Chair of Space Mobility and Propulsion

Lectures, Design Challenges, Practical Courses & Engineering Projects OFFERING

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Our Teaching Philosophy

Learning is supposed to be fun, so let's make it so!

Learning is not "parroting".

Learning is the development of that "engineering gut feeling" that rests on deep knowledge and understanding makes of you not just a good engineer but a great one.

Interaction with the study material, with the lecturer, and between students is key to understanding!

The right balance between fundamental theory and system real application knowledge is foundational for taking what we learn into what we can do with it!

Our Offering

Lectures

Design Challenges

Practical Courses

Engineering Projects

Our Offering – Lectures

The purpose of the Lectures is to give students foundational understanding. Lectures are interactive and built around use-cases and examples.

1. Introduction to Spaceflight
2. Rocket Propulsion I
3. Electric Space Propulsion

Our Offering – Design Challenges

The purpose of the Design Challenges is to give students – working in groups – the opportunity to actively engage and deep dive into and engineering design process. Learning engineering and refining important soft-skills!

1. Rocket Propulsion II Design Challenge

2. Spacecraft Propulsion Design Challenge

No Exam instead three deliverables: Report – Pitch – Software coding developed and associated documentation and commenting

…And there are prizes!

Setup of the Design Challenges

Lectures provide:
- Design Challenge content and setup
- Basics needed for the design

Exercises provide:
- exchange on tools and main questions
- possibility of checking progress

Above all:
- Interactive discussions about main trade-offs

Students are evaluated for the individual performance as well as the overall performance of their team

The evaluation criteria are as follows:
1. Overall concept - 33%
2. Technical strength of detailed design - 34%
3. Pitch & Report Document - 33%

Our Offering – Practical Courses

1. Control and Simulation of a Rocket-Hopper Demonstrator

2. Experimental Investigation of Space Propulsion Phenomena


Introduction to Spaceflight
© SpaceX

What we will study in Introduction to Spaceflight

We will study how space systems are conceived, designed, implemented, launched, and operated.

We will cover the fundamental basics of the design of all satellite and space transportation subsystems.

We will learn of the main actors in the space industry and future trends in space

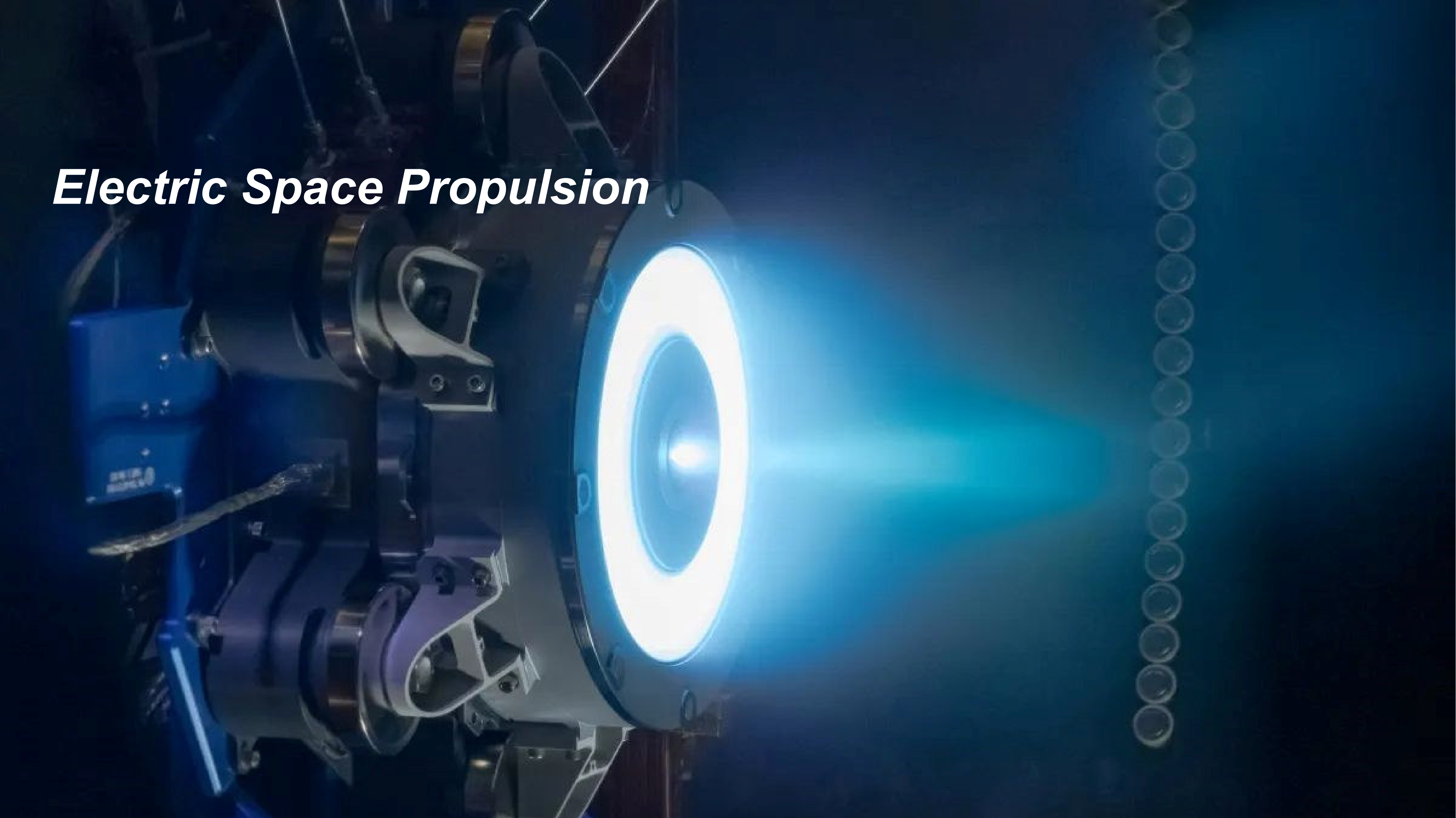
At the end of the course, you will be able to conduct a simplified preliminary design process of a space mission.

Rocket Propulsion I

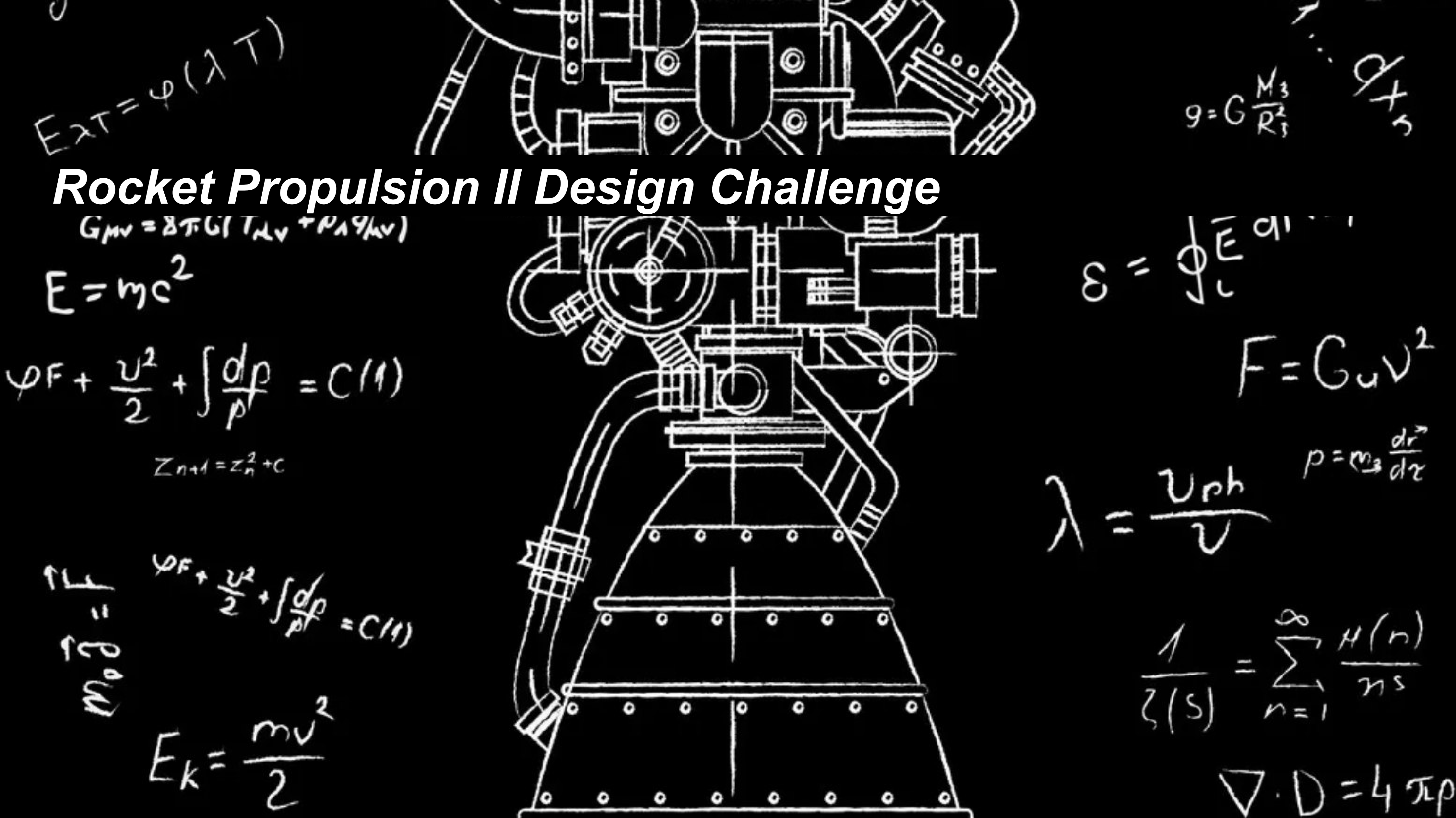
Rocket Propulsion I

Content

Electric Space Propulsion



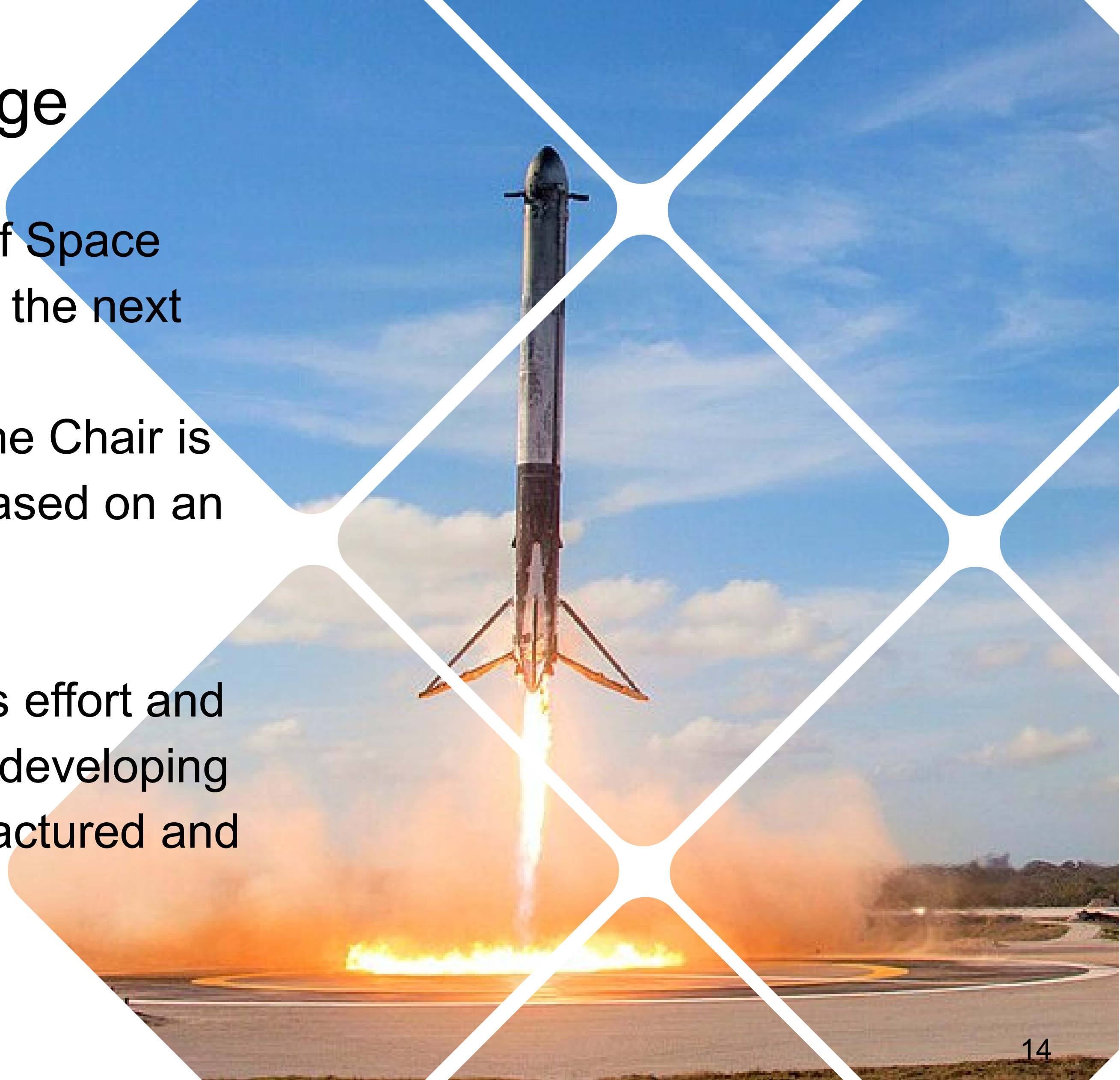
Rocket Propulsion II Design Challenge



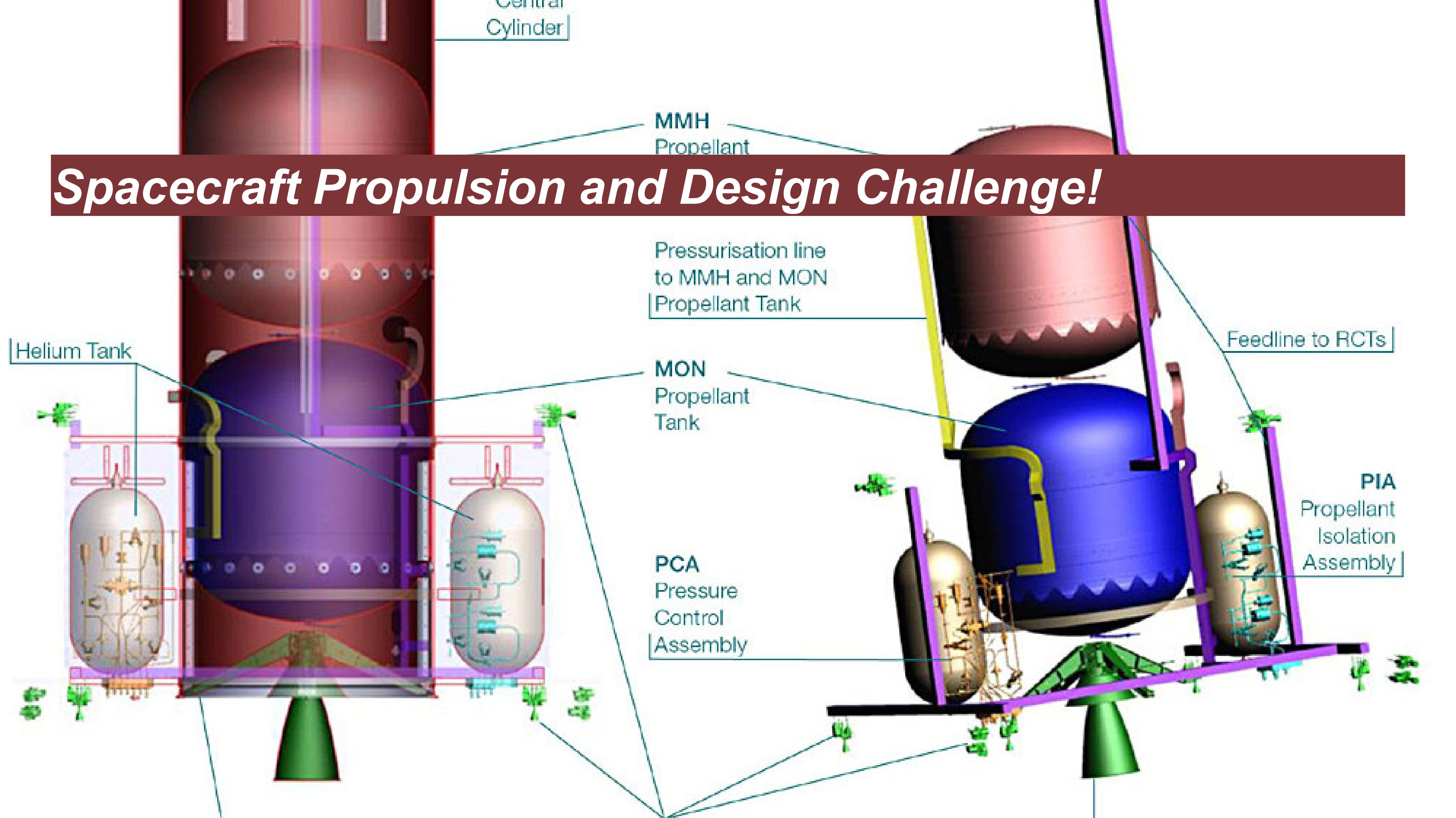
Example Design Challenge

As part of the efforts of the Chair of Space Mobility and Propulsion to develop the next generation of re-configurable and autonomous propulsion systems the Chair is developing ASCENT – a hopper based on an e-pump fed rocket engine.

YOU are now part of this ambitious effort and have the chance of designing and developing your own engine and see it manufactured and fly on ASCENT!



Spacecraft Propulsion and Design Challenge!



Example Design Challenge

Working with other team members you are responsible for the **preliminary design of the propulsion system of the spacecraft** that will bring the probe to Phobos.

Launch:

- a dedicated Ariane 62 from Kourou
- Launch date 02/12/2028

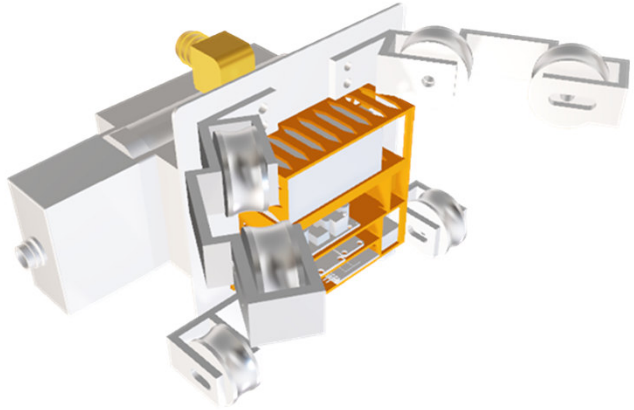
Target orbit:

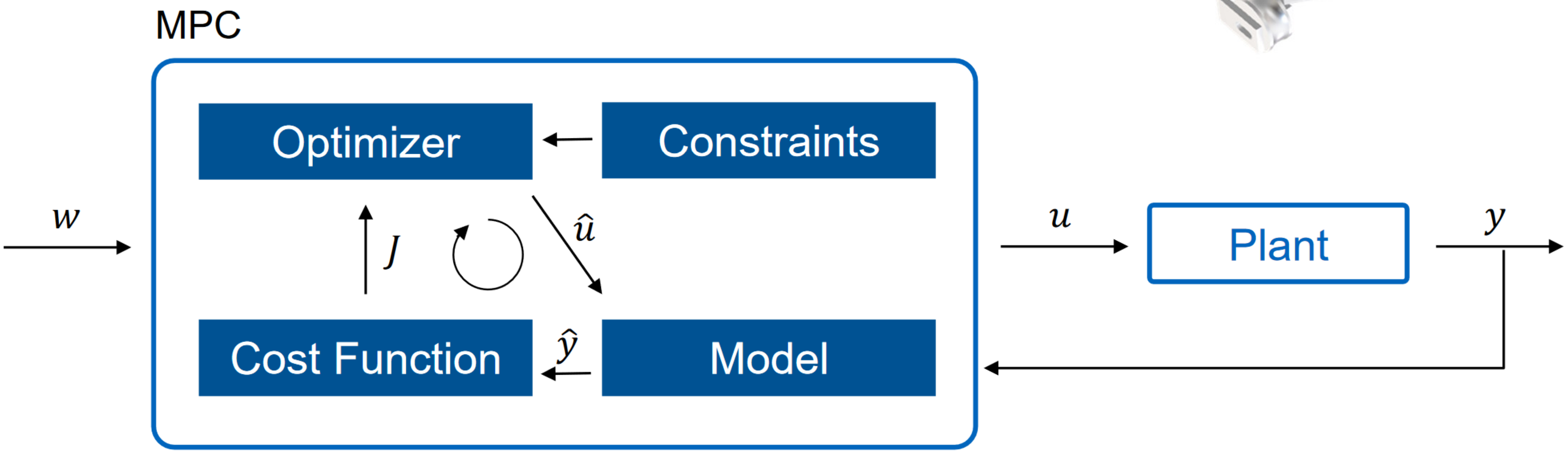
- Orbit around Phobos (Quasi-Satellite Orbit (QSO)) for a minimum of 2 years to study Phobos from space and to serve as a relay for the surface probe
- At end of life (EOL) the spacecraft (S/C) will de-orbited into the martian atmosphere (40km altitude@periapsis)

Control and Simulation of a Rocket-Hopper Demonstrator

Example Course Content

Modern Control Algorithms – MPC





Experimental Investigation of Space Propulsion Phenomena

Example Testing Procedure

Procedure WEPPY

Version 0.3 (16.12.2022)
Last change made by Julian Matt (Supervisor Sascha Dengler)

Test Name ______________________________

Conducted by (2 People) ______________________ ______________________

0 *Prior to this procedure the fluid system is connect in full with the ignition block; the thrust chamber is safely secured and all connections are sealed with o-rings; leak tests have been performed*

1	**Preparation of Test Bench**	**1. Check**	**2. Check**
	Place WEPPY in an outdoor space that can be closed off	☐	☐
	Connect power & data cables of test bench to an outlet and control pc	☐	☐
	Check on Testbench PC in NI MAX if cRIO is connected	☐	☐
	Start Labview 2013 32 bit	☐	☐
	Load WEPPY_ScanMode.lvproj and open WEPPY.vi	☐	☐
	Click Run (Wait up to 2:40 min)	☐	☐
	Digital Input Indicicator should indicate 24V and 5V are ok	☐	☐
	Load calibration file in calibration tab, check Calibration of MFM	☐	☐
	For hot fire tests, connect the igntiton cables to the spark plug & thruster but not the ignitor box	☐	☐
	Check if all Thermocouples are connected to thruster	☐	☐
	Read all the below mentioned abort procedures/scenarios before pressurizing the system	☐	☐
2	**Purge and Conditioning**		
	Close O-DSV and H-DSV (Turned ON) (valves get very hot after some time!)	☐	☐
	Connect N2, H2, O2 Bottle	☐	☐
	Close all pressure regulator completely (never exceed 25 bar outlet pressure!)	☐	☐
	Start LoadCell calibration, make sure to not move anything on the experiment table afterwards	☐	☐
	Close off safety area and ensure all personal/bystanders are safe and aware of upcoming test	☐	☐

WHEN do we offer **WHAT**?

Winter Semester	Sommer Semester
Introduction to Spaceflight	Rocket Propulsion II Design Challenge
Rocket Propulsion I	Spacecraft Design Challenge
Electric Propulsion	Experimental Investigation of Space Propulsion Phenomena
	Control and Simulation of a Rocket-Hopper Demonstrator

Learning is a joint journey of lecturer and student – Let’s get started!

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