

Considerations on life support systems for interstellar travel: a regenerative story

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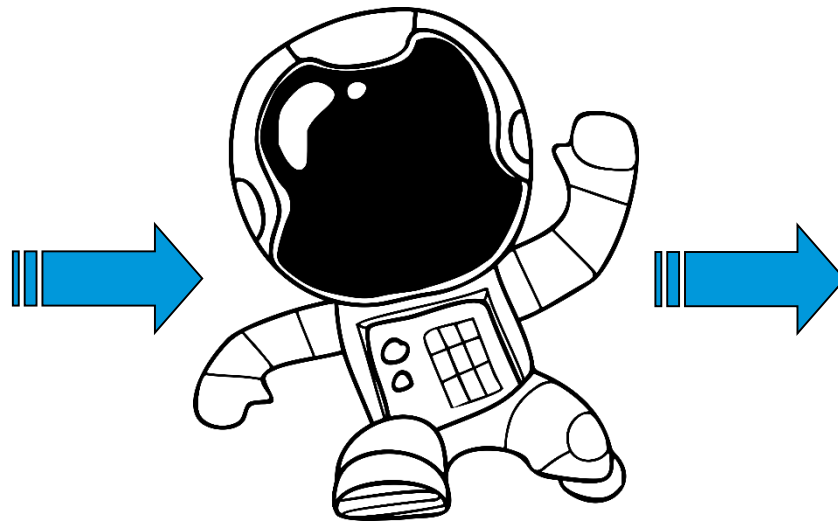
The basics

Inputs:

O₂

Water

Food



Outputs:

Urine

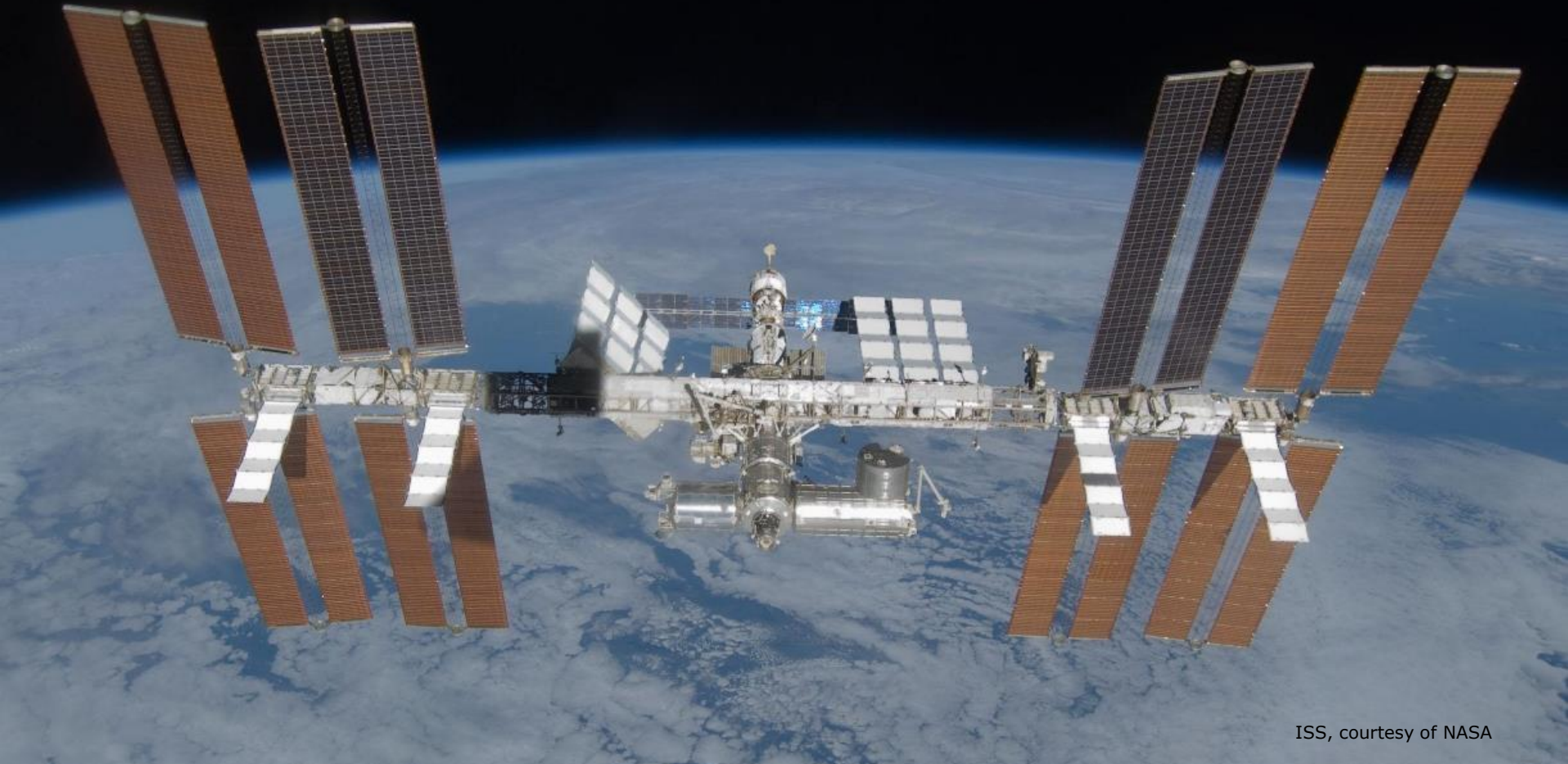
Feces

CO₂

Transpiration

Contaminants

Current system - ISS



ISS, courtesy of NASA

Current systems (ISS)

- ATMOSPHERE
 - Carbon Dioxide Scrubber (zeolites) [CDRA, Vozduck]
 - Oxygen Generation (water electrolysis) [OGA, Elektron]
 - Sabatier reactor ($\text{CO}_2 + \text{H}_2 \rightarrow \text{O}_2 + \text{CH}_4$) [CReA]
 - Trace Contaminants Control System



CDRA, courtesy of NASA



Elektron, courtesy of NASA

Current systems (ISS)

- WATER
 - Urine Processor Assembly
 - Water Processor Assembly
- FOOD
 - Small Growth Chambers [Veggie, APH]



WRS and OGA,
courtesy of NASA



Veggie, courtesy of Oleg Artemyev



APH, courtesy of NASA

Future Development



- Upgrades/Improvement of current systems
 - Brine Processing
 - Hydrogen recovery (methane pyrolysis, Bosch reaction)
 - TCCS via Photocatalysis
- Bioregenerative Systems
 - BIOS-3, Biosphere2 & CEEF in the past
 - Lunar Palace and MELiSSA today

Bioregenerative Systems – Closed Systems



Courtesy of Krasnoyarsk Academgorodok

Model of the BIOS-3 project

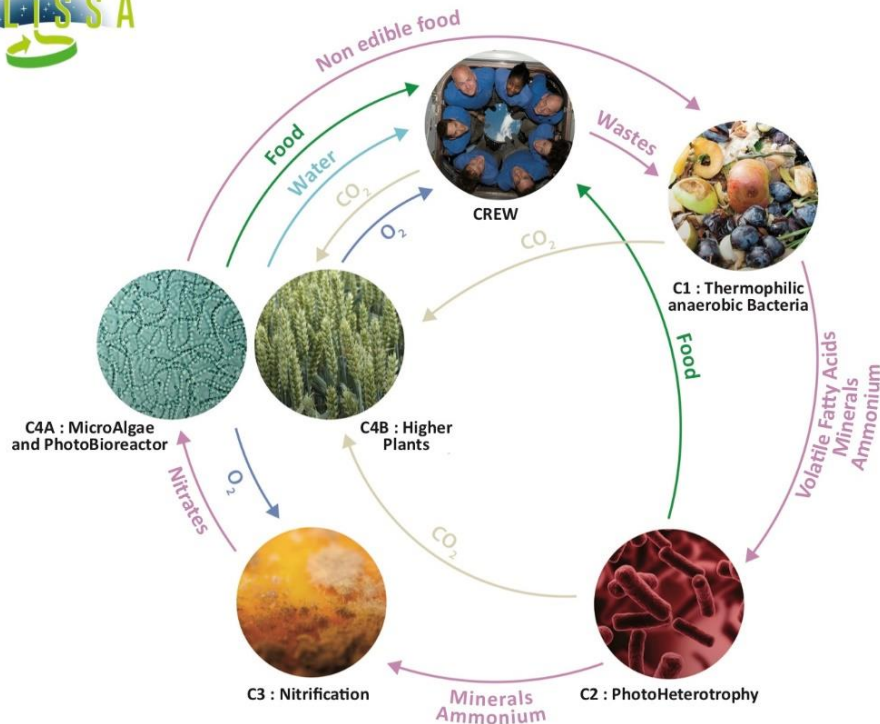
Aerial picture of Biosphere-2

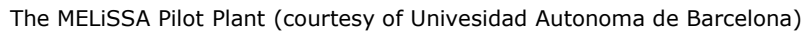


Courtesy of University of Arizona

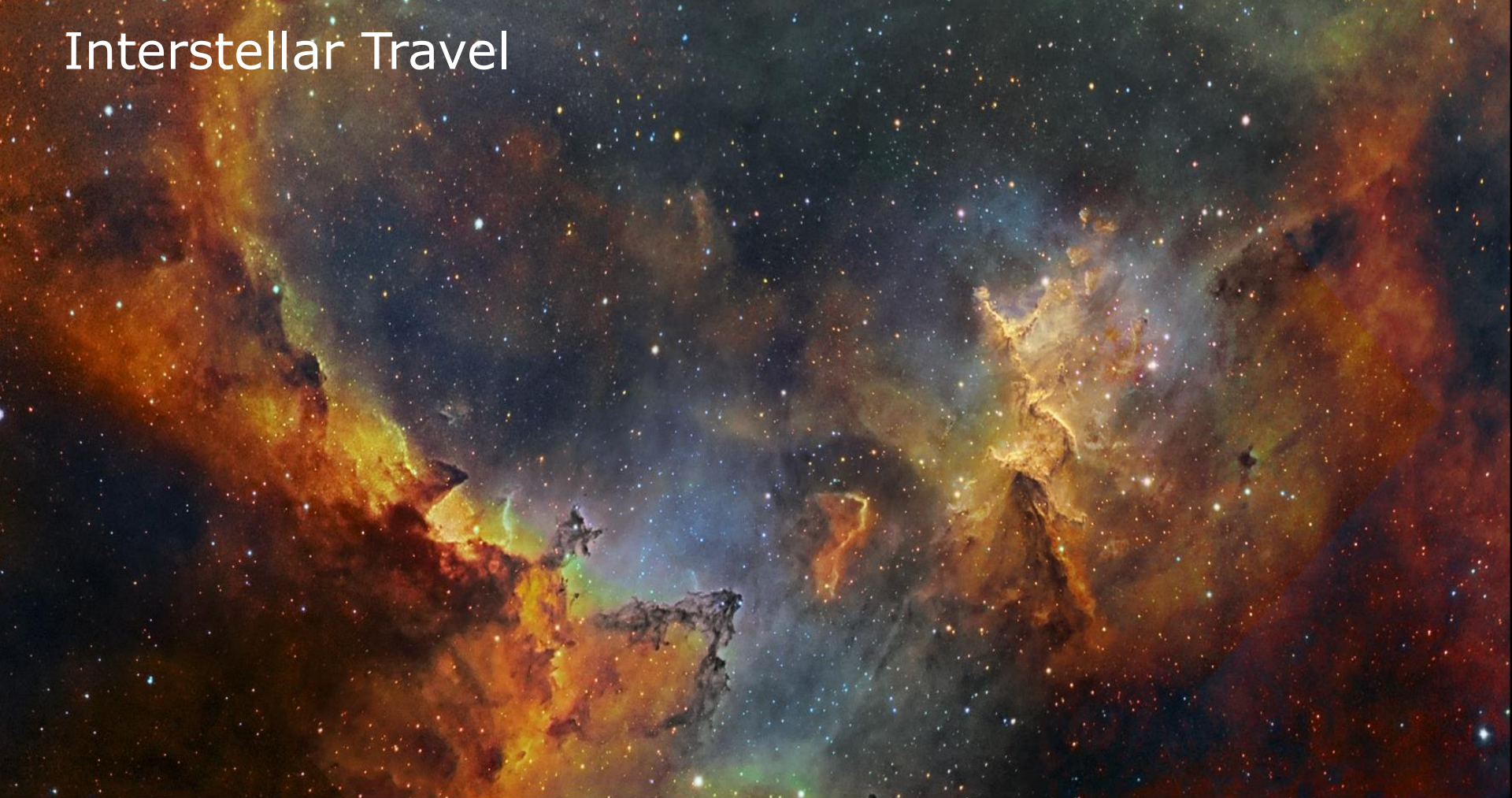
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The MELiSSA Project





Interstellar Travel



Interstellar travel – a matter of patience



Closest stars: $\sim 10 - 100$ ly (light-year)

Maximum speed: ~ 0.1 c

(30 000 km/s, 2000x
Voyager max speed)



Total journey: $\sim 100 - 1000$ years!

Hibernation



Courtesy of Lucasfilm and 20th Century Fox



Generation ship



It's all a matter of size

- 100 y travel
- 10 000 people
- Consumables (Kg/d/cm):
 - 5 metabolic
 - 10 hygiene
- 99.9% closure



5 500 ton lost!!!



Courtesy of Lucasfilm

Life Support, in a broader sense

We also have to consider:

- Diet
- Power
- Psychological wellbeing

Last, but not the least:

- Knowledge Preservation
- Legislation
- Society organization
- ...

Conclusion



Courtesy of Crytek

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Thanks for your time!

Any question?