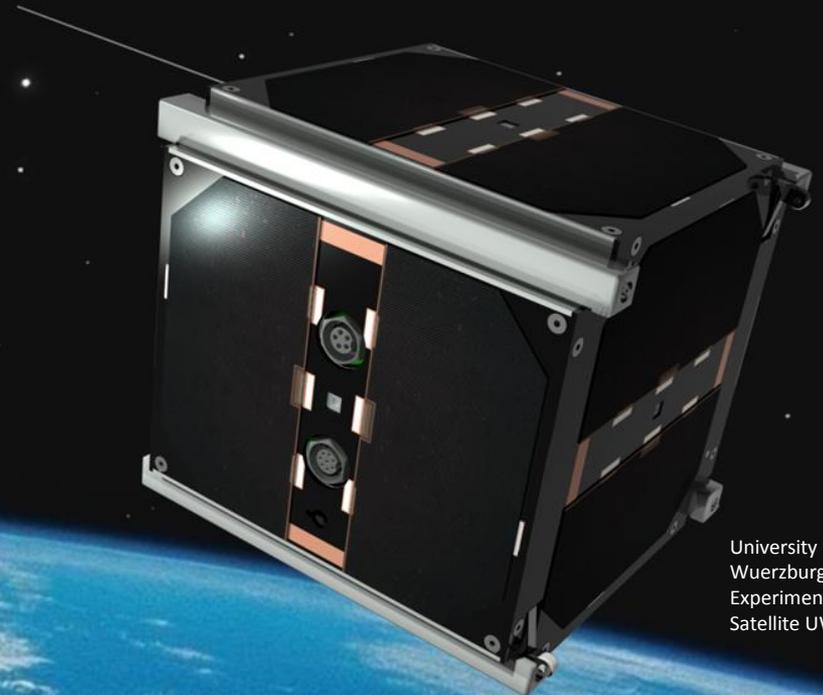




Student Space Activities in Würzburg, Germany

3rd UNISEC Global Meeting
July 05, Tokyo, Japan



University
Würzburg
Experimental
Satellite UWE-3



Longterm Roadmap

University Würzburg Experimental satellites | NetSat



2018 NetSat-1 to NetSat-4
Formation Flying Mission

- Distributed Computing Capabilities
- Formation Control
- DTNs, MANets

- **2017 UWE-5**
Relative Navigation
- **2016 UWE-4**
Position Control
- **2013 UWE-3**
Attitude Control
- **2009 UWE-2**
Attitude- and Orbit Determination
- **2005 UWE-1**
Telecommunication "Internet in Space"

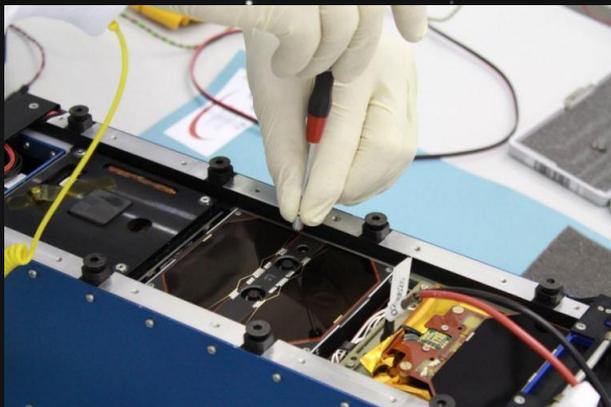
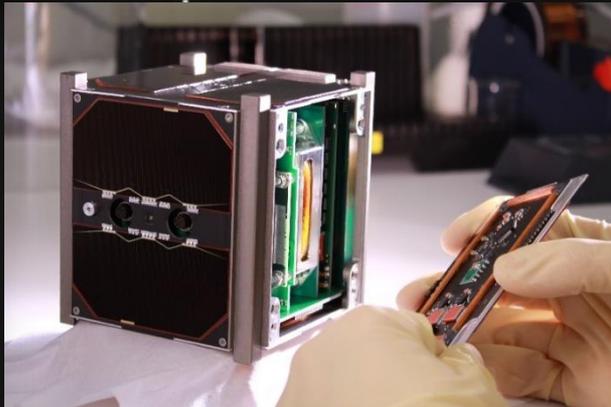
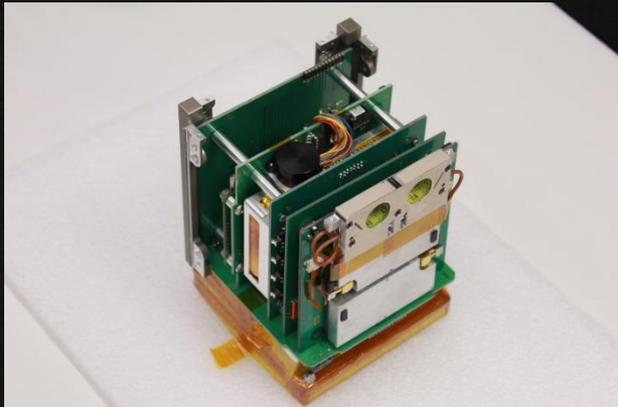




UWE-3 Launch and Operation

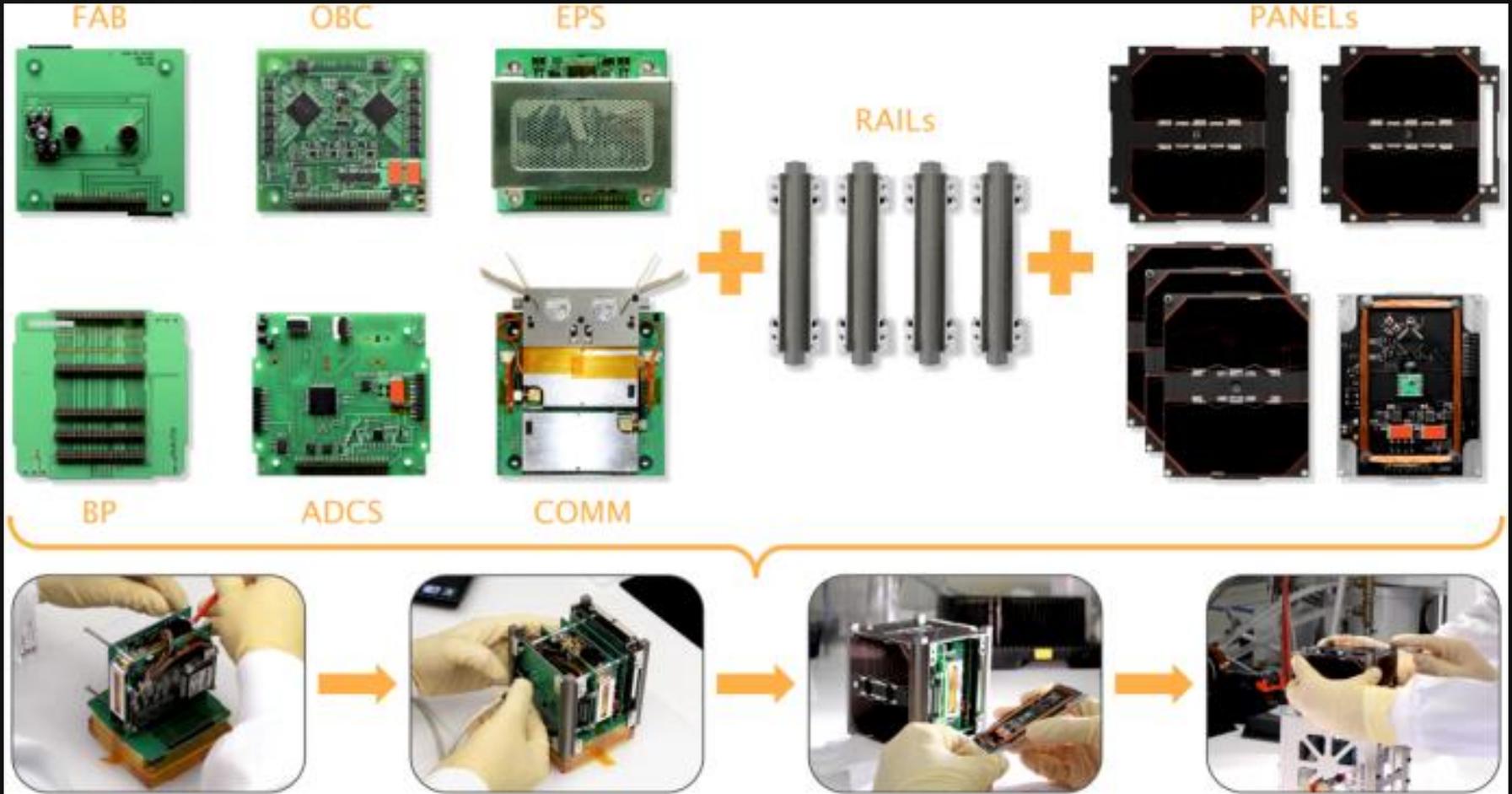
Launched in Nov. 2013,

3 extensive software updates for more features, continuously operational





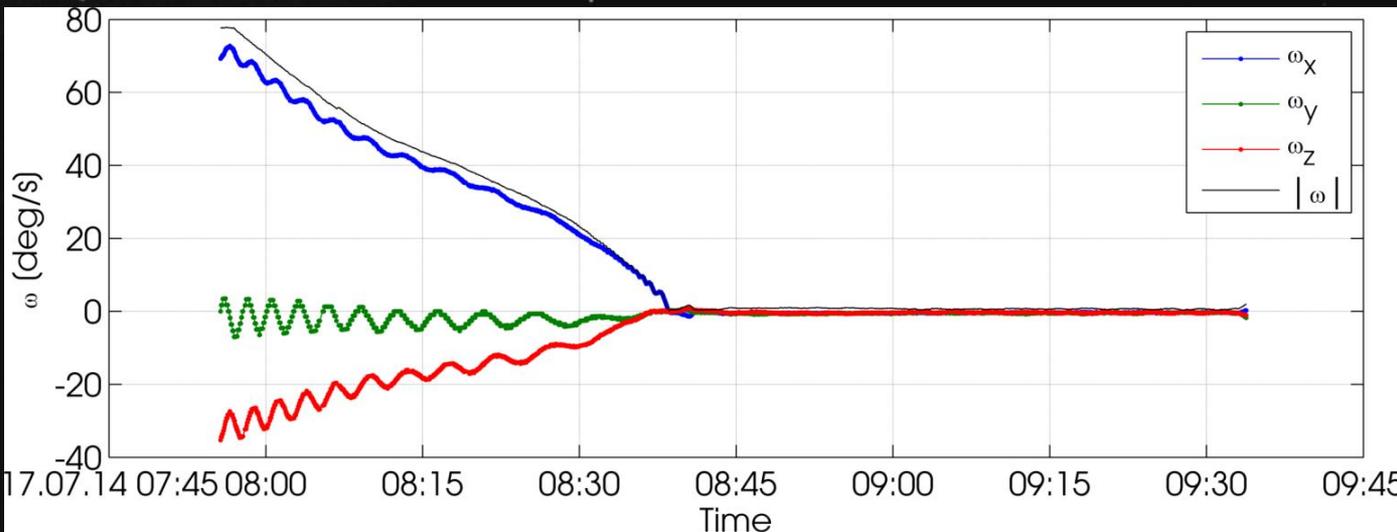
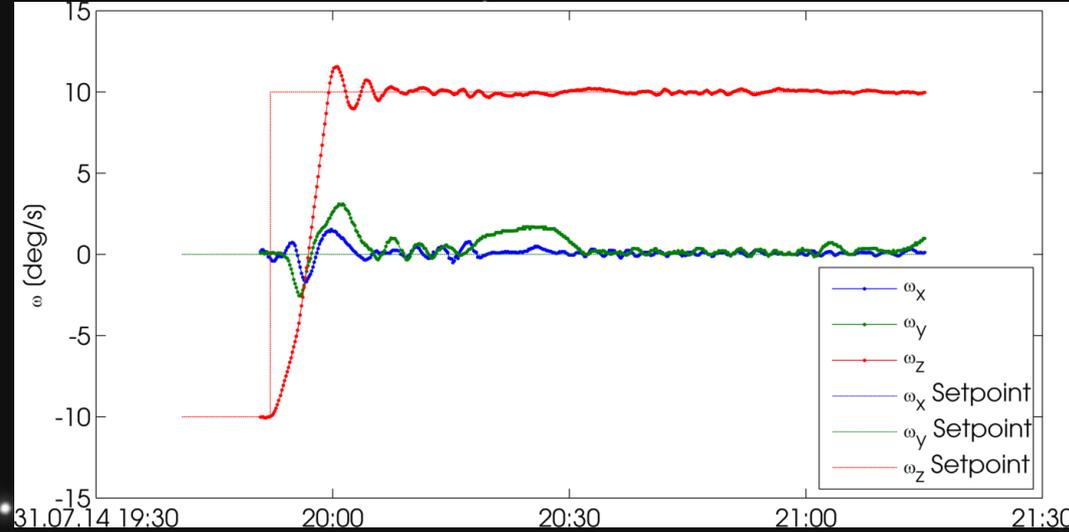
UWE Bus





Attitude Control

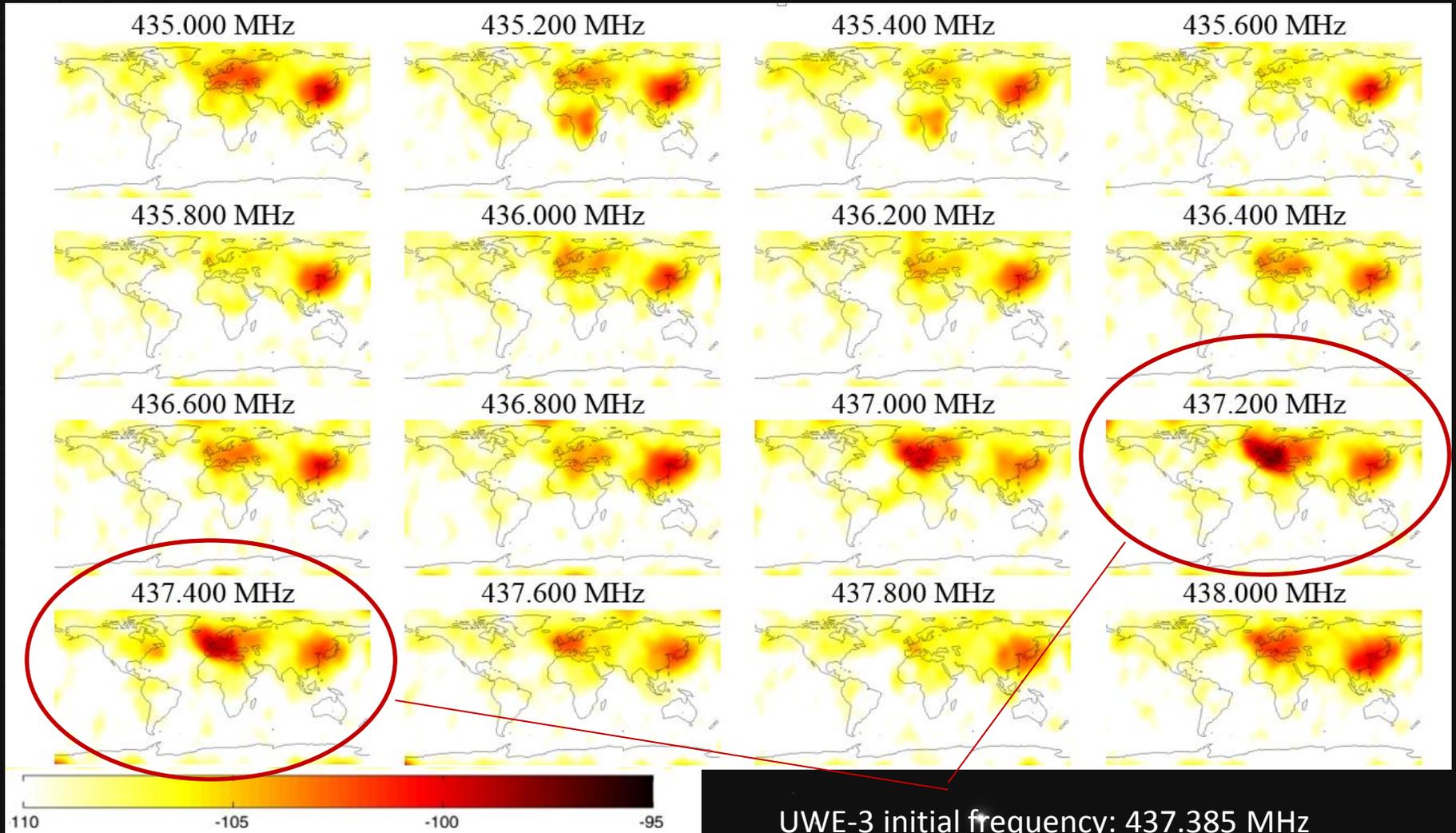
- Precise spin control of one axis (z-axis) as preparation for spin stabilized control
- Transition from -10 deg/s to 10 deg/s in 18 min



Spin dumping could be proven effectively even from high spin rates of >80 deg/s



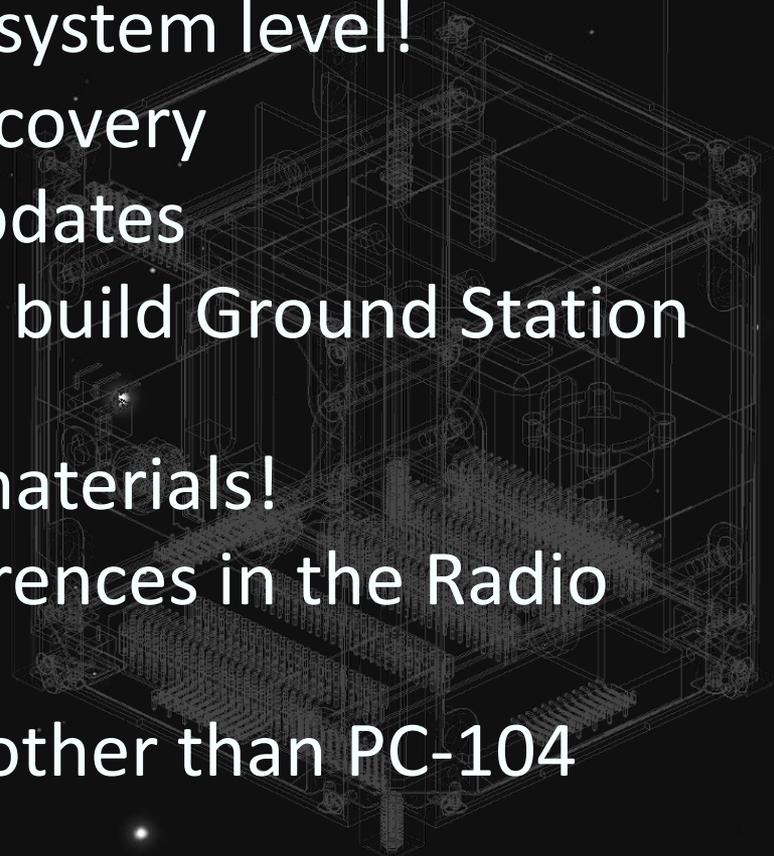
Frequency Interference





Lessons learned

- Modularity reduces complexity
- Testing, testing, testing... during development on component, subsystem and system level!
- Redundancy and latch-up recovery
- Plan for in-orbit software Updates
- Include Radio Amateurs and build Ground Station Network
- Be careful about magnetic materials!
- There are Frequency Interferences in the Radio Amateur Band
- New CubeSat Bus Standard other than PC-104

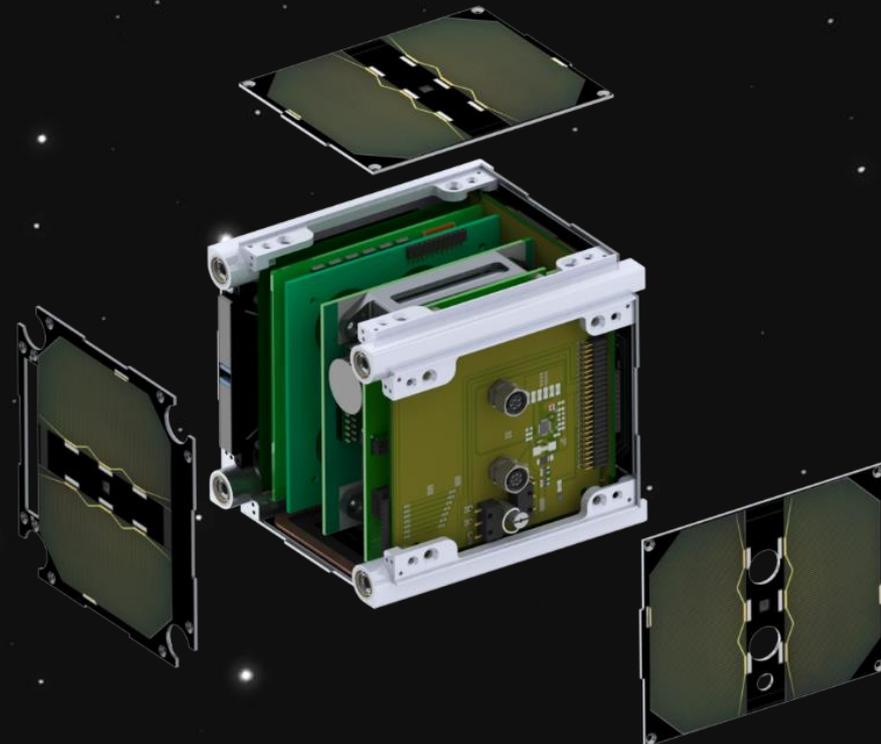




UWE-4

Electric Propulsion in the 1U Class

- National Partners for electric prop. System
- Attitude and Orbit control possible
- Launch as soon as possible

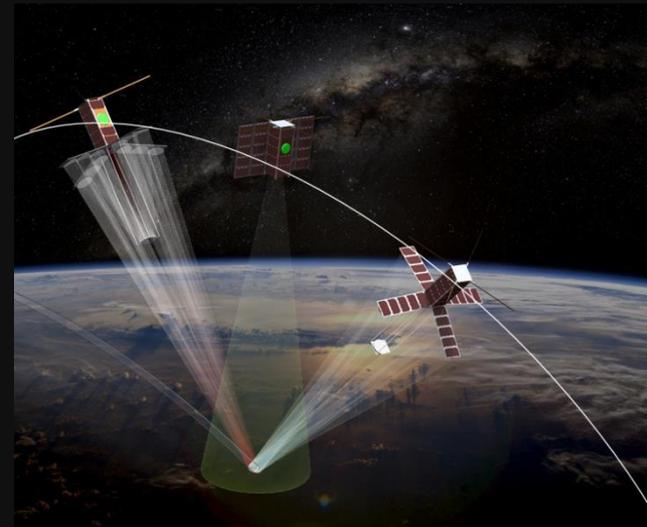
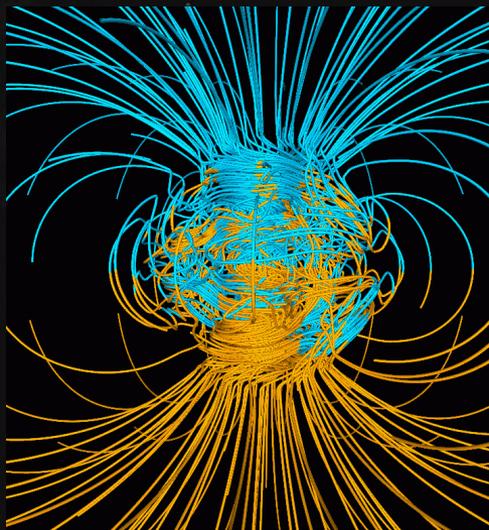




NetSat

Formation Flying CubeSats

- Inter-Satellite Communication
- Distributed Sensor System
- Relative Navigation
- Autonomous and Adaptive Formation Control Strategies

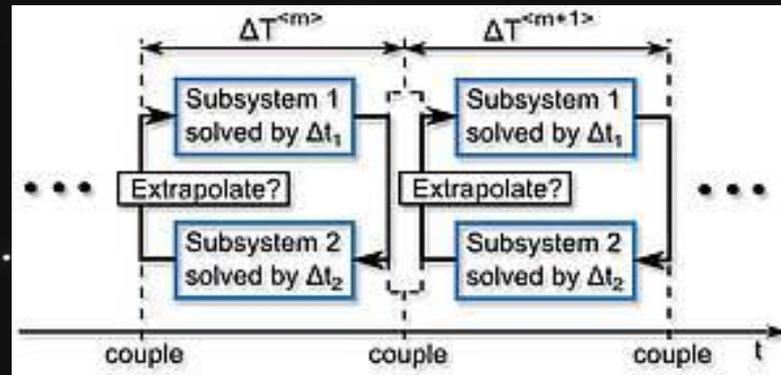




Simulation Framework

Extended Simulator for Formation Flying Satellites

- Multi-rate and hybrid
- High fidelity attitude and orbit simulation
- Incorporating communication and subsystem simulation
- Inherent support for hardware-in-the-loop tests



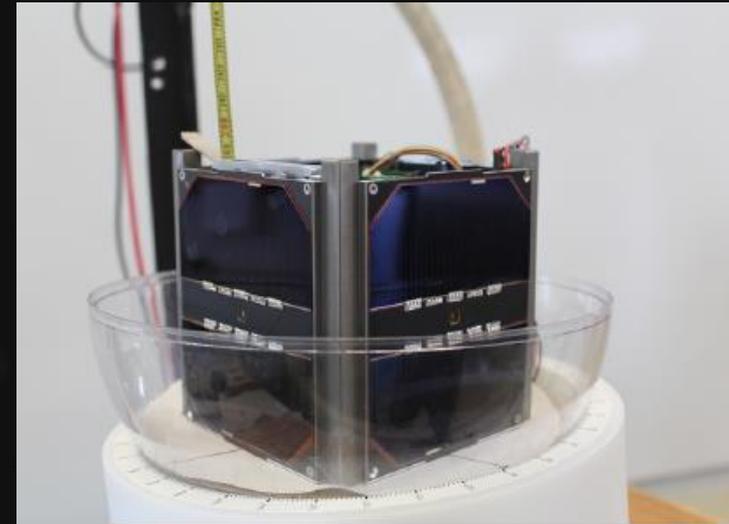
<http://www.v2c2.at/research/ee-software/co-simulation/>



Formation Test Center

Test Facility for Formation Flying Satellites

- Hardware-in-the-loop tests for control systems
- Test of inter-satellite communication
- Relative Navigation tests



Thank you for your attention!

