Mission characterization of LEO targets

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21th International Workshop On Laser Ranging, Canberra,
November 5-9, 2018

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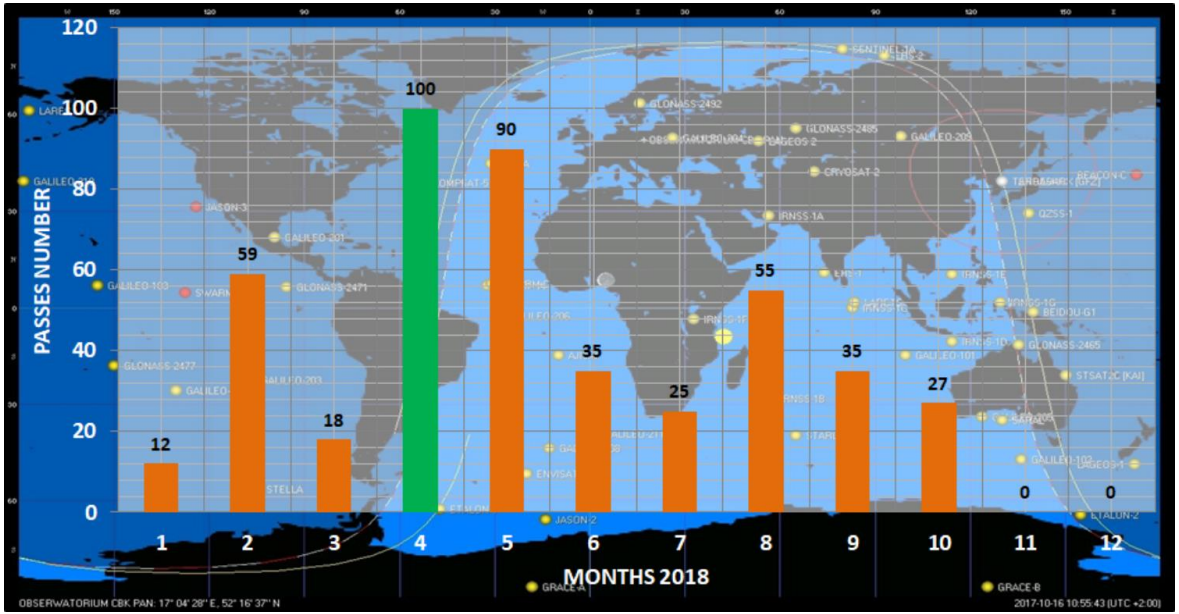
SD statistics in 2018– all passes



Our targets in 2018

ADEOS-2
ENVISAT
ERS-1&2
JASON-1
OICETS
SEASAT-1
TOPEX

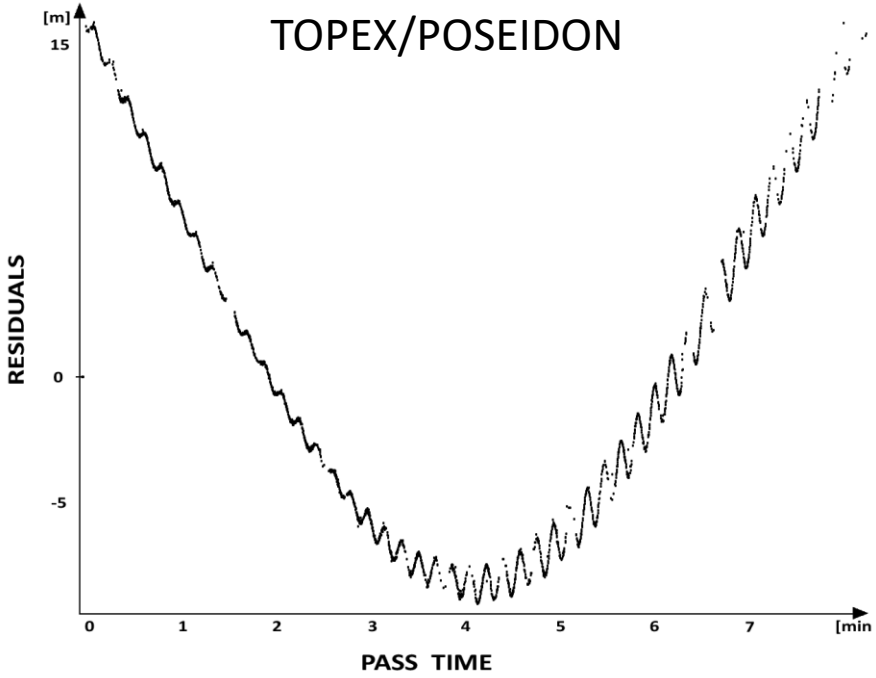
R/B's:
28480
31114

Till the end of October, 2018, BORL station has performed 456 passes of LEO space debris targets (5769 NP's) with the average RMS of the measurements from 2.5 cm to 45.1 cm

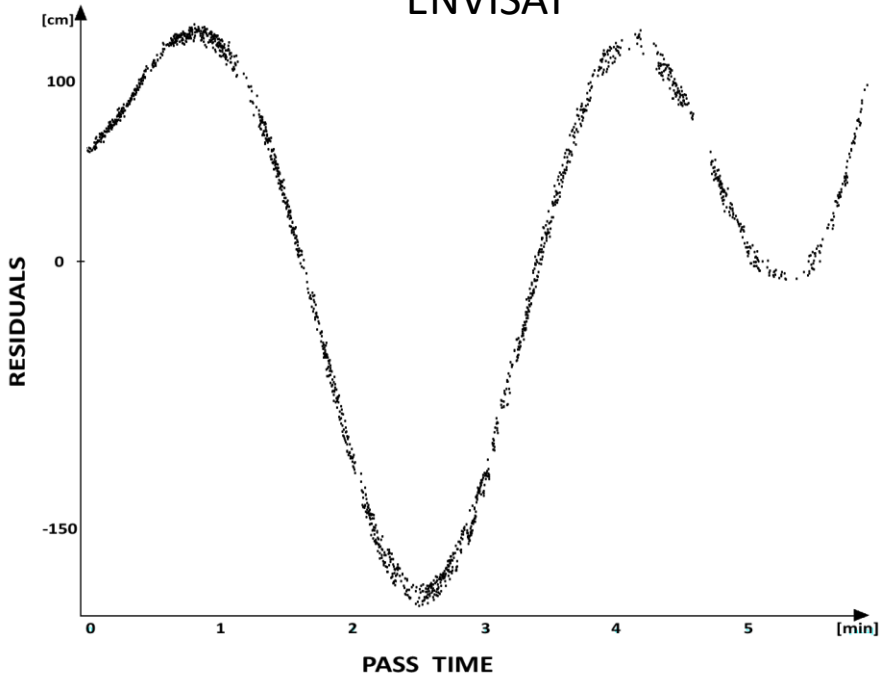
BORL 7811 SETUP

What you can get from 10Hz laser ?

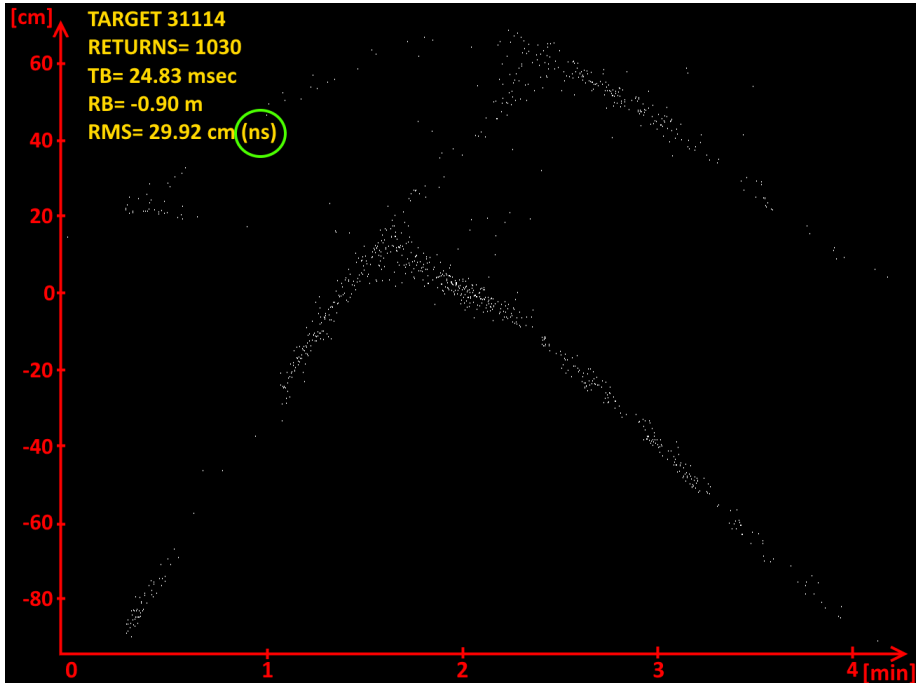
TOPEX/POSEIDON

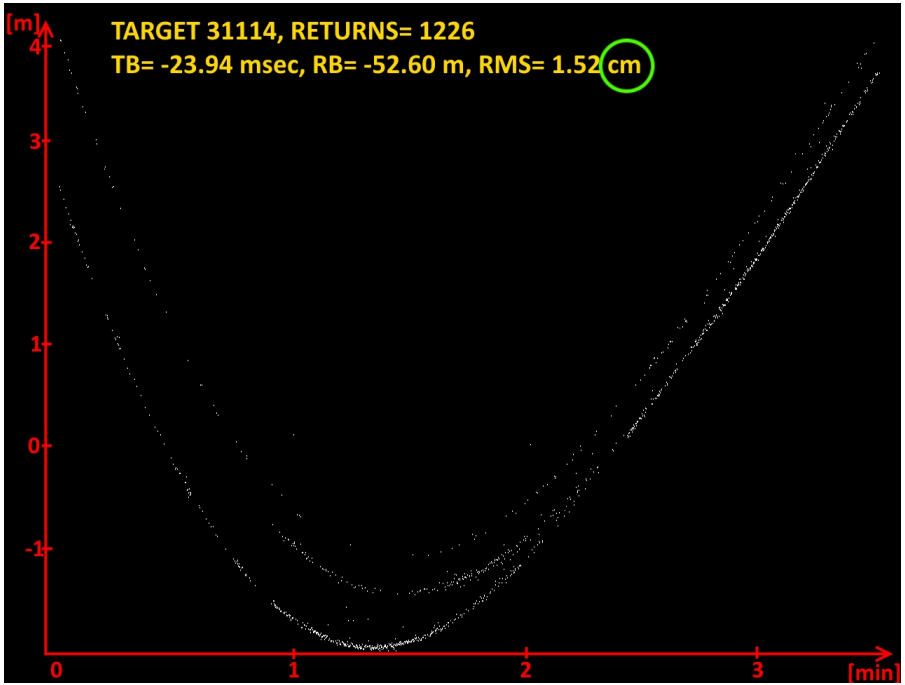


ENVISAT



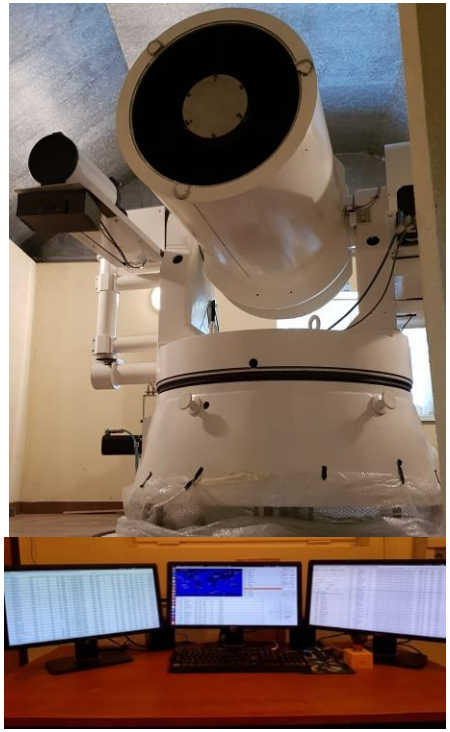
What you can get from 10Hz laser ?





CBK SLR – SECOND SETUP

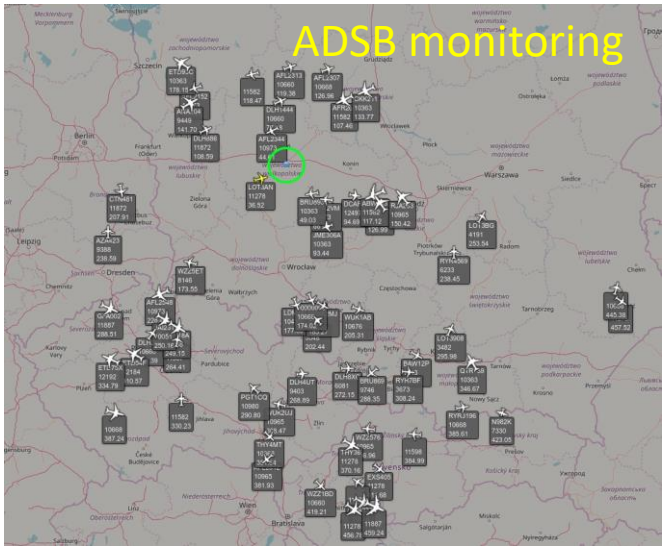
CBK SLR – second system

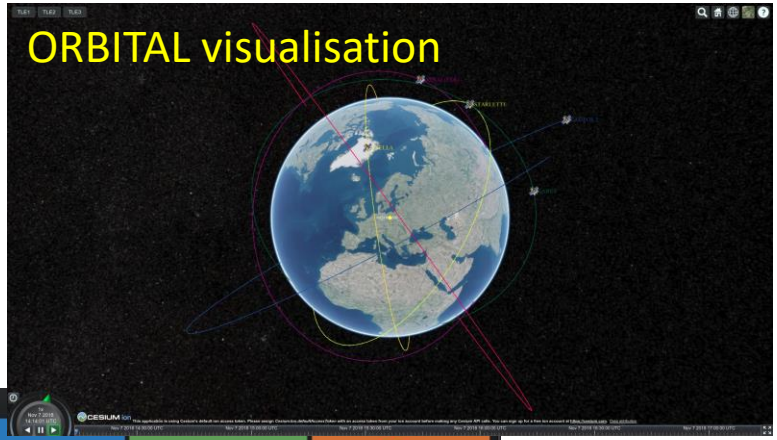


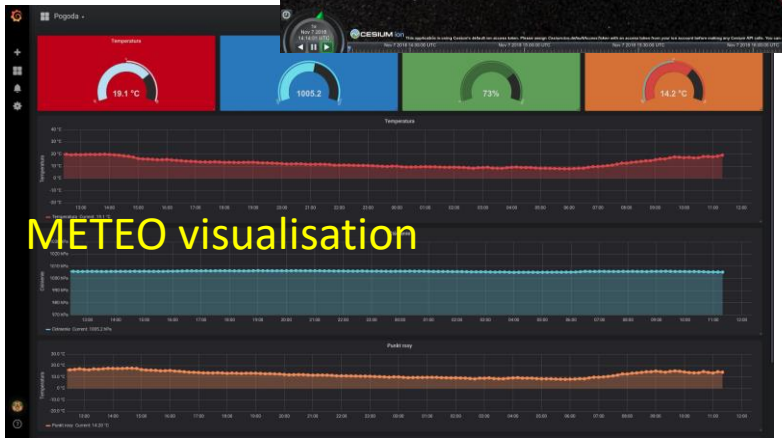
Parameter	CSLRB – CBK Borowiec SLR station (Cassegrain B setup) - HARDWARE
Mount	Alt-Azimuth, system resolution < 1 arcsec (Servo drive & PLC's)
Sensor telescope	Cassegrain 65 cm
Guiding telescope	RC 8''
Detector types	ASI1600MMC, main telescope, **using for tests** ASI174MMC, guiding telescope, **using for tests**
Laser	Continuum Surelite III (450 mJ/532 nm, 3-5 ns)
Time Interval Counter	Event timer
Detector	SPAD – developed by CBK, **in progress**
Beam divergence controlling	developed by CBK, **in progress**
Day/Night observations	Full automatic Iris & filter wheel changer, **in progress**
ADSB shutter module	**Developed and done by CBK**

CBK Borowiec SLR station (Cassegrain B setup) – SOFTWARE
• satellite/space debris predictions, **done**
• visualization in real-time and in simulating mode (tracking and Doppler parameters; eg. Az, El, distance, up & down RF link), **done**
• historical data analysis (SQL Data base), **done**
• real-time mode of tracking and laser data acquisition, **in progress**
• real-time and fast communication with altazimuth mount, **done**
• real-time process control (mount, peripherals, detector, etc.)
• data acquisition from event timer, **in progress**

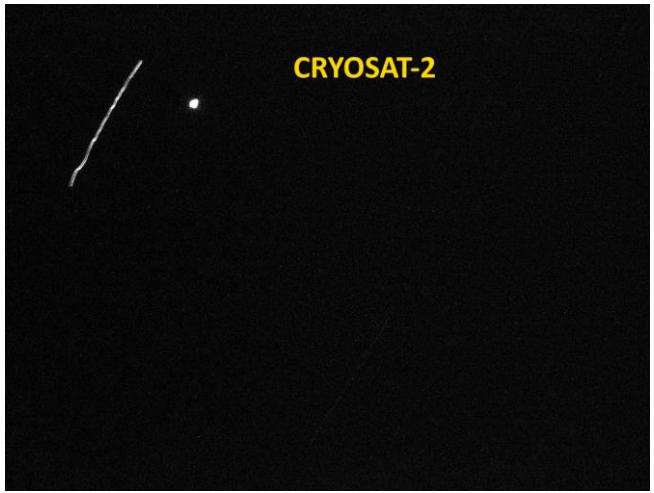
Developped functionalities of the second setup

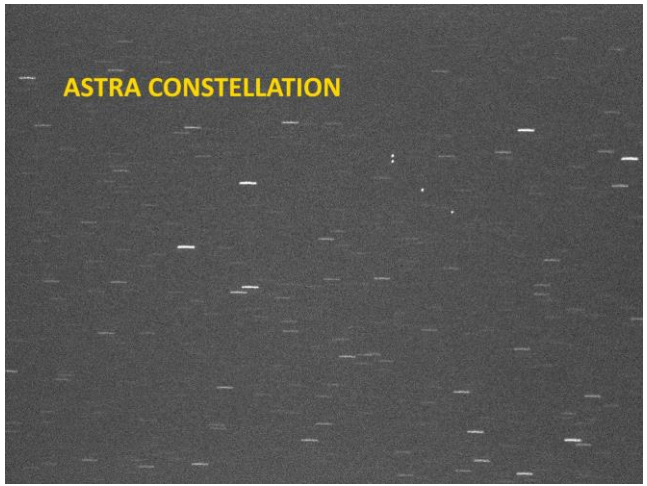






First optical passive tests – from LEO to GEO





EXPOSURE TIME
1 sec (CRYOSAT-2)
5 sec (ASTRA)

TELESCOPE
RC 8''

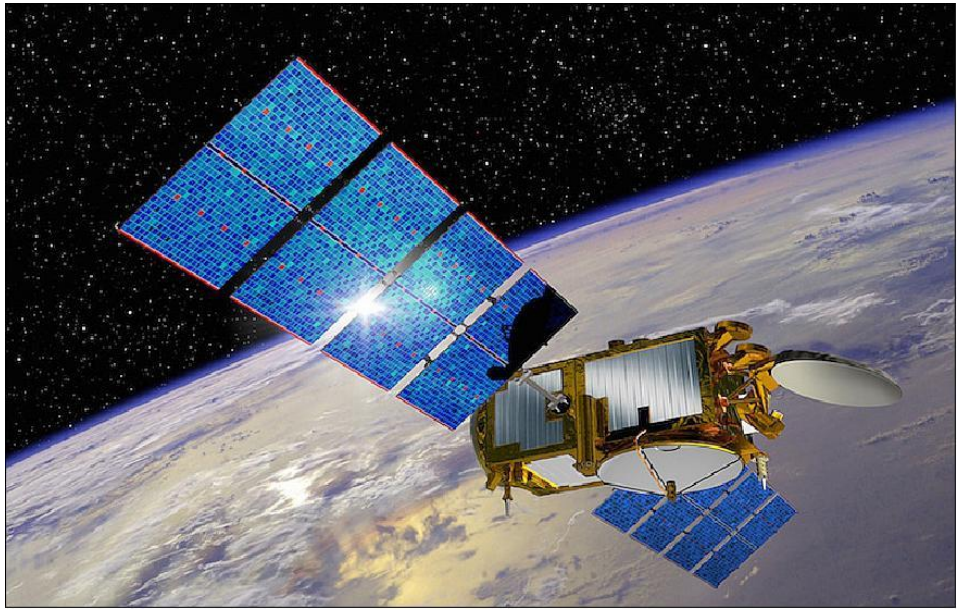
DETECTOR TYPE
ASI 1600MMC (MONO, COOLED CAMERA, SPECTRA RANGE 400-800 nm)

FOV
38'x29'

OBJECTIVES

- collection of pictures of satellites equipped with sollar arrays (with distinction on silicon arrays and gallium arsenide) and without these arrays
- the collected pictures will be used for data corellation and to determine the probability of the effectiveness of targets (satellites/space debris) distinguishing
- system callibration including correction of the distance between diffraction grating and camera
- specification of the parameters for the futured advanced spectra module placed on the main telescope (aperture 65 cm)
- missions characterization for needs of SST activity

Spectroscopy of LEO targets – preliminary stage



	JASON-3
Sponsor	NASA, CNES, Eumetsat, NOAA
Launch date	January 17, 2016
COSPAR ID	1600201
TECHNICAL PARAMETERS	
Dimensions	3.8 m x 10 m x 2m
Mass [kg]	550
Sollar arrays	2 two deployable solar arrays, each with four 1.5 by 0.8-meter panels covered with silicon solar cells
ORBITAL PARAMETERS	
Inclination	66°
Eccentricity	0.001
Perigee [km]	1336
Period [min.]	112

Spectroscopy of LEO targets – preliminary stage

PASS
17 OCTOBER 2018, 18:53:32 UTC

EXPOSURE TIME
1 sec

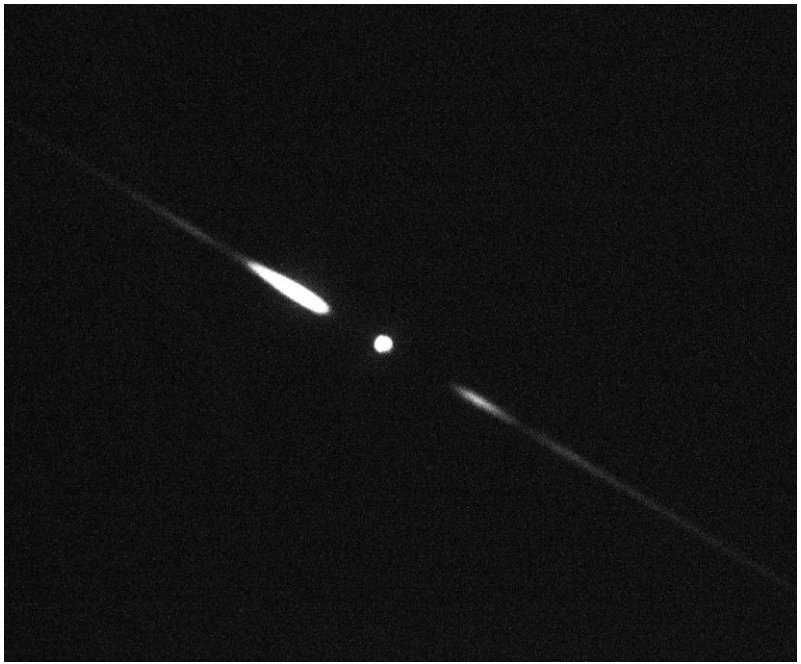
WEATHER CONDITIONS
HIGH THIN CLOUDS

TELESCOPE
RC 8’’

DIFFRACTION GRATING 100

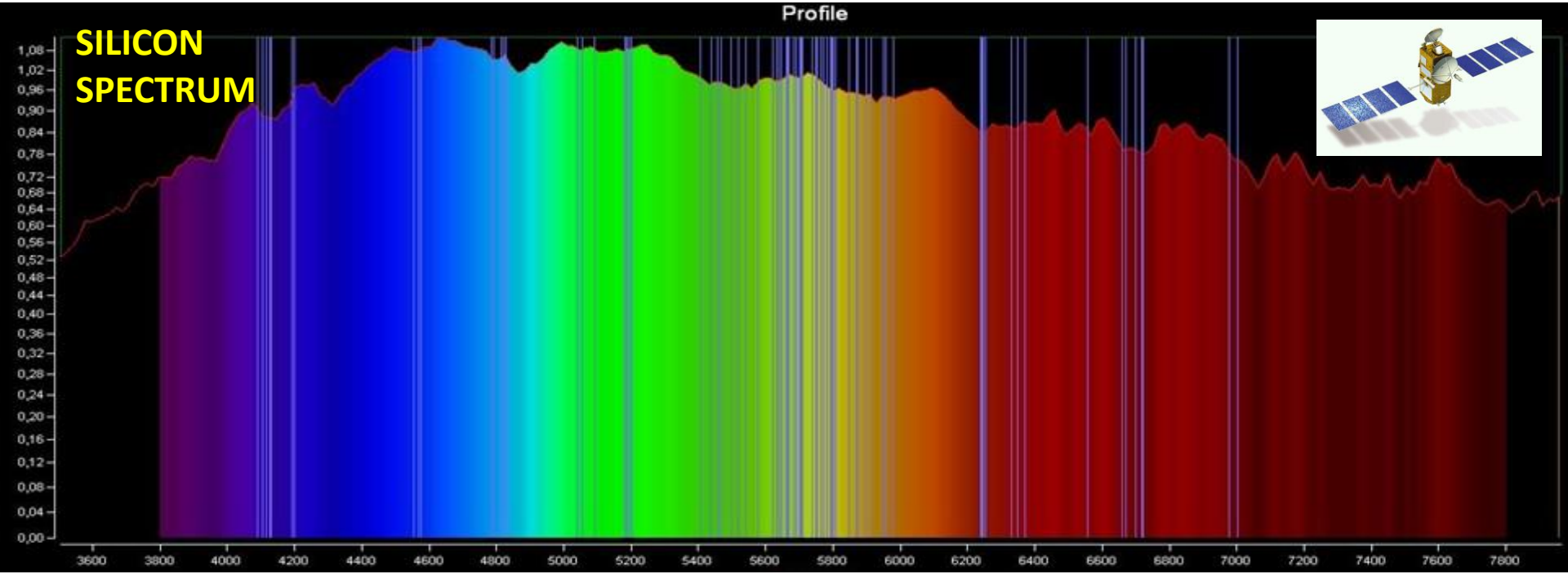
DETECTOR TYPE
ASI 1600MMC (MONO, COOLED CAMERA, SPECTRA RANGE 400-800 nm)

FOV
38’ x 29’



Spectroscopy of LEO targets – preliminary stage
SPECTRUM of JASON-3

Real-time Spectroscopy software



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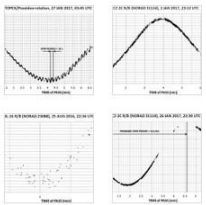

Tables (3)

Table 1

Advances in Space Research
Available online 7 March 2018
In Press, Corrected Proof

First laser measurements to space debris in Poland

Paweł Lejba [a], Tomasz Suchodolski [a], Piotr Michałek [a], Jacek Bartoszak [a], Stanisław Schillak [b], Stanisław Zapaśnik [a]

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Abstract

The Borowiec Satellite Laser Ranging station (BORL 7811, Borowiec) being a part of the Space Research Centre of the Polish Academy of Sciences (SRC PAS) went through modernization in 2014–2015. One of the main tasks of the modernization was the installation of a high-energy laser module dedicated to space debris tracking. Surelite III by Continuum is a Nd:YAG pulse laser with 10 Hz repetition rate, a pulse width of 3–5 ns and a pulse energy of 450 mJ for green (532 nm). This new laser unit was integrated with the SLR system at Borowiec performing standard satellite tracking. In 2016 BORL 7811 participated

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Feedback

SUMMARY

- the second CBK SLR setup should be fully operational including laser ranging, spectroscopy and fotometry before next laser workshop in China (keep fingers crossed ☺)
- FOR SURE, we need more good engineers ! ☺
- Some constraints/restricitions/limitations wrt the presented technique:

telescope pointing accuracy, camera/detector focus, the distance to the target, constant of diffraction grating, diffraction grating position relative to camera, target position/orientation wrt the station, weather conditions (atmospheric effects like seeing), others...

- to combine different techniques we can get much more informations about the target during one pass
- several new targets are being plan to tests (e.g. TOPEX, SEASAT, CHINESE and RUSSIAN BOOSTERS)
- when our spectroscopy approach will be confirmed by the results, then we invest into advanced spectra module
- there are our first results, any remarks, suggestions are welcomed ☺

Have sometimes
some fun during your work ! ☺