



# Virtual Technologies for Extreme Environment Effect Mitigation

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# Introduction

**In the next 25 years we can expect that:**

- ◆ **human beings presence in various extreme environments like Moon or even Mars.**
- ◆ **new Virtual Reality (VR) applications available to augment our capabilities in areas ranging from entertainment to medicine and engineering**
- ◆ **VR or AR (Augmented Reality) employed where the human being is facing highly demanding challenges.**

# Related Main Mission Characteristics

## Present Habitation Facilities:

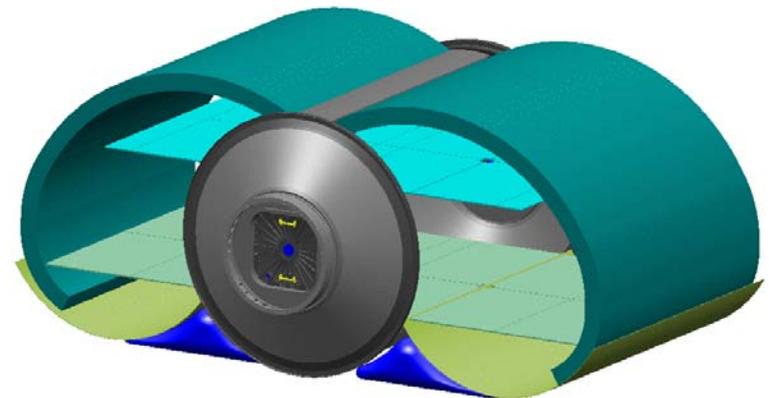
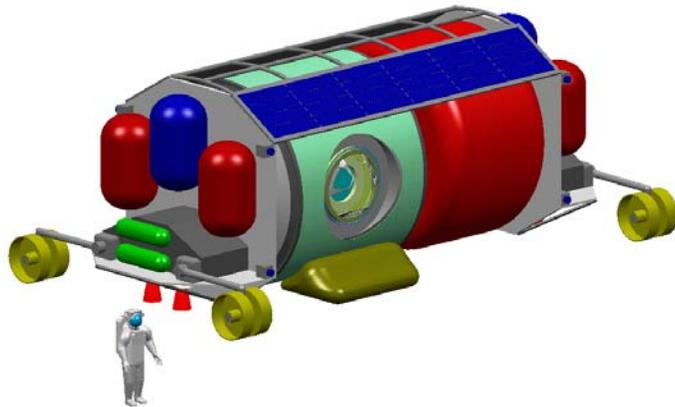
- ◆ Typical ISS module is providing 28 m<sup>3</sup> of habitable volume



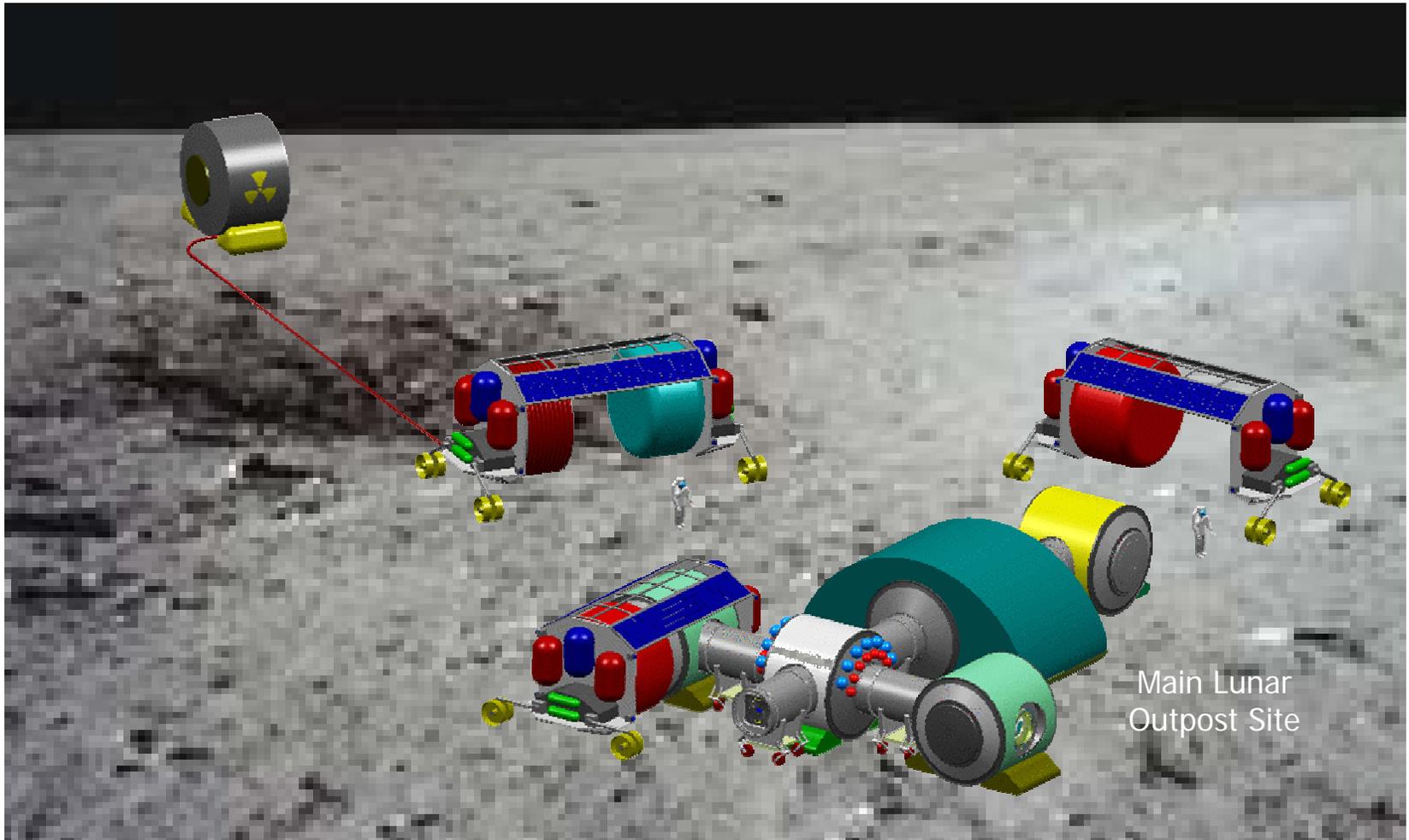
# Related Main Mission Characteristics

## Future Habitation Facilities:

- ◆ Crew Exploration Vehicle (CEV) plus Mission Module approx. 14 m<sup>3</sup> net volume available for the crew
- ◆ Up to 200 m<sup>3</sup> gross volume available for the crew for habitability and working areas. This volume may be increased with an additional logistic cargo module that can be connected to the main habitation and laboratory module.



# Lunar Outpost – Preliminary Pictorial view



Main Lunar  
Outpost Site

# Identification of the Problem

- ◆ **Future Moon and Mars human exploration missions foresee a series of long missions with one year permanence on Moon surface and three years missions to Mars.**
- ◆ **VR/AR techniques employed to augment crew capability in controlling the overall system, robots and handling communications.**
- ◆ **VR/AR based training techniques used both on ground and in orbit.**



# Some issues & Possible role of VR

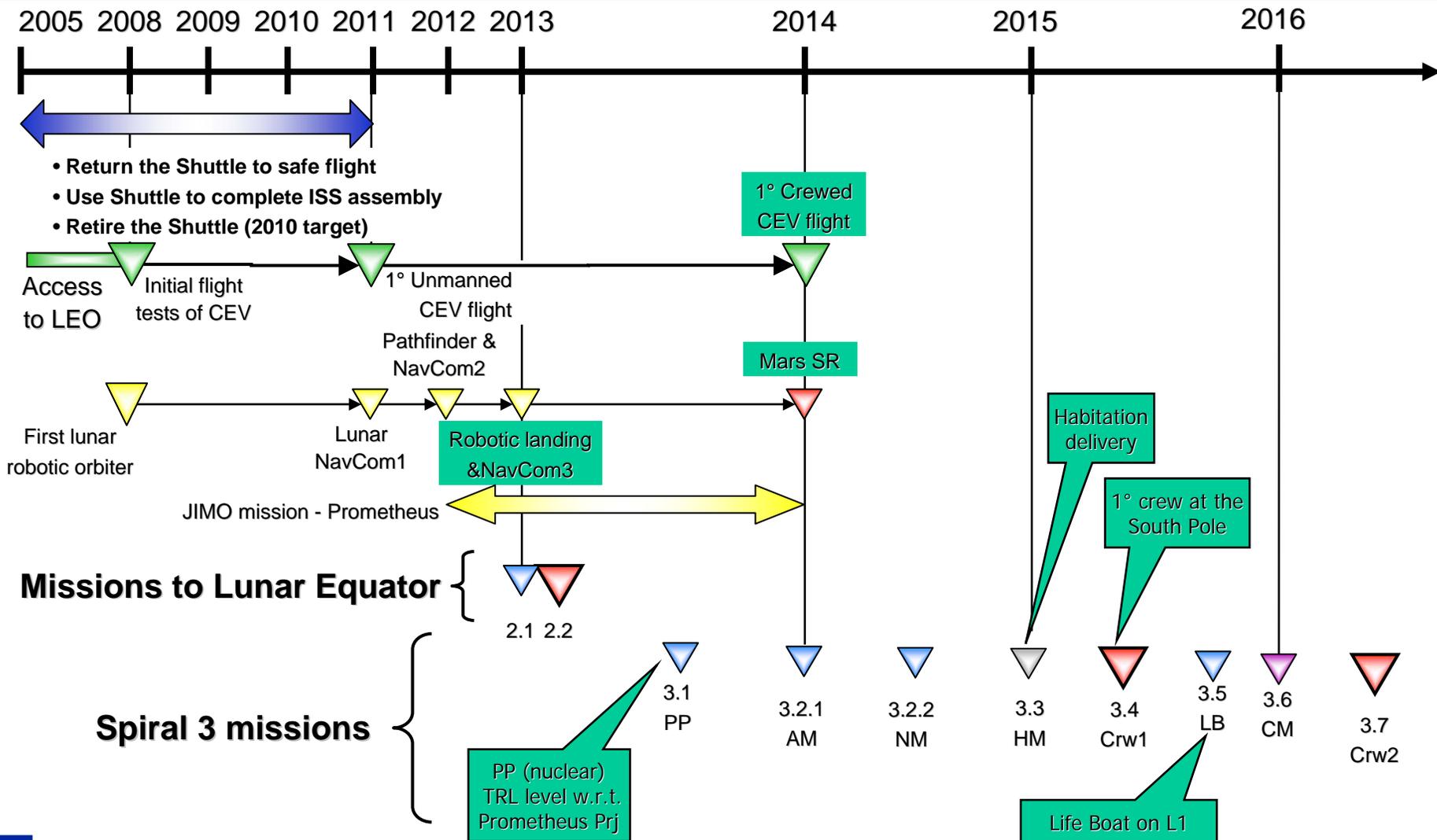
- ◆ **Communications – time lag**
- ◆ **Safety & Isolation – from several days to months**
- ◆ **Group dynamics and roles of each astronaut**

**VR/AR can provide a platform for applications to improve communications, to reduce the isolation impacts, and to improve safety by supporting procedures and on-board training**

**VR/AR may be employed in maintenance of crew's psychical well-being and in maintaining team's positive attitude and cohesion.**

**VR/AR must be an integrated systems**

# Lunar Exploration timeline (until base assembly and activation completed)



# Discussion

- ◆ **Private experiences vs. common experience - How can the group dynamics be supported?**
- ◆ **Communication system: How to overcome the time lag constraint maintaining a level of “quality” and “effectiveness” in communication?**
- ◆ **How and when can VR/AR be used to support the Crew’s Psychological Health?**
- ◆ **How can the psychological well-being of the singular member and of the group be monitored?**
- ◆ **VR/AR are used for training as well as to provide information and control capability but can VR/AR be exploited to the level required without overloading the human being?**
- ◆ **New interfaces are being developed including the BCI: how can these be used without violating ethical rules?**

# Conclusion

- ◆ **Extreme environments can be used as technological trend identification and then can become valid test beds for research and development of new techniques**
- ◆ **User centred approach is more and more needed in order not to be overcome by the technological concentration**



Thank you