

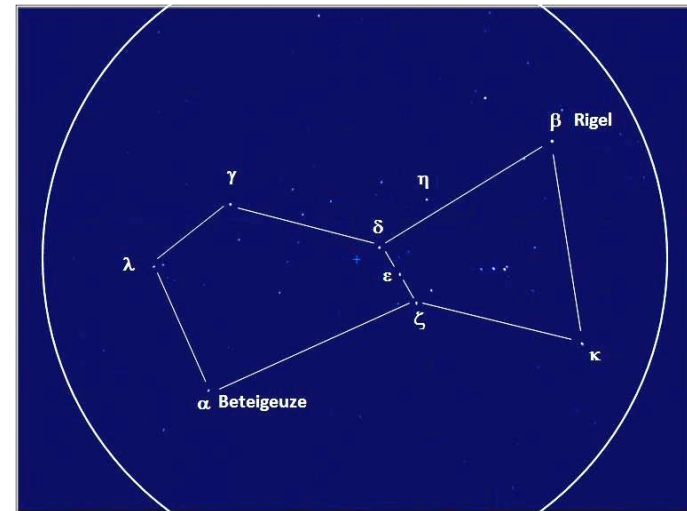
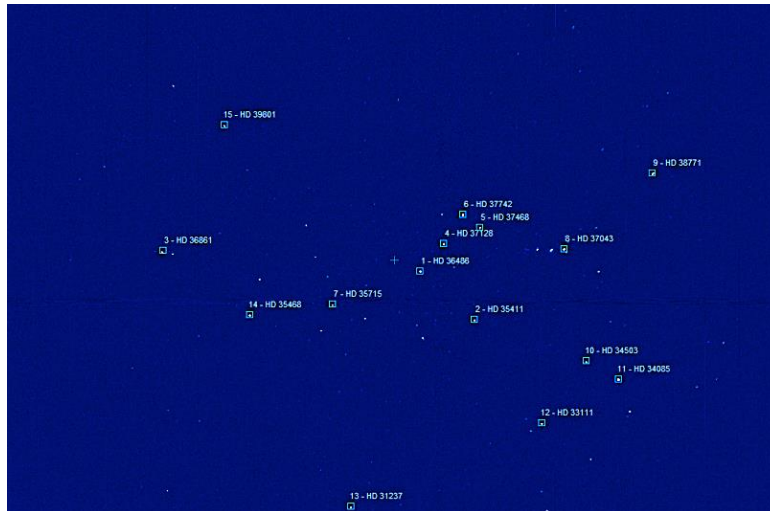
BRITE Constellation – A Case Study



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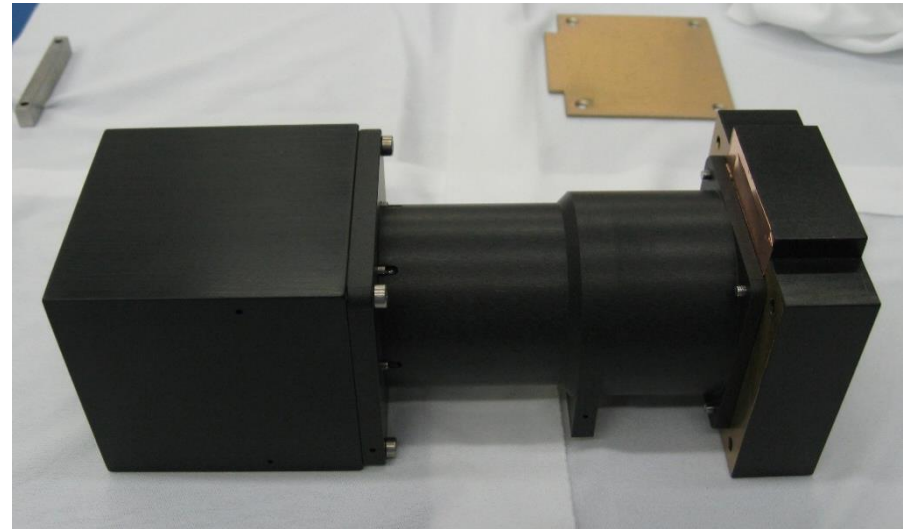
BRITE (BRiGht Target Explorer)

- First nanosatellite constellation dedicated to an astronomy mission (asteroseismology)
- 5 spacecraft operational in Space
 - Austria (BRITE-Austria/TUGSAT-1 & UniBRITE)
 - Poland (BRITE-PL1 „Lem“ & BRITE-PL2 „Heveliusz“)
 - Canada (BRITE-CAN1 „Toronto“)



Scientific Goals

- Photometric measurement of brightness and temperature variations of massive luminous stars (up to visual magnitude 4)
- Fastest data cadence: few minutes
- Time base: up to 2 years
- high duty cycle
- 2-colour (blue and red)
- 24° field of view
- Deliberately defocused



BRITE Flight Model

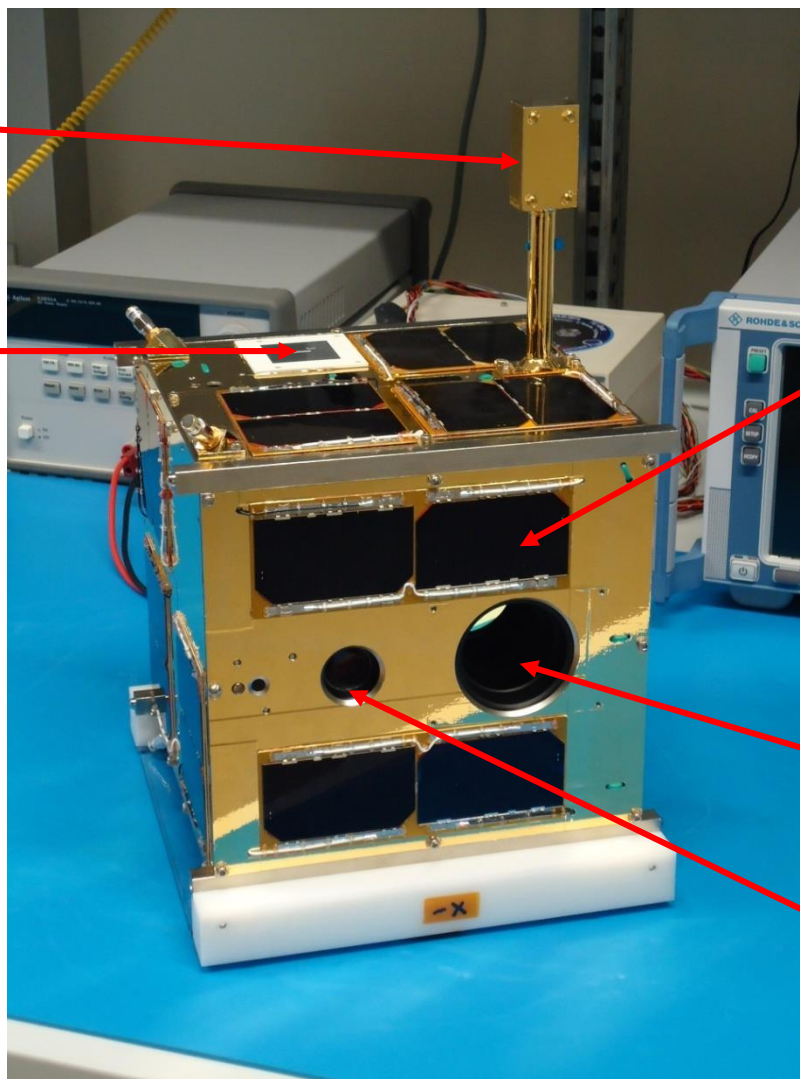
magnetometer

S-band antenna

Size: 20 x 20 x 20 cm

Mass: 6.8 kg

Power: 6...10 W



solar cells

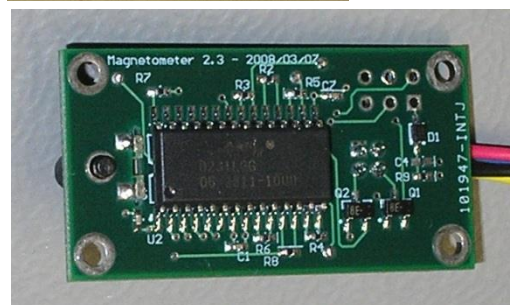
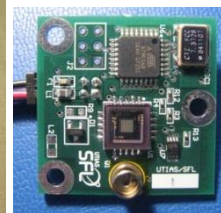
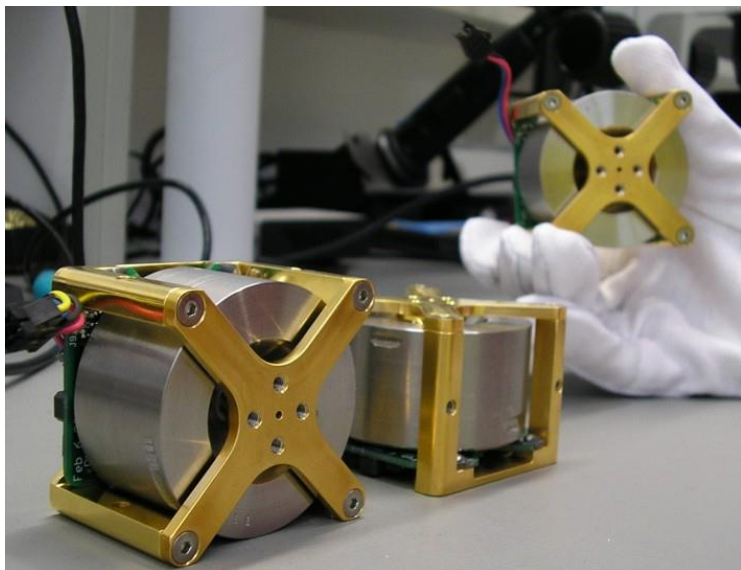
telescope

star tracker

Attitude Control System

Precise alignment of camera to target stars

3 miniature momentum wheels, magnetorquer, sun sensors, magnetometer, star sensor and attitude control computer provide alignment at arc minute level



Communications System

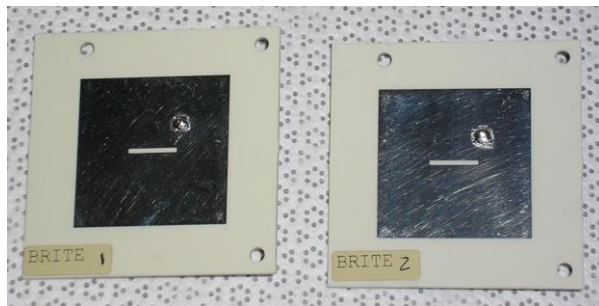
Frequencies

- UHF: command uplink (amateur radio)
- Science S-Band: science and telemetry data downlink

Data rates:

- Downlink: 32 - 256 kbit/s
- Uplink: 9.6 kbit/s

Data volume / day: ~ 20 Megabyte (spec: 2 MB)



S-Band antennas



Transmitter

Launch

- TUGSAT-1/BRITE-Austria and UniBRITE were launched by PSLV-C20 of ISRO/ANTRIX on 25 February 2013 from the Satish Dhawan Space Centre in Sriharikota
- Sun-synchronous LEO orbit



Courtesy: ISRO

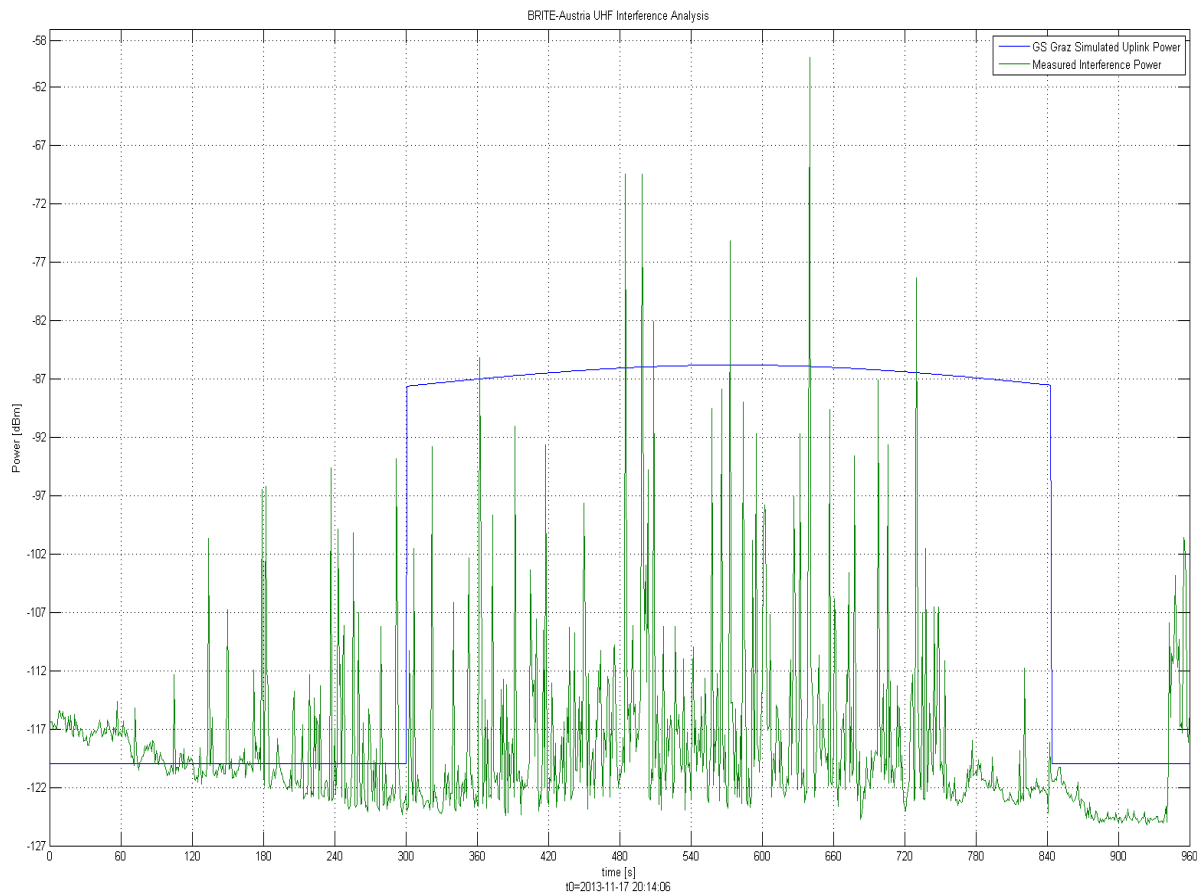
Mission Operations

- 14 orbits per day
 - 3 orbits in morning sequence
 - 3 - 4 orbits in evening sequence
- Automatic & remote ground stations operations supported
- BRITE-Austria operated from Graz
- UniBRITE operated from Toronto



UHF Interference

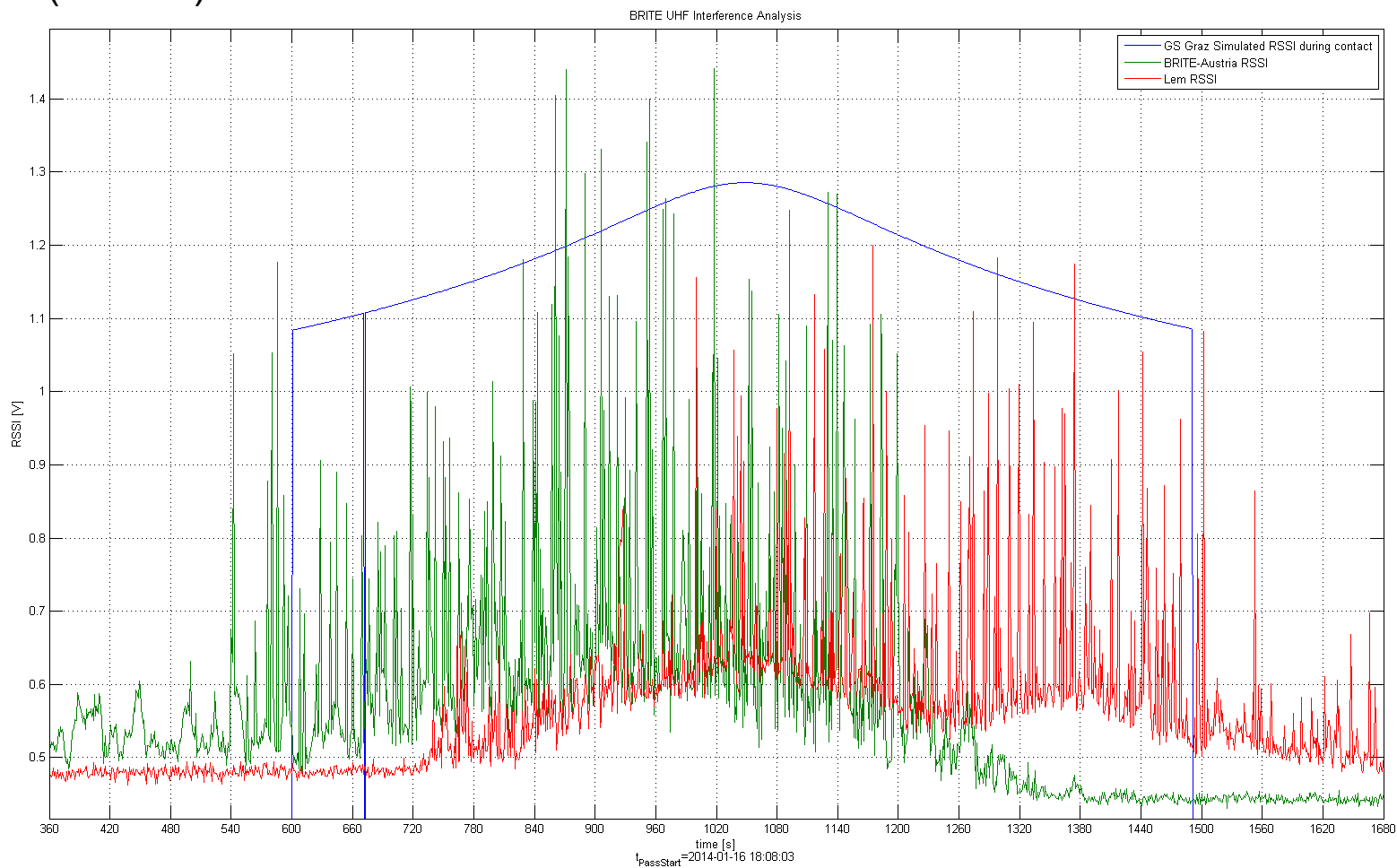
Persistent since October 2013



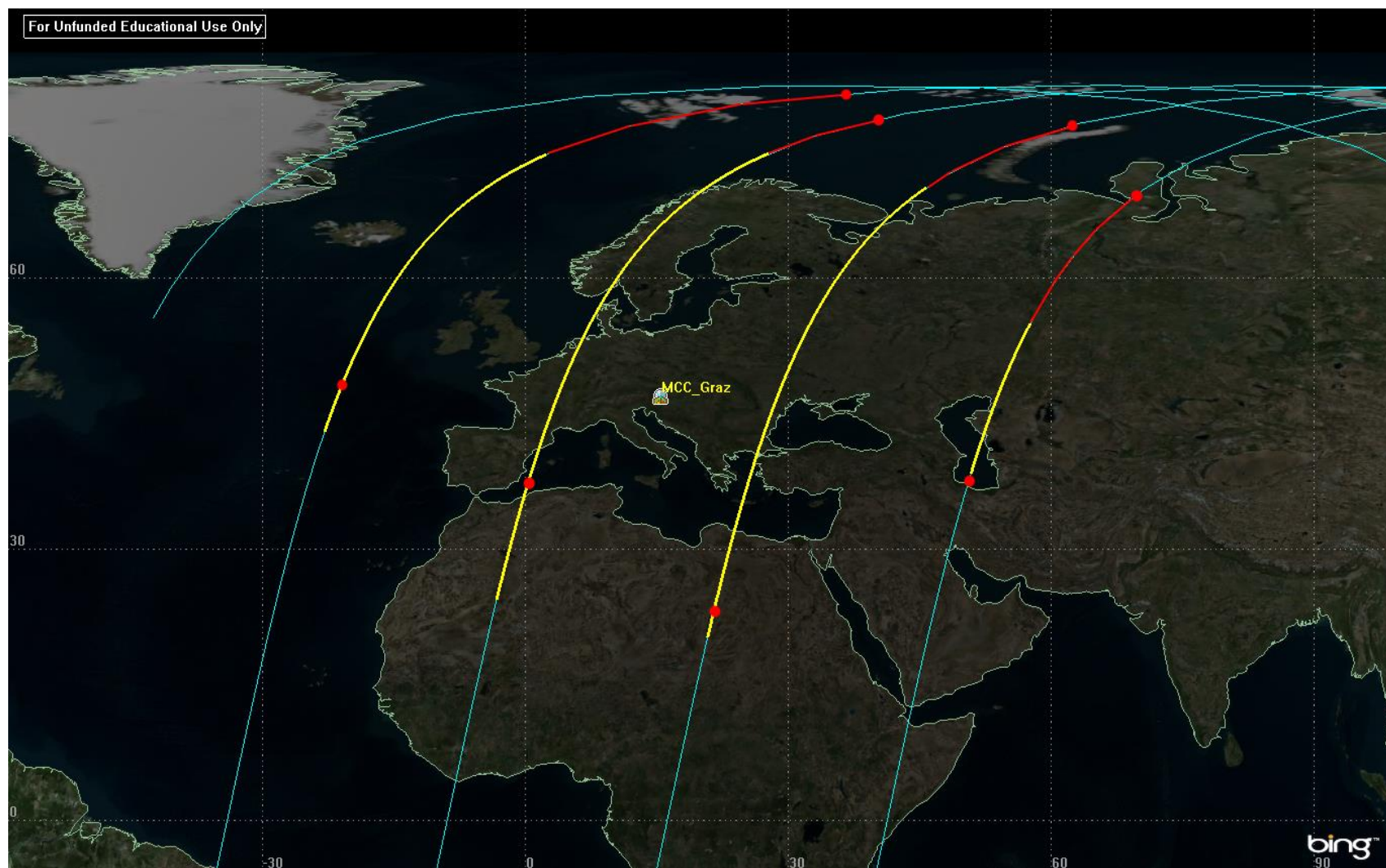
UHF Interference

Green: TUGSAT-1 (Austria)

Red: LEM (Poalnd)

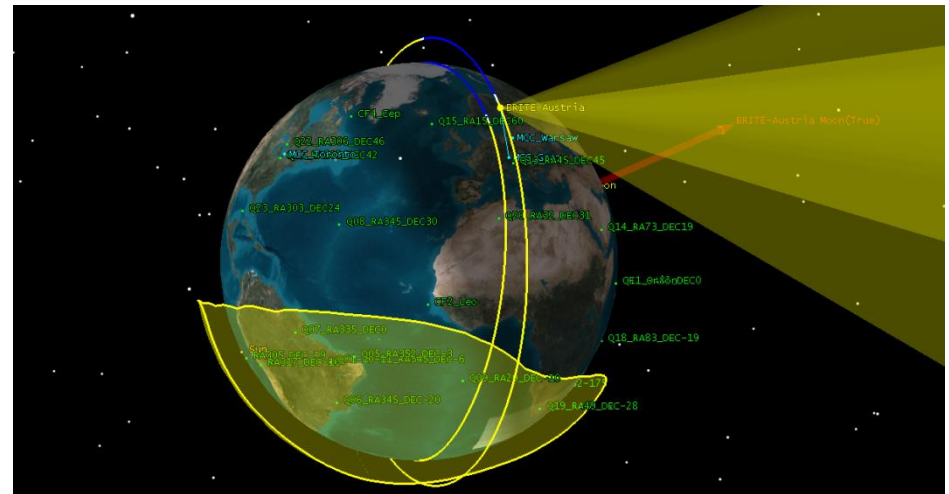


UHF Inteference



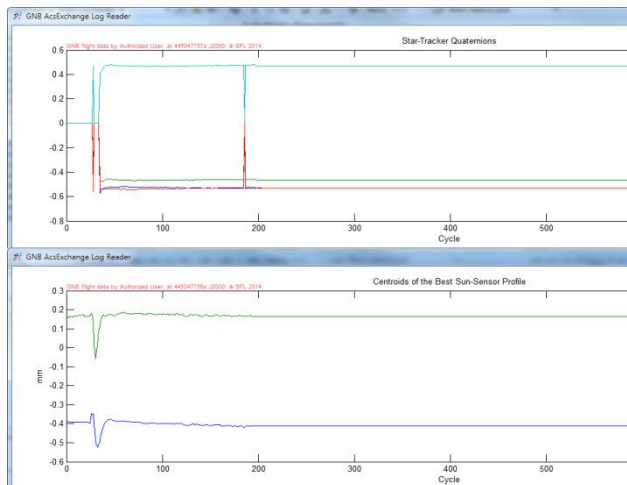
Management

- BRITE Executive Science Team (BEST)
 - ✓ Scientists from Austria, Canada, Poland
 - ✓ Defines targets
- Operation teams
 - ✓ Prepare commands for spacecraft,
 - ✓ up- and downloads

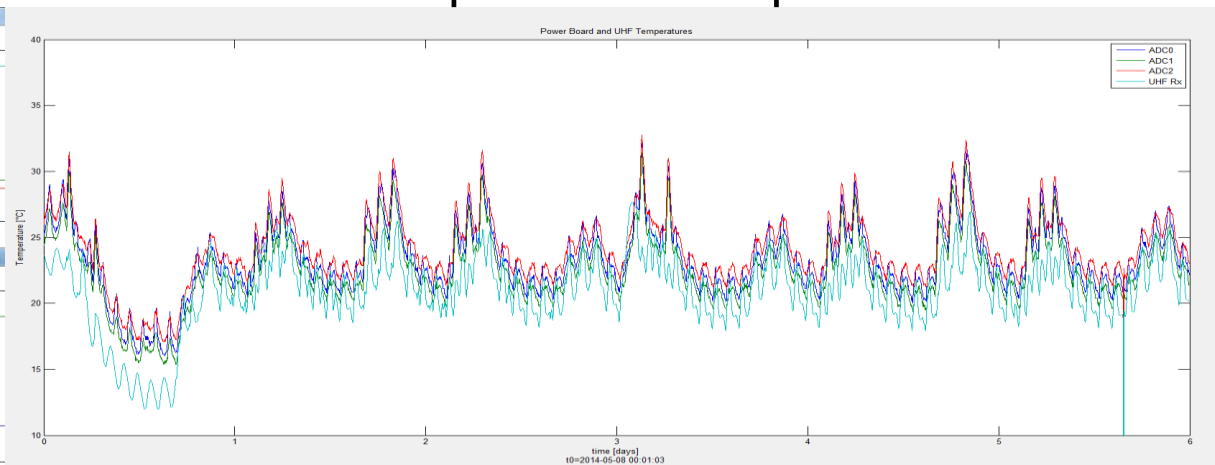


Satellite Performance

Attitude

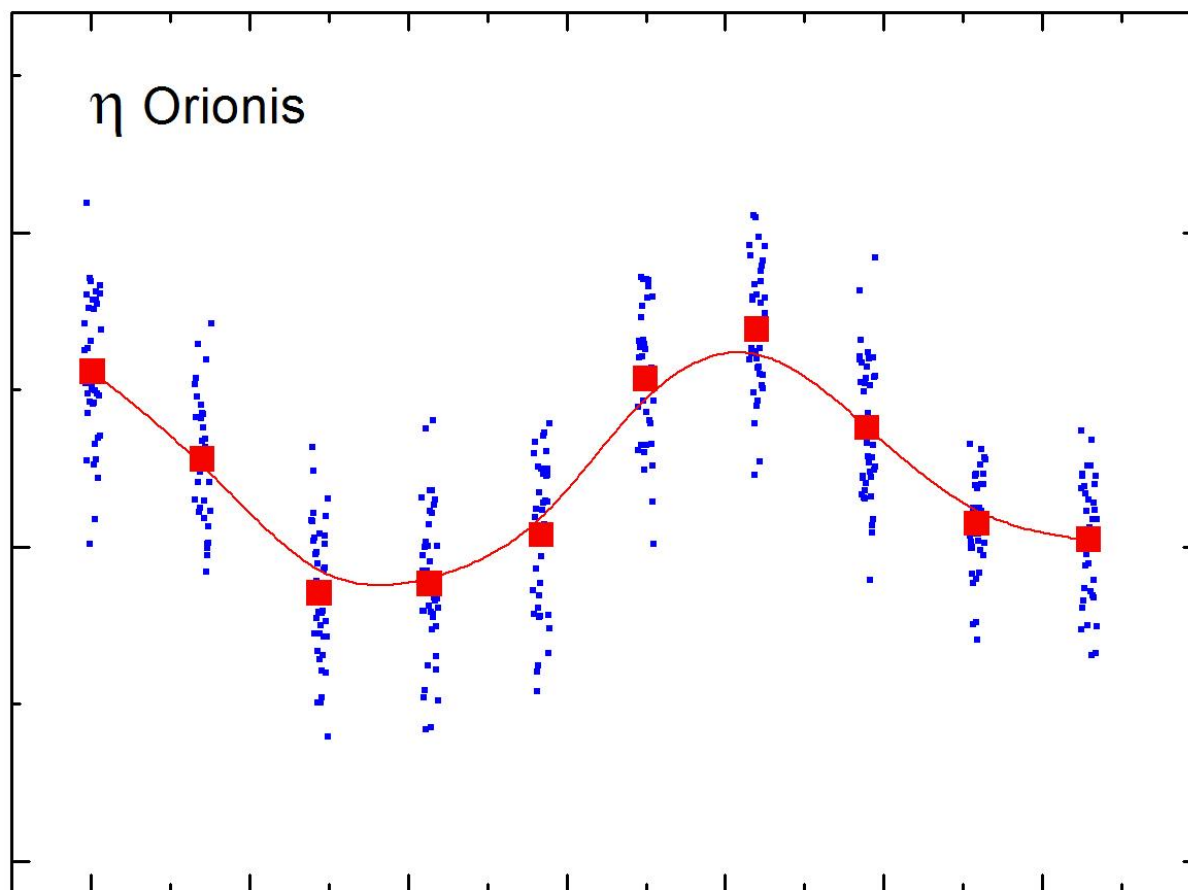


Spacecraft temperature



- RMS pointing stability in X / Y: 1.6 / 1.5 pixels (2 – 3 pixels)
- Up to 20 subrasters: 32x32 to 24x24 pixels
- Typical 1 sec integrations, stacking available
- CCD deterioration due to radiation -> chopping

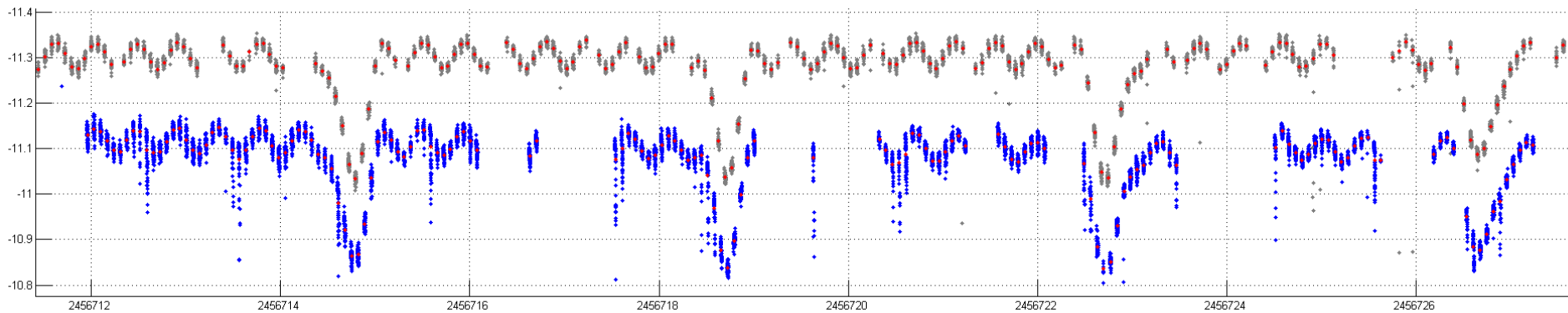
Results for Eta Orionis



2013 - 12 - 05

Variation of mean brightness:
Pulsations of the star

Light Curve for Orion



Gray curve: TUGSAT-1/BRITE-Austria (blue filter)

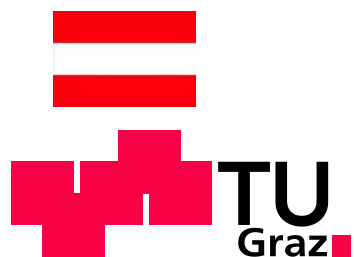
Blue curve: UniBRITE (red filter)

Legal Matters

- Frequency coordination started nearly immediately after kick-off in 2006
- Coordination with ITU via the Austrian Administration and directly with IARU
- Registered as „constellation“ (all BRITE spacecraft have same frequencies)
 - BRITE (NGSO) Satellite Network Ref. API/A/6652
- BRITE triggered implementation of Austrian Space Law (in force since December 2011)
- Notification process with Ministry of Transport, Innovation and Technology
- Registration with UN/OOSA by Austrian Foreign Ministry and Ministry of Transport, Innovation and Technology

Summary

- BRITE-Constellation is the world 's first nanosatellite constellation dedicated to astronomy
- 5 spacecraft of BRITE-Constellation operational
- BRITE-Austria and UniBRITE have each orbited 10.000 times around Earth, travelling 450 million km
- Scientific & technical requirements fully met
- Science fields: 150 days in Orion, Centaurus, Perseus, and Vela Puppis.
- Observing program developed till end 2016
- Scientific data analysis under way



Thank you for your attention!