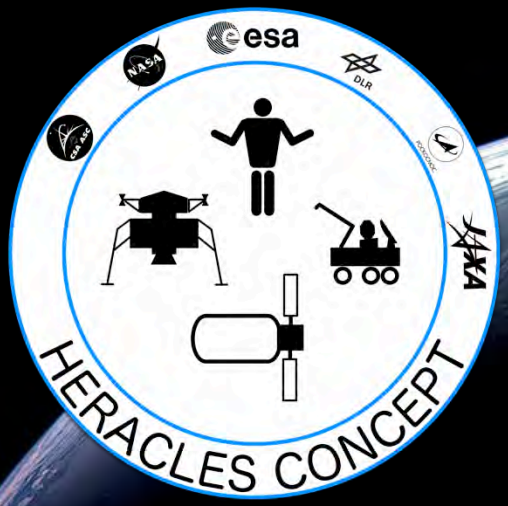

HERACLES CONCEPT – AN INTERNATIONAL LUNAR EXPLORATION ARCHITECTURE STUDY

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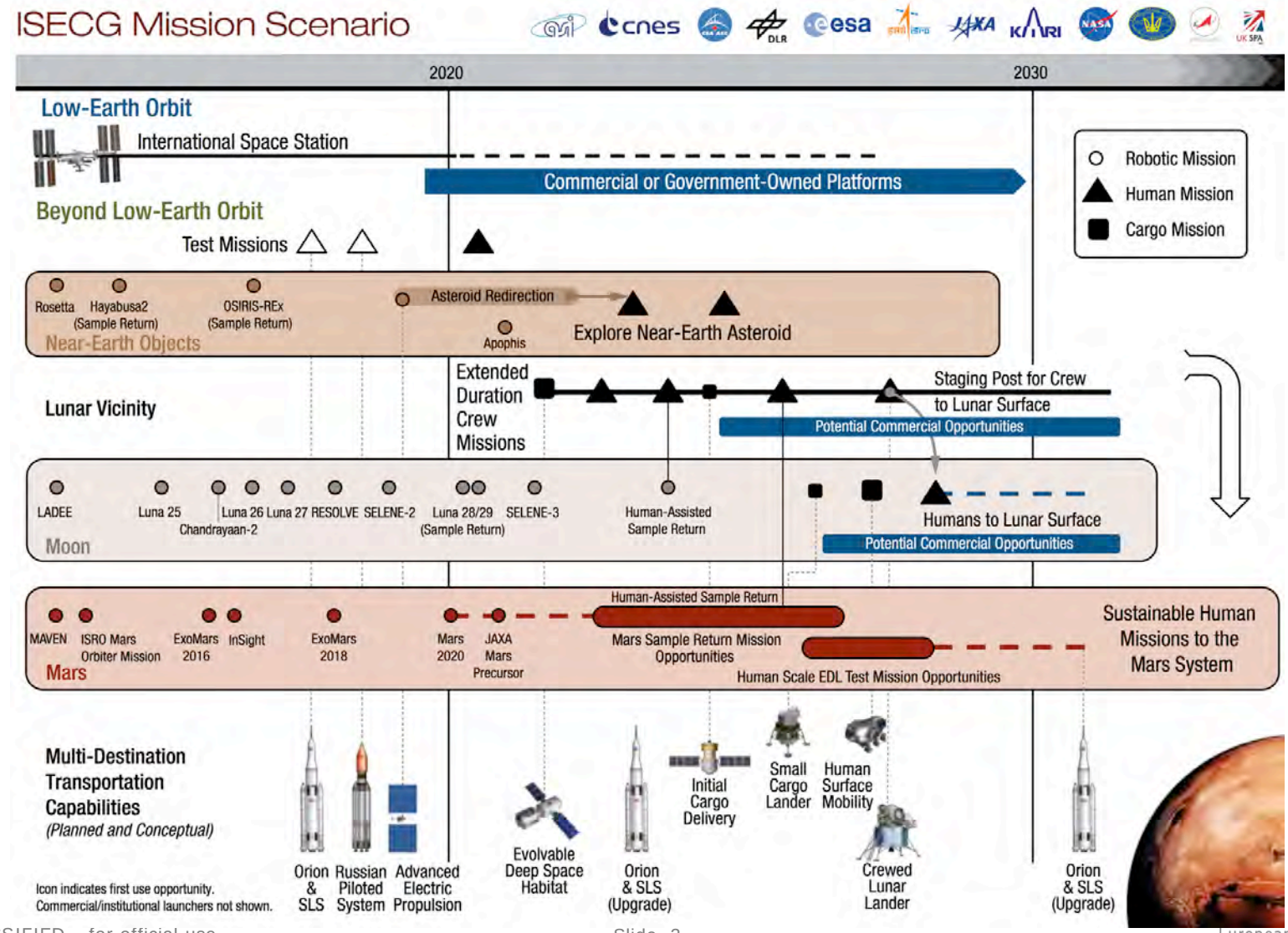
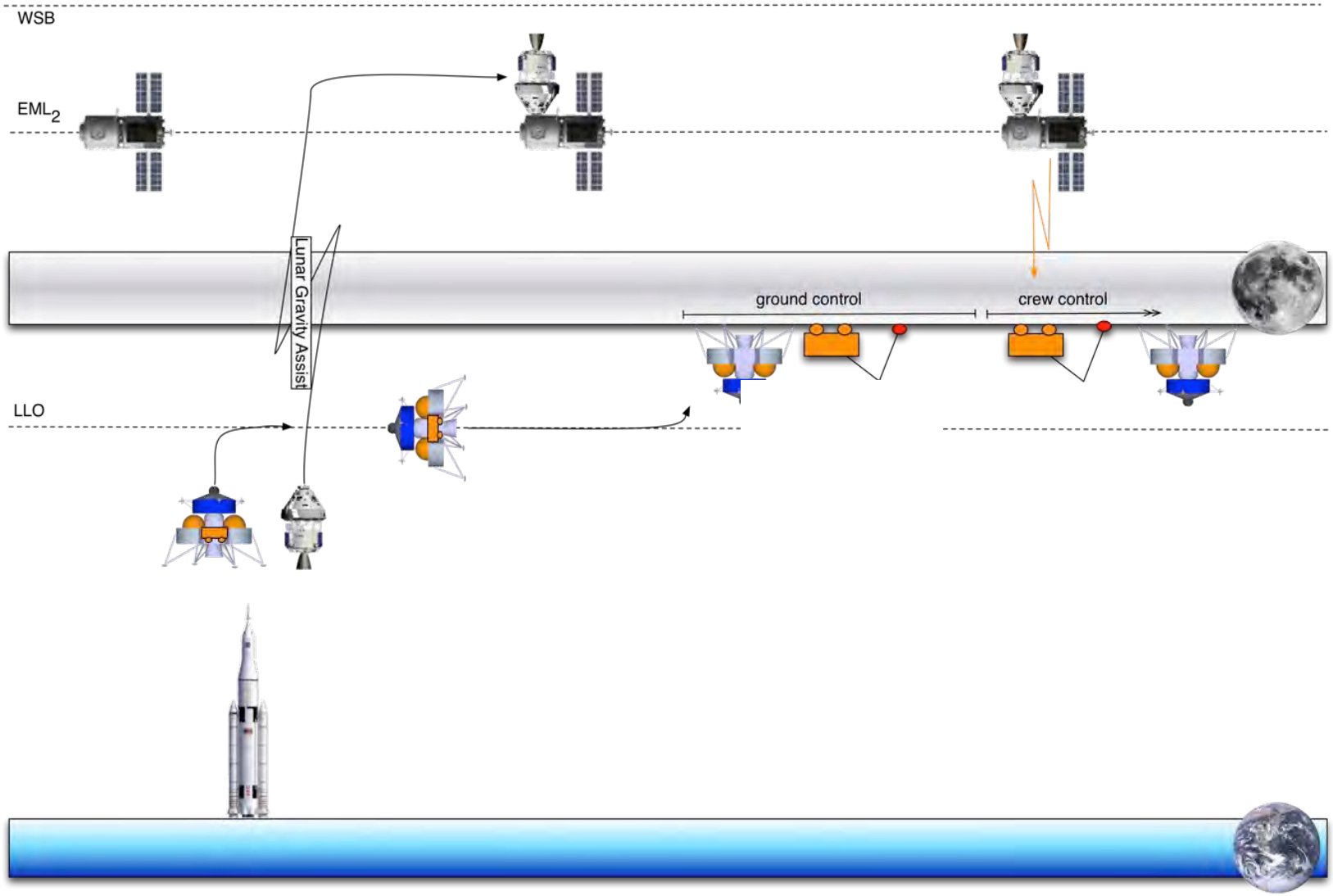
SCIENCE OPPORTUNITIES IN THE FRAME OF HUMAN-ROBOTIC LUNAR EXPLORATION

- In the frame of and coordinated by ISECG, ESA leads a study ("HERACLES") to assess the benefits of a human-robotic lunar exploration mission in the mid-2020s
- Full coordination of science objectives with the community is required
- Content: Context, Architecture scenario, capabilities, surface campaign, volatiles, role of human spaceflight infrastructure, conclusions
- Objective: advance coordination of near-term exploration goals between communities and agencies

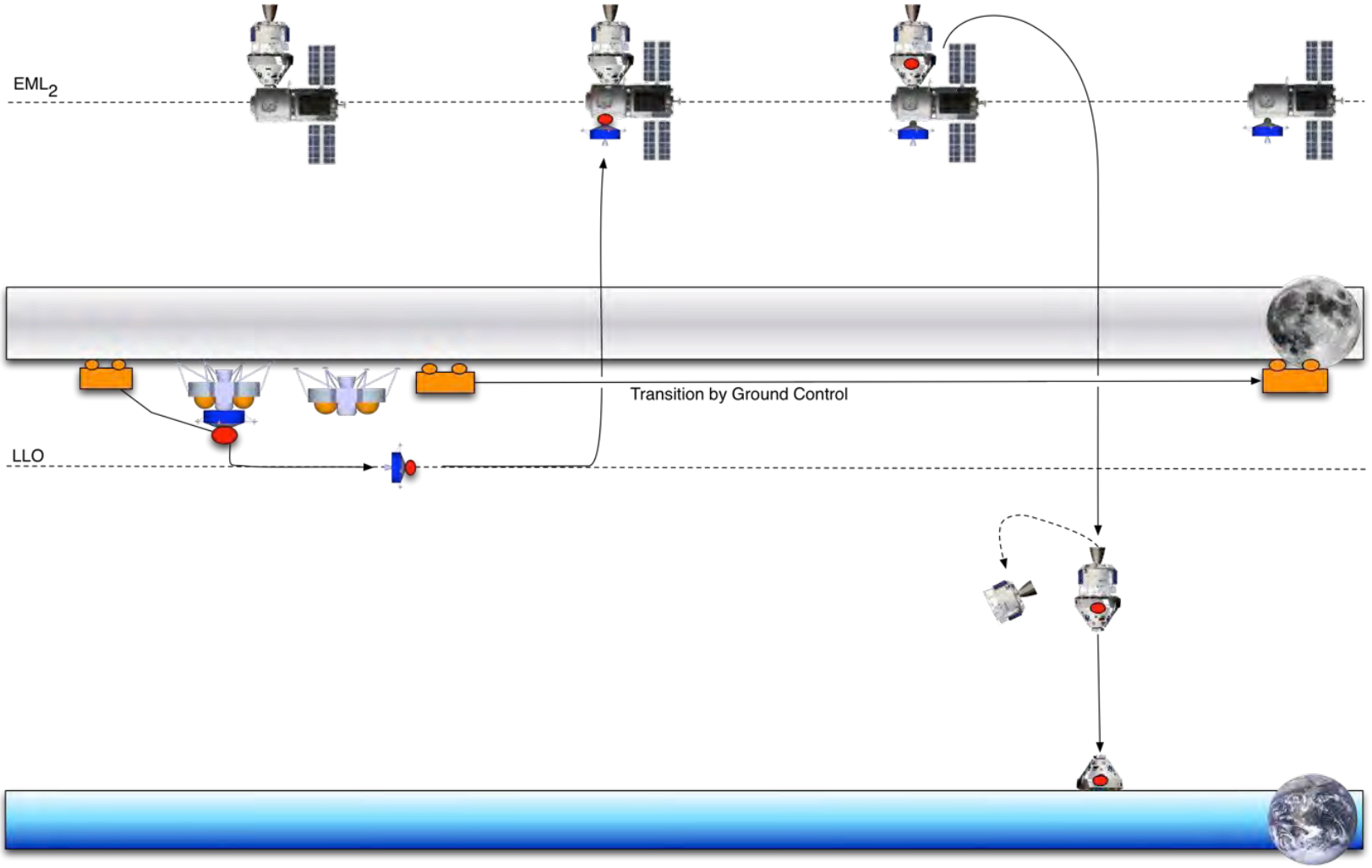
HERACLES IN THE GLOBAL EXPLORATION ROADMAP



Mission Scenario – Launch to Sampling Complete

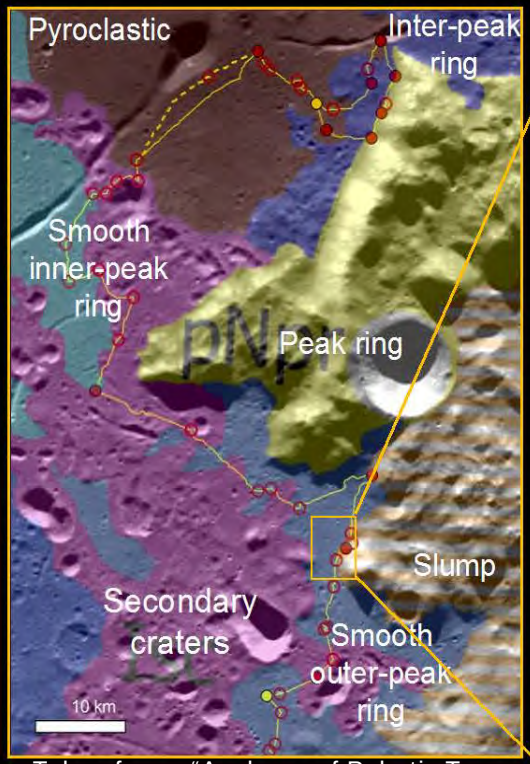


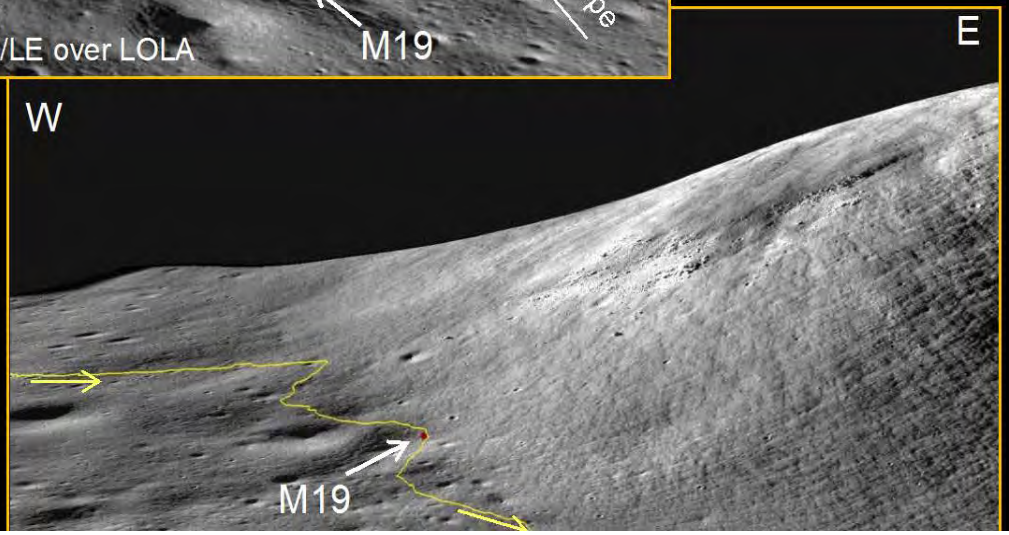
Mission Scenario – Moon Departure to Earth Return



Item	Mass [kg]
Ascent stage	620
Descent stage	1442
Rover	505
Sample container	22
Ascent propellant	1564
Descent propellant	5196
total	9349

TESTING THE CAPABILITIES IN A SCHRÖDINGER TRAVERSE





Taken from: "Analyses of Robotic Traverses and Sample Sites for the HERACLES Human-Assisted Sample Return Mission Concept" by the
2015 Exploration Science Summer Interns:
Abigail Calzada-Diaz, Dayl Martin, Francesca McDonald, Sean O'Hara, Sarinya Paisarnsombat, Edgar Steenstra, Christian Venturino
Boeing Interns:
Mark Leader, Shelby Bottoms
Advisors: David Kring, Kurt Klaus

INTEGRATING RESOURCE UTILISATION INTO A HUMAN ARCHITECTURE

- Inspiration: first “drink of non-Earth water”
- What comes after characterisation phase?
- Is there a role of a HERACLES-type architecture in this?
- How could an “interface” to a human architecture look like?

THE ALTERNATIVES AND THE ROLE OF HSF INFRASTRUCTURE

- Today there are considerations of various bilateral or domestic lunar sample return missions
- Given the need for international cooperation in exploration there is an opportunity for considering a common capability for preparing human missions and providing high-quality sample return
- Such an architecture **relies** on functional support by the human spaceflight infrastructure (cis-lunar habitat) **in a critical way**
- It is thus important to support agencies in understanding the value of this functional support being built into the human spaceflight infrastructure

CONCLUSION

- One possible option for lunar exploration for the mid-2020s is a coordinated multi-lateral human precursor and sample return architecture
- An on-going study has confirmed the claimed capabilities utilising human spaceflight infrastructure
- There are open questions remaining
    - Sub-system level feasibility
    - Distribution of roles of crew and ground
    - Assignment of functions to architecture elements
- There is significant flexibility in the architecture
    - Launch mode
    - Resupply logistics
    - Landing sites
- A cross-community (HSF – planetology) effort is needed to advance both in agency programmatics as well as in community involvement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THANK YOU !
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