

UNIVERSITÀ  
DEGLI STUDI  
DI PADOVA

# Integrated navigation and docking systems for small satellites

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Supervisor: To be defined

Admission to the 1<sup>st</sup> year - 14 December 2023



## 1. Introduction

- a) In-Orbit Servicing
- b) Space Rider Observer Cube (SROC)

## 2. Doctoral work objective

## 3. Research activities

## 4. PhD timeline

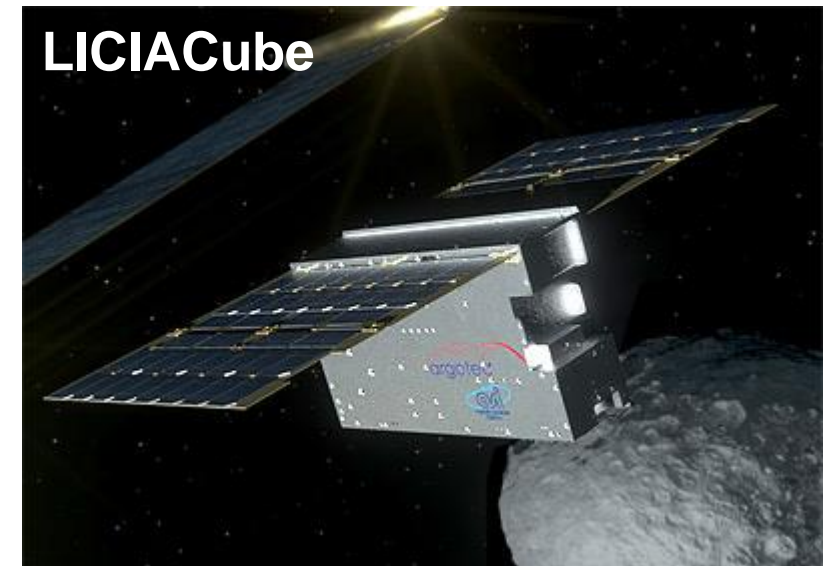
In-Orbit Servicing (IOS) and In-Orbit Assembly (IOA) operations:

- Refuelling
- Refurbishment
- Deorbiting
- Inspection (LICIACube, AeroCube-10)
- ...

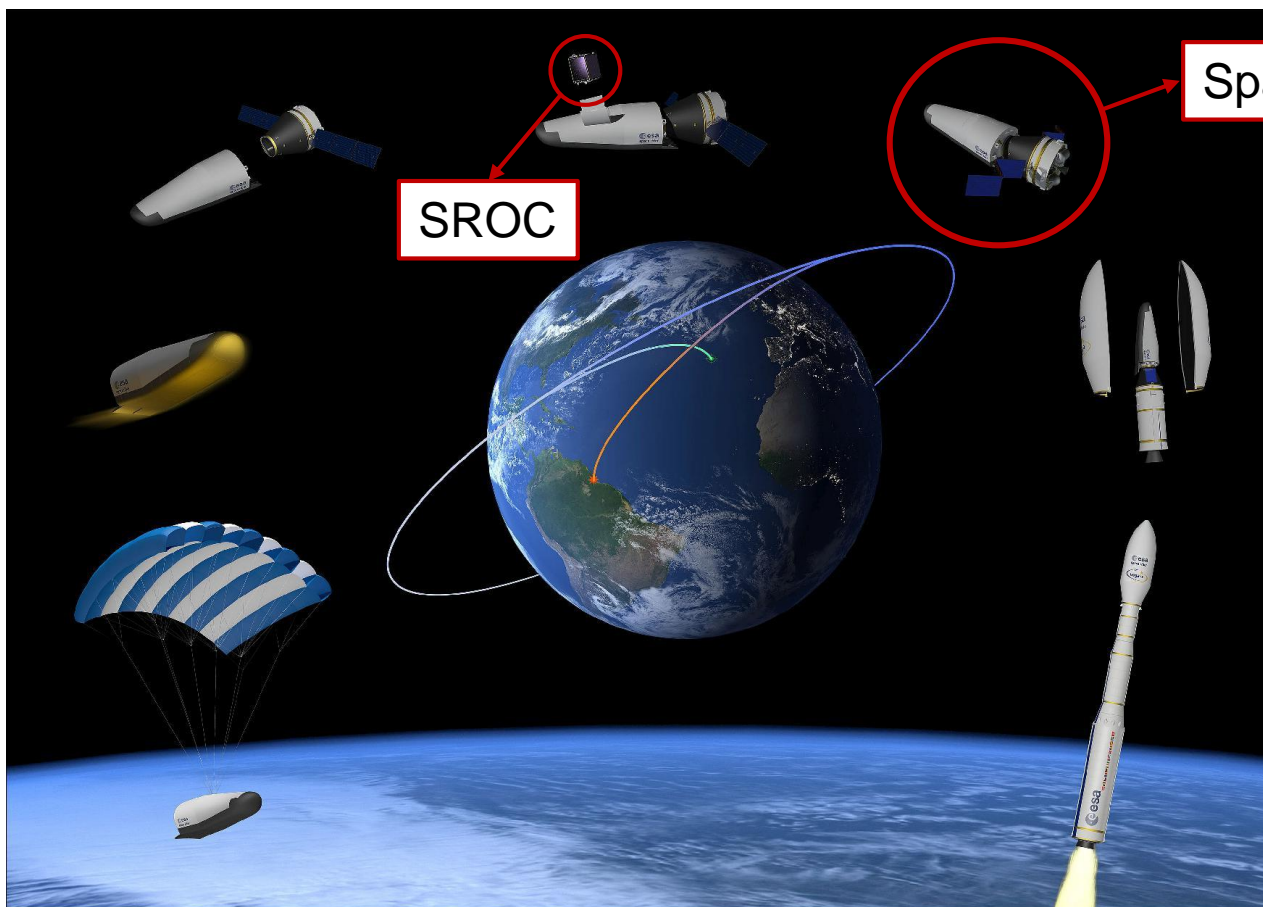
There are two satellites, a **Chaser** performing the servicing operations on the **Target**. To perform the servicing, the Chaser has to be equipped with:

- Capture mechanism
- Sensor suite
- Navigation algorithm

Cubesat are playing a major role in the space industry but introduce challenges related to the **miniaturization of technologies**.



## Space Rider Observer Cube (SROC)



Space Rider (SR)

SROC

SROC will perform:

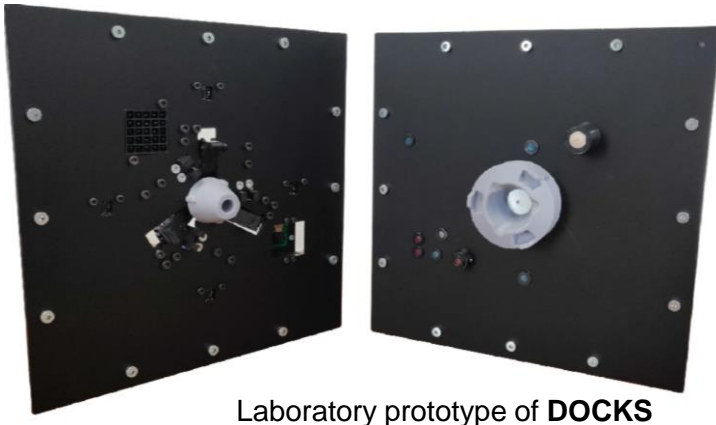
- Inspection of SR
- **Rendezvous and docking** through a docking mechanism with the MPCD located in the MPCB of Space Rider

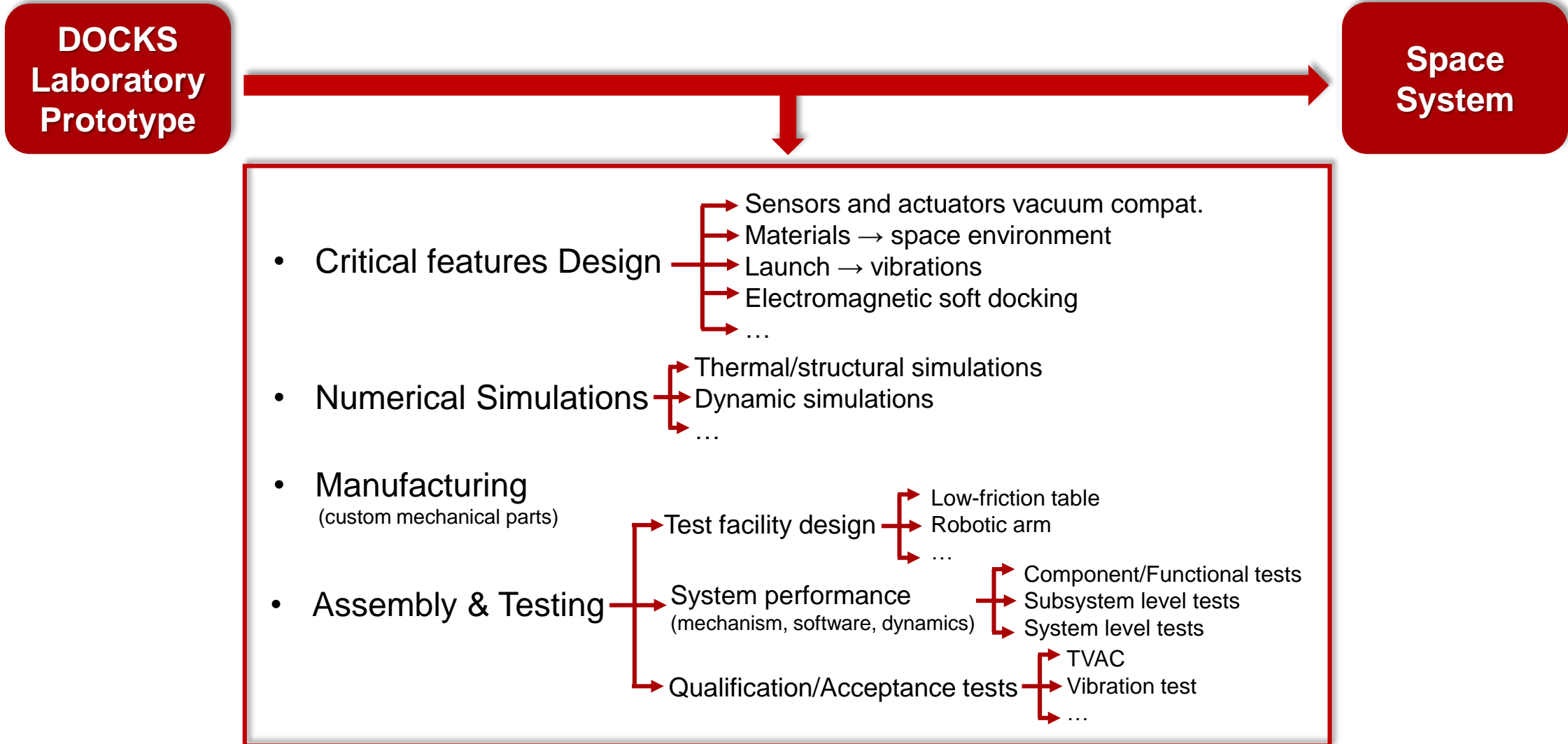
SROC Consortium:

- UniPD
  - Stellar Project
  - PoliTO
  - Tyvak
- Development of the docking system **DOCKS**
- Development of SROC CubeSat

**Objective:** Development and testing of the advanced **ENGINEERING MODELS** of the docking system **DOCKS**:

1. Breadboard Model
  2. Engineering Qualification Model (EQM)
  3. Proto-Flight Model (PFM)
- } under **Stellar Project** supervision



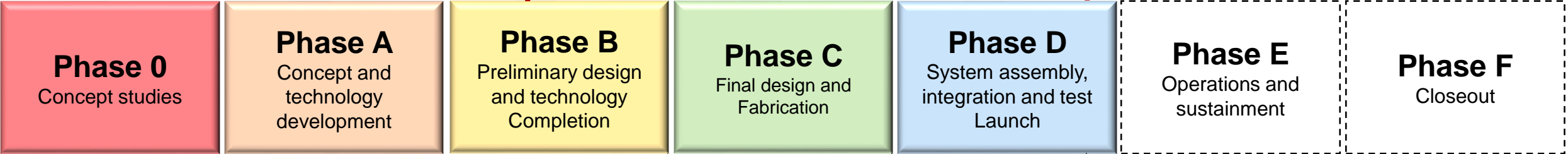


- Docking mechanism
- Sensor suite
- Navigation algorithm

**DOCKS  
Laboratory  
Prototype**



**Space  
System**



Mission Milestones:

PDR

CDR

SIR

Advanced Models:

Bread.

EQM

PFM



## 1. State of the art of Docking Systems for small satellites

- ❖ Bibliographic research to study the state of the art of the technologies involved (space compatibility of materials) and of the qualification tests (ECSS standard regulations).
- ❖ Study of the critical features that are not considered during the development of laboratory prototype

## 2. Design Phase

- ❖ Numerical Simulations of the system to study its behaviour
- ❖ Selection of actuators according to the simulations, and selection of sensors and materials that have vacuum compatibility/have flight heritage.
- ❖ Detailed design, integrating the new solutions studied and selected.



## 3. Testing Phase

- ❖ Laboratory set-up definition
- ❖ Manufacturing and assembly of the DOCKS Breadboard model. Functional and performance tests are going to be performed.
- ❖ Manufacturing and assembly of the DOCKS EQM. Execution of functional/performance test and qualification tests.
- ❖ Manufacturing and assembly of the DOCKS PFM. Execution of acceptance tests on PFM.
- ❖ For all the models:  
Functional and performance tests are going to be performed under representative kinematic/dynamic conditions.



## ❖ 12 months – UniPD

Activities (foreseen):

- DOCKS Breadboard model
- Functional and performances tests under representative conditions

## ❖ 18 months – Stellar Project Srl

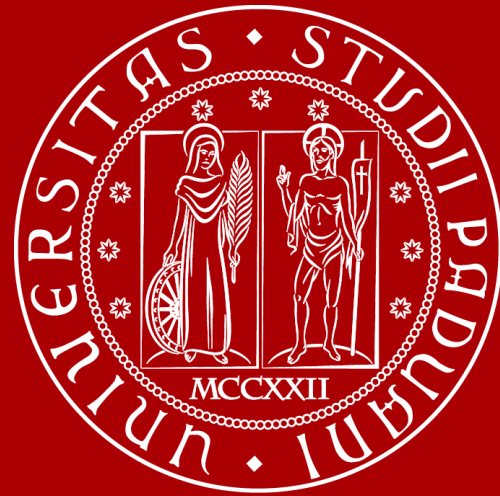
Activities (foreseen):

- DOCKS EQM and PFM
- Qualification/Acceptance tests

## ❖ 6 months – Abroad (TBD)



# Thanks for the attention



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