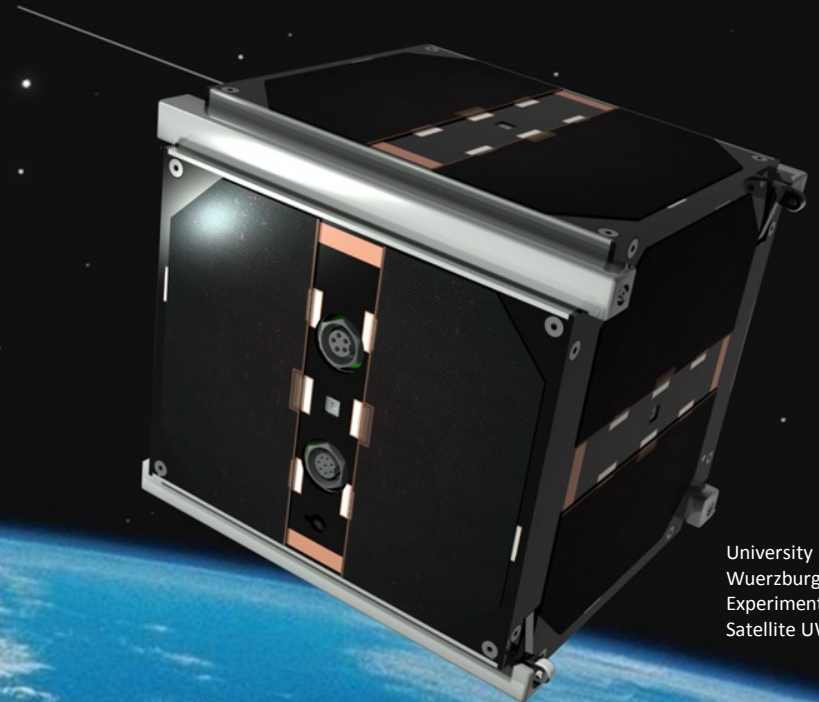# Student Space Activities in Würzburg, Germany

3rd UNISEC Global Meeting

July 05, Tokyo, Japan
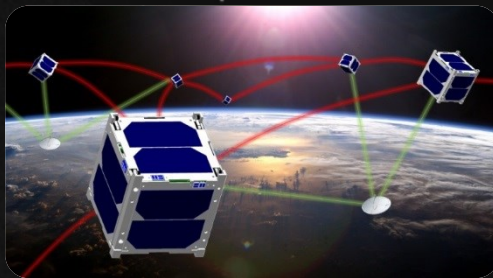
University Wuerzburg Experimental Satellite UWE-3

Longterm Roadmap

University **W**ürzburg **E**xperimental 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
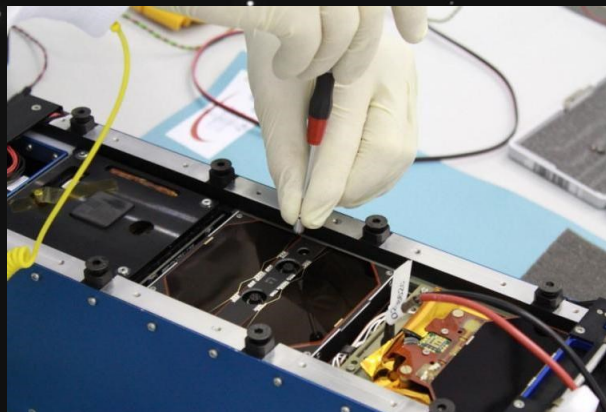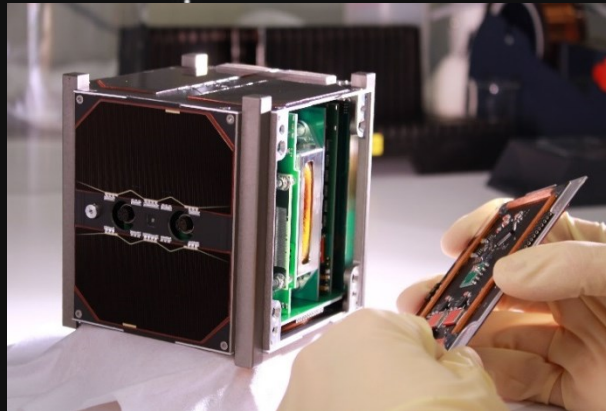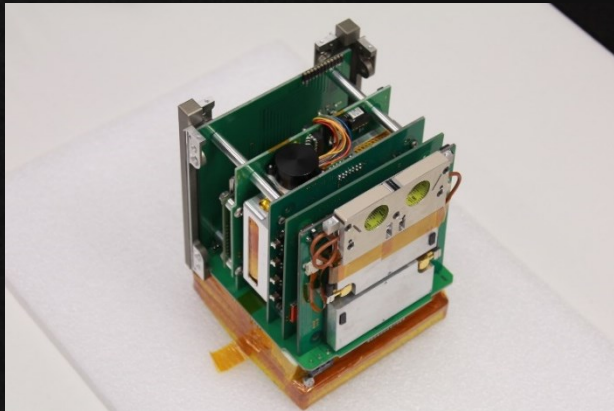- Telecommunication "Internet in Space"
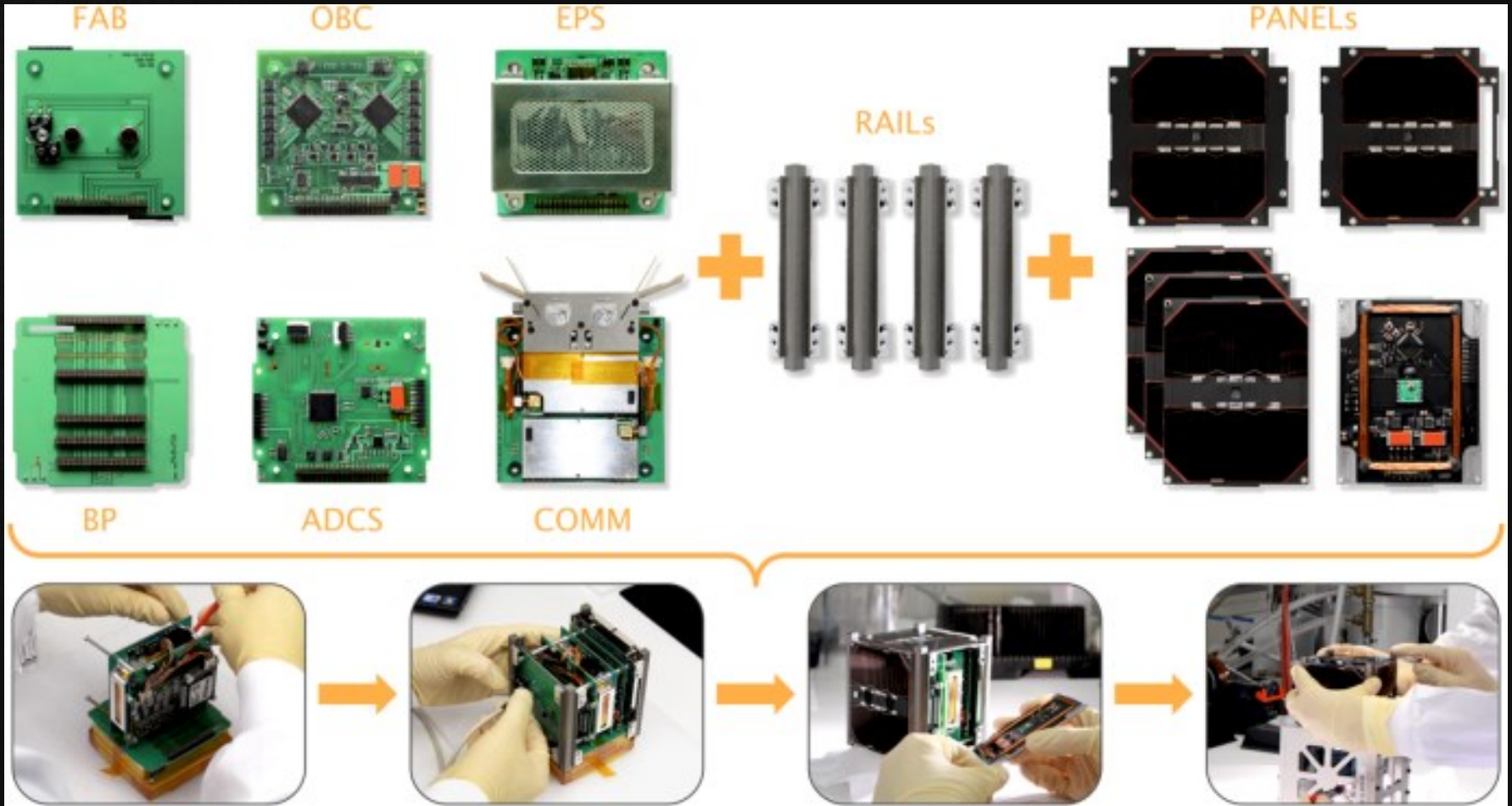
UWE-3 Launch and Operation

Launched in Nov. 2013,
3 extensive software updates for more features, continuously operational
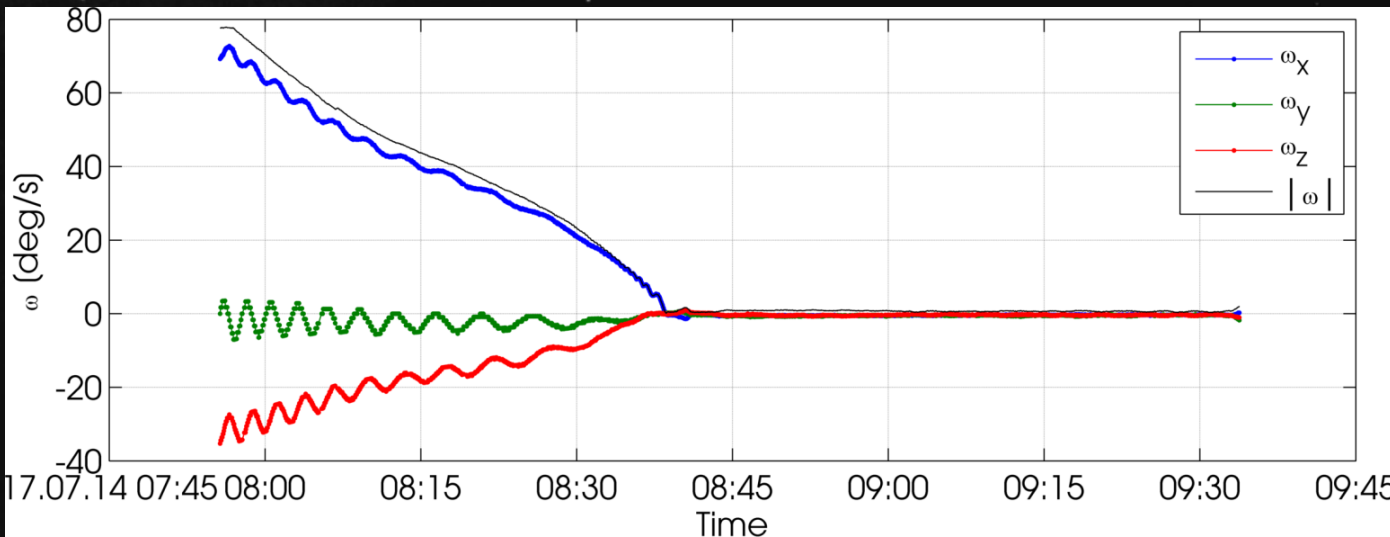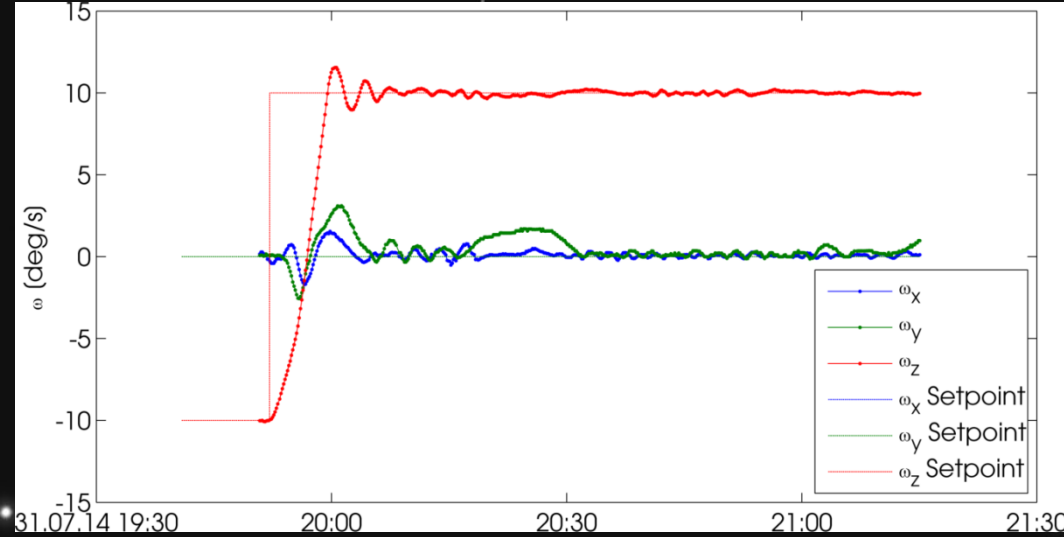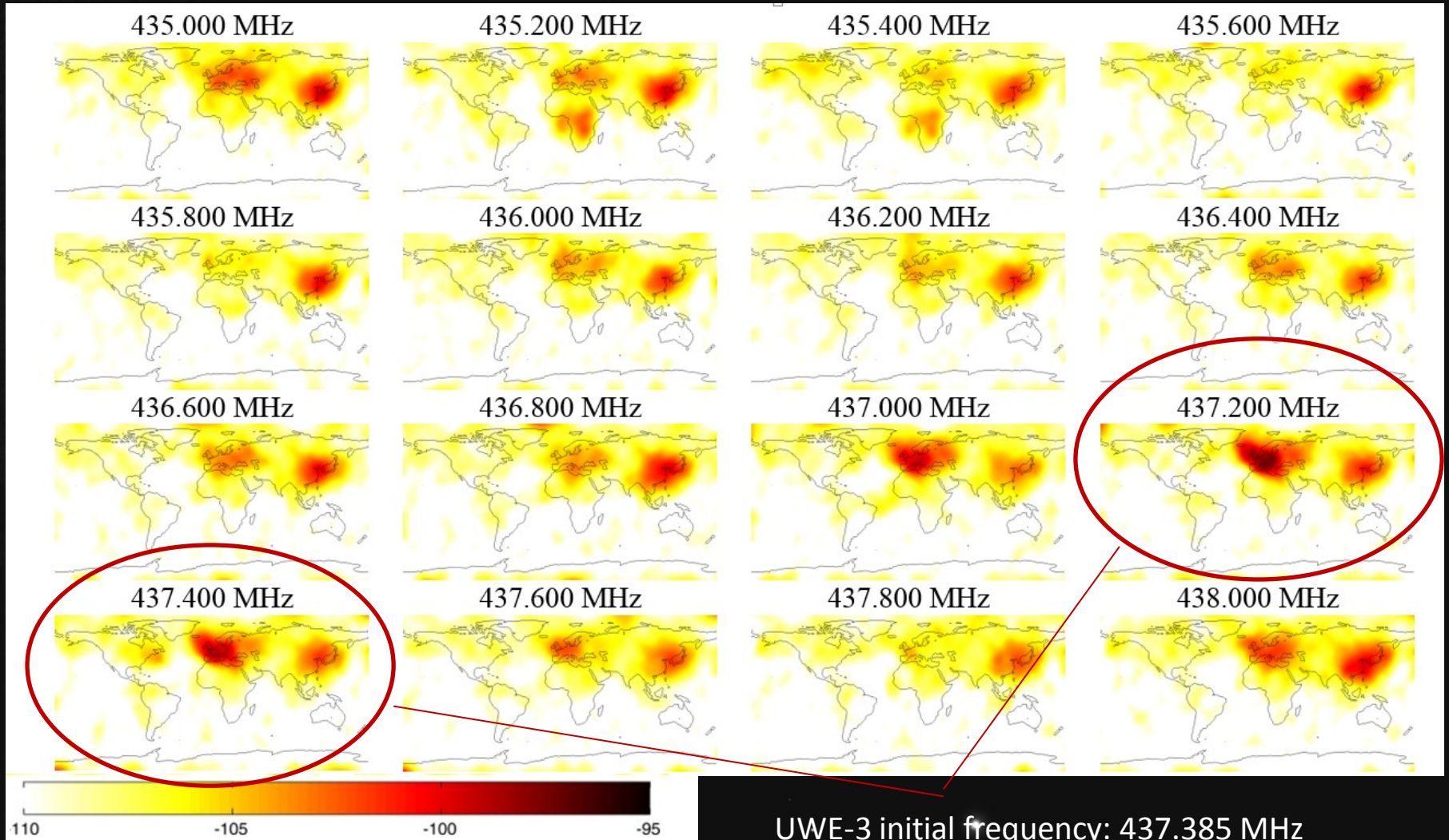
UWE Bus

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

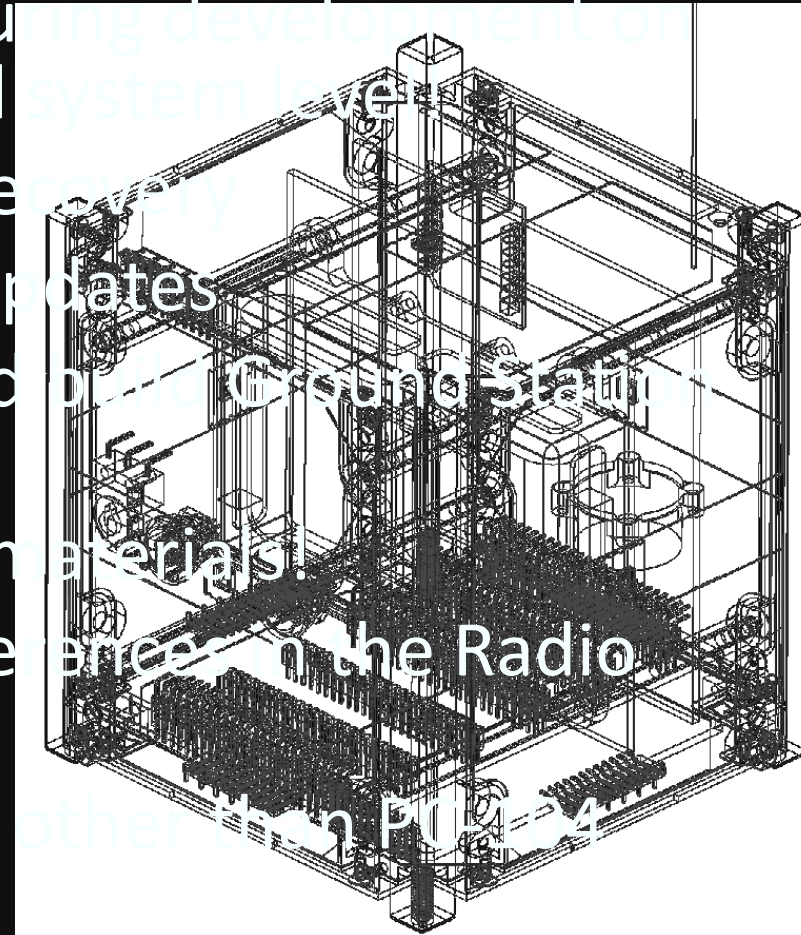Spin dumping could be proven effectively even from high spin rates of >80 deg/s

Frequency Interference

RSSI [dBm]

UWE-3 initial frequency: 437.385 MHz

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
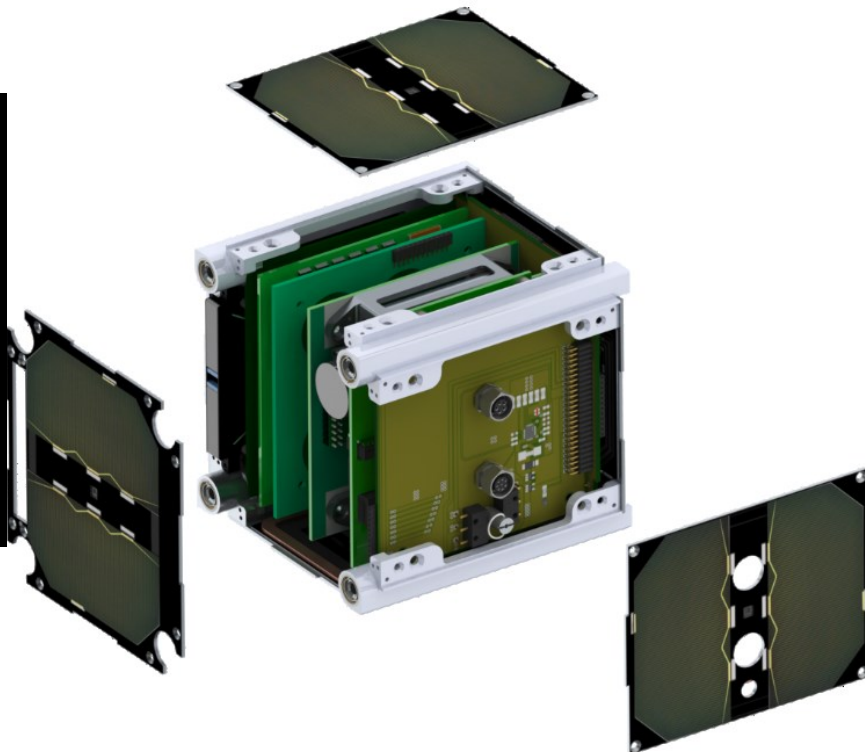- New CubeSat Bus Standard other then PC-104

UWE-4

Electric Propulsion in the 1U Class

- National Partners for electric prop. System

- Attitude and Orbit control possible

- Launch

NetSat

Formation Flying CubeSats

- Inter-Satellite Communication

- Distributed Sensor System

- Relative Navigation

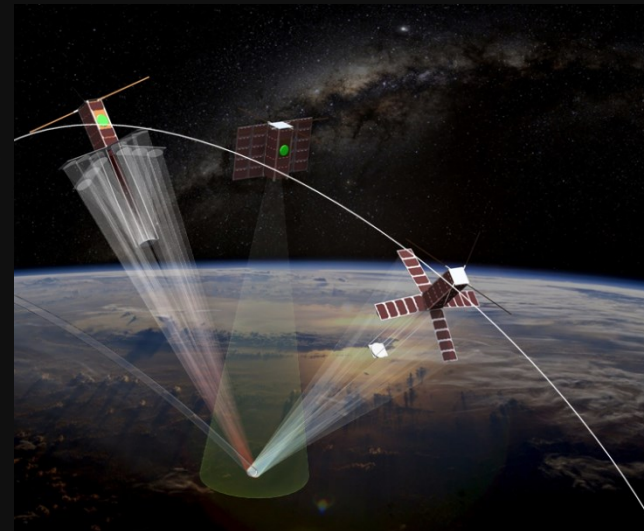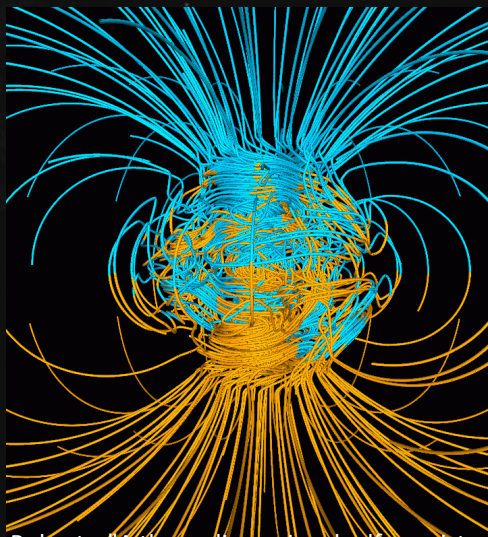- Autonomous and Adaptive Formation Control Strategies

Image thanks to
G.A. Glatzmaier and P.H. Roberts, "A three-dimensional self-consistent computer simulation of a geomagnetic field reversal", Nature 377 (1995), p. 203-209 .
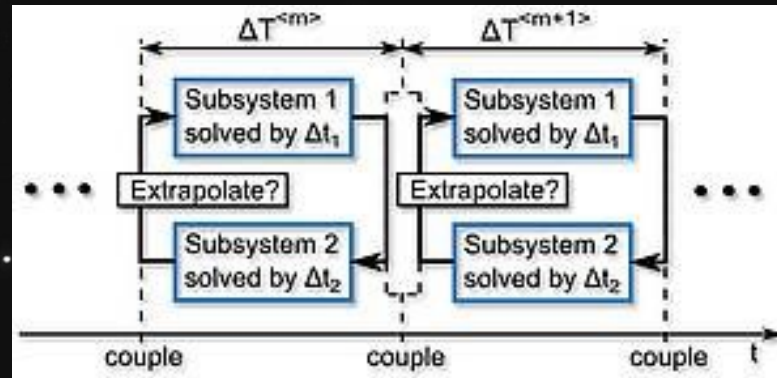http://www.es.ucsc.edu/~glatz/geodynamo.html

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

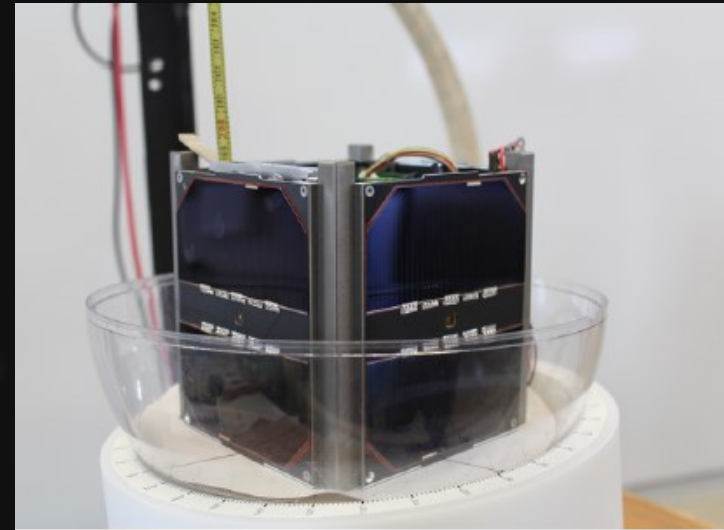http://www.v2c2.at/research/ee-software/co-simulation/

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!