ASTR 475/575 Group Projects

The goal of this project is to work in teams to develop mission proposals for astrobiological exploration in the solar system. The class will divide into two teams, working on two distinct missions. For each mission, the teams will develop a space mission concept, consisting of a 5-page report and a 15 minute presentation. The other team and the instructors will review the proposals, comment on strengths and weaknesses, and provide an evaluation (weak/good/very good/excellent). The basic evaluation criteria are scientific merit and feasibility. Thus, proposals must develop a compelling science case and discuss the feasibility of the proposed approach. Rather than specifying costs for the missions, we will assume that cost correlates with payload mass, and instead constrain the total mass of the mission instrumentation to be 2500 kg.

For each mission concept, we provide a list of possible approaches to choose from. Teams may choose one or more elements from the list, as long as they fit within the mass limit. If a team wishes to try something else, please check with us first.

Your proposals should contain a *quantitative* argument for the architecture chosen and an evaluation of the science benefits of the mission.

Mission: Europa Ocean Explorer
Science Goal: *Search for microscopic photosynthetic organisms in the subsurface ocean of Europa.*
Mission Objective: *Take a sample of liquid water on Europa without sterilizing it.*
Assume that a target area has been identified on Europa where the ice appears less thick. Assume that your mission starts from a Europa orbiter with zero velocity.
Possible Mission Components:

- Impactor (10 kg + arbitrary mass)
- Submersible vehicle (250 kg)
- Heated Drill (1000 kg motor without energy source, tube: 1kg/m depth drilled)
- Power Drill + carbohydrate lubricants (1000 kg motor without energy source + 1kg /m depth drilled)
- Rover (2 km range)
- H Bombs (500 kg, 1 Mton)
- Unfolding Solar Collector (100 kg for 20m2, efficiency 17%)
- Robotic Arm (150 kg / 3m)
- Autonomous lab unit (200 kg)
- Pump (100 kg)
- Return vehicle (400 kg)

Mission: Mars
Science Goal: Search for extinct life on Mars.
Mission Objective: Search for martian microfossils at multiple different locations that probe different areas from the young habitable Mars. Probe relevant depths and define measurements that can assess the likelihood of biomorph structures being fossils. Assume mission starts from an orbiter.

- Impactor (30 kg propulsion+ arbitrary mass)
- Oil-cooled Drill (1000 kg + 10 kg/meter drilled)
- Heater
- Rover (300 kg + 100 kg/1 km range travelled)
- High-power optical microscope (50 kg)
- Transmission Electron microscope (200 kg)
- Ion microprobe (200 kg)
- H Bombs
- Robotic Arm (150 kg / 3m)
- Sophisticated image recognition unit (50 kg)
- High-Power Antenna for Earth communication (75 kg)
- Unfolding Solar Arrays (100 kg for 20m2, efficiency 17%)
- Return capsule (300 kg / 1kg payload)

Schedule:

2/28	Discuss mission concepts and divide into teams (2-3 students/team)
4/6	Each team submit a 1-page abstract of their proposal
4/20	Written proposals due
4/25	Project presentations
4/27	Project presentations