

ENVISAT

Spin and Attitude Determination Using SLR

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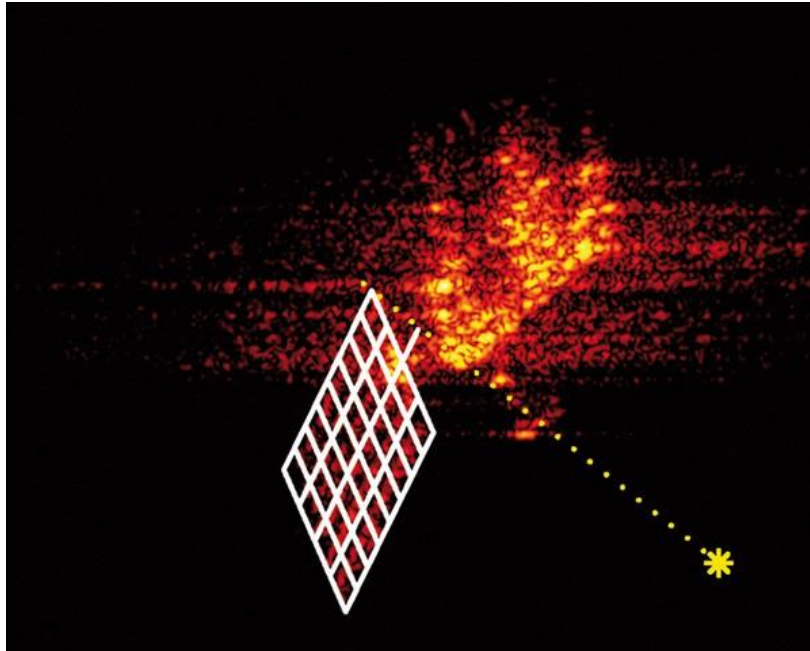
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[2] KASI: Korea Astronomy and Space Science Institute

History:

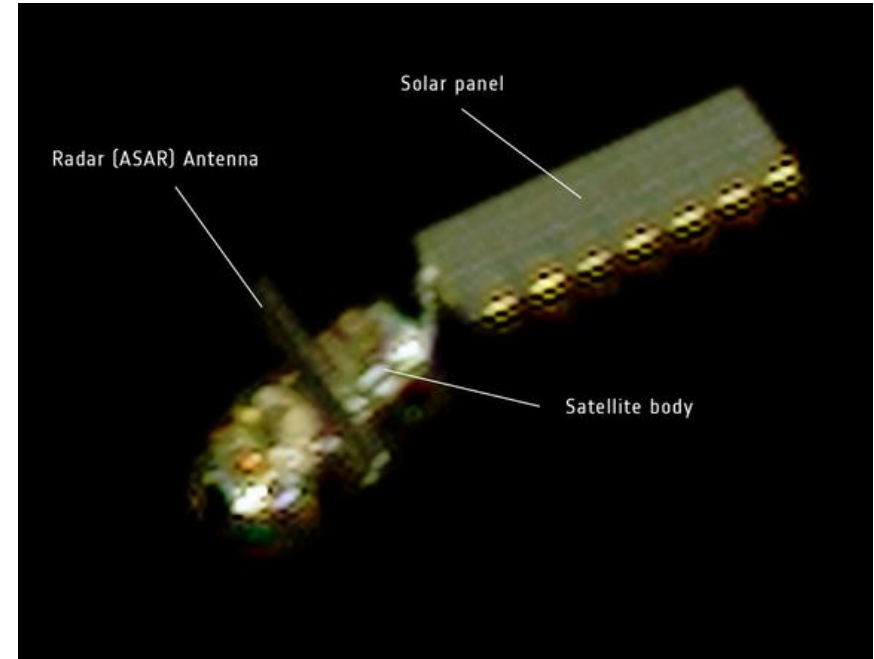
- ENVISAT is dead since April 2012; Graz re-started SLR using TLE (October 2012)
- DLR started producing CPF predictions in May 2013: e.g. `envisat_cpf_131028_8011.dlr`
- Graz started producing CPF predictions in Sept. 2013: e.g. `envisat_cpf_131028_8011.aas`
- 19 SLR stations successfully tracked ENVISAT in 2013 - **THANK YOU !**
- This SLR data allows us now to determine
 - Accurate orbits
 - Spin duration
 - Spin axis

For other methods, like RADAR and PASSIVE OPTICAL SYSTEMS, it is difficult (and more expensive) to determine attitude, spin etc. of such targets ...

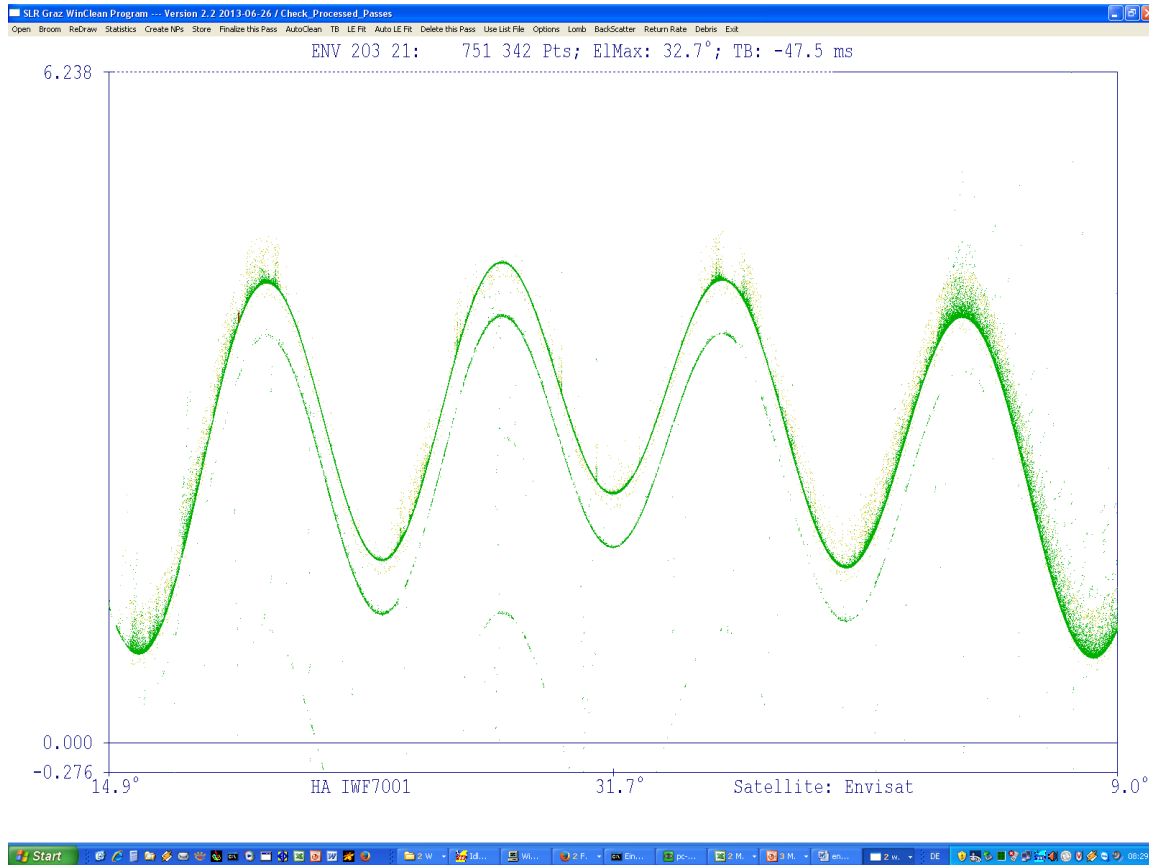


ISAR (Inverse Synthetic Aperture Radar) image – using the TIRA Radar system near Bonn - with superimposed wireframe model of the solar panel (white) and plotted direction of the sun (yellow).

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Optical images also have been acquired by a space based telescope (French Pléiades system) for a short period of time, from a distance of approximately 100 km; but this requires special conditions (sun-lit, short distance etc.)



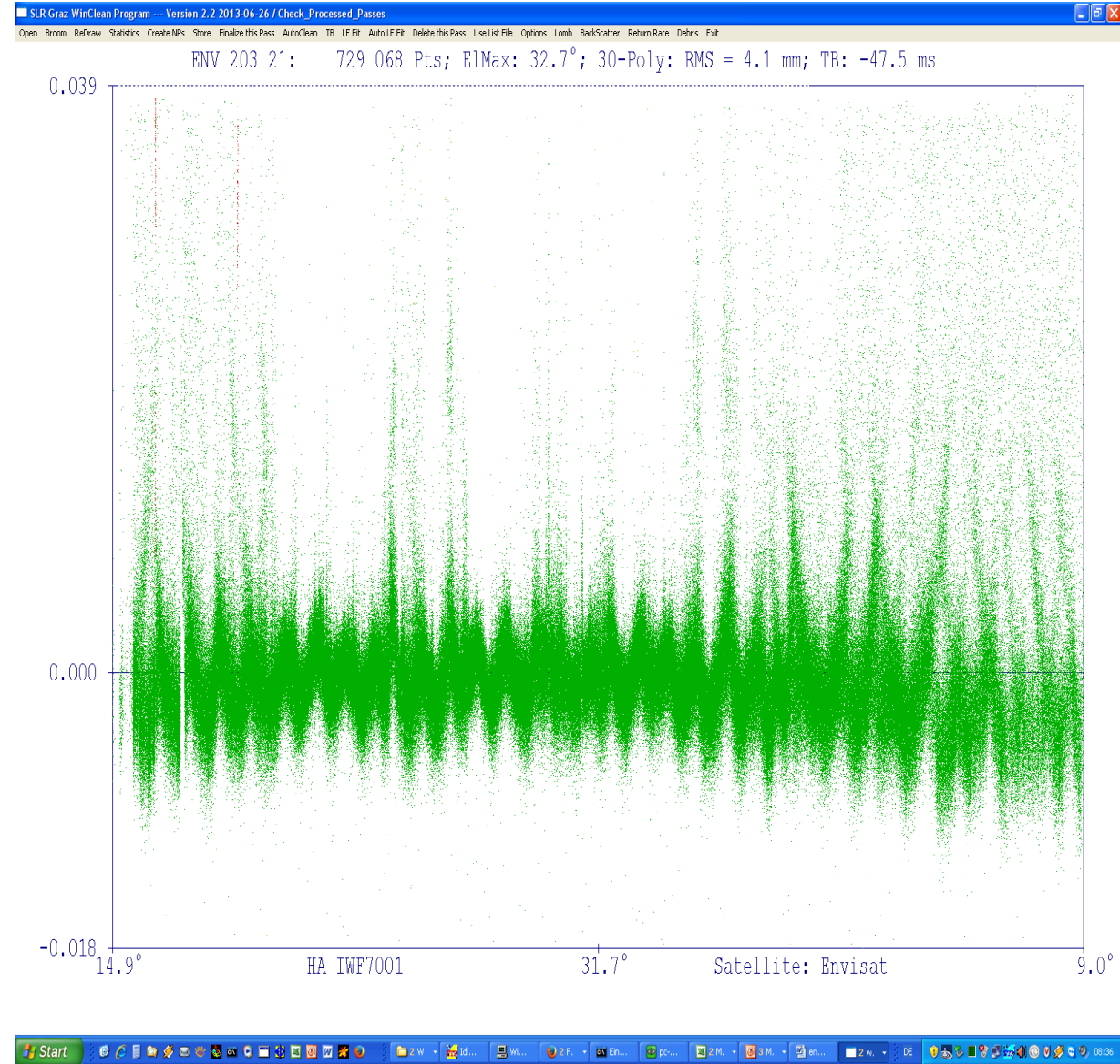
- A typical GRAZ ENV pass: July 2013
- Tracked with 2 kHz laser / 400 μ J
- Retros ,visible‘ from Graz Station
- > 700 000 good returns
- **Large** oscillations (± 2 m) due to spin
- Slight pre-tracks due to laser leakage



And this is what we get via SLR: Only distances, BUT:

- Measured from 19 ILRS Stations;
- During day and night;
- No special conditions required

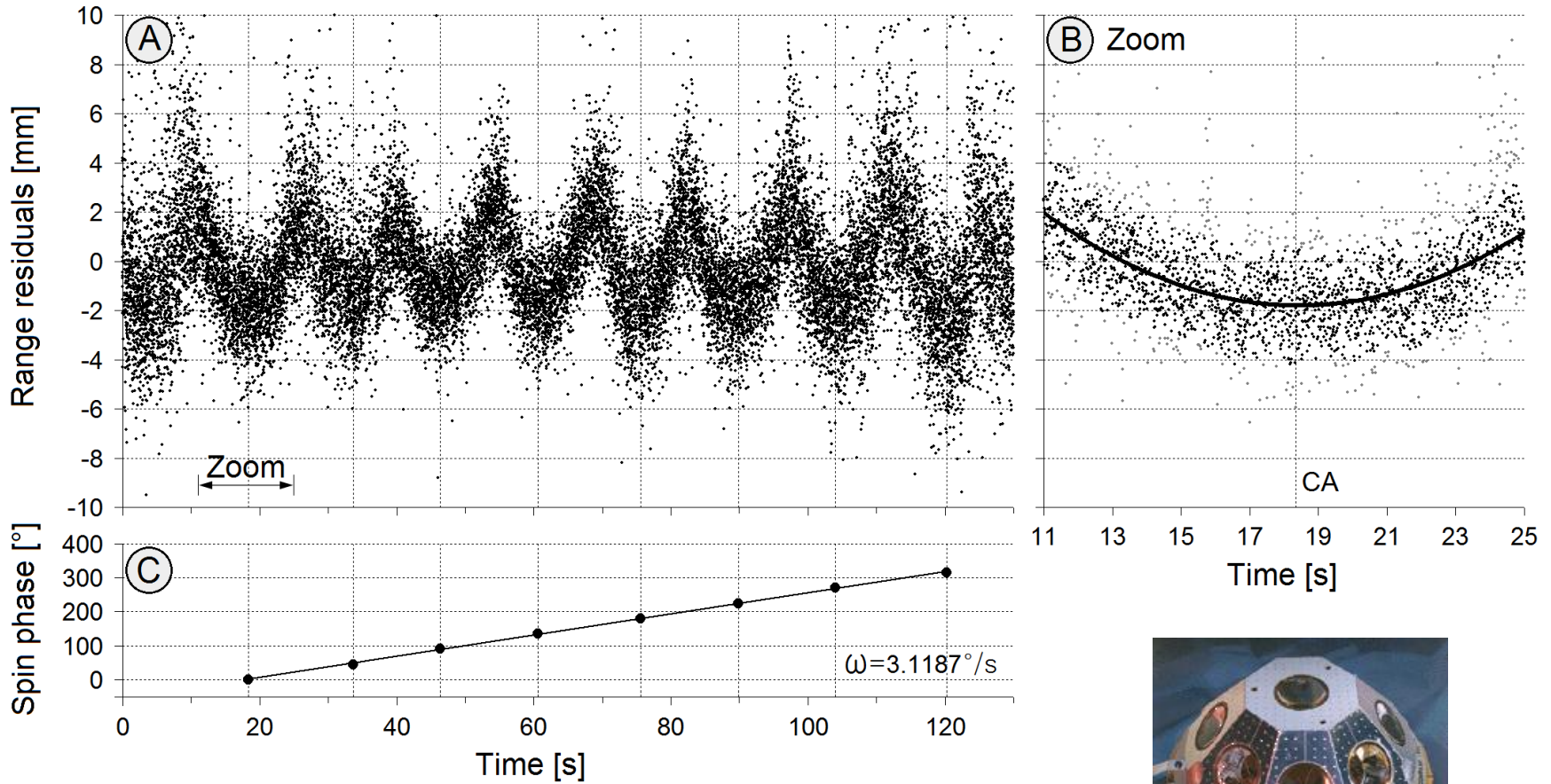
ENVISAT Retro



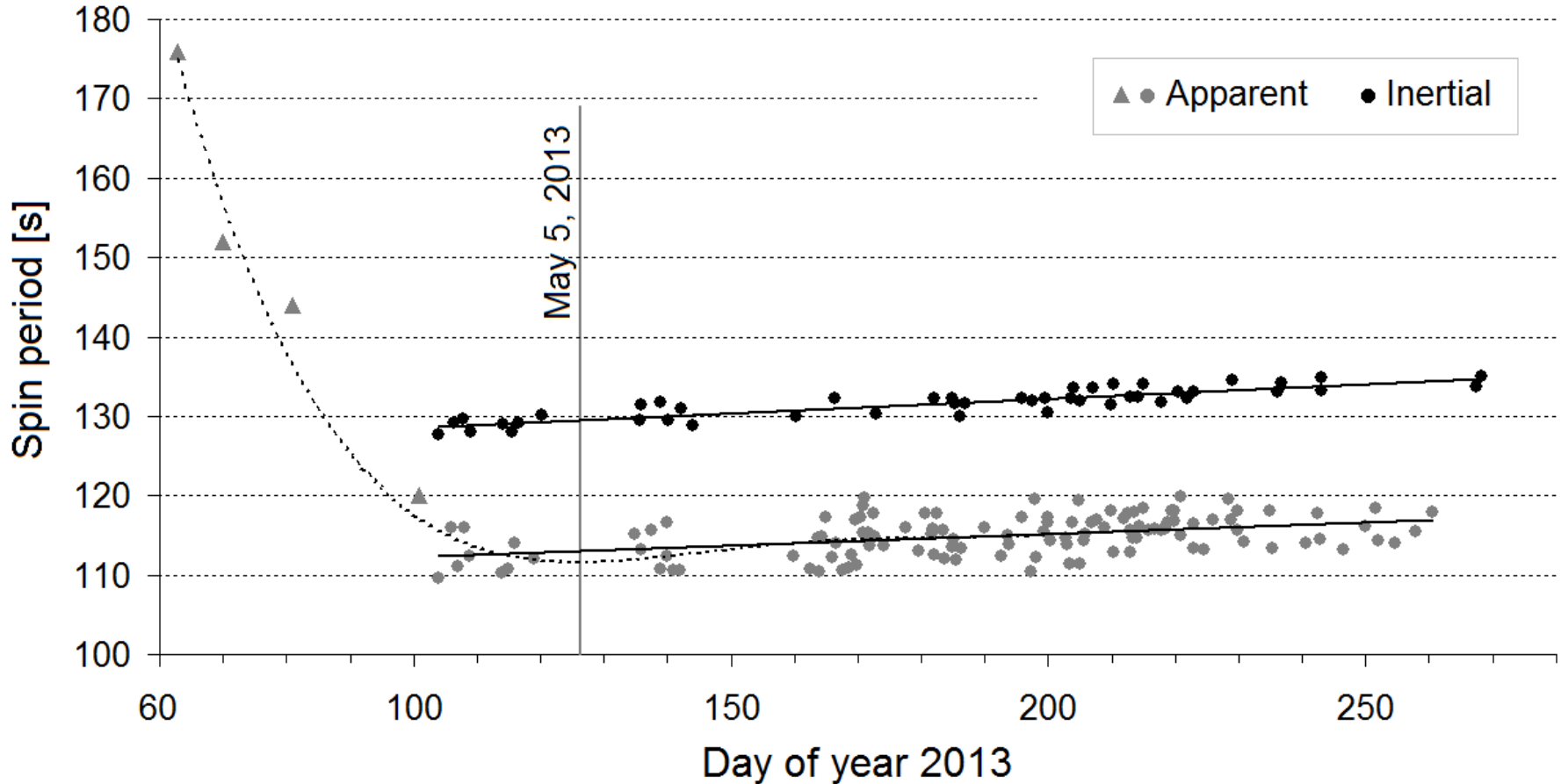
- Same GRAZ ENV pass: July 2013
- > 700 k good returns from RETROS
- 30 degree poly fit necessary
- **Small** oscillations (\pm several mm)
- Due to 8 retro-reflectors
- Used to derive spin period



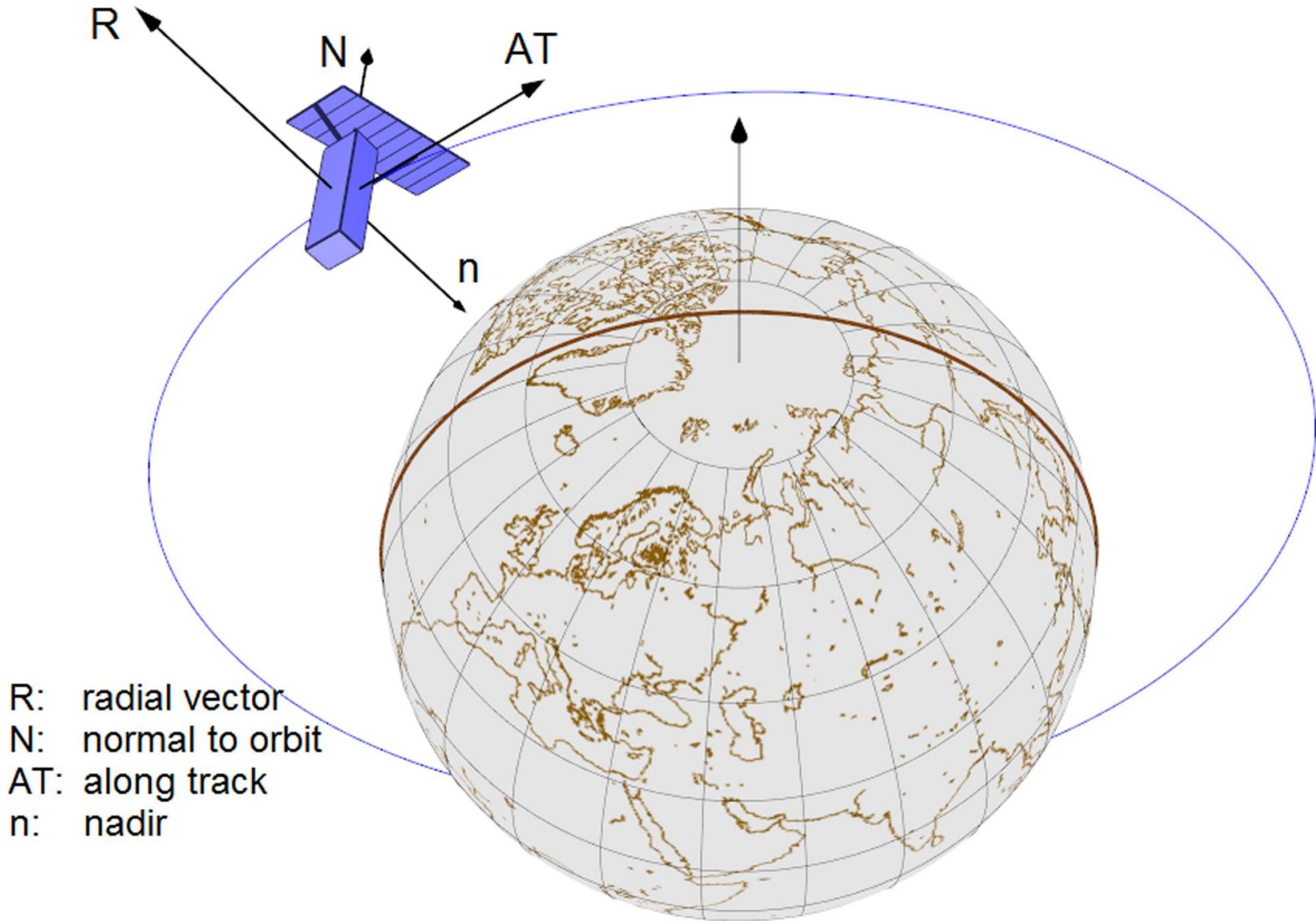
ENVISAT Retro



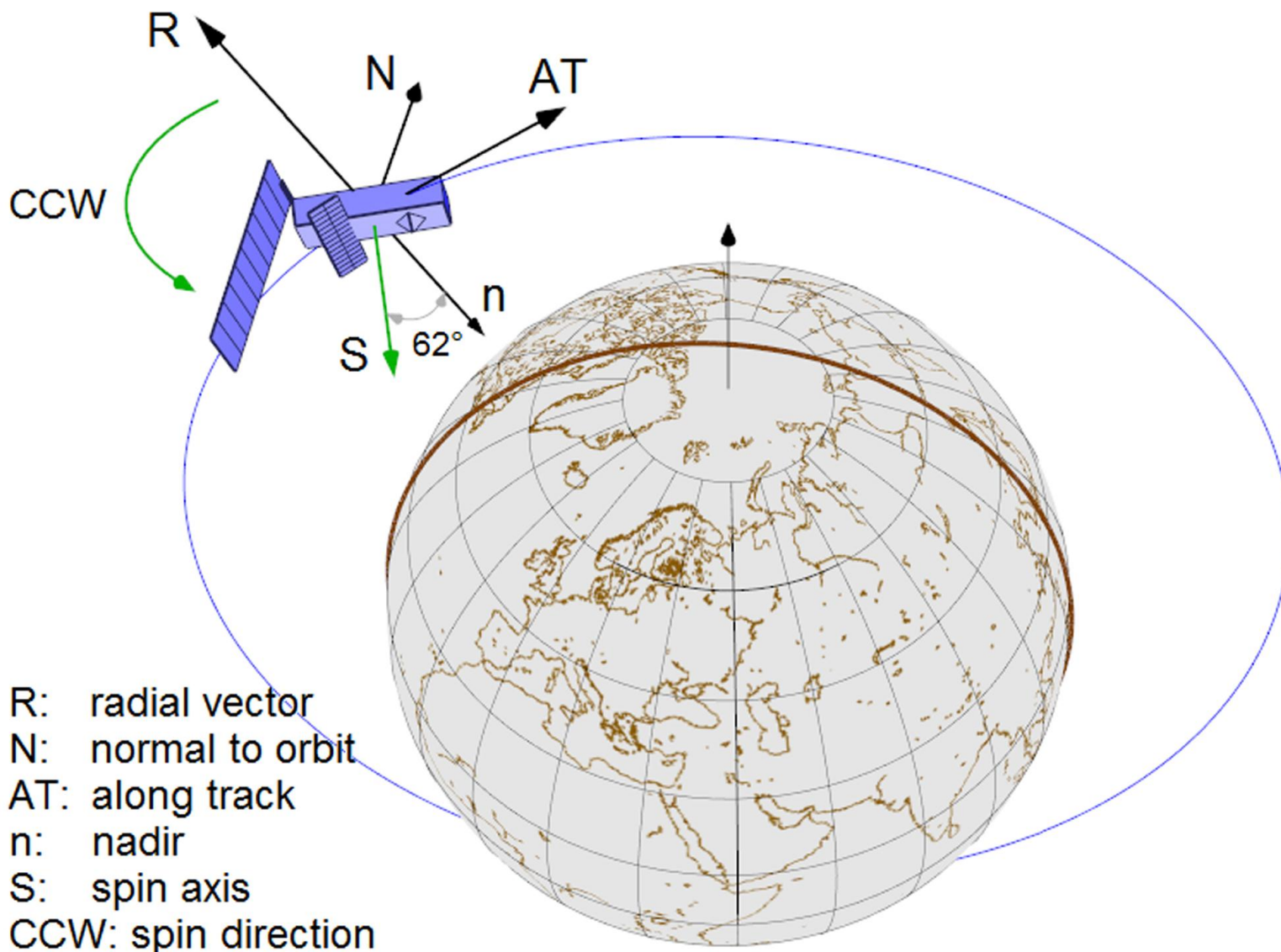
Small oscillations (\pm several mm) due to retros: Used to derive inertial spin period

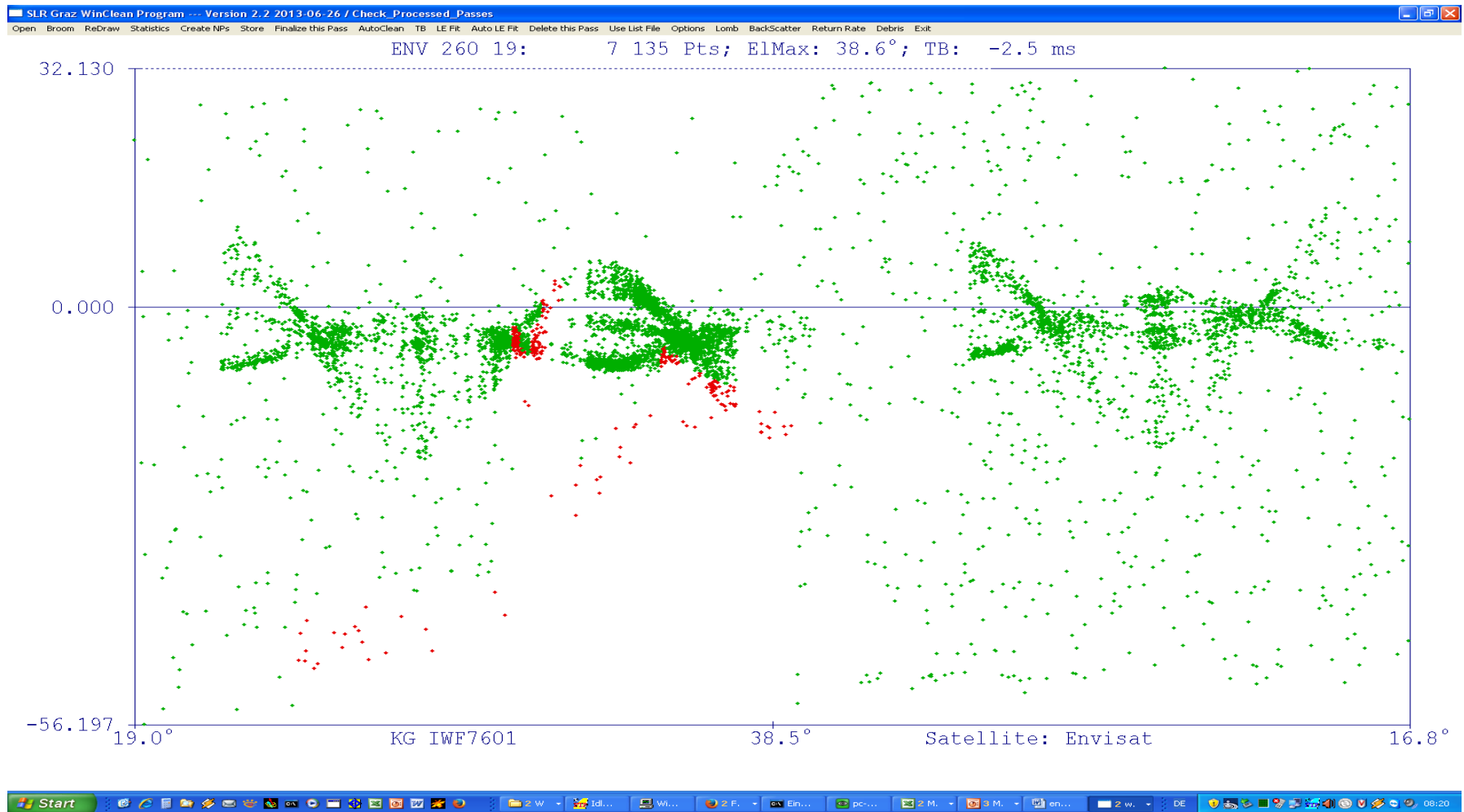


Inertial spin period (black circles) and apparent spin period (gray points) of Envisat during 2013: $134.74 \text{ s} \pm 0.91 \text{ s}$ (September 25, 2013), slowing down with 0.0367 s / day .



R: radial vector
 N: normal to orbit
 AT: along track
 n: nadir

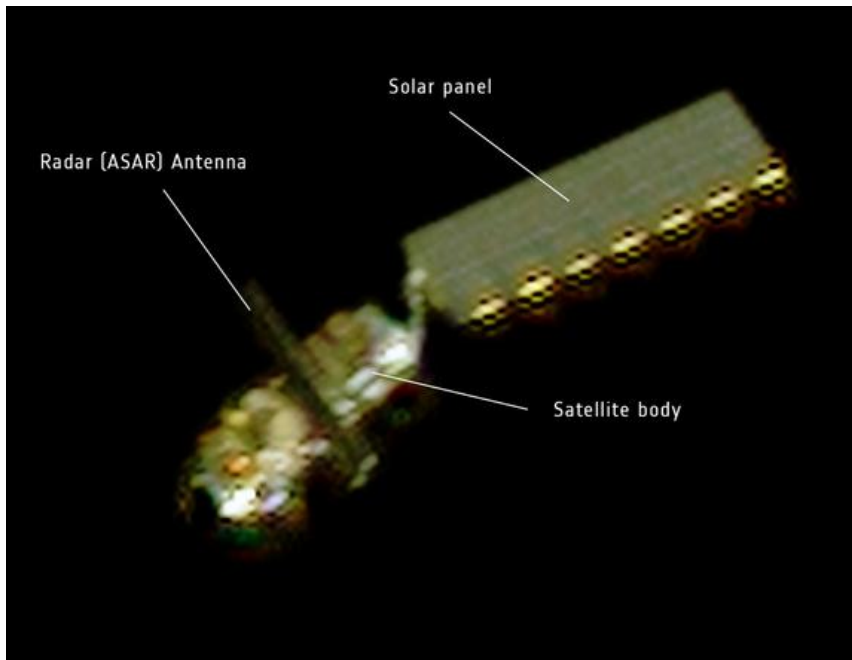




Just for Completeness: ENVISAT tracked with DLR Laser #2: 200 mJ, 80 Hz, 3 ns

NO retros visible – only diffuse reflections from body / solar panel / antennas etc.

- Accurate spin duration and spin axis orientation can be derived from SLR data
- Retros of ENVISAT are only, visible' from any SLR Station:
 - **During daylight passes:** **If the pass is EAST of your station**
 - **During night passes:** **If the pass is WEST of your station**
- The other passes can be tracked only with (strong) debris laser



ENVISAT image: French Pleiades Space based telescope, 100 km distance, 15 April 2013

Thank you