

BRITE – One Year in Orbit



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Contents

- Scientific Goals
- Mission Description
- Commissioning
- Science Data Collection
- Summary

BRITE (BRiGht Target Explorer)

- Nanosatellite constellation
- 6 spacecraft
 - Austria (BRITE-Austria/TUGSAT-1 & UniBRITE)
 - Poland (BRITE-PL1 „Lem“ & BRITE-PL2 „Heweliusz“)
 - Canada (BRITE-CAN1 „Toronto“ & BRITE-CAN2 „Montreal“)



- Dedicated to a challenging astereoseismological mission



Scientific Goals

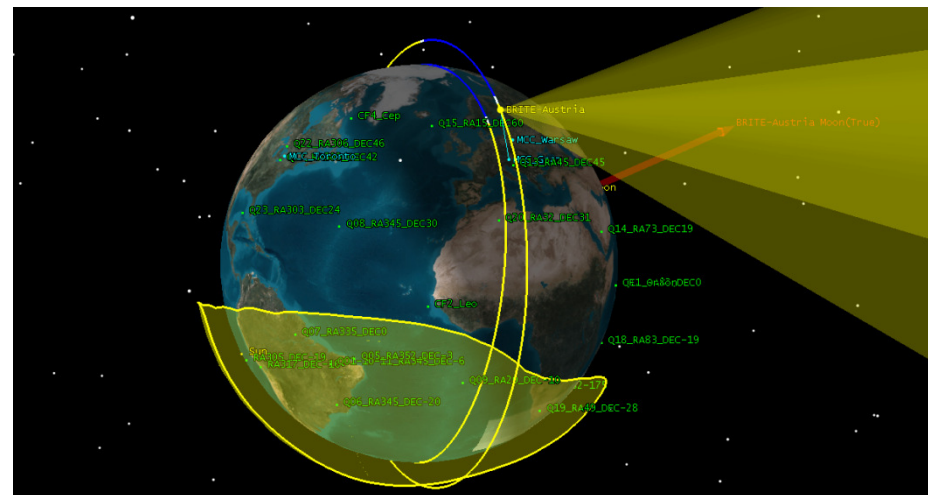
- Photometric measurement of brightness and temperature variations of massive luminous stars (magnitude +4)
- 2 spectral ranges (blue and red)
- Time series collection per target: >100 days
- Mission duration: at least 2 years

BRITE Targets

- Bright, massive stars
 - eject enriched gasses into interstellar medium (ISM)
 - heavy elements critical for formation of future stars, terrestrial planets, organics
- Hot luminous hydrogen-burning stars (O to F stars)
- Cool luminous stars: Asymptotic Giant Branch (AGB) stars, cool giants and cool supergiants
- Search for pulsations
 - structure
 - ages

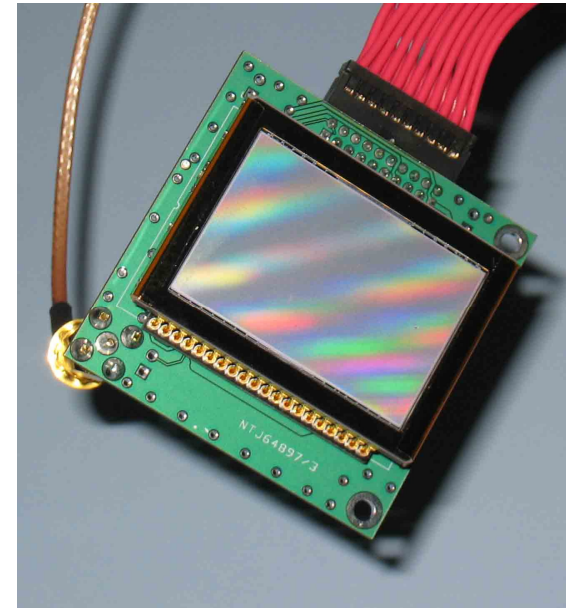
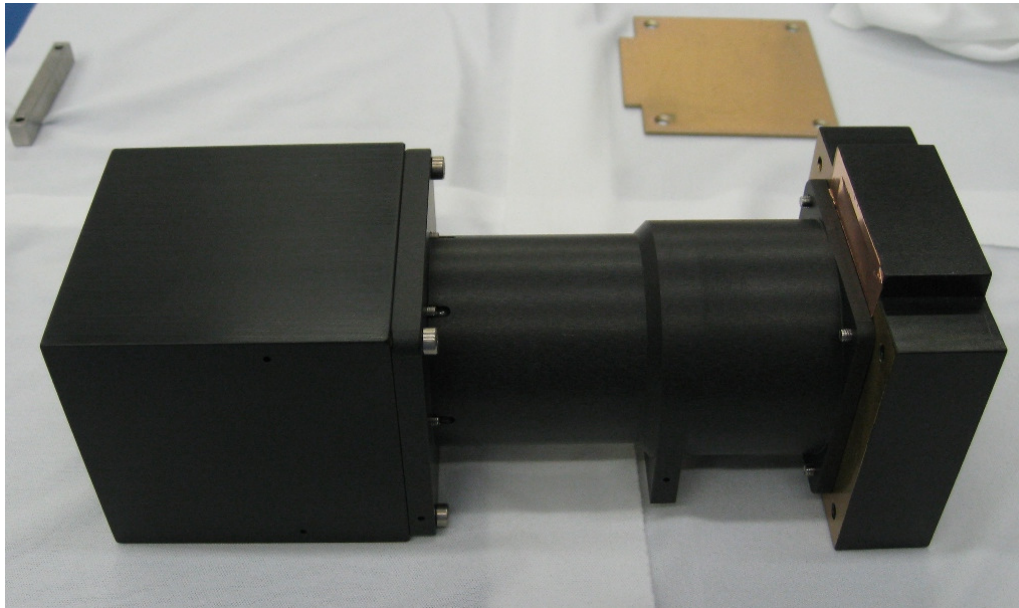
Target Selection

- BRITE Executive Science Team (BEST)
 - Scientists from Austria, Canada, Poland
- BEST defines targets
- Commands for spacecraft prepared and uploaded by the operations teams



Scientific Instrument

- Small telescope with CCD sensor
- 2 types of filters: blue and red
- Time and spectral resolution
- No moveable parts



TUGSAT-1/BRITE-Austria Flight Model

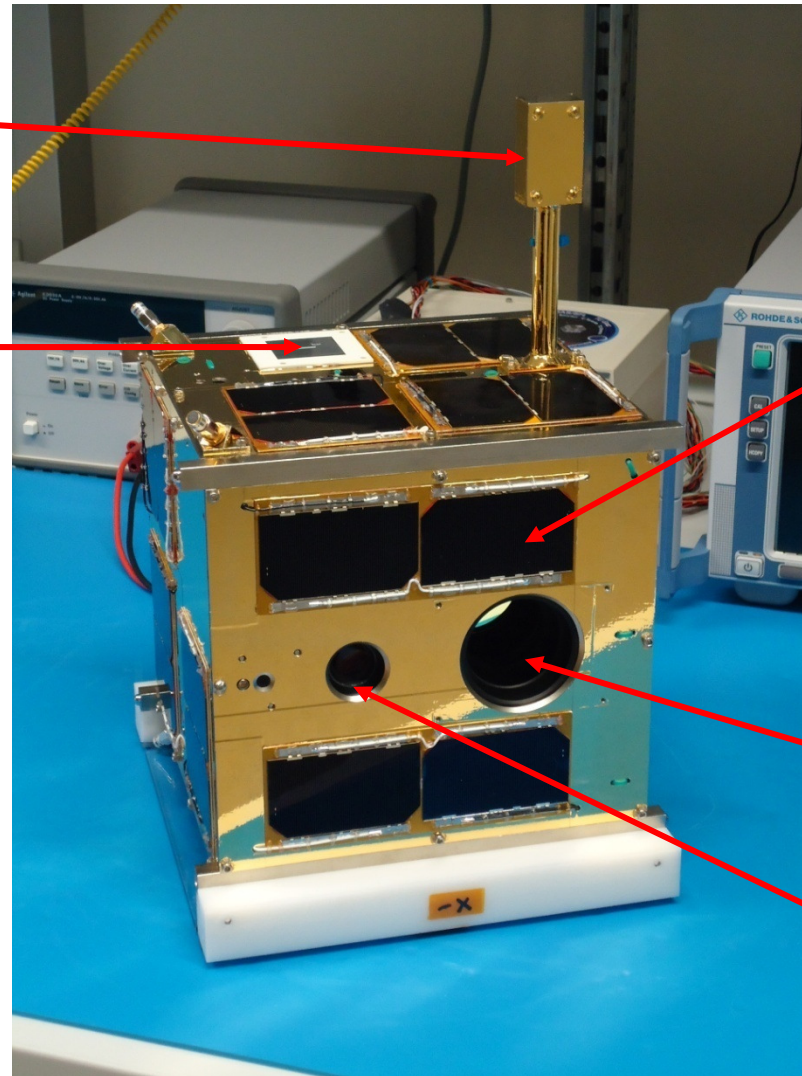
magnetometer

S-band antenna

solar cells

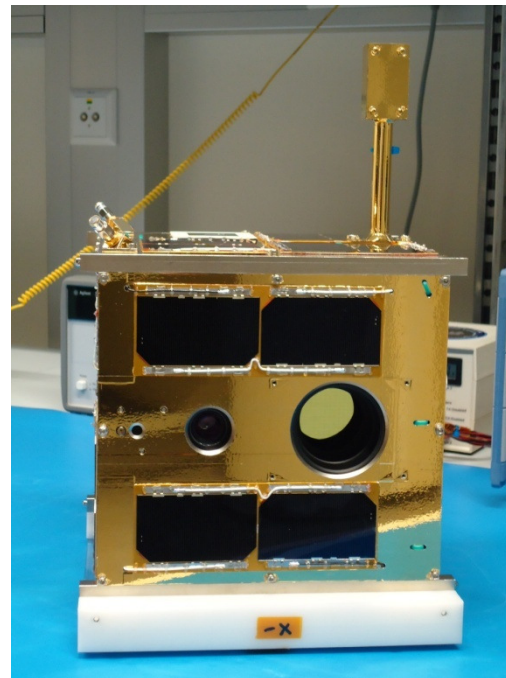
telescope

star tracker



Technology

based on pioneering developments by the
Space Flight Lab of the University Toronto
GNB (generic nanosatellite bus)



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

First Contact

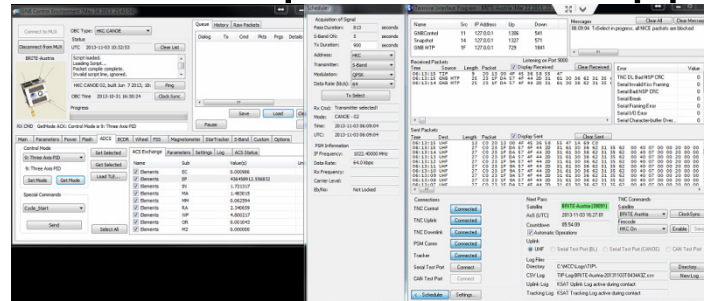
- First pass over Graz ground station (S-/UHF-Band):
 - 3 hours after launch
- Verifying health status
 - TUGSAT-1/BRITE-Austria
 - UniBRITE

Name	Value	Unit	Validity	Conditions	Date Received
DC Current	0.04	A	0.00 < Value < 0.10		00:00:00 Nov 02 2013
DC Voltage	14.92	V	13 < Value < 16		00:00:00 Nov 02 2013
RF1 Current	0.000	A	0 < Value < 0.010		00:00:00 Nov 02 2013
RF1 Voltage	1.20	V	0.75 < Value < 1.25		00:00:00 Nov 02 2013
RF Supply Current	0.001	A	Value < 0.004 F SW		00:00:00 Nov 02 2013
Regulator Voltage	3.20	V	0.75 < Value < 3.25		00:00:00 Nov 02 2013
Regulator Temp	38.00	°C	30 < Value < 40 F SW		00:00:00 Nov 02 2013
Temperature Voltage	0.04	V	0.75 < Value < 1.25		00:00:00 Nov 02 2013
Temperature Current	0.000	A	Value < 0.01		00:00:00 Nov 02 2013
RF1 Regulator Voltage	0.001	A	Value < 0.10		00:00:00 Nov 02 2013
RF1 Regulator Current	0.001	A	Value < 0.10		00:00:00 Nov 02 2013
RF2 Regulator Voltage	0.001	A	Value < 0.10		00:00:00 Nov 02 2013
RF2 Regulator Current	0.001	A	Value < 0.10		00:00:00 Nov 02 2013
Temp 1 Current	33.20	mA			00:00:00 Nov 02 2013
Temp 1 Voltage	38.20	mA			00:00:00 Nov 02 2013
Temp 2 Current	7.00	mA			00:00:00 Nov 02 2013
Temp 2 Voltage	0.000	A			00:00:00 Nov 02 2013
Reaction Wheel 1 Voltage	4.20	V	4.1 < Value < 5.5 F SW		00:00:00 Nov 02 2013
Reaction Wheel 2 Voltage	4.20	V	4.1 < Value < 5.5 F SW		00:00:00 Nov 02 2013
Reaction Wheel 3 Voltage	4.20	V	4.1 < Value < 5.5 F SW		00:00:00 Nov 02 2013
Wheel 1 Speed	46.220	rad/s			00:00:00 Nov 02 2013
Wheel 2 Speed	46.340	rad/s			00:00:00 Nov 02 2013
Wheel 3 Speed	46.940	rad/s			00:00:00 Nov 02 2013
RF Switch Opened Voltage	0.004	V	0 < Value < 0.01 F SW		00:00:00 Nov 02 2013
RF Switch Opened Current	0.004	A	Value < 0.01 F SW		00:00:00 Nov 02 2013
RF Switch Voltage	0.001	V	0.00 < Value < 0.01		00:00:00 Nov 02 2013
RF Switch Current	0.001	A	0.00 < Value < 0.01		00:00:00 Nov 02 2013
RF1 Mode SW	0				00:00:00 Nov 02 2013
RF2 Mode SW	0				00:00:00 Nov 02 2013
State Vector 01 (m)	0.001	rad/s			00:00:00 Nov 02 2013
State Vector 02 (m)	0.000	rad/s			00:00:00 Nov 02 2013
State Vector 03 (m)	-0.003	rad/s			00:00:00 Nov 02 2013
State Vector 04 (m)	0.000				00:00:00 Nov 02 2013
State Vector 05 (m)	0.000				00:00:00 Nov 02 2013
State Vector 06 (m)	0.000				00:00:00 Nov 02 2013
State Vector 07 (m)	0.000				00:00:00 Nov 02 2013
State Vector 08 (m)	0.000				00:00:00 Nov 02 2013
State Counter	100100				00:00:00 Nov 02 2013
RF1 Transducer Phase	0.000	rad	Value < 0.1		00:00:00 Nov 02 2013



Mission Control in Graz, Austria

- 14 orbits per day
 - 3 orbits in morning
 - 3 orbits in evening
- Automatic ground stations operations supported



Ground Stations

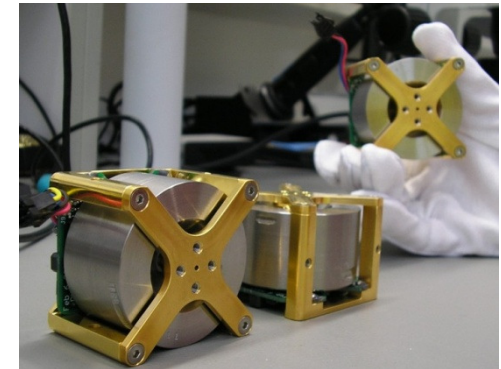
- Graz, Austria
 - Control of BRITE-Austria
- Toronto, Canada
 - Control of UniBRITE in 2013/2014
 - Control of BRITE-Toronto and BRITE-Montreal
- Warsaw, Poland
 - Control of BRITE-LEM and Heweliusz
- All stations can track and collect data from all BRITE satellites (redundancy)
- Science teams retrieve verified raw data from servers

Commissioning

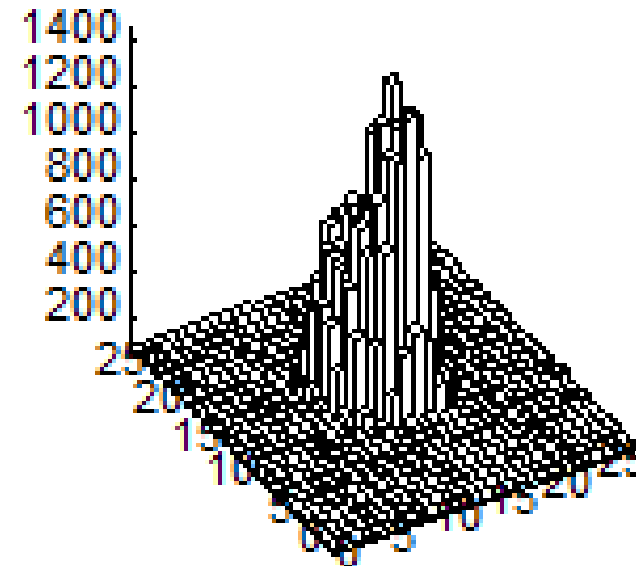
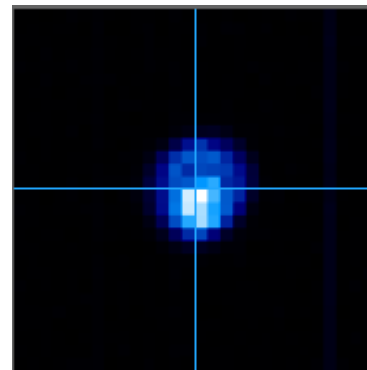
- Check-out of subsystems
 - Telemetry (communications system)
 - On-board computers (3)
 - Power system
 - Attitude control system (ADCS)

- ADCS
 - Coarse Pointing
 - Fine Pointing
 - Pointing Accuracy: < 1 arc minute (~ 2 pixels)
 - Star Tracker parameter optimisation

- Characterisation of Payload (instrument)



First Image



Delta Corvus B9V mag=2.95

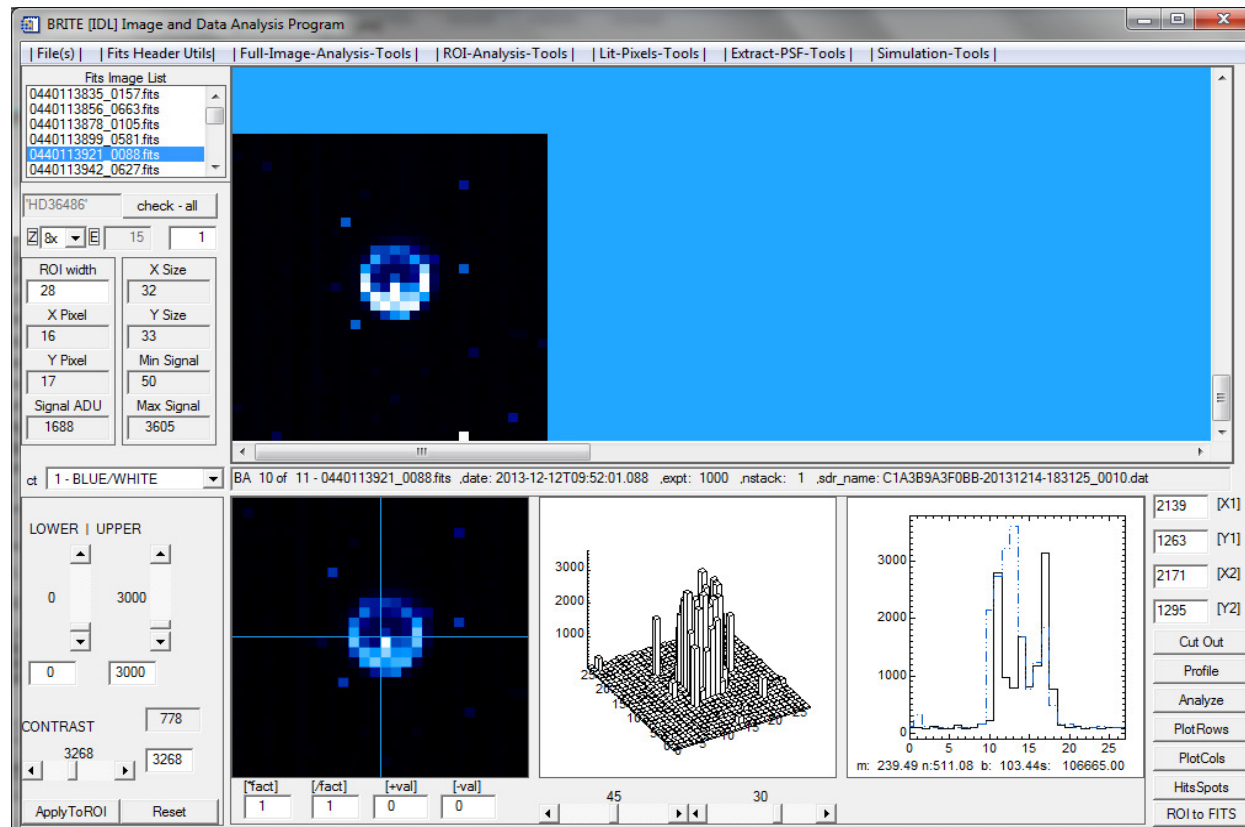
Brightness Distribution (Point Spread Function)

Image taken during 404th orbit by BRITE-Austria/TUGSAT-1 on 23 March 2013
Processed by Dr.Rainer Kuschnig (University of Vienna)

Activities Summer – Fall 2013

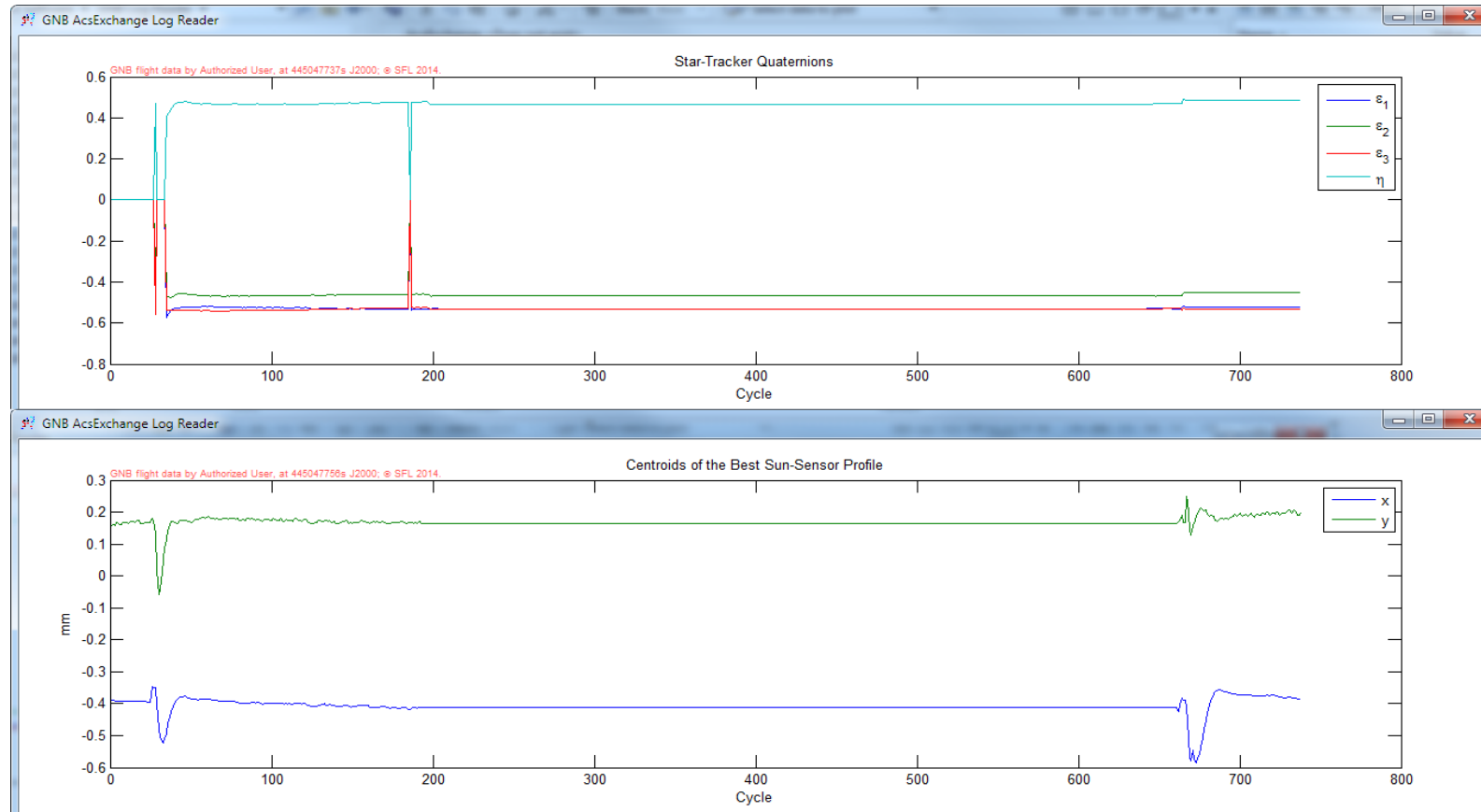
- Payload Characterisation (TUGSAT-1)
- Attitude Control System Optimisation (UniBRITE)
- Reduction of commissioning time
- Fine Pointing achieved in November 2013
Performance better than specification
- Science data collection since November

Payload Characterisation



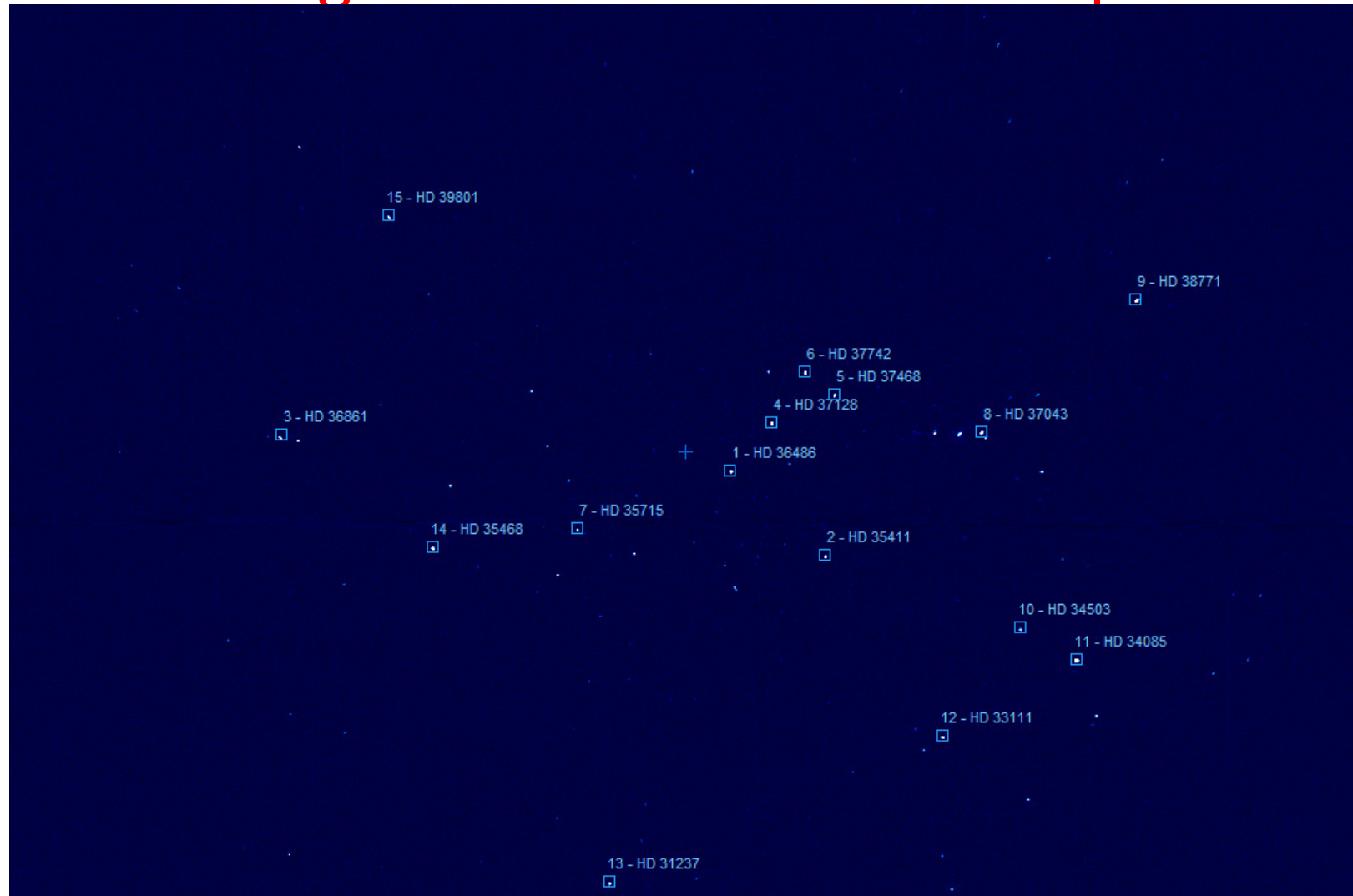
- Verification of Point Spread Function, CCD sensitivity
- Identifications of hot pixels on CCD (removal by software)

Pointing Performance



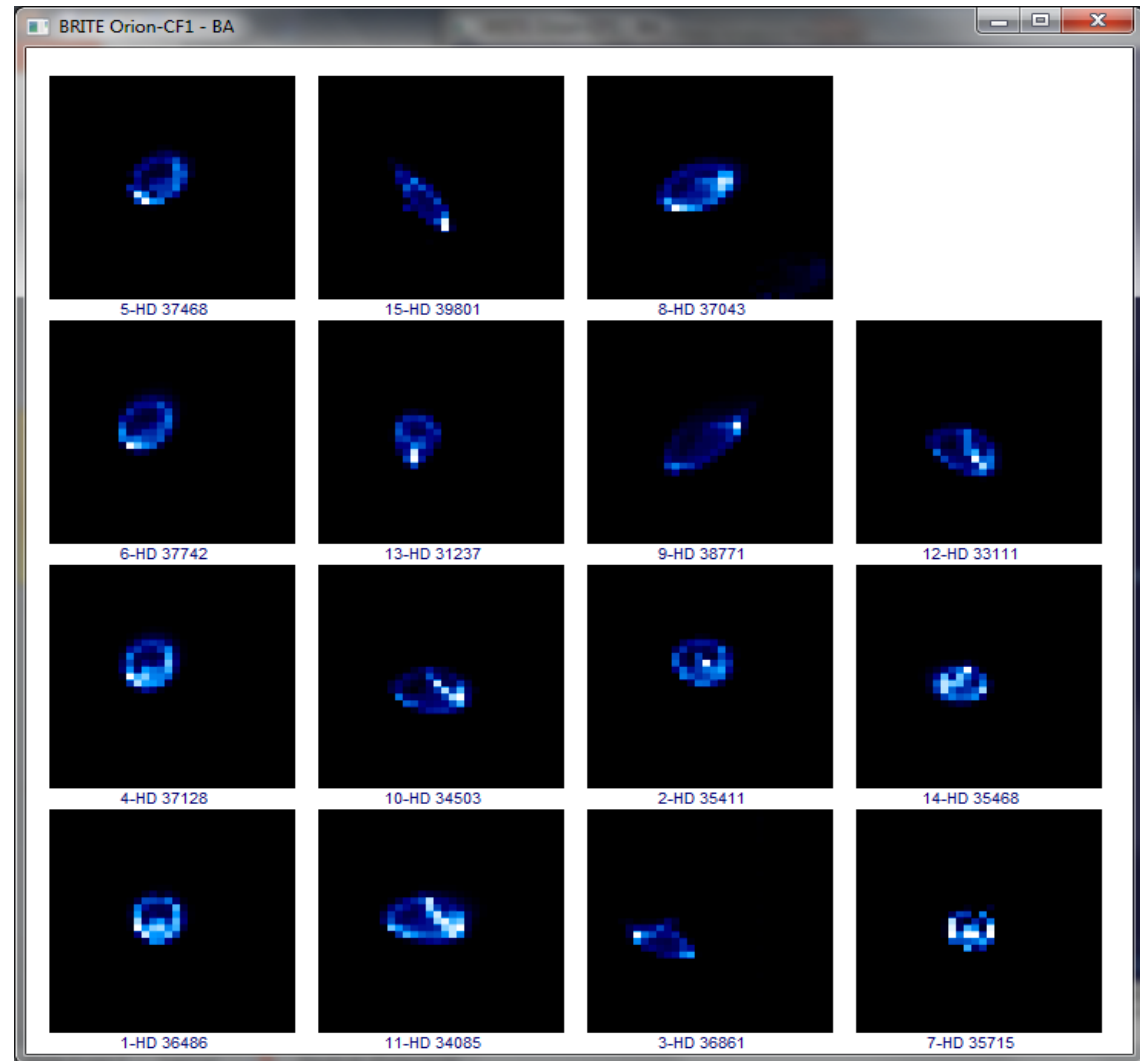
RMS pointing errors in X and Y are 1.6 and 1.5 pixels (specified: 2 – 3 pixels)

Image of Orion taken from Space



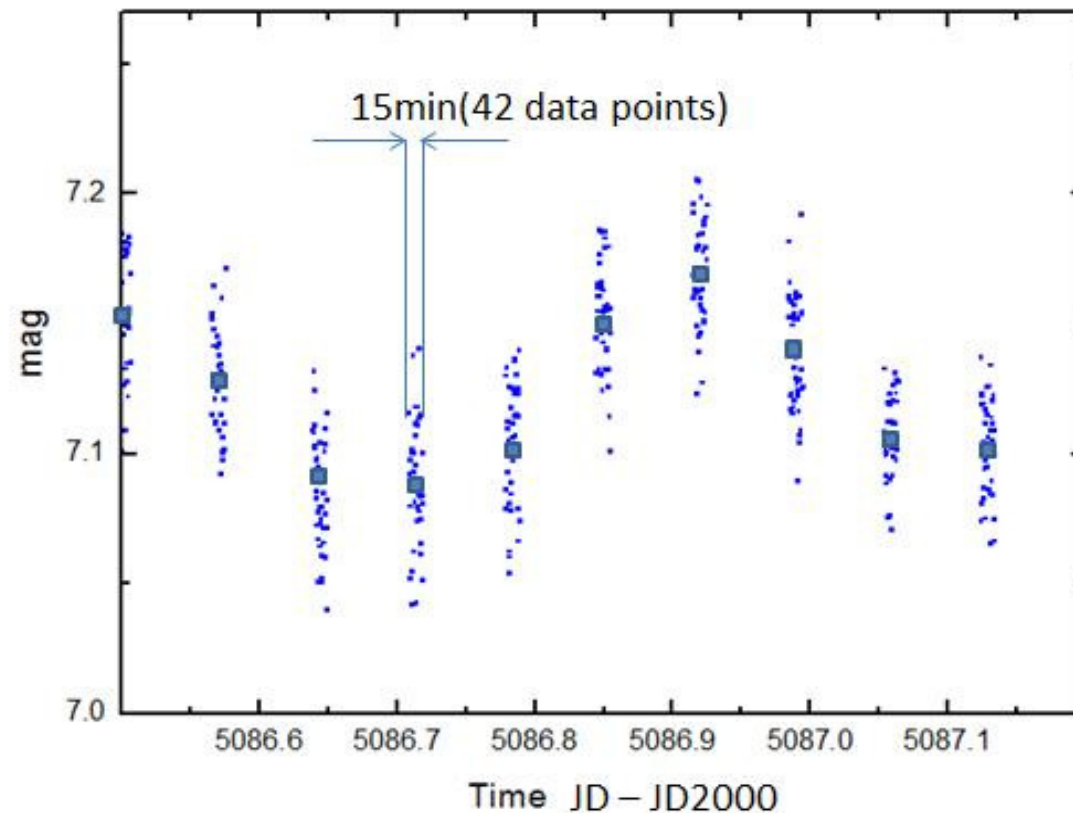
Raster Photometry

- Raster: 30 x 30 pixels



All 15 rasters during one observation, spacecraft pointing at Orion

Processed Data of Eta Orionis



changes in the mean signals brightness measurements:
intrinsic stellar variations

Summary

- BRITE Constellation is the world's first nanosatellite constellation dedicated to an astronomy mission
- First 3 members of BRITE constellation in orbit
- Planned constellation completed this year
- Scientific & mission requirements fully met
- Scientific data collection under way



Thank you for your attention!