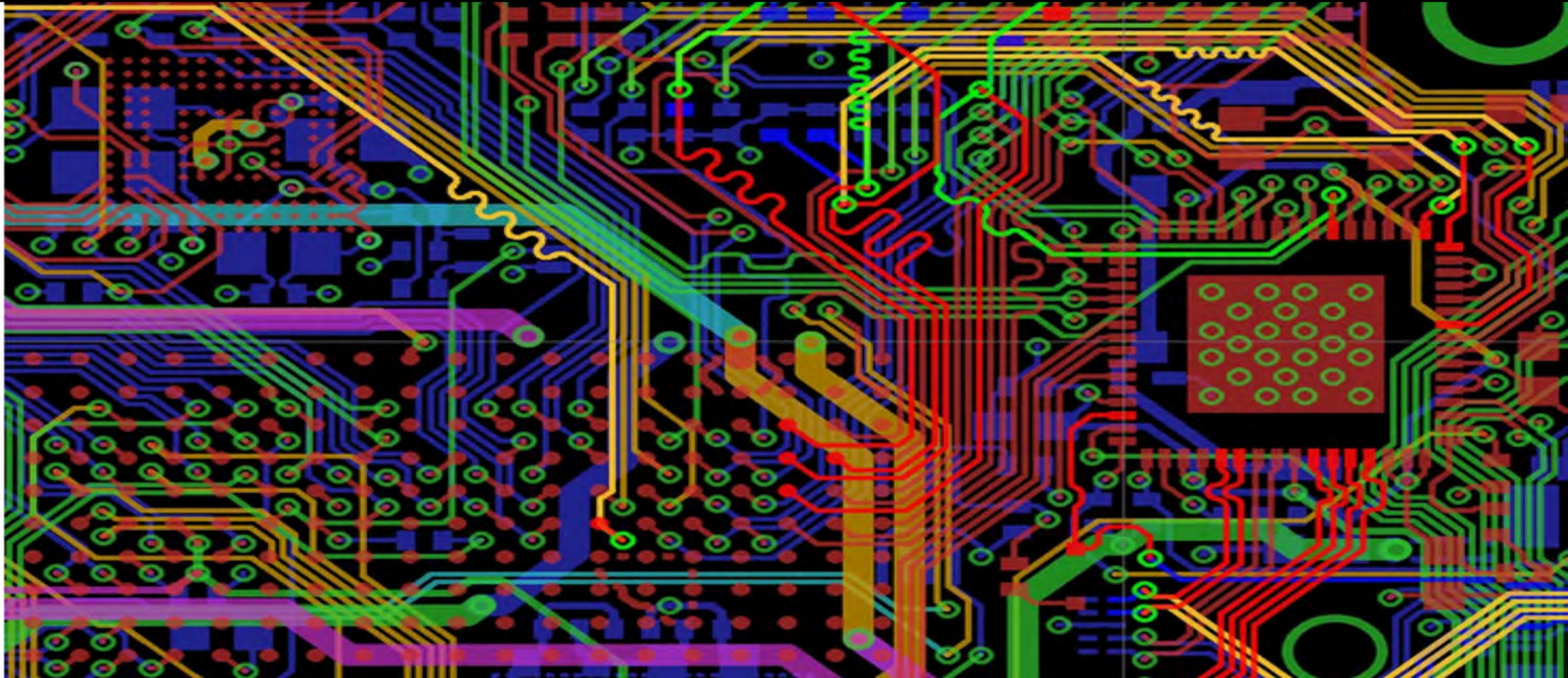
Dual Use Technology: Plowshare Initiative

NSSP � NASA � Civilians

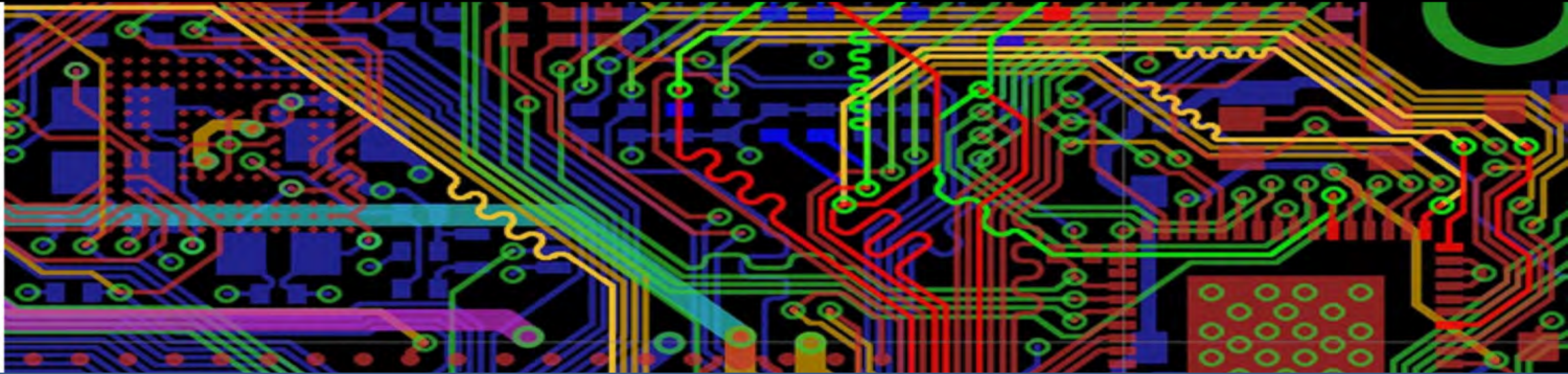
Predictive AI – Project Omnivore; Mud Creek, UT



AI Algorithms Not Always Optimized for Desired Human Scale Outcomes



AI Algorithms Not Always Optimized for Desired Human Scale Outcomes



User: "Give me an optimized board with a minimum threshold at 20%"
AI: Creates a new PCB with >20% increased efficiency in lab conditions, fails entirely in field.
Result: Investigation reveals that the machine built the PCB using resistance across a board with components not hard wired, but rather, circuit current induced proximal flow in components at a given temperature but not at another. Entire system shut down.
Take Home: A Human-like computer IS NOT a HUMAN! Don't assume that you understand

AI Algorithms Not Always Optimized for Desired Human Scale Outcomes

What are societal impacts of technology transfer as we attempt to overcome the leap beyond cis-lunar space?

Is AI, nanotech, cyber-enhancement, etc. predictable?

What if AI gets away from our control?

Positive consequences?

Negative consequences?

Is there another option? Low cost?

AI Algorithms Not Always Optimized for Desired Human Scale Outcomes

"LAPD Now Recruiting New Officers: Google AI Breitbart
LAPD Unhappy With Image." NPR 1OCT19

Health and Human Performance: The Zubrin Solution

NASA wants a lunar base and they site large technological obstacles for Mars:

- Advanced propulsion and power needed to reduce transit time
    - CONFINED ENVIRONMENT - Do not need extra habitable volume on a long trip, surplus crew accommodations is unnecessary
    - MICROGRAVITY - Tether with Upper Stage and spin up to create artificial gravity and counter microgravity problems
    - RADIATION - Storm shelter for SPEs only needs 6 inches of water protection, radiation exposure is a SNOW DAY EXCUSE, imposing same risk to crew aboard the space station without going anywhere..

“The proper role of an astronaut is to explore, the ISS has reduced the role of the astronauts to guinea pigs instead of explorers.“

Government: “Crewed missions to Mars?”

Me:

Yeah, about that...

- Rome was not built in a day, nor did humans reach the moon in one term.
- If this is going to happen, we need to COMMIT.
- Human spaceflight can NOT be treated as a political pissing match.
- Spaceflight. Needs. Money.

Who owns space?

- Probably not Elon Musk.
- According to the Outer Space Treaty, nobody can own anything up there.
- E.g., Elon Musk can’t have a privately owned Mars colony.
- Neither can Donald Trump, at least for now.
- Does he care? Does Putin care? Should you care?

Who’s going to get us there?

- Private industry or government programs?
  - Potential resources vs. long-term stability?
- Single entities or big collaborations?
  - What if one party pulls out halfway through?
- Realistic budgets and deadlines.

What if something goes wrong out there?

- Moon missions can do a direct abort. Mars missions can't.
- Months to get there, months to get back.
- Who takes responsibility if something breaks or someone dies?
- Preparedness and cooperation in the event of a disaster.

Credits and References - The Psience

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