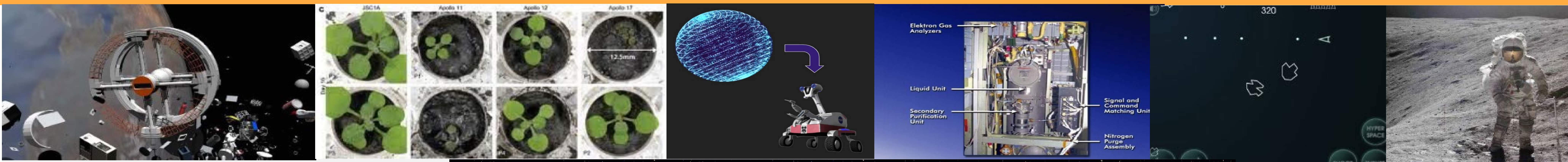


Developing a Multi-Agent Teaming Testbed for Space Operations at the U.S. Air Force Academy (USAFA)

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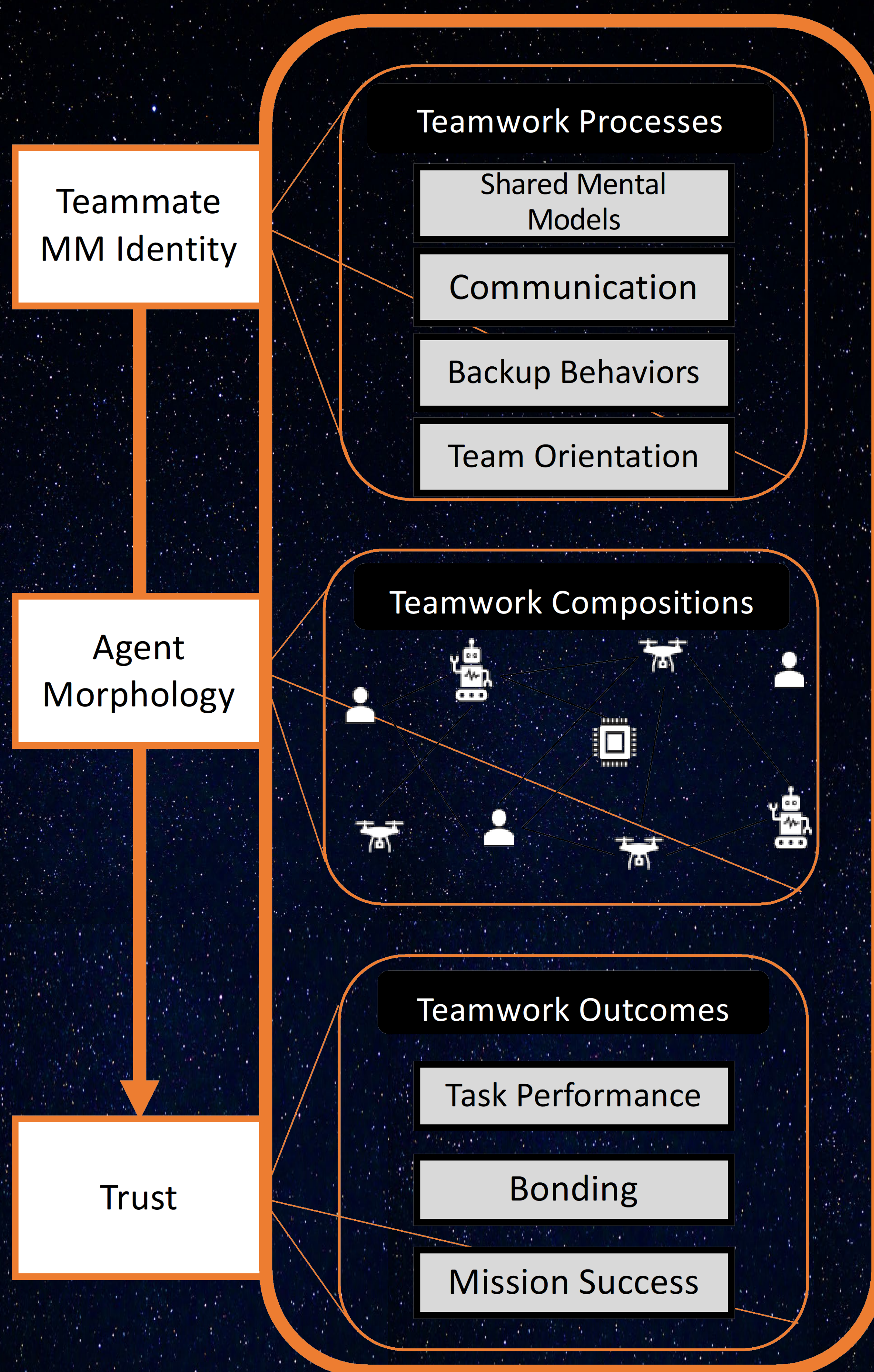
Problem Statement:

- Space operations will require multi-agent, heterogeneous teaming with large & diverse human & autonomy teams.
- Applying the science of human-human teams is a way to realize these complex human-autonomy teams.
- However, tools and techniques are needed to study such constellations of human-autonomy teams.



Research Aims:

- **Aim #1:** Long-Term model of Team processes/outcomes throughout teaming life cycle
- **Aim #2:** Implementing trust and performance model to agents
- **Aim #3:** Model different timescales with different parameters of transferability



Agent Identity Switching

Welcome! You have been chosen to be part of research team Beta for a mission on the moon.

You will be working at Moonbase Alpha with artificial agents (A.I. and robots) to complete research and maintenance tasks.

Please go through the next several slides to familiarize yourself with the agents you will be working with.

Map of Moonbase Alpha

Tau
Tau is an artificial intelligence that works at Moonbase Alpha. Tau's purpose is to assist researchers on base. Tau's identity resides in the sphere shown below, but can be transferred to robots when doing so is useful, such as for making repairs in places human cannot go to. You can see an example of such a robot here that has arms and welding attachments. Tau is the only entity you will interact with, so although Tau may look different minute to minute, it's still the same Tau who likes to work on solar panels and watch the sun go across the earth.

Tau's Identity

Independence	Speed
Intelligence	Welding Fuel
Lunar Knowledge	Dexterity

Once you start operating the robots, Tau's identity will transfer out of its body and into them. This means that Tau will be with you during the entire duration of your mission, even if it looks a little different from time to time.

Tau in Robot 1 **Tau in Robot 2**

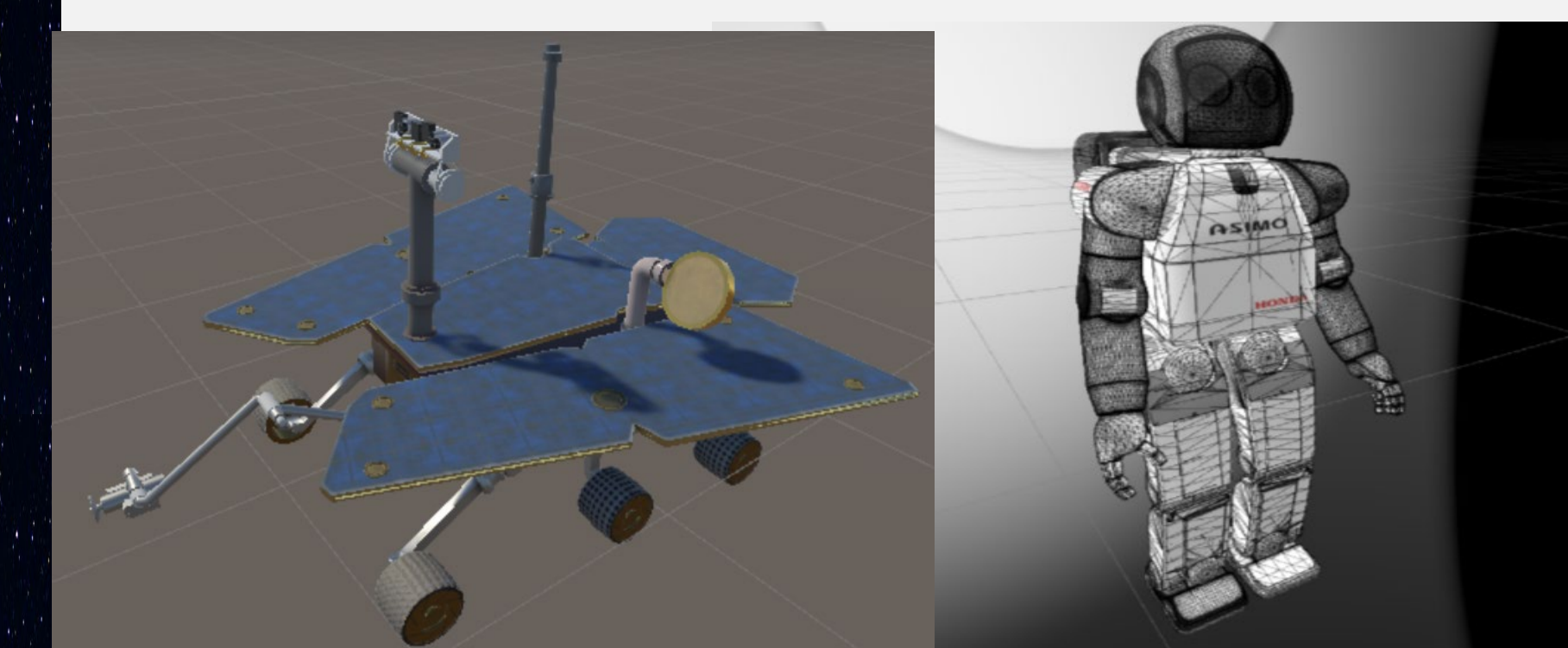
Independence	Independence
Intelligence	Intelligence
Dexterity	Welding Fuel

Once Tau has transferred into the robots, the intelligence and independence increases as Tau brings along its own knowledge into the physical bodies of the robots.

Testbed Mini-Games:

1. Space Junk Removal
2. Oxygen Generation Assembly Maintenance
3. Plant Resource Management
4. Radiation Detection
5. Temperature Regulation
6. Oxygen Tank Maintenance

See above banner for concept art



Way Ahead:

- Explore off-the-shelf solutions (e.g., Moonbase Alpha for error execution)
- Systematic Sprint Cycles for Simulation/ Testing
- Tradeoff analysis of VR/AR
- Inform design of future USAFA Space Education Campus

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