



**Jet Propulsion Laboratory**  
California Institute of Technology

# The Innovation Foundry's Architecture Team – Identifying Tomorrow's Space Missions Today

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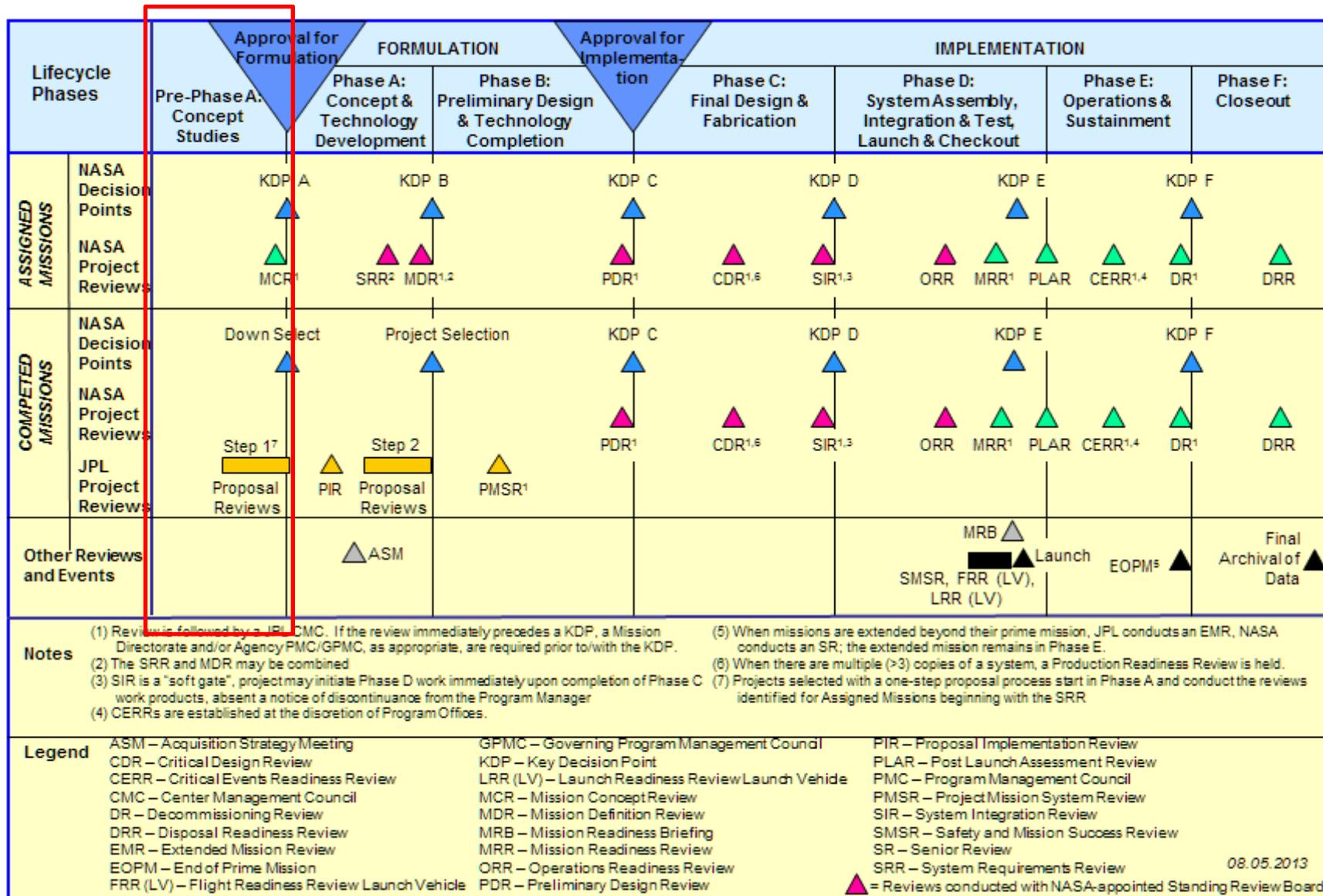
**JPL Innovation Foundry**



# NASA Creates Competed Missions in the 1990's

- NASA wanted to “darken the sky” with planetary spacecraft
  - In response, decides to add Competed Missions to its portfolio of Assigned Missions
  - For Competed Missions, Principal Investigators were required to submit proposals prior to Phase A
- Problem:
  - NASA provided very little guidance for Pre-Phase A activities

# NASA had Minimal Guidance for Pre-Phase A Activities





# JPL Established a Formulation Office



- JPL's Response
  - Establishes the “Strategic Planning & Project Formulation Office” in 2005
    - Now called the “Innovation Foundry”
- The Innovation Foundry is composed of two “shops”
  - Concept Shop
    - Concept Innovation Methods (A-Team)
    - Concept Design Methods (Team X)
  - Proposal Shop



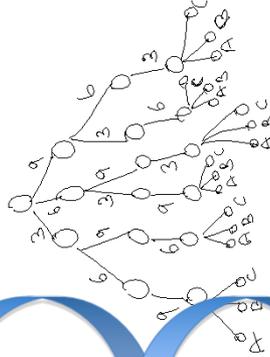


# CMLs: A Powerful Communication Tool

Cocktail Napkin



Trade Space



Baseline Concept



Preliminary Implementation Baseline



CML 1

CML 2

CML 3

CML 4

CML 5

CML 6

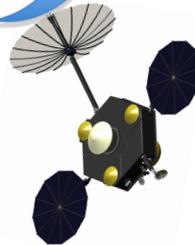
CML 7

CML 8

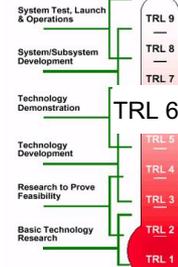
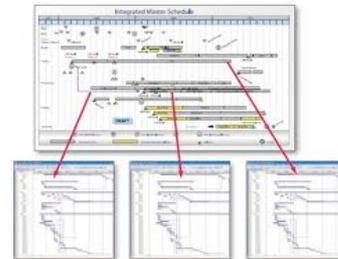
$$F=ma$$

Initial Feasibility

Point Design



Integrated Concept



Integrated Baseline



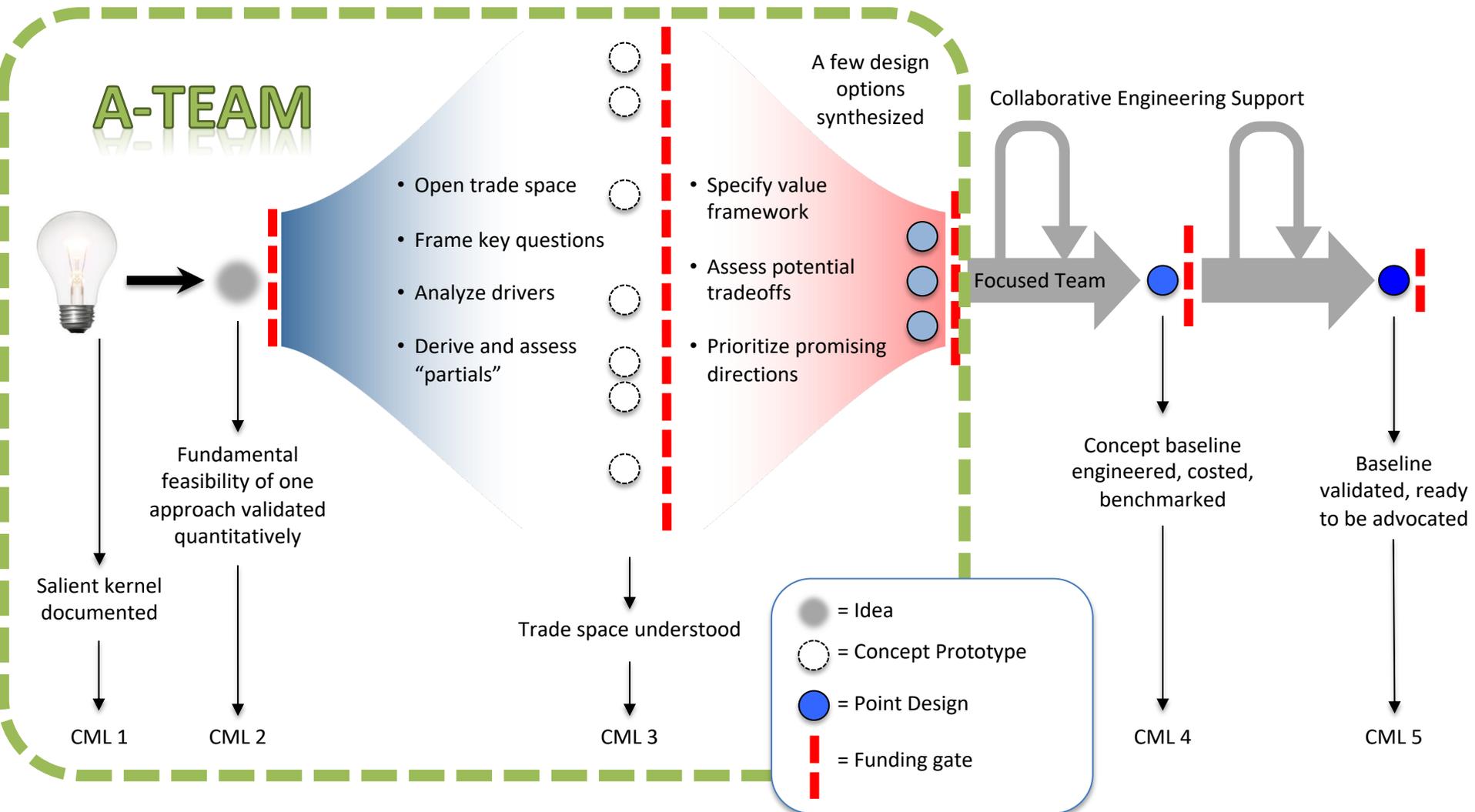


# CMLs: A Powerful Communication Tool

Lifecycle Phase	Pre-Phase A			Phase A			
	Advance Studies			Concept Development		Early Formulation	
CML	1	2	3	4	5	6	7
Name	Cocktail Napkin	Initial Feasibility	Trade Space	Point Design	Baseline Concept	Integrated Concept	Preliminary Implementation Baseline
Lifecycle Gate	-	-	-	Concept Gate (Draft AO Out / Mission Study Report)	Baseline Commitment Gate/ MCR	Step 2 Submittal	PMSR/MDR
<b>Science</b>							
Attribute	P4 Section						
Science Objectives & System Requirements	5.3	Science objectives described in one sentence	Objectives described to levels that allow comparison with previous investigations and NASA science community documents	Objectives linked to investigations and measurements; Science return as a function of cost, risk and programmatic quantified	Produce draft Science Traceability Matrix; Initial Level 1 requirements considered; Specifying one Baseline and one Threshold Science investigation; Key Performance Parameters listed	Science Traceability Matrix (or equivalent) produced; Preliminary PLRA produced (assigned projects)	Proposed Level 1 requirements documented Level 2 & 3 driving requirements listed; Full and minimum success criteria defined; Baseline PLRA submitted @ SRR (assigned projects)  Update PLRA if necessary; Preliminary Level 2 & 3 requirements listed
Science Data System	5.4	-	Identify science data drivers	Science data rates and volume included in trade space analysis	Science data system sizing	Science data processing architecture, release and archive approach defined	Science data management approach (includes Level 0, 1, 2 data products) defined  Same as for CML 6
<b>Technical</b>							



# The Architecture Team (A-Team)





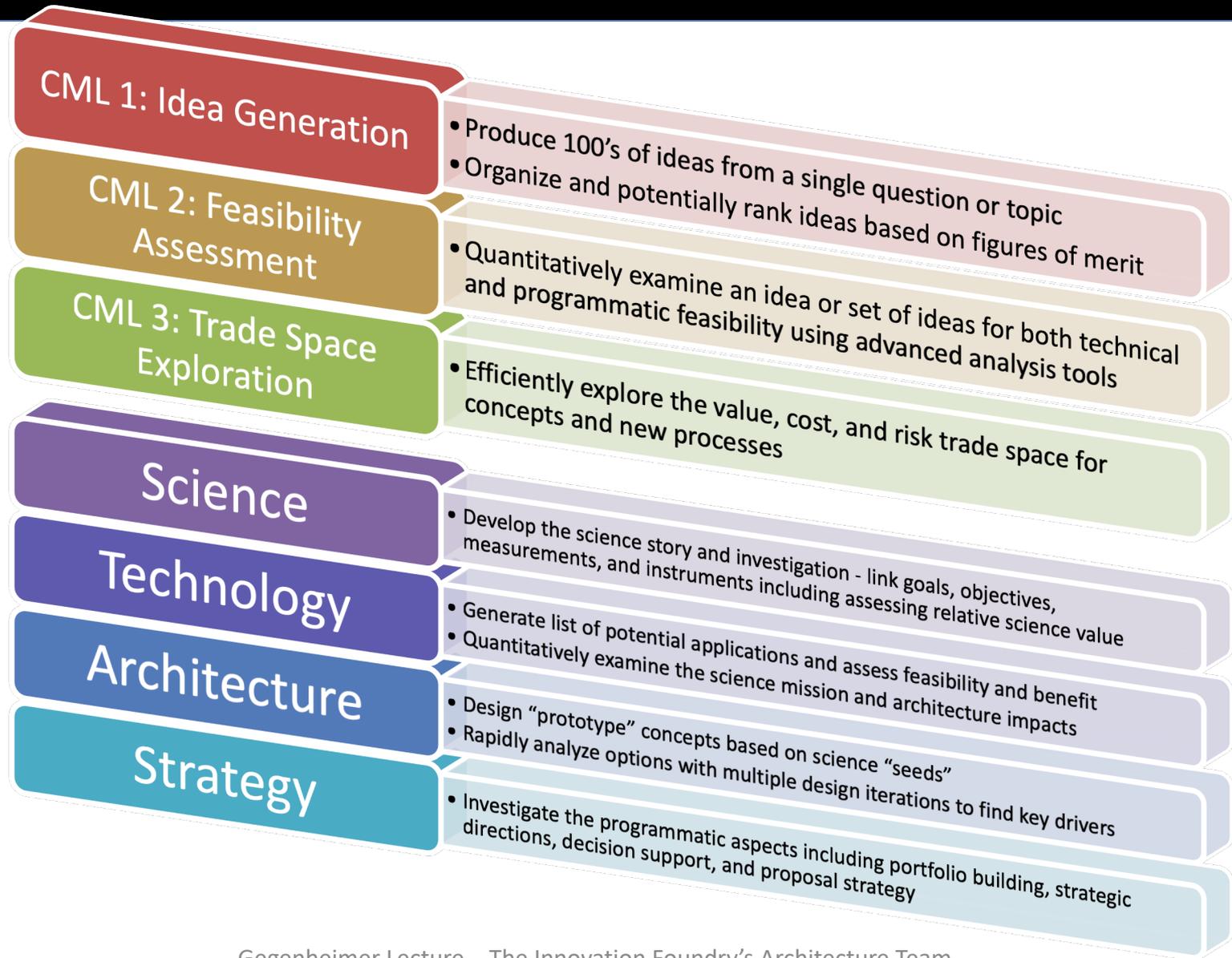
# A Creative Space for Brainstorming



The A-Team efficiently explores the science, implementation, and programmatic trade space in early concept formulation.



# The A-Team Study Types

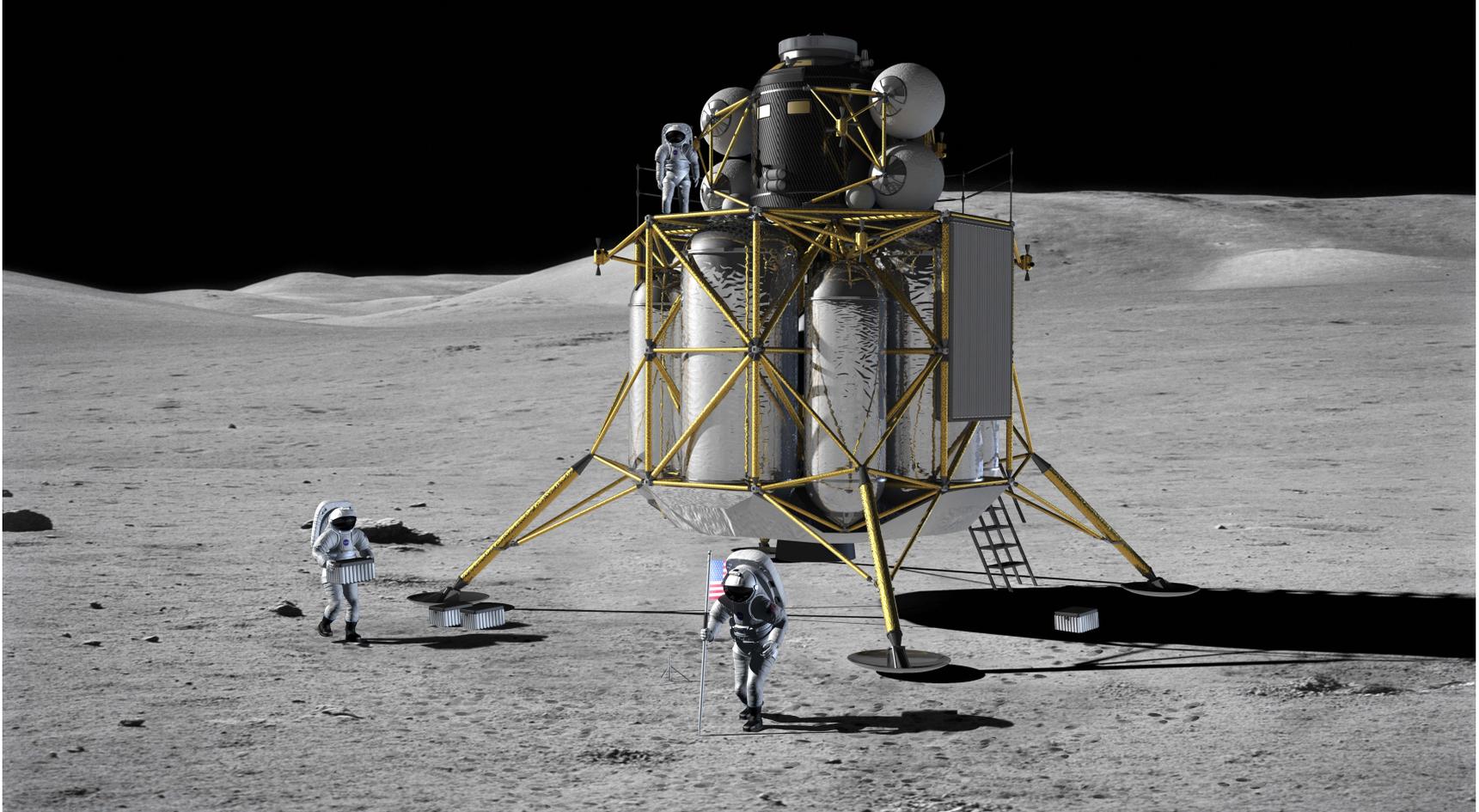




# A Look at a Few Advanced Mission Concepts



# Returning Astronauts to the Moon





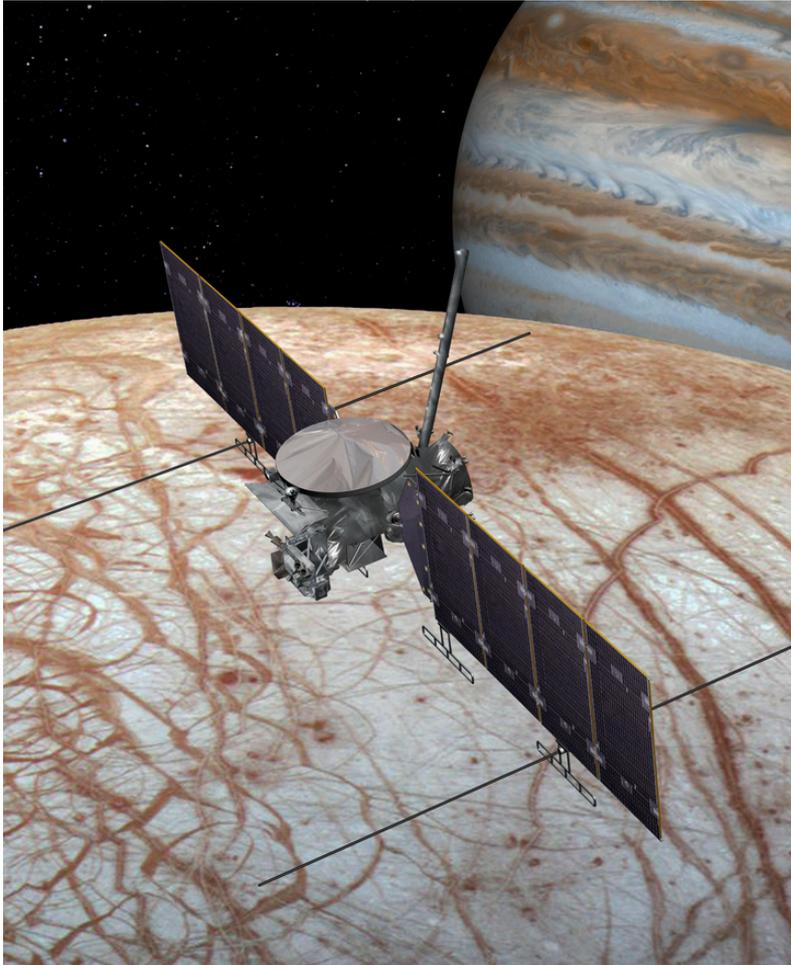
# Returning Astronauts to the Moon



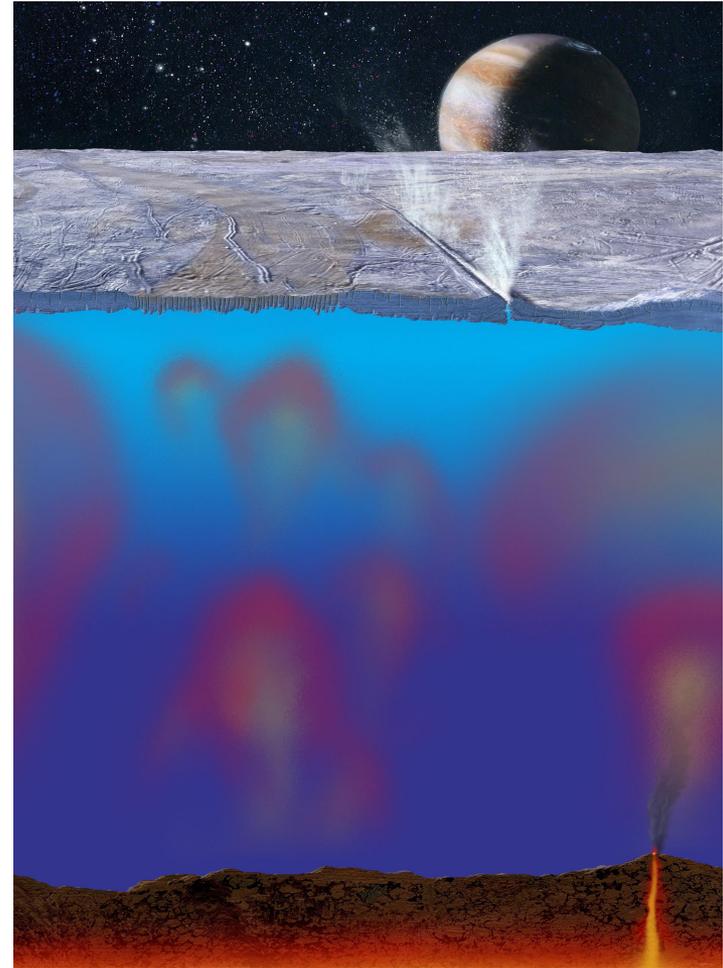
*ATHLETE – All-Terrain Hex-Limbed Extra-Terrestrial Explorer*



# Planned Europa Mission



*Artist's concept*





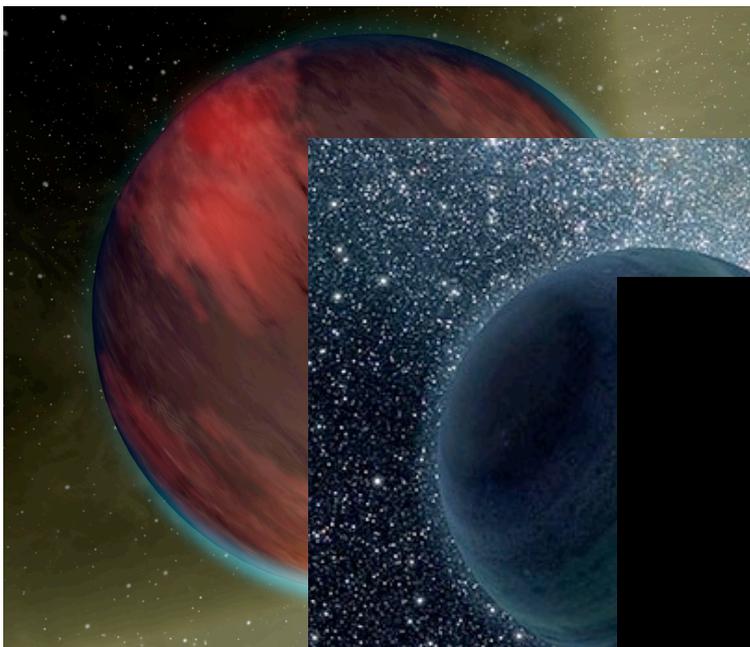
# Driving Where?



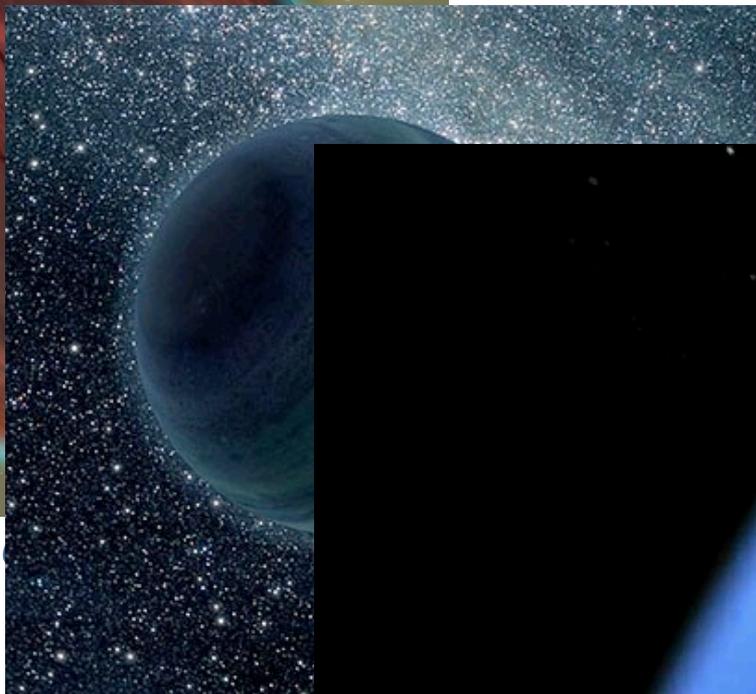
*BRUIE – Buoyant Rover Under Ice Exploration*



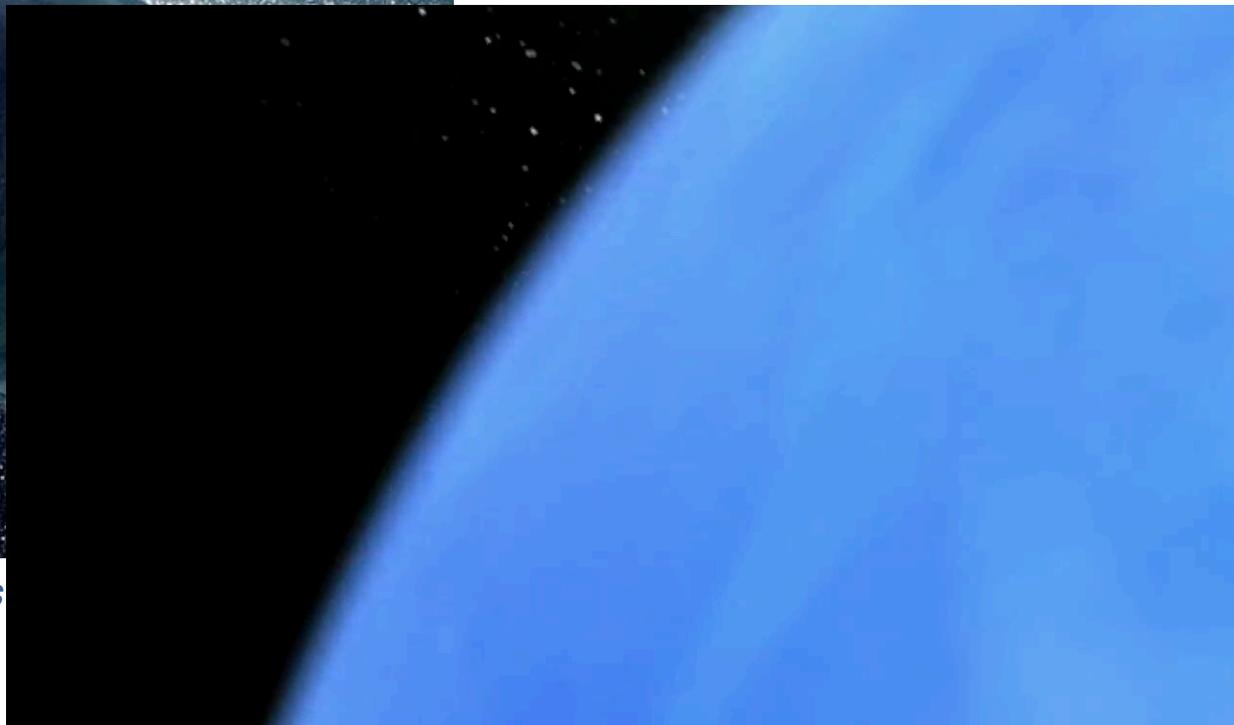
# Many Bizarre Types of Worlds



*"Hot Jupiters"*



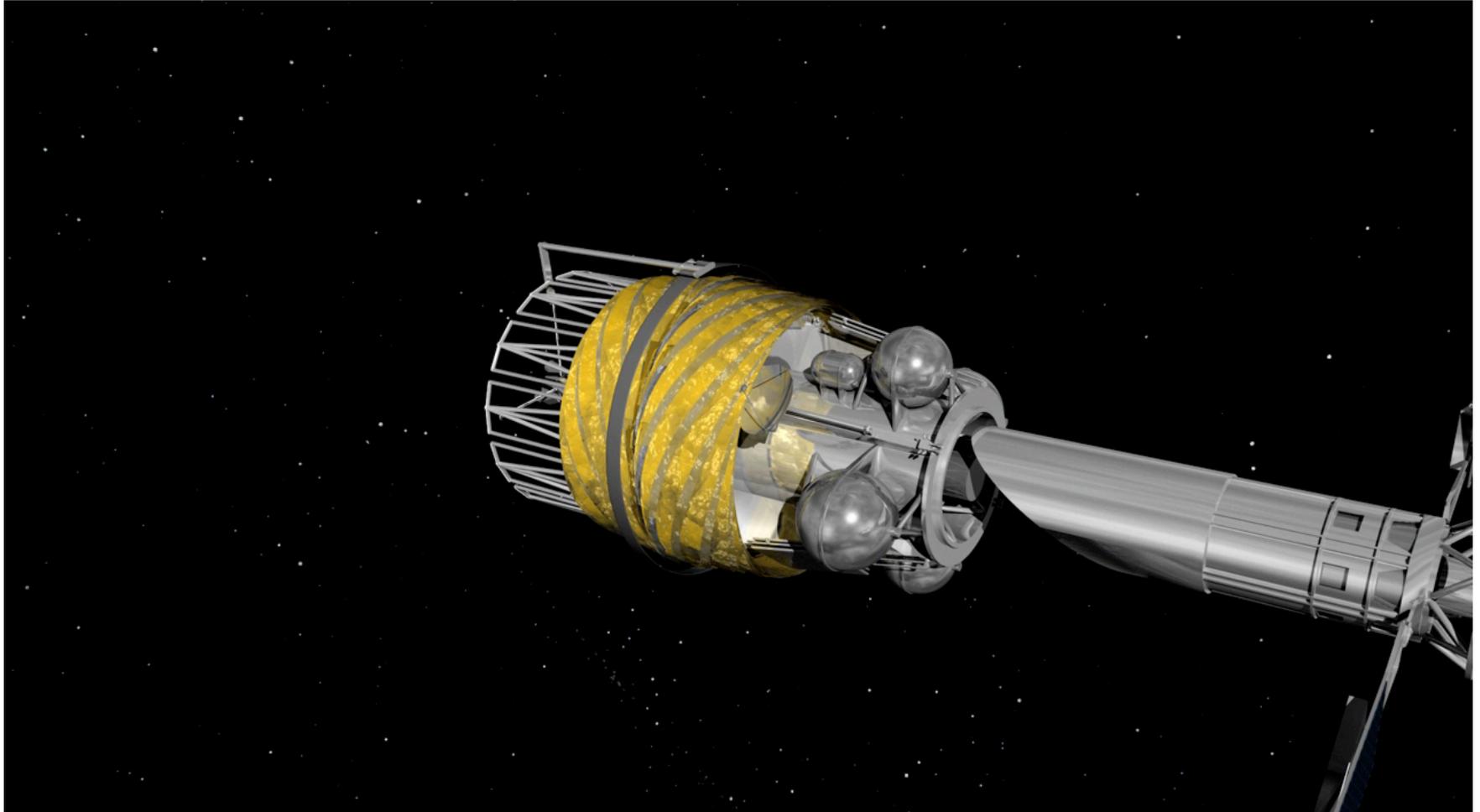
*"Orphan Worlds"*



*"Ocean Worlds"*



# Proposed Starshade



*Pre-Decisional – For Planning and Discussion Purposes Only*



# Conclusions

- The A-Team is composed of 15 core members who focus on early mission concept using formulation best practices and subject matter experts
  - A collection of people, ideas, and objects that promotes innovation at JPL
  - A testing ground for new processes and tools
  - 150 studies completed in 5 years is a testament of the value of A-Team