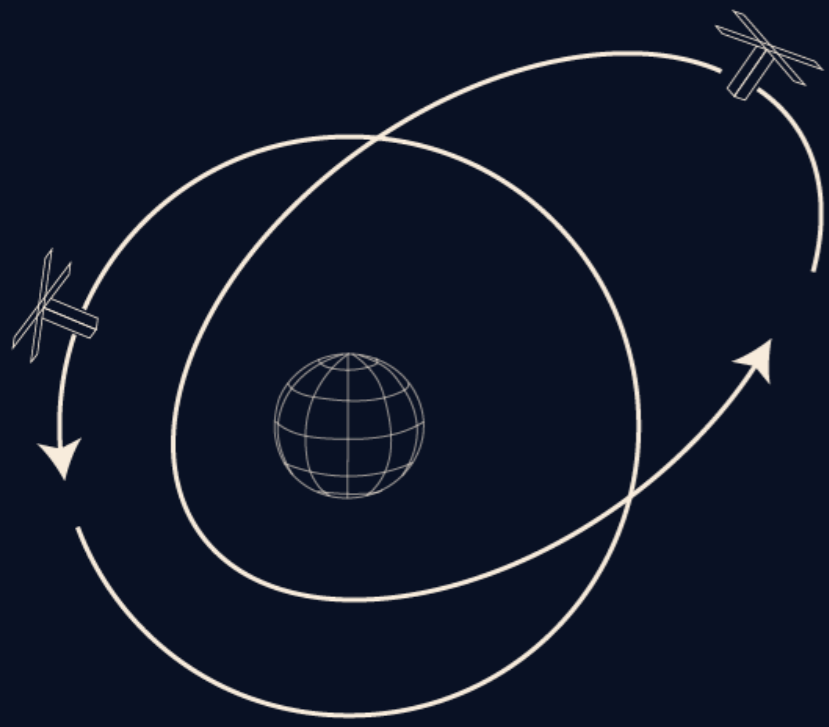




A Student Lead CubeSat Mission from EPFL

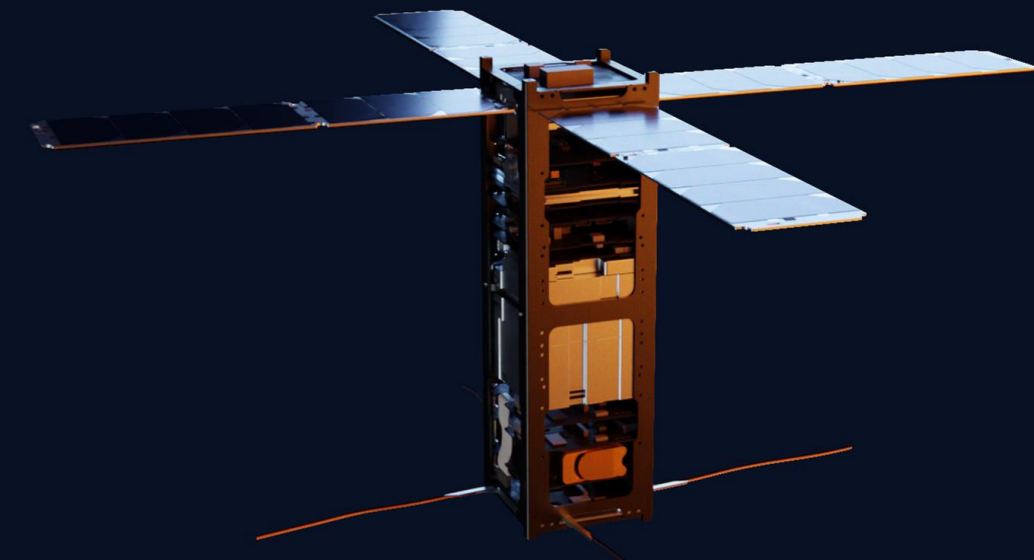
EPFL Spacecraft Team



The Mission

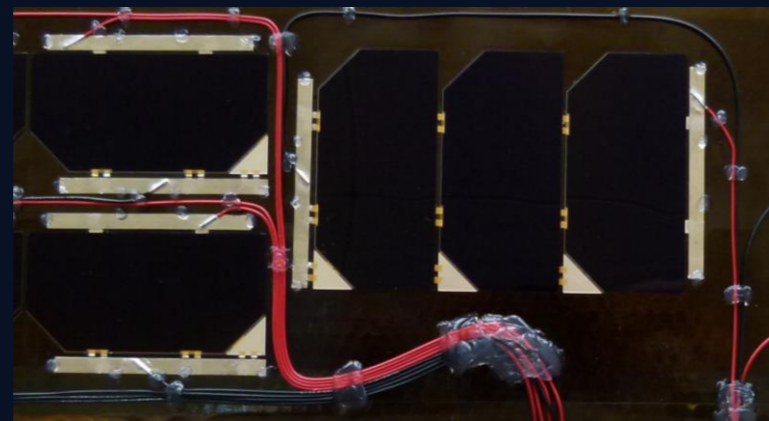
The CHESS mission aims to research the density and composition of the earth's exosphere using two 3U cubesats in a 550km circular and 400-1000km elliptical orbit. The primary scientific payloads are a mass spectrometer (Cubesat TOF) from the University of Bern and a GNSS board from ETH Zürich. Additionally, an in-house OBC and solar panels from RUAG for in-orbit validation are carried as secondary payloads.

The mission is managed by the EPFL Spacecraft Team, a student lead association supervised by the EPFL Space Center and experts of other Universities in Switzerland.



RUAG Solar Cells

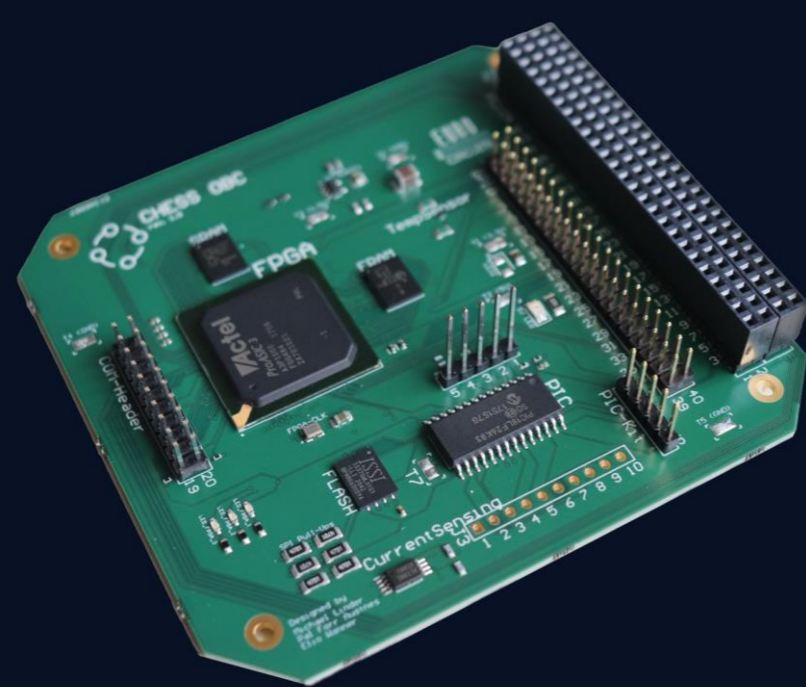
- Designed by RUAG
- 3 solar cells on a commercial solar array
- Different cells on the two satellites
- Performance and degradation measurements in flight
- Benefits from chemical composition measurements
- Not essential for the satellites power budget



In-House OBC

Our in-house OBC is designed by students from EPFL, HES SO, and HES ARC. The board will fly as a payload for in-orbit validation.

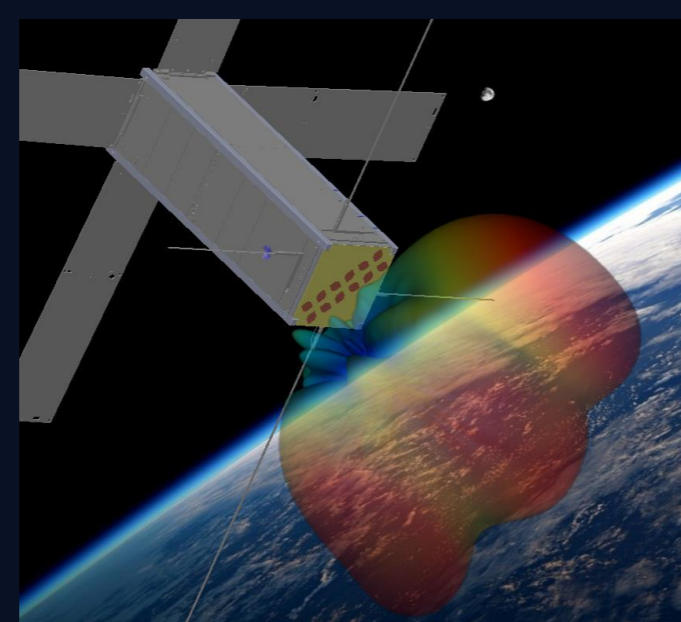
- Based on a ProAsic FPGA
- Hosting an SRAM and FRAM
- Temperature sensor on board
- Soft RiscV processor written in SpinalHDL
- In-Orbit reprogramming of the FPGA and flight software possible
- NASAs F' flight software framework



X Band Antenna from HSLU

The Lucerne University of Applied Sciences and Arts has a lot of experience in the field of telecommunications systems. Their X band antenna improves our link budget due to

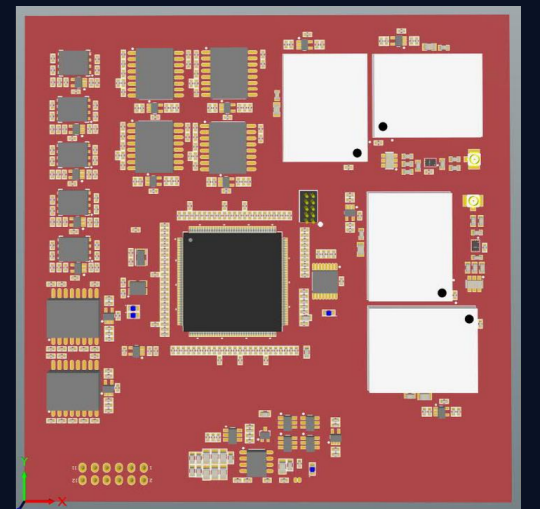
- Custom lightweight antenna
- Special beam shape to increase the transmission time up to 40 % compared to a standard design



GNSS from ETHZ

The GNSS board from ETH Zürich [1][2] is based on a modified ZED-F9P module from u-blox - further optimized for the following operations:

- Precise orbit determination
- Estimation of air density (drag)
- Monitoring of space weather (ionospheric activity)
- Complemented by retro-reflectors for satellite laser tracking



COTS Components

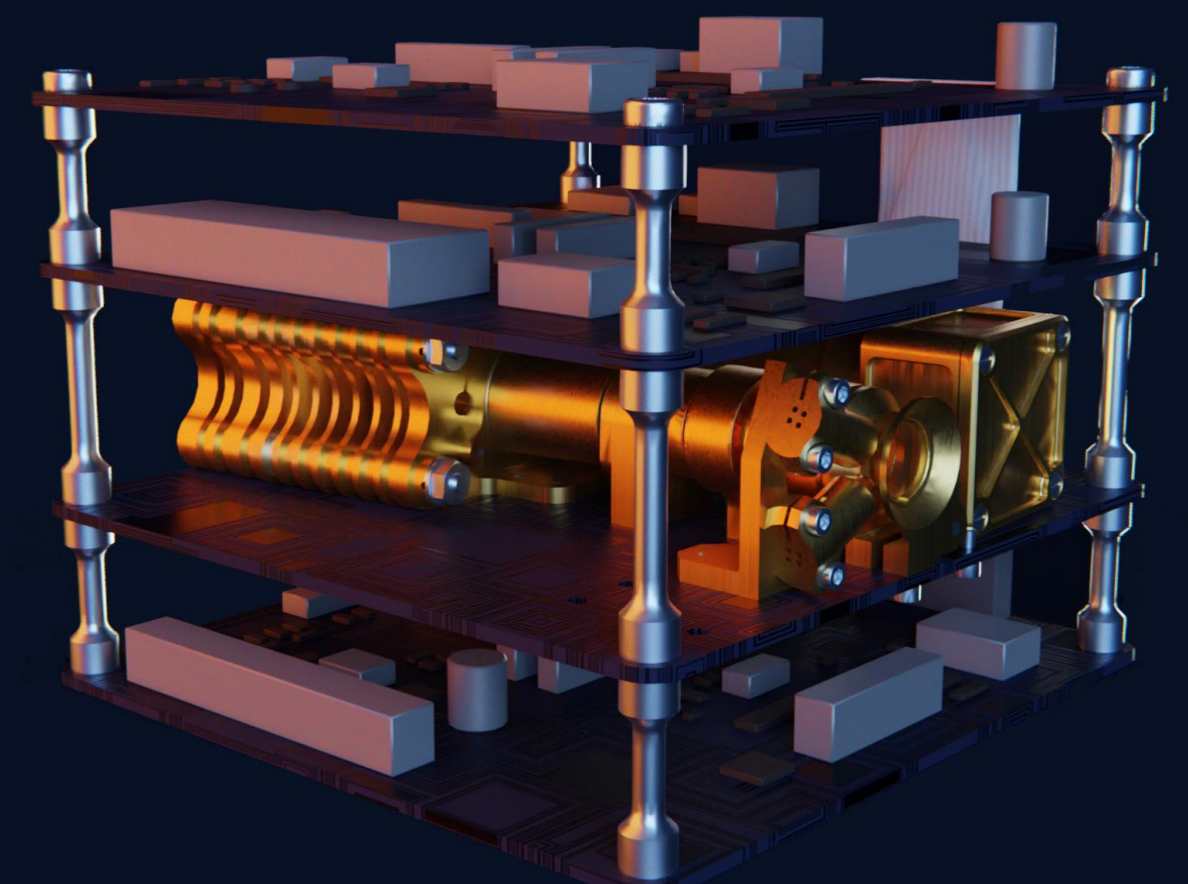
We rely on COTS components for the bus to reduce the risk of technical failure. We use

- OBC I (Endurosat)
- EPS II (Endurosat)
- ADCS (CubeSpace)
- UHF Transceiver II and Antenna (Endurosat)
- XBand Transceiver (Endurosat)

University of Bern's TOF Mass Spectrometer

The CubeSatTOF instrument [3] is a mass spectrometer developed by the University of Bern with industry partners.

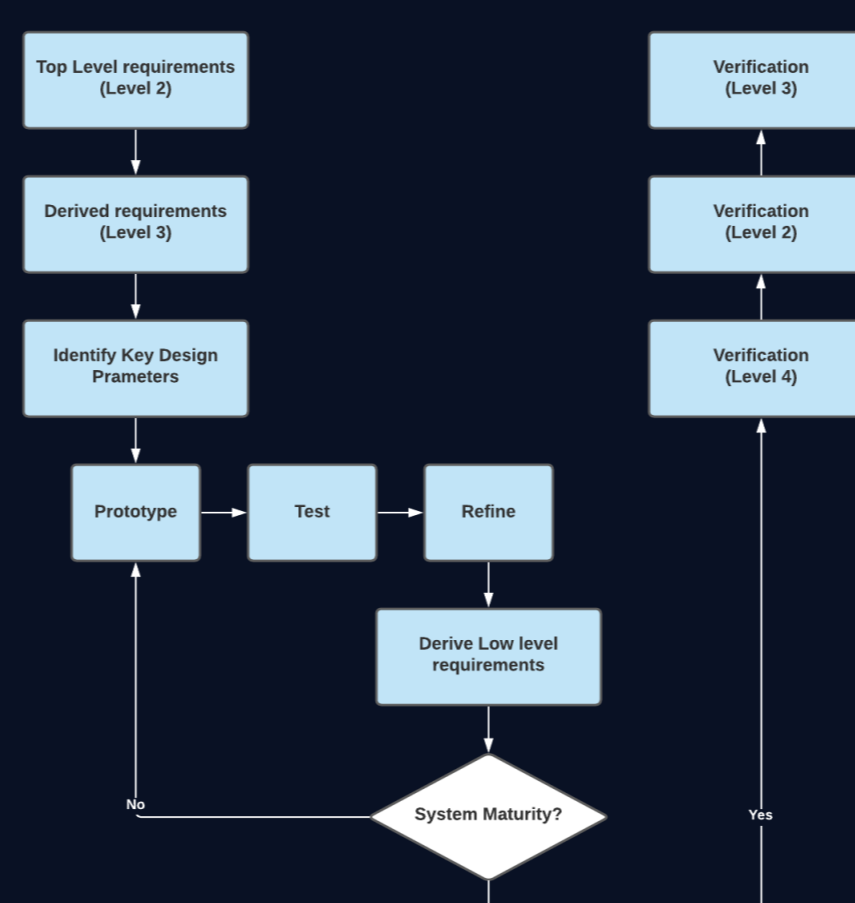
- Sensitive chemical composition analysis of the exosphere and ionosphere
- Analysis of
 - exospheric temperatures
 - atmospheric escape
 - dynamics of the exosphere and its drivers
 - night-side transport of species



Systems Engineering

One single source of truth :

At CHESS, Systems engineering is centralized in a cloud based software. This allows us to track and propagate the changes in variables from the subsystem-level to the whole system, automatically as a function of all the satellites components. This enables the team to have a reusable model of the satellite and, therefore be more productive and efficient during the life cycle of the project.



A modified V model for more efficiency:

The early phases of our mission were all about the development of rigorous requirements.

We created a hybrid version of the classic V model in which we iterate with a loop of Prototyping, testing, refining and finally deriving the low level requirements. This enables us to progress faster on our design solutions thanks to the flexibility of requirements. Engineers spend time refining the concept rather than wasting time on optimizing for unnecessary requirements.