BRITE-Austria/TUGSAT-1
A Best Practice Example

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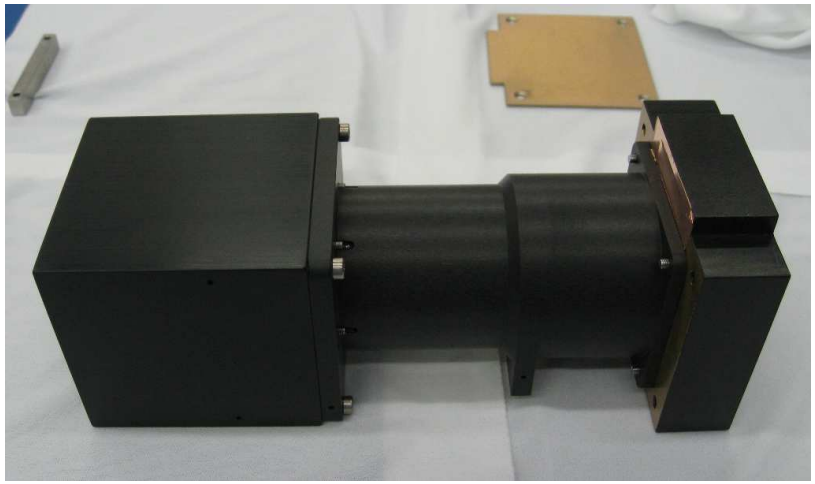
BRITE (BRIght Target Explorer)

- Nanosatellite constellation
- 6 spacecraft
  - Austria
  - Poland
  - Canada

- Dedicated to astereoseismological mission

Scientific Goal

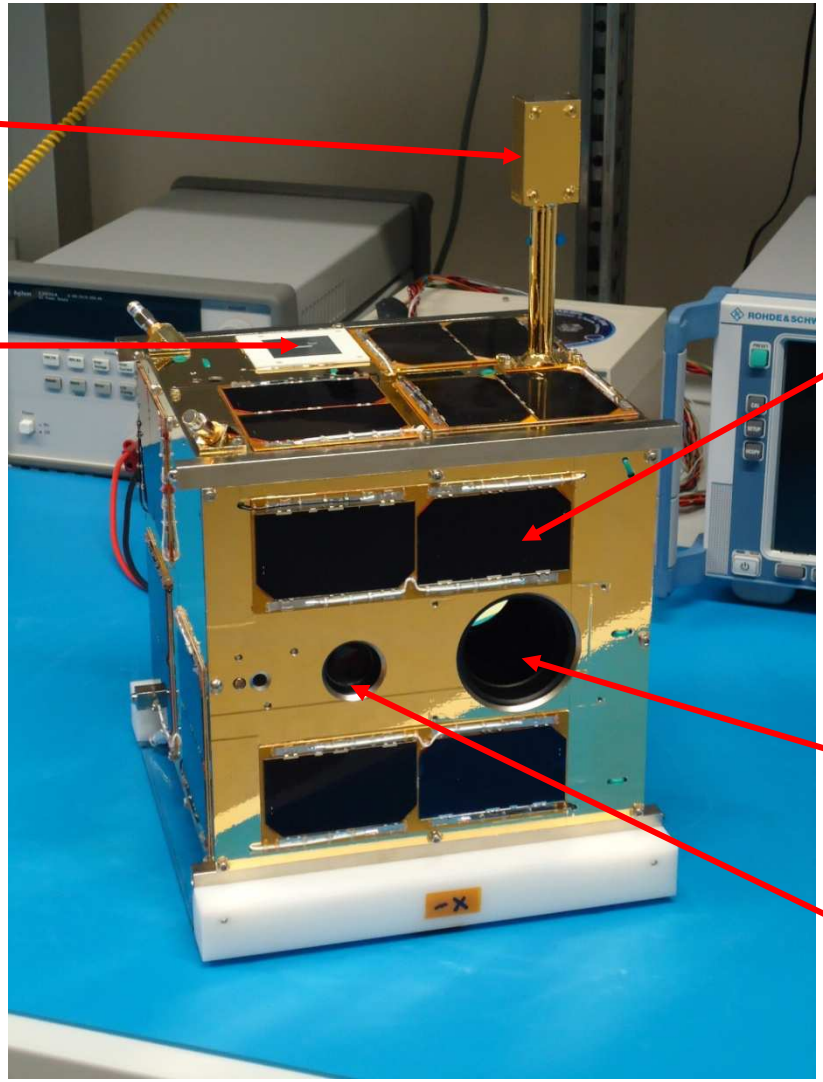
- Measurement of brightness and temperature variations of massive luminous stars (magnitude +3.5) by differential photometry
- 2 spectral ranges (blue and red)
- Time series collection per target: 100+ days
- Mission duration: at least 2 years



BRITE CONSTELLATION

- 6 satellites, operating in pairs
  - red/blue filter instrument
- 2 Austrian: TUGSAT-1/BRITE-Austria & UniBRITE
- 2 Polish: BRITE-PL1 (LEM) & BRITE-PL2 (Heweliusz)
- 2 Canadian: BRITE-CAN 1 (Toronto) & BRITE-CAN 2 (Montreal)

TUGSAT-1/BRITE-Austria Flight Model



Size: 20x20x20 cm

Mass: 6.8 kg

Electrical power: 6 W

Transmit power: 0.5 W

Frequency bands:
S / UHF / (VHF)

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

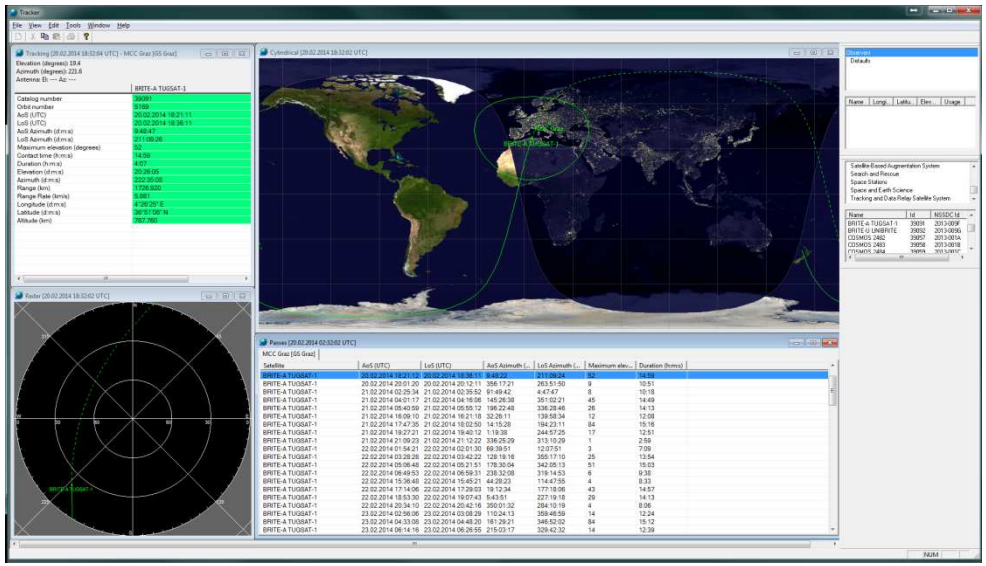
- Sun-synchonous LEO dusk/dawn orbit
- Austria became launching state!

Ground Station
and Mission Control Centre Graz

3 m tracking antenna
for S-Band & UHF bands

First Contact

- 3 hours after launch
- First pass over Graz ground station
  - S-band downlink
  - UHF uplink
  - Up to 256 kbit/s downlink data rate
- Verifying health status
  - TUGSAT-1/BRITE-Austria
  - UniBRITE



Mission Control

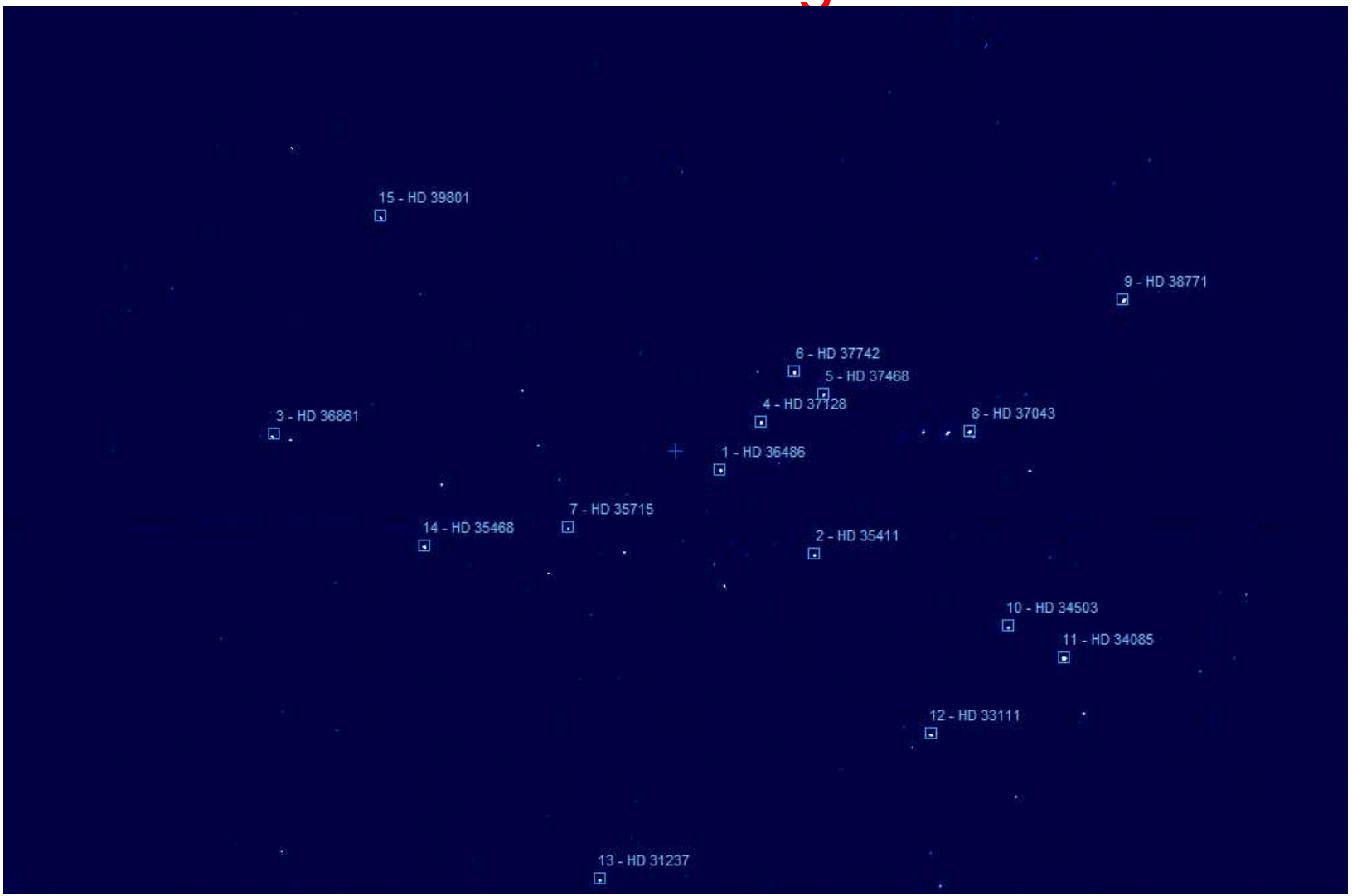
14 orbits per day

Automatic operations suppported

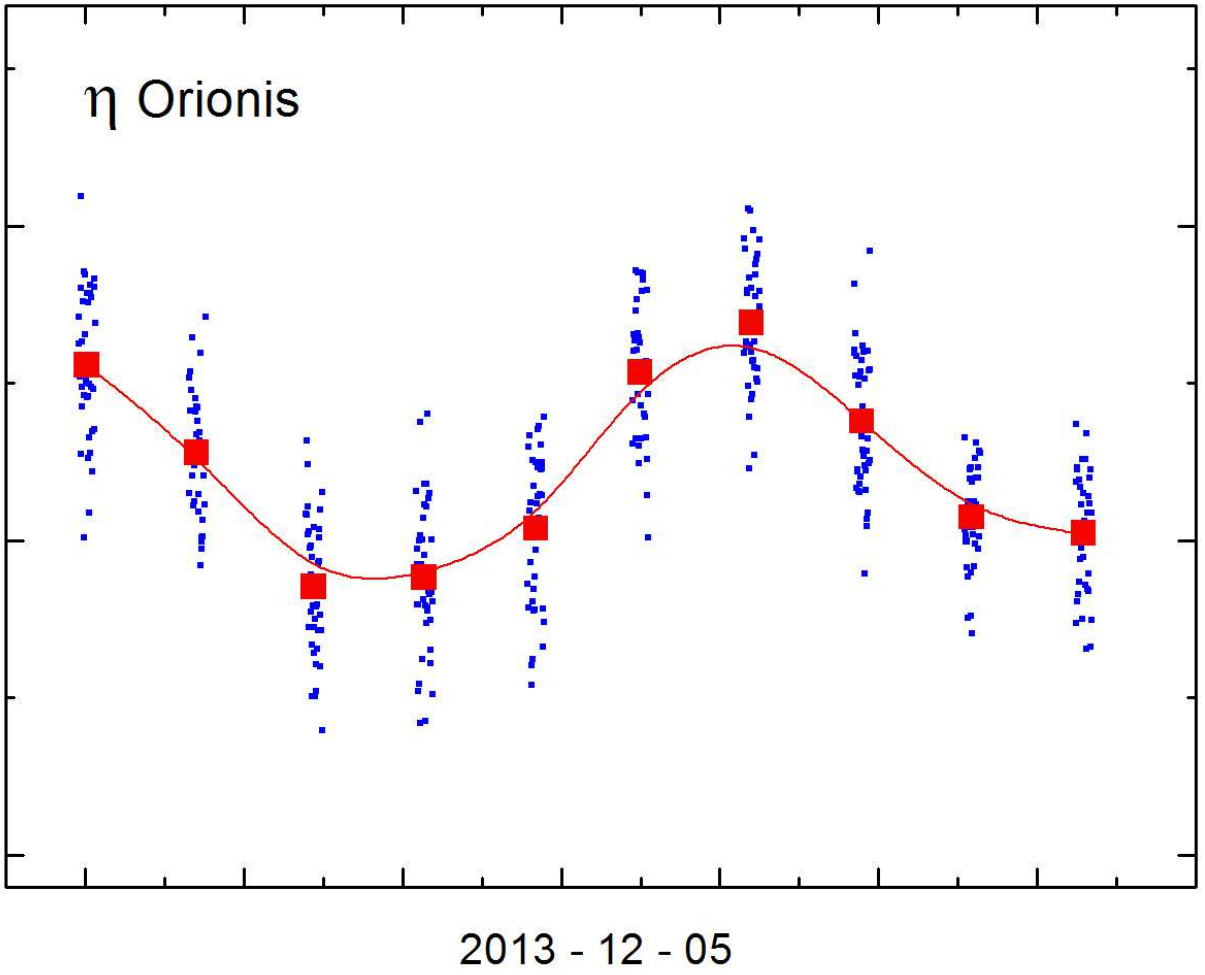
3 orbits in morning

3 orbits in evening

Orion Image


15 - HD 39801
9 - HD 38771
6 - HD 37742
5 - HD 37468
4 - HD 37128
3 - HD 36861
8 - HD 37043
1 - HD 36486
7 - HD 35715
14 - HD 35468
2 - HD 35411
10 - HD 34503
11 - HD 34085
12 - HD 33111
13 - HD 31237

Results for Eta Orionis



Brigthness variations are due to star pulsations

Frequency Coordination

- Institute has been developing radio communiations systems since the 1970ies
- Registration of ground stations and frequency assignments by the Austrian Radiocommunication Bureau well-known procedure
- Registration process started immediately after the contract for the BRITE project by Austrian Aeronautics and Space Agency was awarded
- Data about frequencies (VHF/UHF/Science S-Band) delivered to the Office
- Very good contact to ITU

Frequency Coordination (2)

- ITU software tool used to generate Advance Publication Information (API) data package
- Submission by Austrian Radiocommunication Bureau to ITU, filing „BRITE Constellation“ (BRITE-Austria & UniBRITE)
- Parallel submission to IARU for the amateur radio subsystem of the spacecraft (VHF/UHF)

- Ground Station authoristation requested to the Radiocommunications Office for Styria and Carinthia in Graz
- Permission for the UHF/S-Band ground station granted

Frequency Coordination (3)

- Clarification requests by administrations in Europe, Asia-Pacific, and North America collected by Austrian Administration and ITU
  - Potential interference to other space services
  - Advantage: frequencies were already coordinated by Canada for North America / Canada
- Communicated to administration -> delievered to TUG
- TUG Graz provided answers to administration
- Formal communications to ITU, published in API/B
- Final notification about 1 year before launch
- „Bring Into Use“ notification after launch
  - Actual orbital parameters provided

Frequency Coordination (4)

- Important: satellite owner/operator has to notify both IARU and ITU, even if only amateur satellite service frequencies are used
- Frequency coordination process is alleviated for satellites using only amateur radio bands, as they are already coordinated.
- Recent CubeSat launches showed that not all undergo this process
- Interference risk!!!

Operations

- If amateur satellite services frequencies are used, all operations personnel has to possess a valid amateur radio license (see Art.1 and 25 of ITU RR)

- Spacecraft needs a call-sign (OE 0 GUT)
- Ground station needs a call-sign (OE 6 XUG)

Insurance

- Insurance possibilities investigated
- Only 1 British insurance company made verbal offer
- Premium 30 to 50 % of spacecraft cost
- Spacecraft not insured
- Launch not insured

- Transport of spacecraft to external environmental tests and to launch site insured (several k€ per event)

- Personnel covered by insurance of TU Graz during integration work in Sriharikota

Launch Contract

- UTIAS/SFL acted as launch service provider
  - Science Team made recommendation on suitable orbits (SSO)
- Contract (MoU) between TU Graz and UTIAS in 2011
- UTIAS negotiated and set up Launch Services Contract with ISRO/ANTRIX

Space Law

- Austrian Space Law set in force in December 2011
- BRITE-Austria project was initiated before
- Only notification process to Ministry of Transport , Innovation and Technology (bmvit)
- Next satellite: permission process

Space Law Compliance

- Evidence of know-how, capabilities and reliability of applicant
  - previous Space projects, background experience
  - CVs of personnel
- No danger for public safety, health, persons & goods
- No infringement of national and international law
- Space debris issues
  - External study contract to University of Stuttgart by Austrian Aeronautics and Space Agency
  - No harmful materials, no break-ups, no explosives used
  - Deactivation after service
- Evidence of frequency coordination with ITU
- Exemption from liability insurance (public interest)

Registration

- All data about spacecraft and final orbital parameters provided to bmvit
- Austrian Ministry of European and International Affairs sent registration to UN/OOSA
- BRITE-Austria/TUGSAT-1 and UniBRITE in UN data base
- NORAD/Spacetrack database:
  - BRITE-A TUGSAT-1 : object SCC# 39091
  - BRITE-U UniBRITE : object SCC# 39092

Summary

- BRITE Constellation is the world‘s first nanosatellite constellation dedicated to a challenging astronomy mission
- First 3 members of BRITE constellation in orbit

  Planned constellation completed this year
- Scientific & mission requirements fully met
- Demonstration that demanding scientific and technological missions can be carried out with small satellites

Summary (2)

- BRITE Mission important stimulus for the implementation of Austrian Space Law
- Number of small satellite missions rising significantly
- Following procedures important to ensure safe and interference-free operations
- BRITE good example of smooth bringing into use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PAN


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Thank you for your attention!