



MOVE Satellites

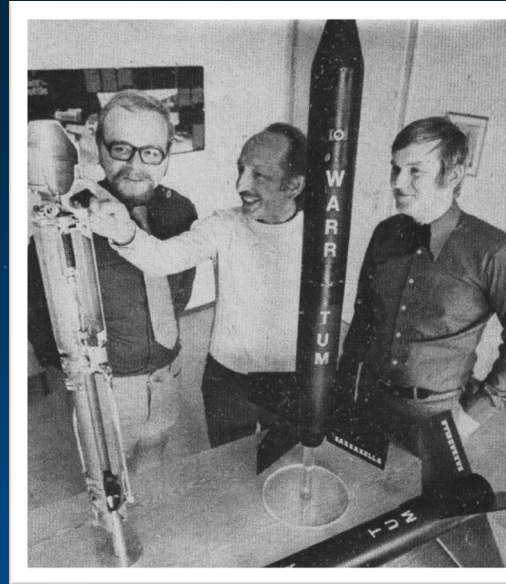
A brief overview of TUM student satellites

Presented By: MSc Marius Anger
Former MOVE member (PM and PR)



History of MOVE and WARR

- WARR (scientific work group for rocketry and space flight) since 1960
- Research:
 - Rocket fuels
 - first German hybrid rocket (1974)
 - Rocket motors (mostly hybrid)



History of MOVE and WARR

- Since 2012: Satellite Technology
- Cubesat development (MOVE)
- Student driven (up to 100 people)

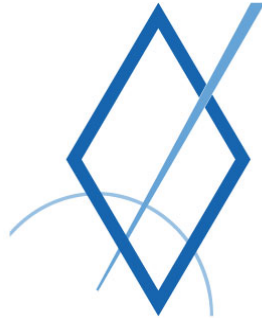


WARR

Scientific Workgroup for
Rocketry and Space Flight



Raketentechnik
seit 1962



Space Elevator
seit 2006



Satellitentechnik
seit 2012



Exploration
seit 2018



Space Labs
seit 2020

MOVE History

First-MOVE (launched 21st Nov 2013)

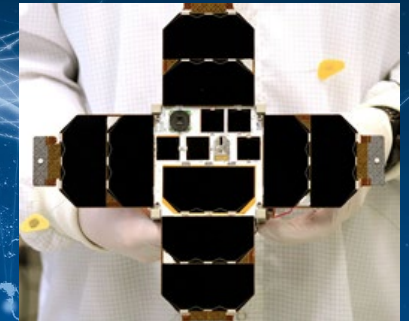
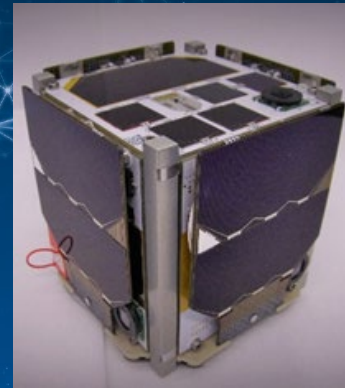
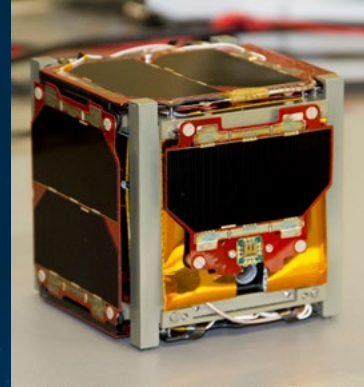
- Experimental Triple Junction Solarcells
- 1.3 MP Camera

MOVE-II (launched 3rd Dec 2018)

- Reusable Shape Memory Alloy Mechanism
- Communication via two Software-Defined Radios
- Fully-Magnetic Attitude Control System

MOVE-IIb (launched 5th July 2019)

- Improved copy of MOVE-II



First-MOVE (2009)

Goal: Built a satellite bus for future missions which only needs minor adjustments

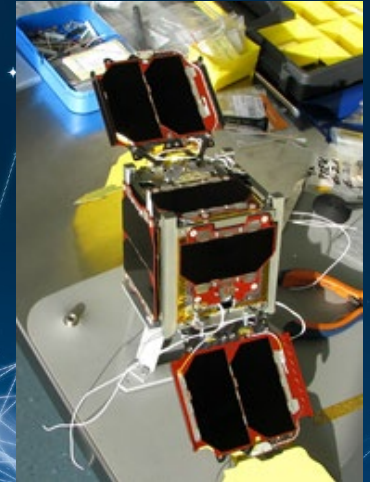
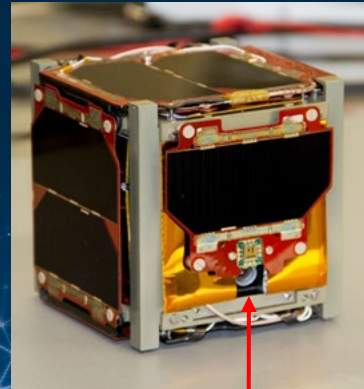
Main Design Objective:

„No matter what, MOVE shall create and deliver data!”

Highest Design Goal:

“Robustness rather than Efficiency”

-> Famous last words

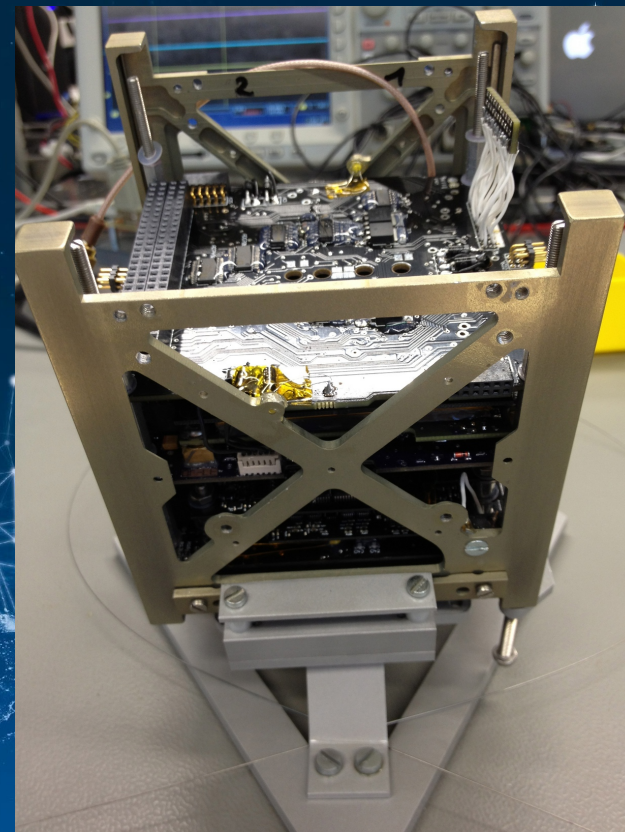


Camera

First-MOVE (2013)

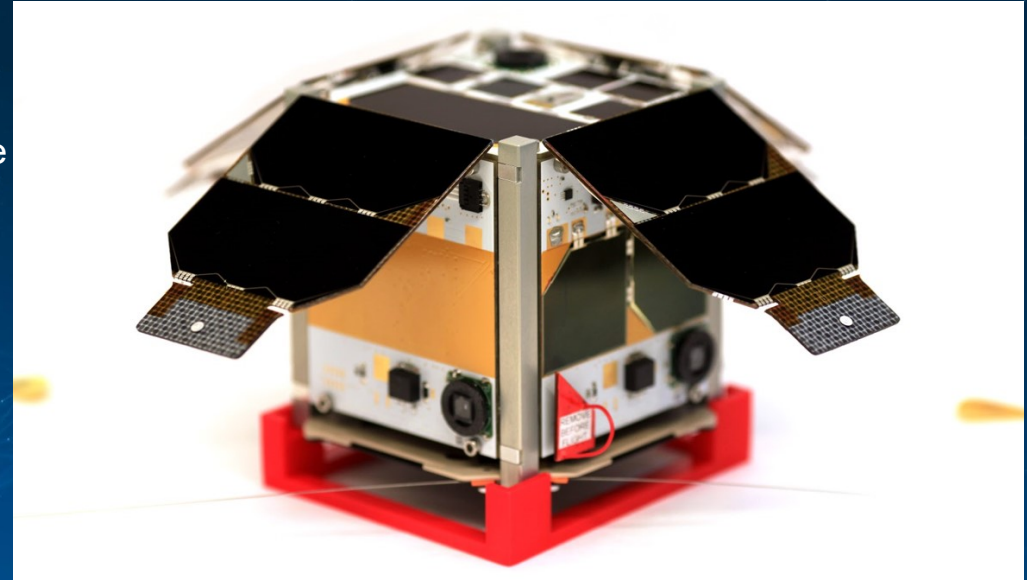
After 2 weeks deployment and successful communications:

- No data beacons
- Only CW beacon every 60 sec
- Propably software damage
- Possible scenario:
 - Hard power reset
 - Errors during write operation
 - Booting not possible anymore



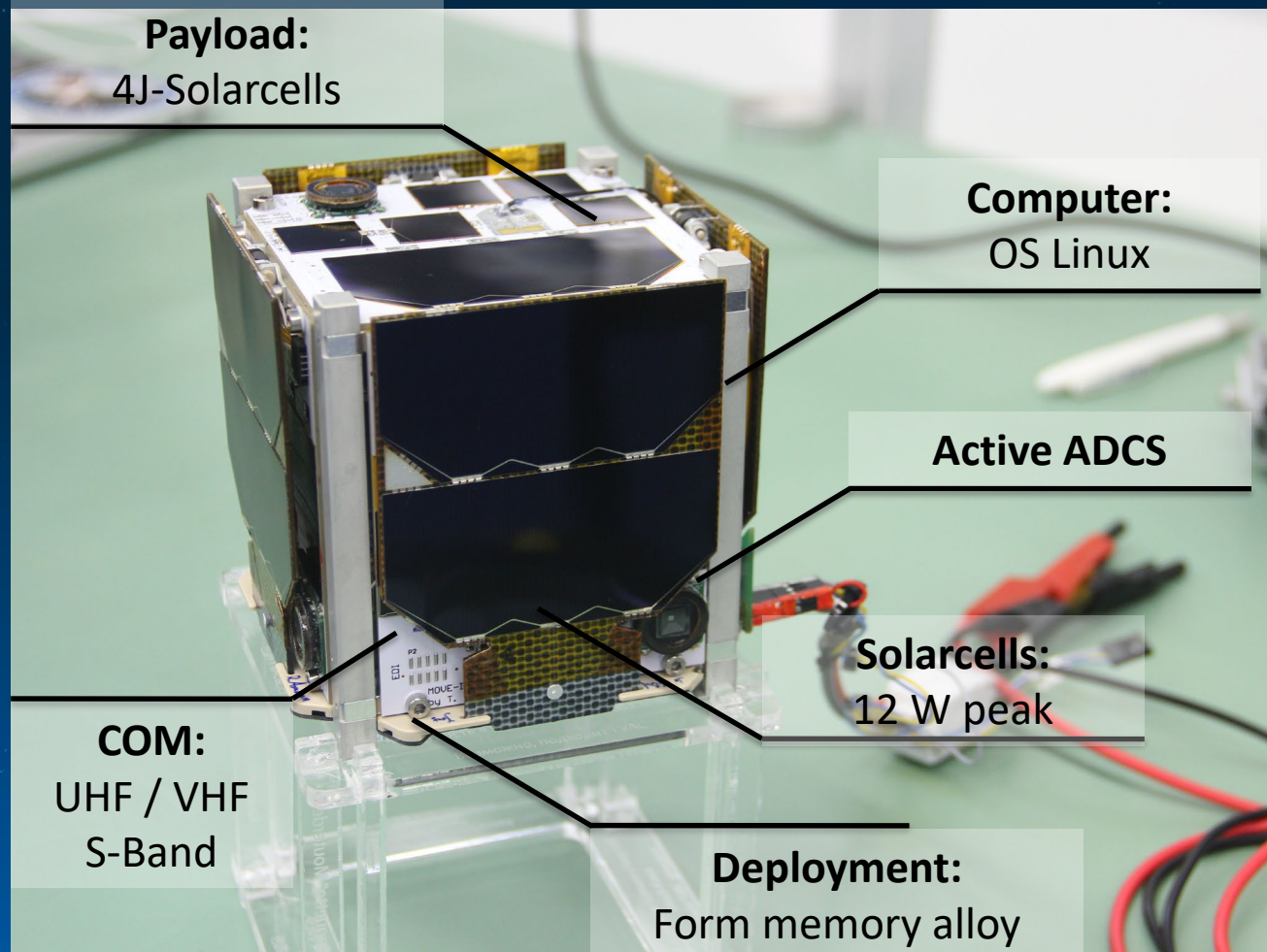
MOVE-II (Project start: 2015)

- Primary objectives: education and satellite bus verification
- Scientific payload: 4 junction solar-cells





MOVE-II



Payload:
4J-Solarcells

Computer:
OS Linux

Active ADCS

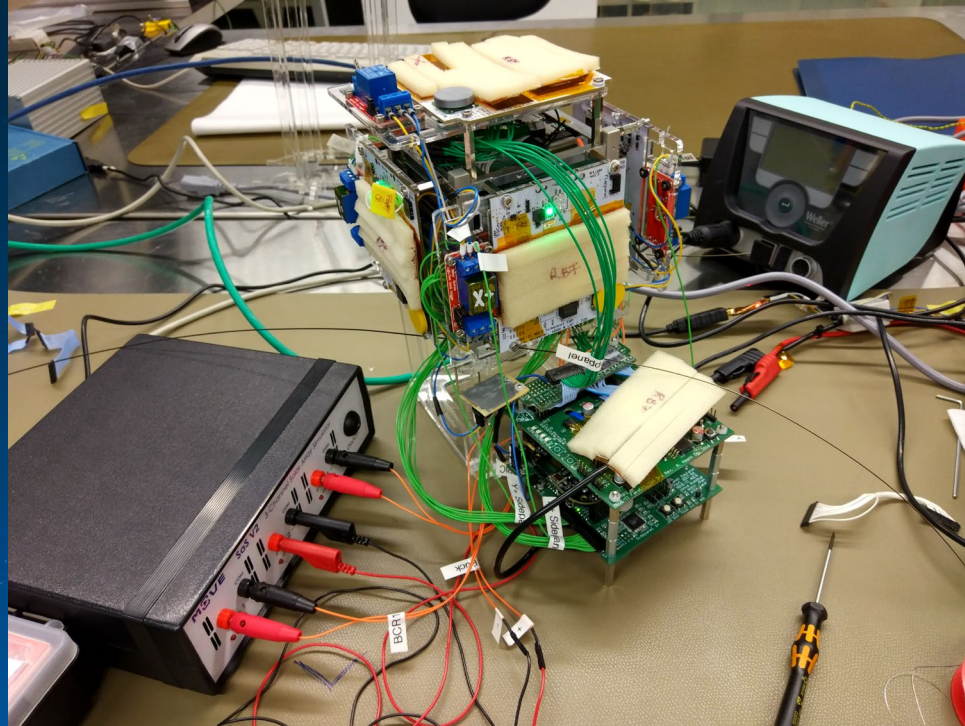
Solarcells:
12 W peak

COM:
UHF / VHF
S-Band

Deployment:
Form memory alloy



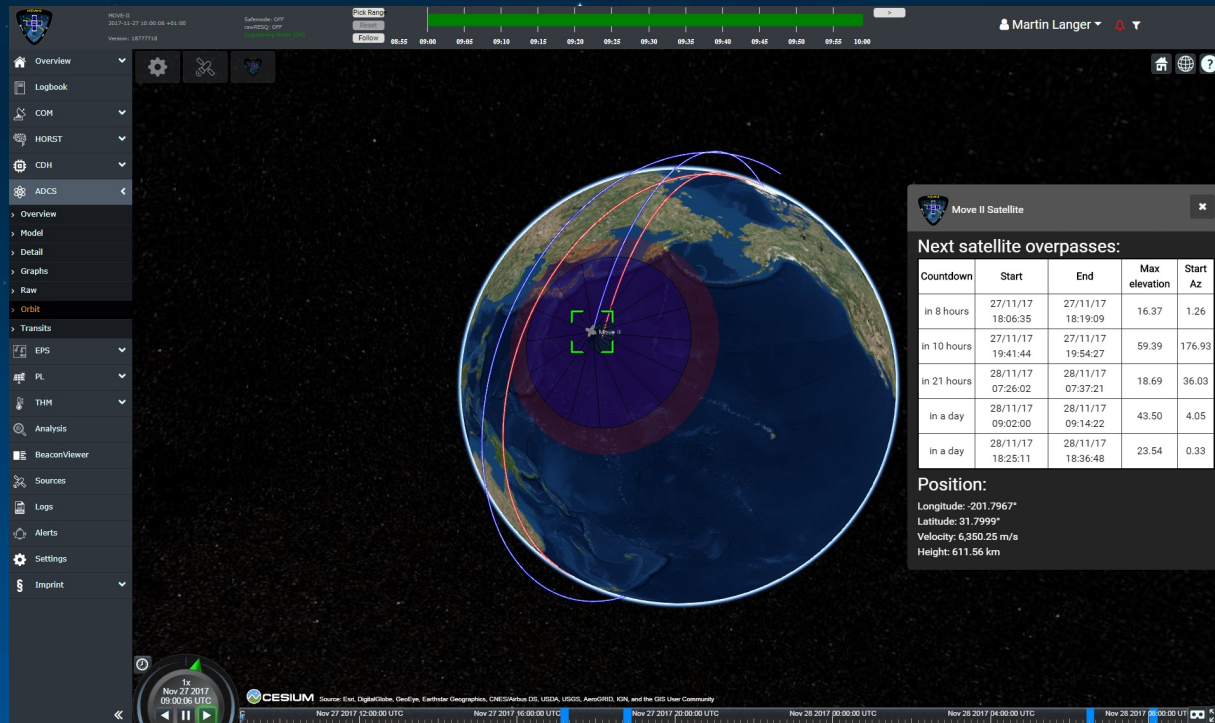
MOVE-II – Testing





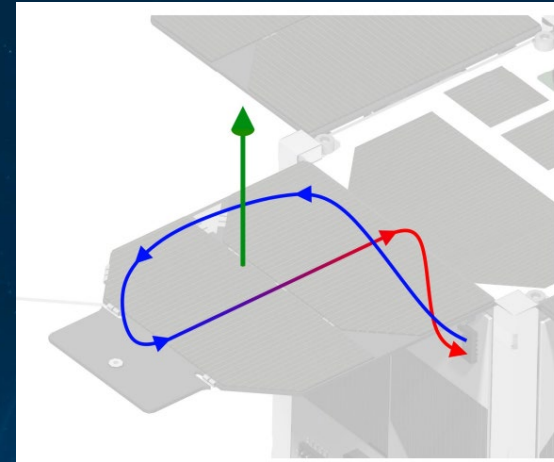
MOVE-II – OPS

- Web base interface
- All data can be viewed
- Commanding capabilities



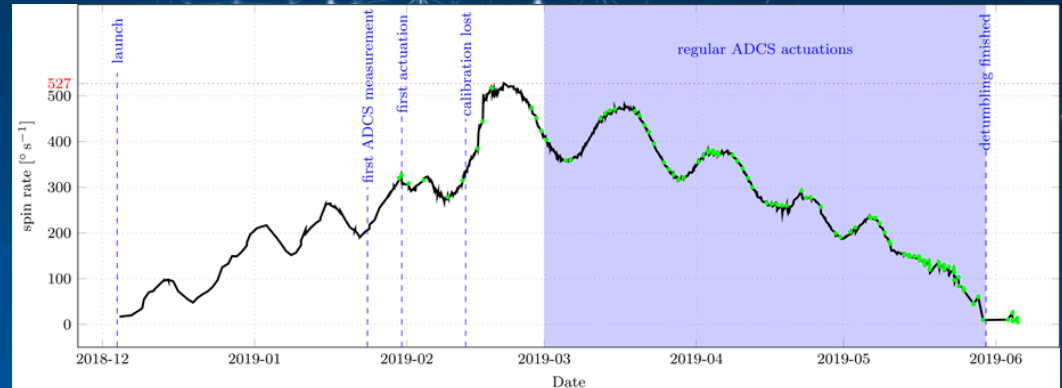
MOVE II Results from Operations

- Operational for **142** weeks
- Commissioning of important subsystems
- Ongoing Payload measurements



Problems:

- High spinrates:
 - Detumbling of satellite from over **500 °/s**
 - Unstable com link
- 0 MB free data
- Negative power budget

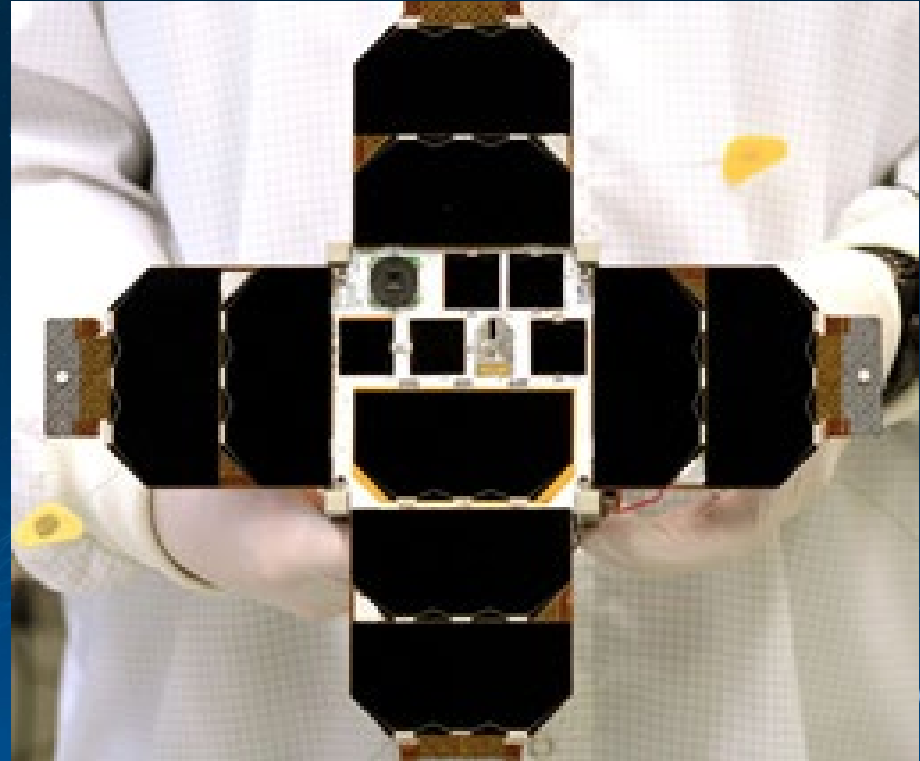


MOVE IIb Results

- **108 weeks in space**
- Limited operations

Problems:

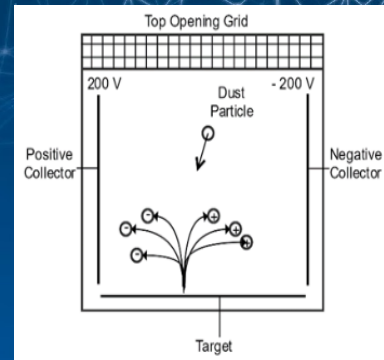
- COM module broken
 - Limited data from satellite
- With help of radio amateurs
 - Beacons received
- High spin rate



MOVE-III Mission: Debris and Micrometeoroid Model Validation

Scientific Objective:

- Conduct in-situ measurements of submillimeter space debris and micrometeoroid particles
- Debris Density Retrieval and Analysis (DEDRA) sensor.



MOVE-III Mission: Debris and Micrometeoroid Model Validation

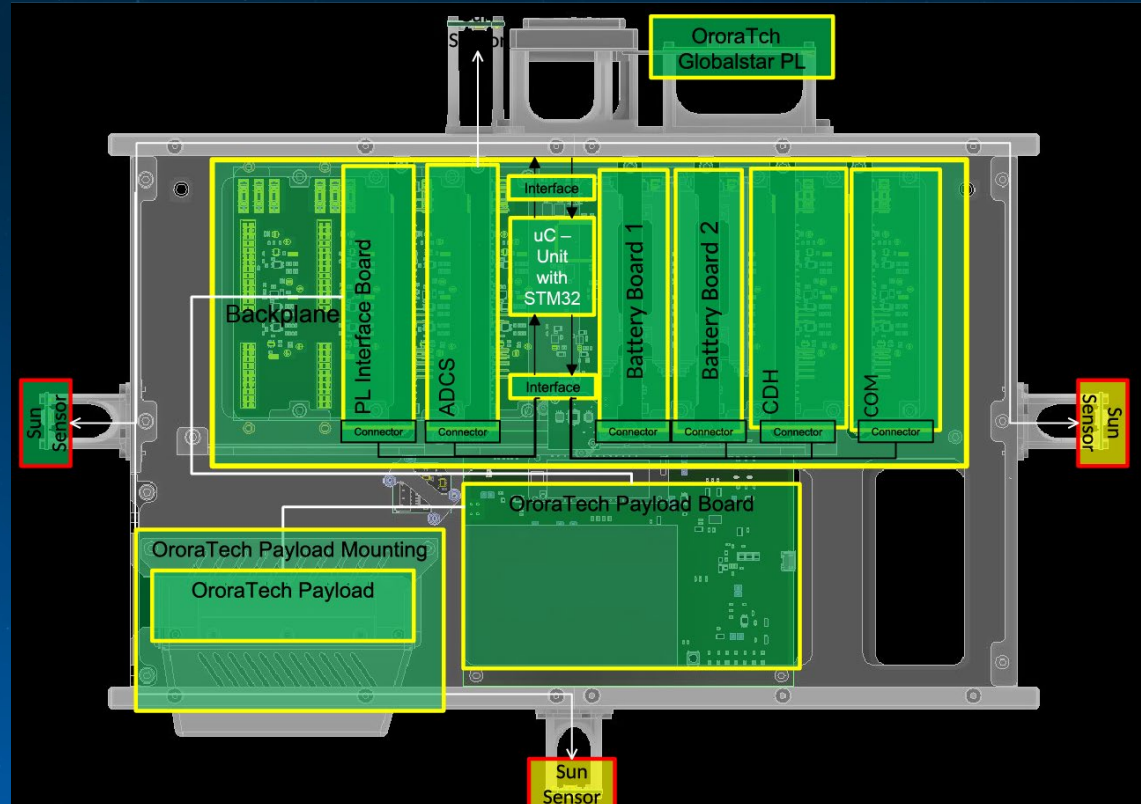
Proposed Configuration

6U CubeSat
3 forward facing sensors (total 300 cm^2)
Sun-synchronous orbit, $>550 \text{ km}$ altitude

- Targeting high flux orbits
- Trying to find the best trade-off between effective sensor area and CubeSat size requirements
- Assessment of micrometeoroid impacts aside from space debris



MOVE-III Balloon System Overview

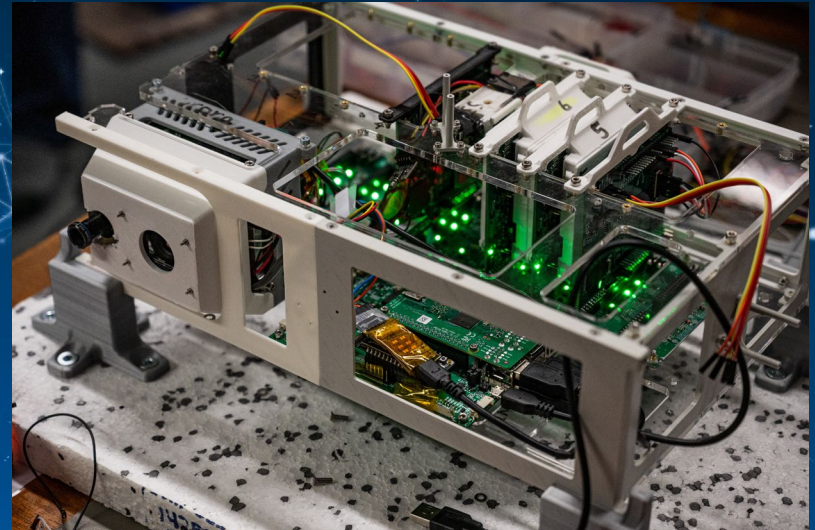
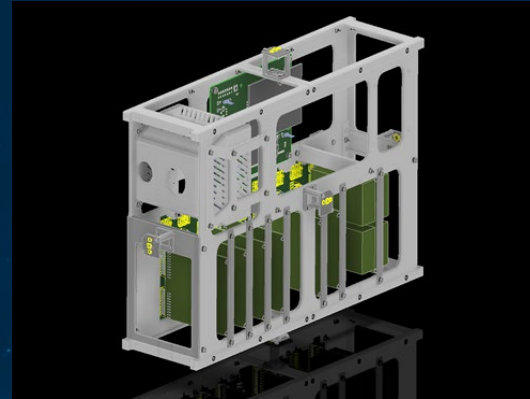


Current Status

- Distributed main bus was successfully launched (balloon)
- Several systems were verified
- Payload data has been collected

Next:

- balloon launch with DTU
 - DTU: GPS-Tracker to track birds
 - Ororatech: Updated IR-Camera
- Dec 2021: Preliminary Design Review
- Subsequent CDR and testing -> Launch in ~2023





Thank you for listening!

move2space.de
warr.de