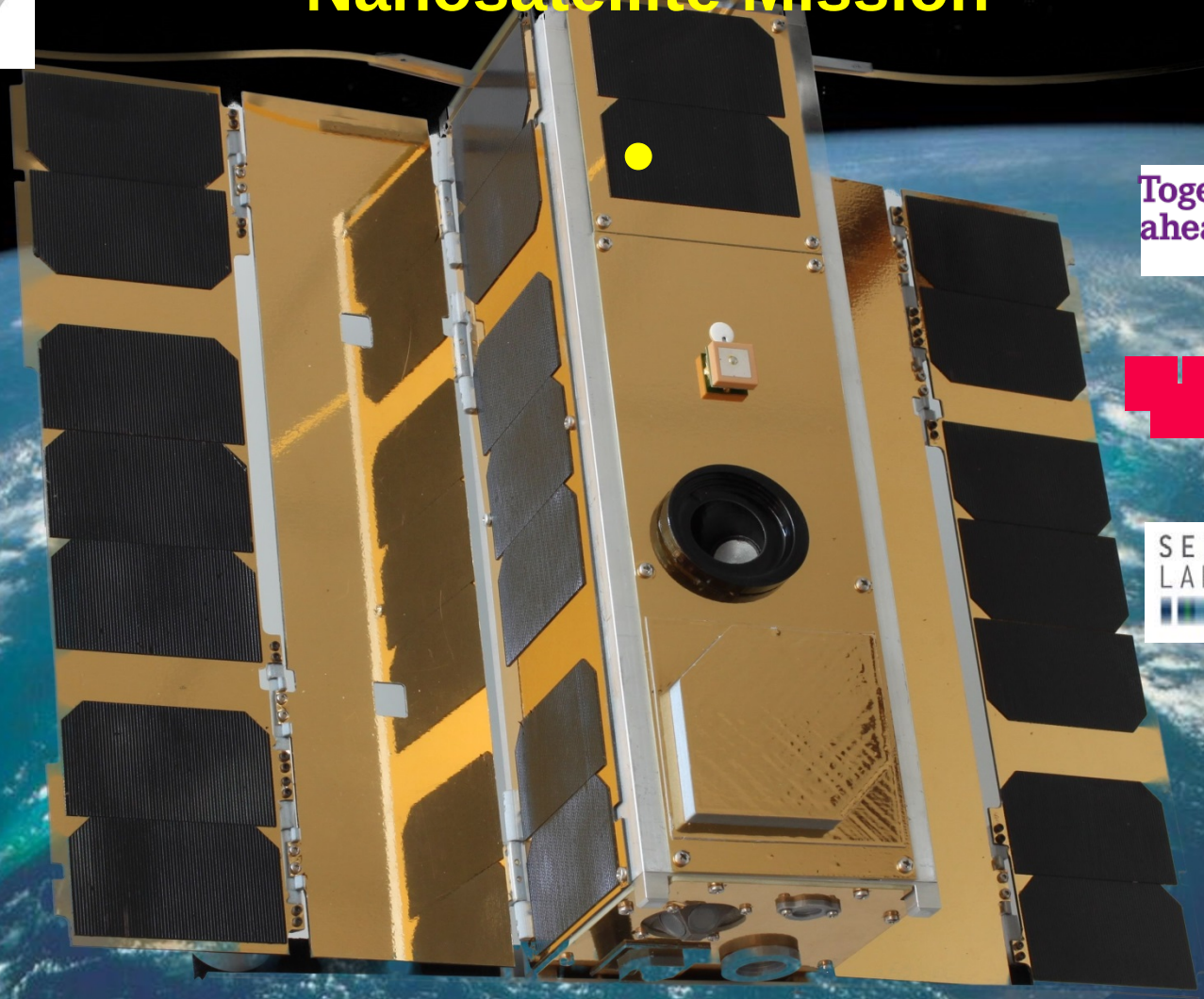
PRETTY

A Passive Altimetry and Dosimetry Nanosatellite Mission



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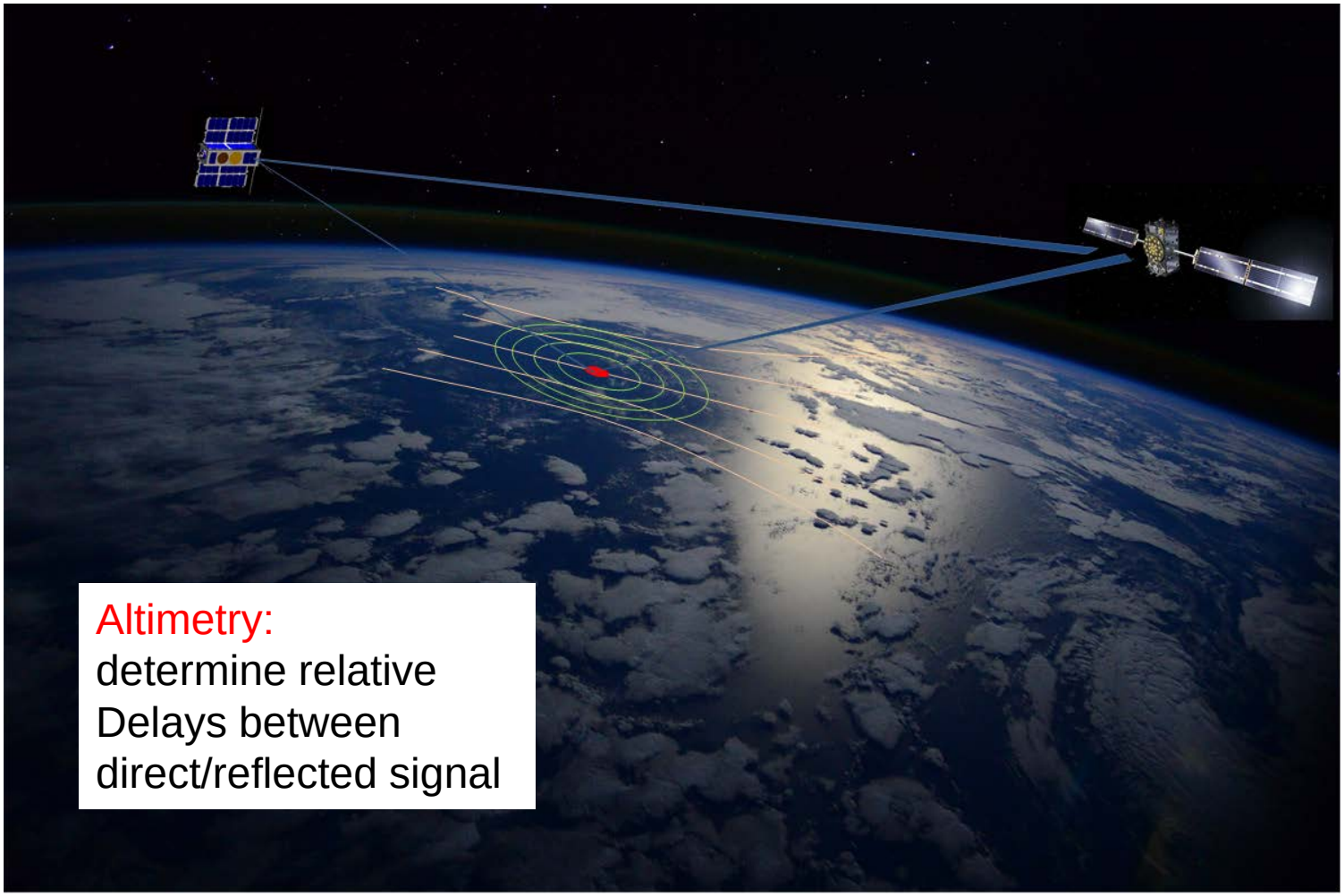
RUAG Space Austria

Contents

Introduction

- TU Graz is developing an advanced CubeSat for ESA, called OPS-SAT
- RUAG Space Austria and TU Graz: study of passive reflectometry (ASAP project)
- Proposal for an Austrian CubeSat to GSTP: PRETTY (Passive REflectometry and DosimeTrY)
- 3U CubeSat with powerful processor and SDR front-end

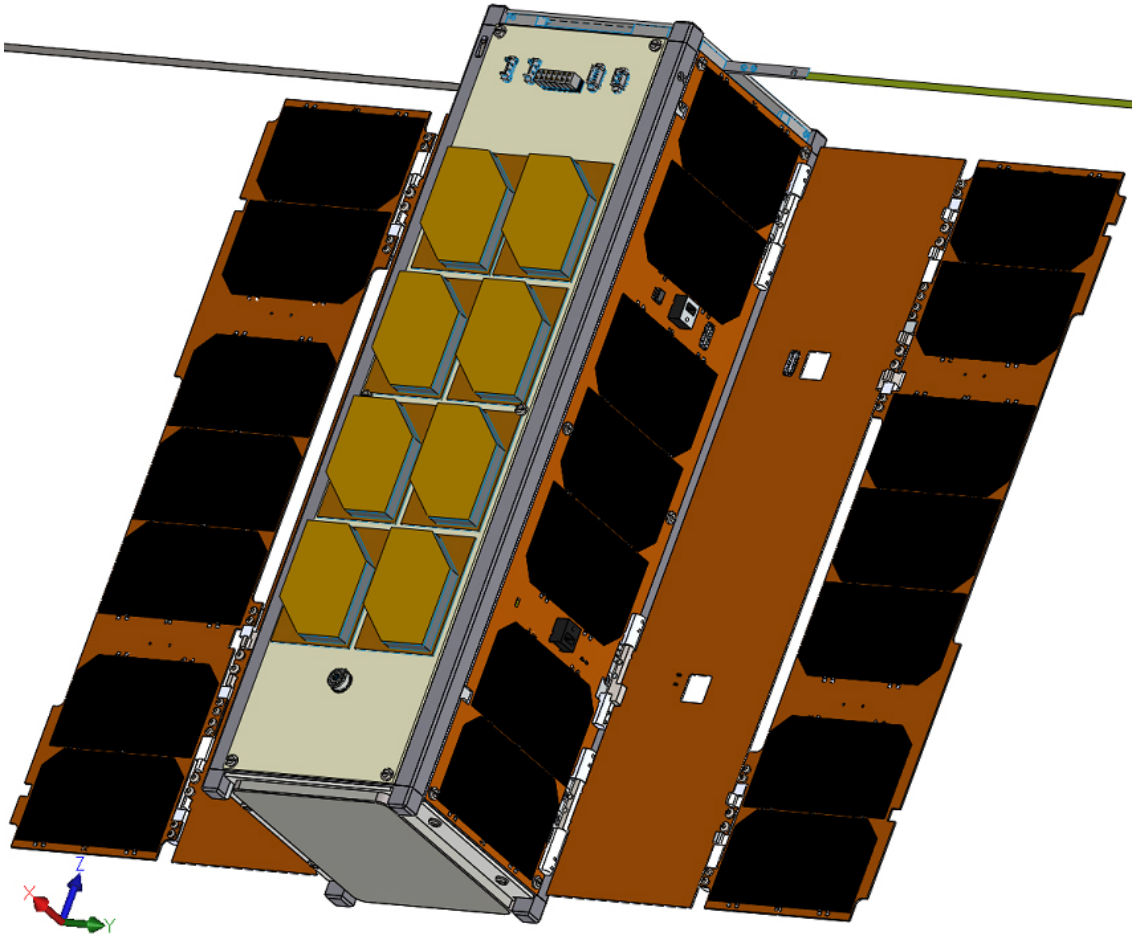
Passive Reflectometry

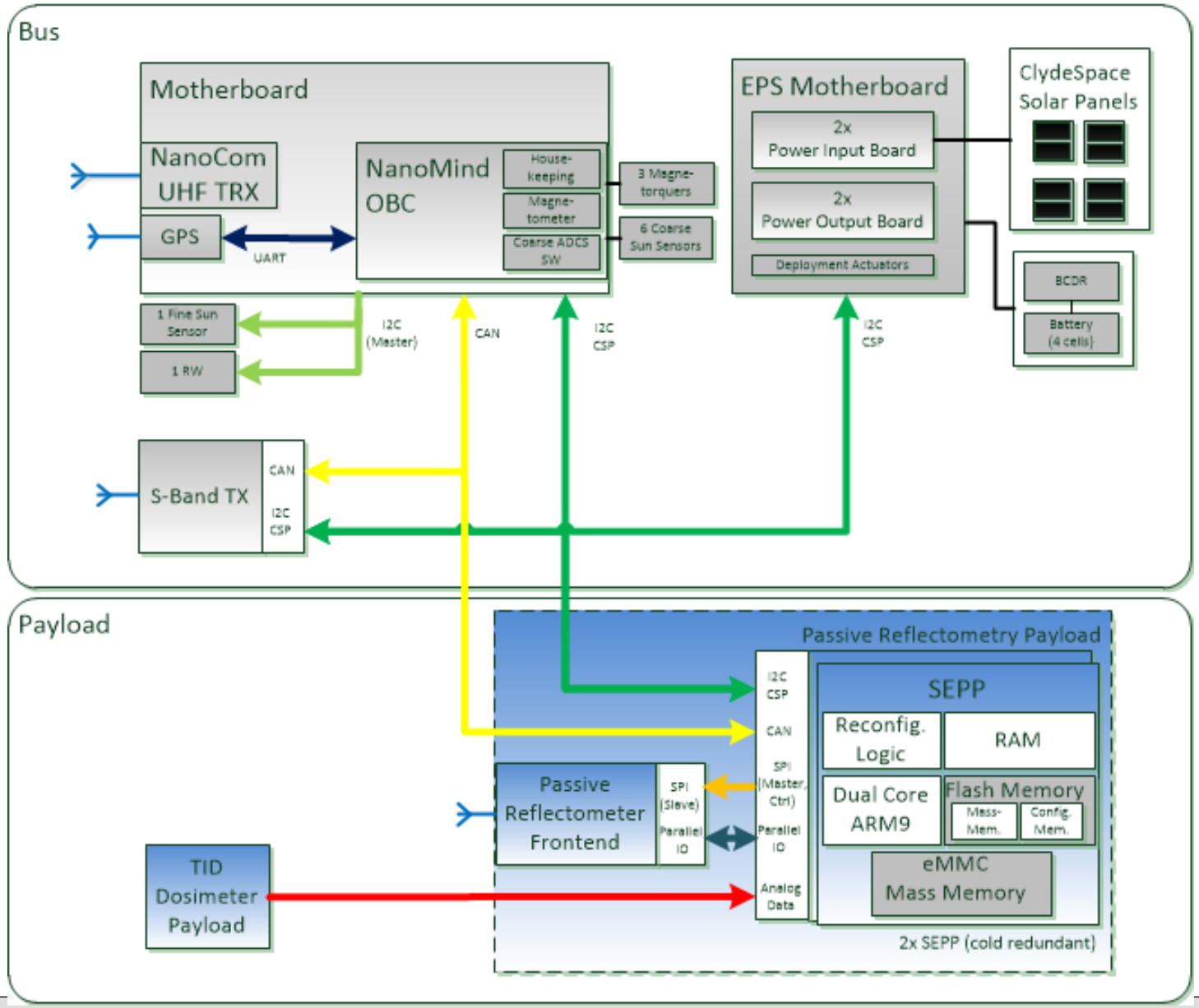


PRETTY

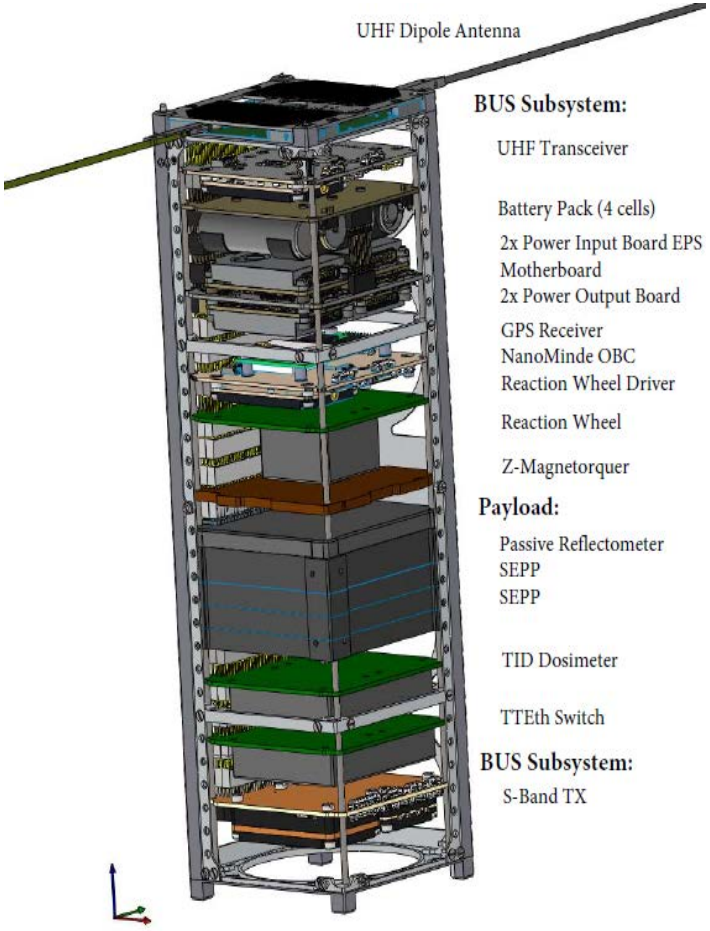
Triple CubeSat (10 x 10 x 30 cm) with deployable solar arrays

Power: 24 W




Bus
Motherboard
NanoCom UHF TRX
GPS
UART
NanoMind OBC
House-keeping
Magne-tometer
Coarse ADCS SW
3 Magne-torquers
6 Coarse Sun Sensors
EPS Motherboard
2x Power Input Board
2x Power Output Board
Deployment Actuators
ClydeSpace Solar Panels
BCDR
Battery (4 cells)
1 Fine Sun Sensor
1 RW
I2C (Master)
CAN
I2C CSP
I2C CSP
S-Band TX
CAN
I2C CSP
Payload
Passive Reflectometry Payload
I2C CSP
CAN
SPI (Master, Ctrl)
Parallel IO
Analog Data
SEPP
Reconfig. Logic
RAM
Dual Core ARM9
Flash Memory
Mass-Mem.
Config. Mem.
eMMC Mass Memory
Passive Reflectometer Frontend
SPI (Slave)
Parallel IO
TID Dosimeter Payload
2x SEPP (cold redundant)

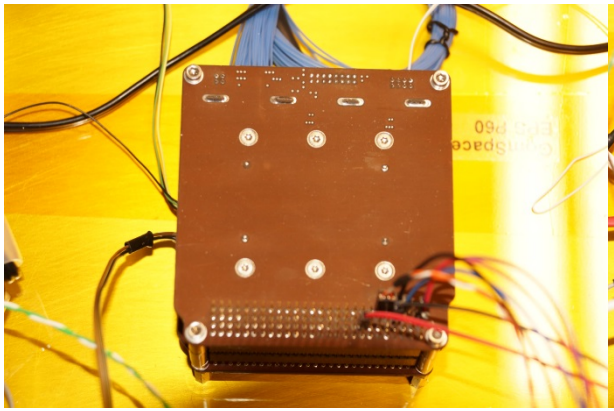
PRETTY

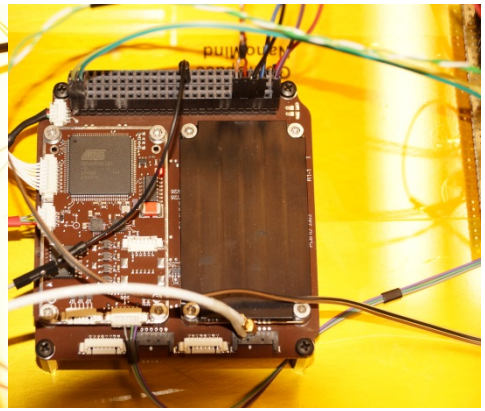


Satellite Bus: flight-proven subsystems

OBC, EPS, UHF transceiver

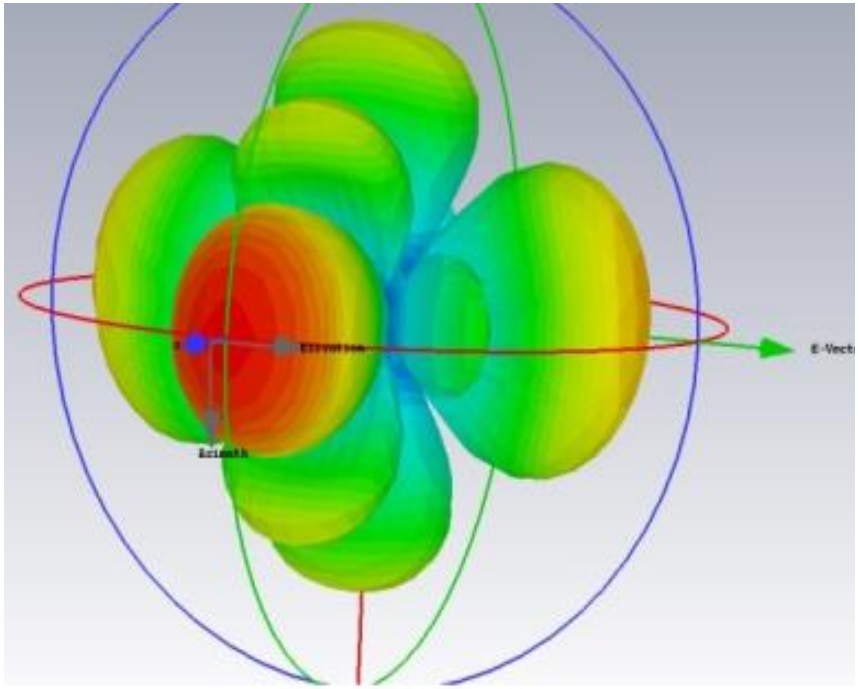
structure, deployable solar arrays

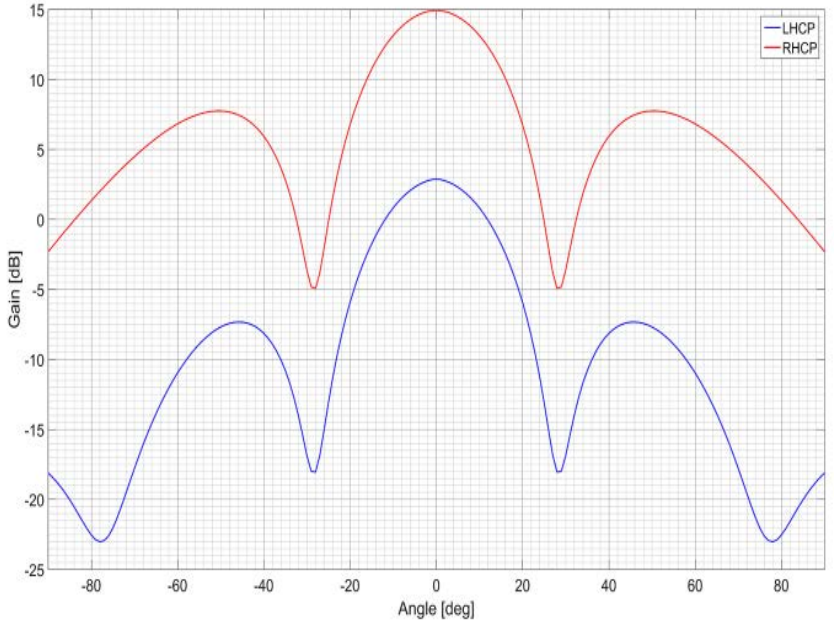




GNSS Antenna

- 8 L-band patches antennas
- Gain: 15 dBi
- Beamwidth: 25.5°
- Bandwidth ~ 70 MHz



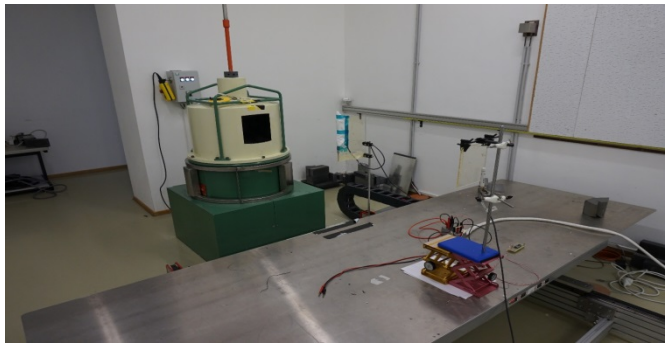


Main Payload:
Satellite Experiment Processing Platform (SEPP)

- 2 x System on Module
  Altera Cyclone V SoC
  in cold redundancy
- Memory
  - 1 GB DDR3 RAM (ECC)
- Mass Memory
  - external 8 GB Industrial SD-Cards (SLC)

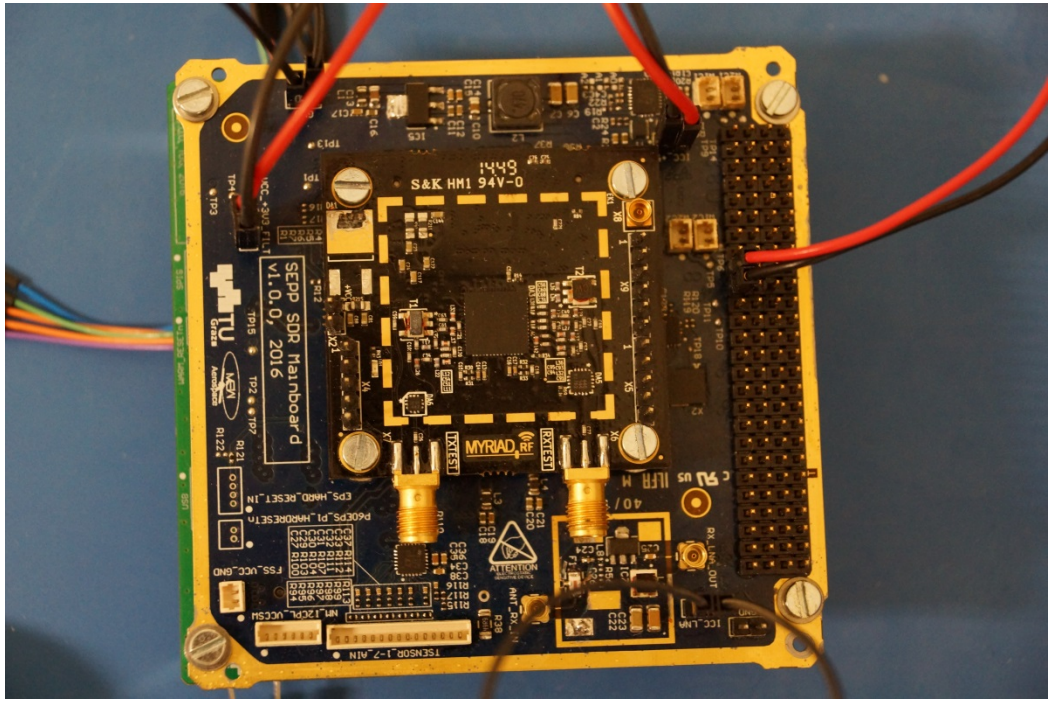
developed by TU Graz

Radiation-tested at ESTEC up to 20 krad



Software-defined Radio Receiver

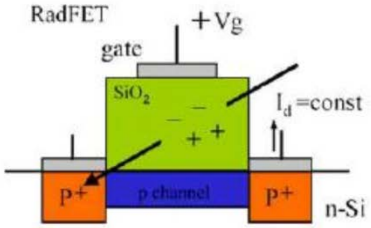
- RF front-end based on commercial SDR chip
- Interfacing with processing platform
- Frequency range: 300 MHz – 6 GHz

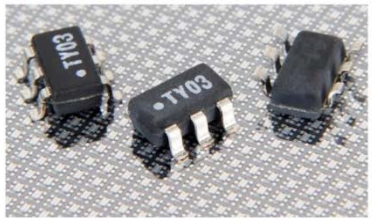


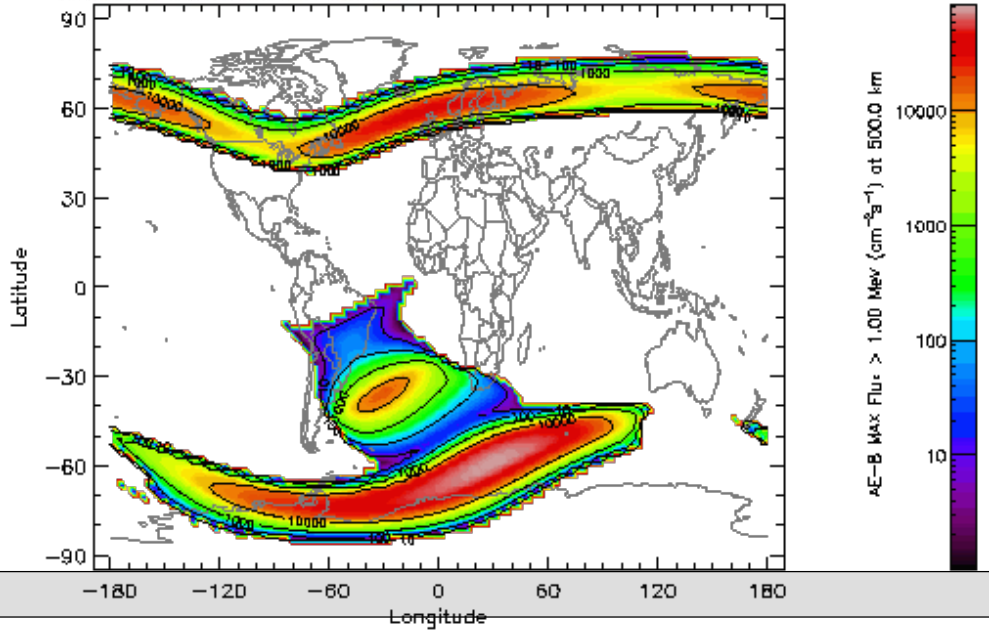
OPS-SAT
Front-end

Dosimeter

- Measuring radiation environment inspacecraft
- Using small, low-power payload with a RADFET
- Payload developed by Seibersdorf Laboratories





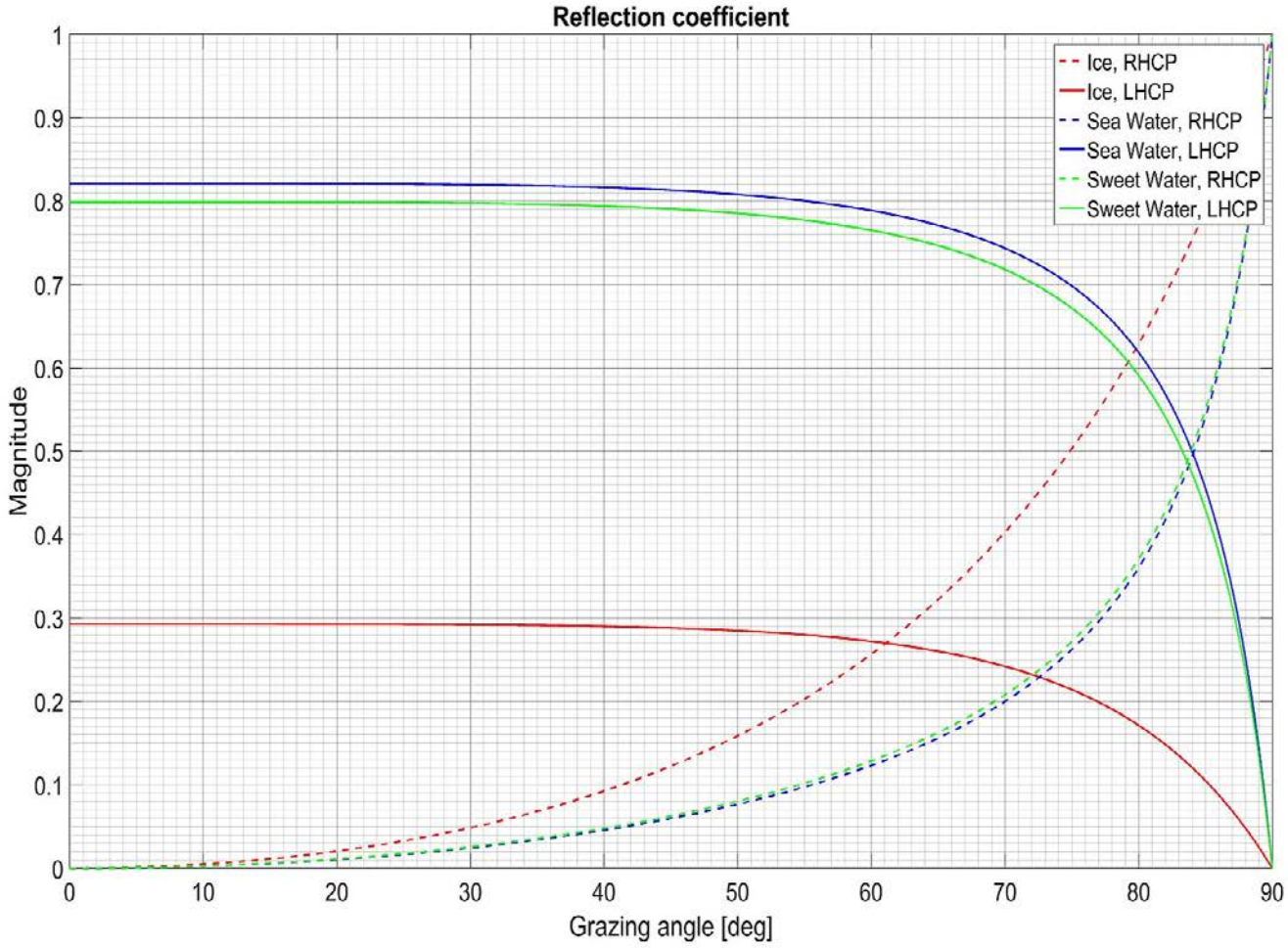


Grazing Altimetry

- Ice area/height analysis
- Sea height analysis

- Measurements at incident angles > 70 degrees
- Moderate requirements on the attitude control system
- Pointing accuracy: 1 degree

Reflection Coefficients



Cross-Correlation

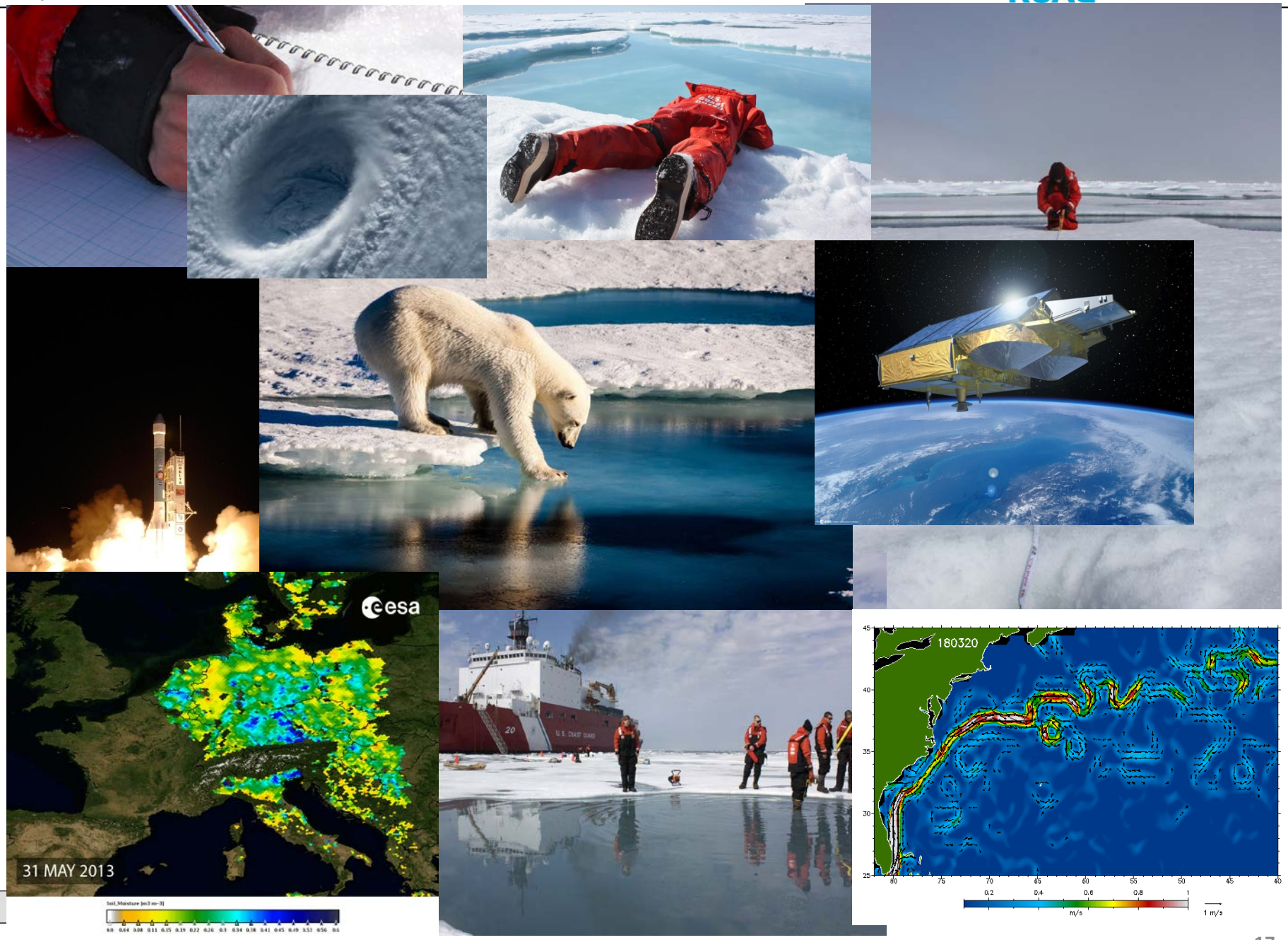
- Cross-correlation approach does not require any knowledge of GNSS spreading codes:
  - encrypted GPS P(Y)-codes,
  - the classified GPS M-code
  - Galileo E1-A signals can be utilised.
- Increases the total signal energy
- Grazing reflections: significantly longer coherence times than reflections at small incidence angles.
- Coherent integration times up to 50 ms expected
- L-Band data down link of geostationary satellites

Data Rate Requirement

- S-Band downlink
- Data rate: 1 Mbit/s
- Data volume/day download: 1.8 Gbit
- Data volume generated: 55 Gbit (max.)
- Reduced duty cycle
- Data compression

Summary

- PRETTY: Passive Reflectometry mission
- Using 3U CubeSat (heritage from OPS-SAT)
- Powerful processor & SDR front-end
- Altimeter realised
  - Sea height
  - Ice cover
- Contribution to climate monitoring
- Measuring of radiation effects
- Phase B running under ESA‘s GSTP program
- Flight in about 2 years expected


esa
31 MAY 2013
180320

Acknowledgements

- Roger Walker (ESA Technical Officer)
- Andreas Hörmer (TU Graz)
- Franz Teschl (TU Graz)
- Robert Finsterbusch (TU Graz)
- Reinhard Zeif (TU Graz)
- Peter Beck (Seibersdorf Laboratories)

This project is carried out under ESA‘s GSTP program with RUAG Space Austria as Prime Contractor

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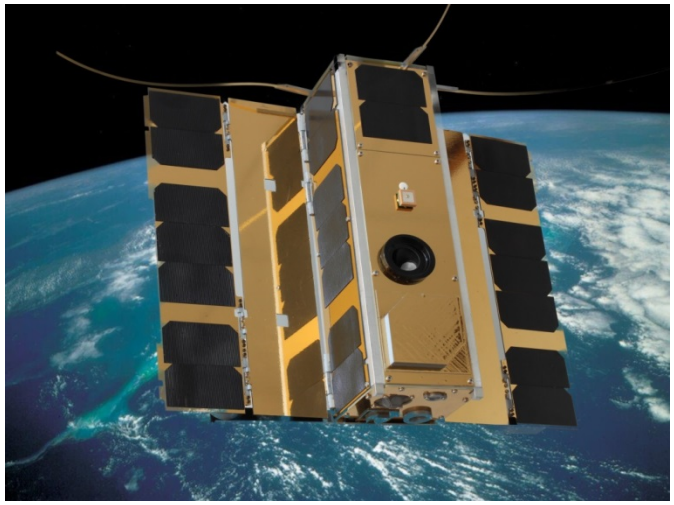

Thank you for your attention!