QB50 RIOMETER SATELLITE

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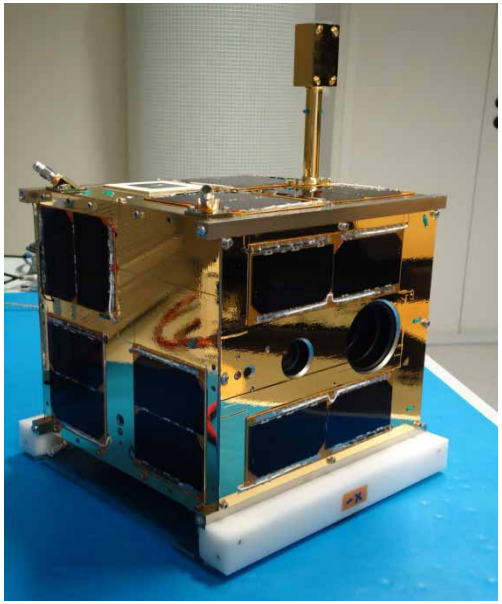
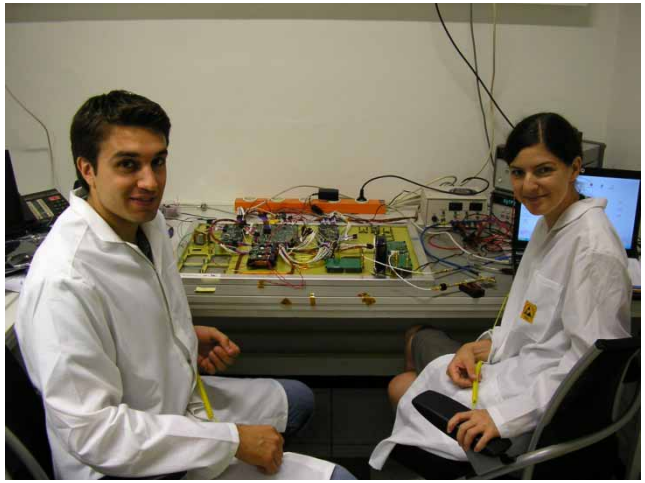
TUGSAT-1/BRITE-AUSTRIA

- Satellite launch-ready
- PSLV C20 scheduled for launch end 2012
- Know-how and infrastructure for nanosatellite development and operations established in Graz





Riometer

- Riometer = relative ionospheric opacity meter): essentially a stable receiving installation on the ground which measures variations of the signal strength of natural extraterrestrial radio sources.
- Dips in the signal are attributed to absorption caused by electron density enhancements in the ionospheric *D*-region. Sporadic enhancements large enough to be detectable by riometers only occur in geomagnetic high latitudes. The lower ionosphere (*D*-region) is responsible for the absorption of radio waves.

Riometer (2)

- Riometer stations exist at high latitude in the Northern and Southern hemisphere
- There is a need to calibrate these stations
- Furthermore, ionospheric conditions (depending on solar activity) can be measured from Space on a global scale: reversing the direction
  - RF transmitters are on ground
  - Receivers are on the small spacecraft

Riometer Satellite

- Riometer satellite for Space Situation Awareness proposed
- Measuring solar activity by a Cubesat on a global scale
- Deriving solar activity directly from ionospheric opacity measurement data

- Additional benefit: all existing ground riometers can be calibrated using the satellite
  - Providing better data
  - A feature not existing unto now

Riometer Satellite for SSA

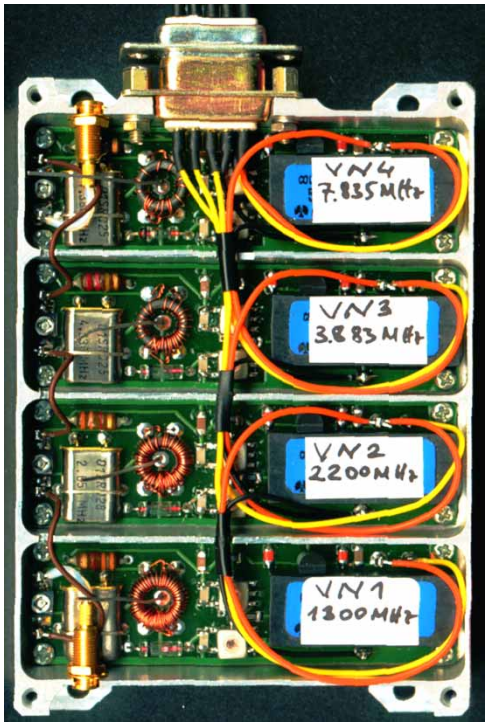
- Observing solar activity is an important goal of the Space Situation Awareness (SSA) program
- Solar activity: derived by measuring radio frequency absorption in the ionosphere
- RIOMETER (relative ionospheric opacity meter) in Space
- Signals in the shortwave radio range received (14, 21, 28 and 50 MHz)
- Transmitted signals from ground through the ionosphere
- Providing tomographic information on ionospheric absorption on a global scale
- From the absorption information about the actual solar activity can then be derived

Riometer

- Ground transmitters at high Northern and Southern latitudes (network exists)
- Measurement of HF signal strength on board of low-cost nanosatellite (Cubesat class), affected by ionospheric attenuation
- Advantage of space-borne sensor: wide area measurement
- Building on expertise of TU Graz with BRITE nanosatellite development and Space heritage of rocket-borne receivers

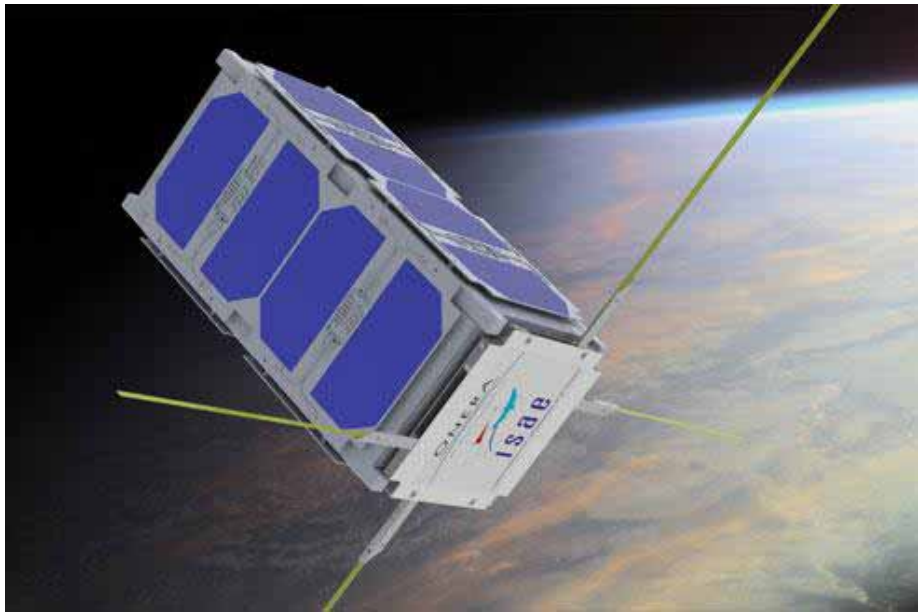
Riometer Satellite

Graz Scientific Payload:



4-channel Riometer receiver

Double Cubesat:



Size: 10 x 10 x 20 cm
Mass: 2 kg

Pre-Selected Experiments

4-needle Langmuir Probe

12 Thermosensors for re-entry experiment

Corner Laser reflectors

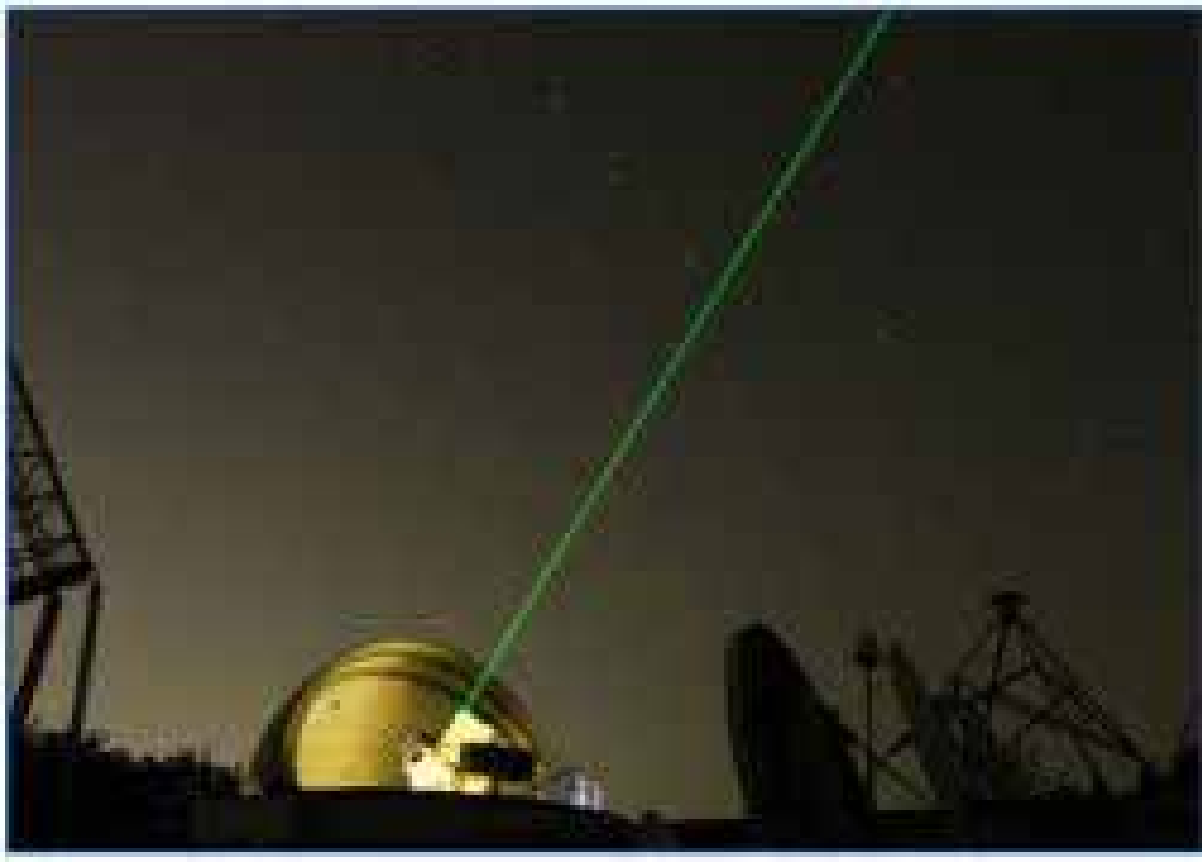
Provided by VKI (only 20 k€ contribution)

System Design Considerations

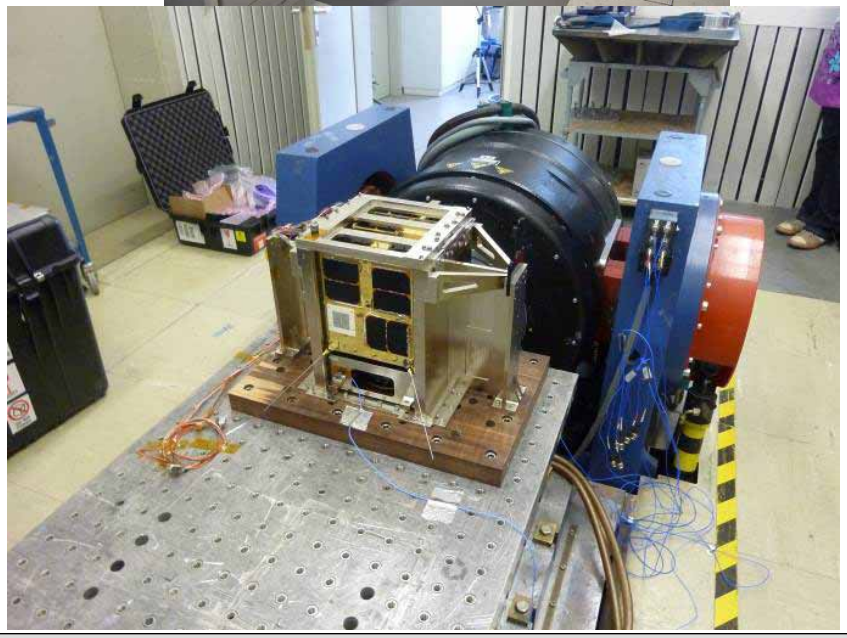
- Receiver (developed for other purposes) has Space heritage
  - flown many times on sounding rockets (very high g loads!)
- Cubesat with simple attitude control (magnetorquers) proposed
  - Low cost
  - Fast development
- New efficient communications system
  - Compatible with ESA GENSO ground station standard
  - TU Graz has a GENSO ground station since July 2011
  - Communications system currently developed by TUG staff

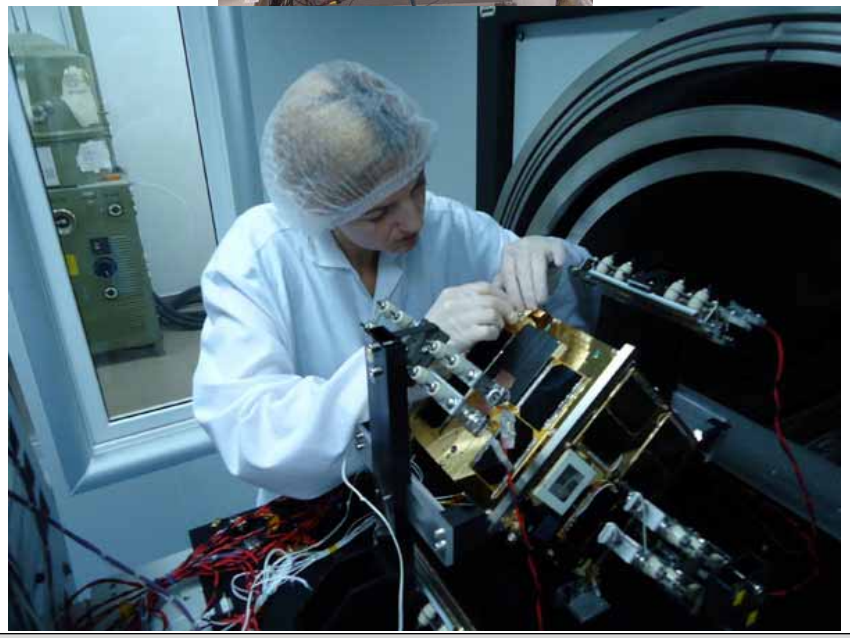
Ground Infrastructure

- GENSO Ground Station exists already at TUG
- Riometer ground transmitters exist in Scandinavia and South Africa
- Cooperation with Norway and South Africa well established (Prof.M.Friedrich, TU Graz; Dr.Lee-Ann McKinnel, Stellenbosh University, SA)
- Laser Tracking Station Lustbühel



QUALIFICATION TESTS





TEST INFRASTRUCTURE

Riometer Satellite, Phases

- Design study (Φ 1):
  - Definition of mission requirements
  - Satellite requirements
  - Payload requirements
  - Satellite design
  - Payload design
- Development, Implementation and Test (Φ 2)
- Launch and Operations (Φ 3)

- Duration: max. 24 months (Phases 1 & 2)

Summary

- QB50 is a challenging mission
- First time 50 satellites launched simultaneously
- Cubesats are primary payload
- Launch, launch integration, pre-selected experiments paid by VKI, FP7 (8 M€)
- Study of lower thermosphere and ionosphere
- Results on solar activity (relevant for SSA)
- Calibration of ground riometers
- Re-entry dynamics study, space debris monitoring
- Synergies with OPS-SAT (long-term mission)

Summary (2)

TU Graz proposal was peer-reviewed and was rated excellent

Selected for QB50 mission