An illustration of the Molniya satellite constellation against a blue sky with stars. Three Molniya satellites are shown in orbit, each with a long, thin antenna trailing behind it. Below the satellites is a large, stylized red star with a yellow outline, set against a map of the Soviet Union. The letters 'С С С Р' are visible on the map. The background transitions from a dark blue sky with stars to a lighter blue sky with a yellow horizon line.

**TOЩАЯ А PHYSICAL
CHARACTERIZATION OF THE
SOVIET RUSSIAN
CONSTELLATION OF
МОЛНИЯ
SATELLITES**

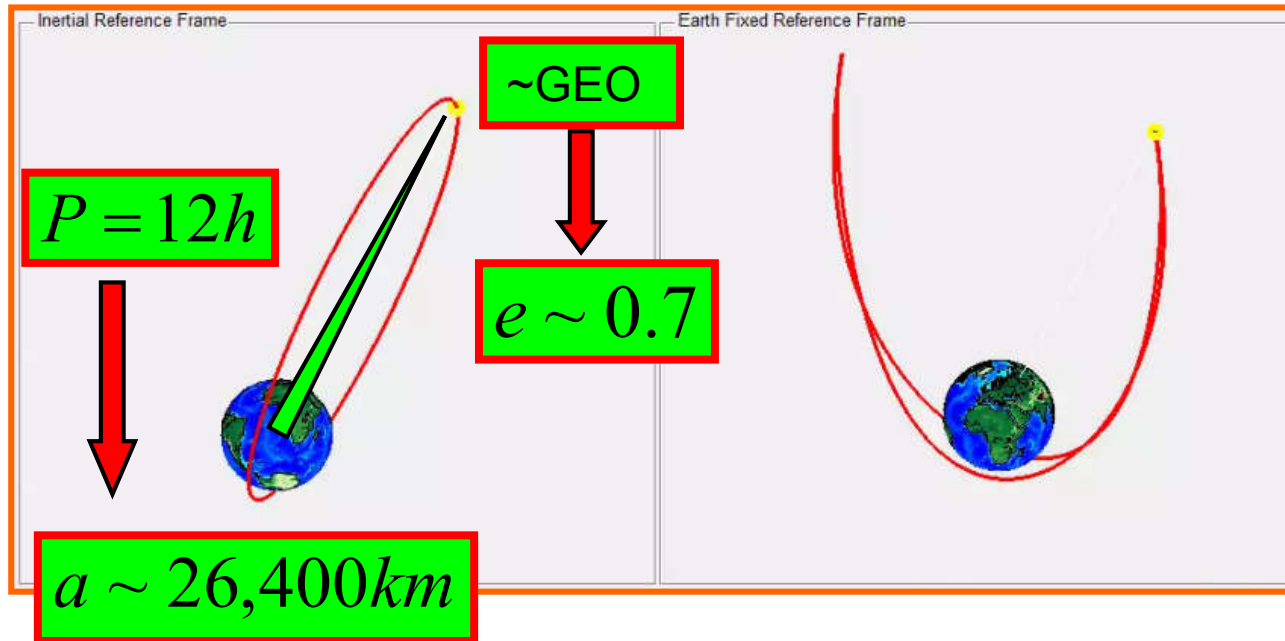
ALBERTO BUZZONI

INAF - OAS

BOLOGNA

ОТЧИЗНА! ПРОГРЕССА И МИРА ЗВЕЗДУ ТЫ ПЕРВОЙ ЗАЖГЛА НАД ЗЕМЛЕЮ.

The molniya orbit



First (Molniya 1-01):
Apr 23, 1965

Last (Molniya 1-93):
Feb 18, 2004

Total: 164 HEO +1 GEO
spacecraft

83% from Plesetsk
Cosmodrome

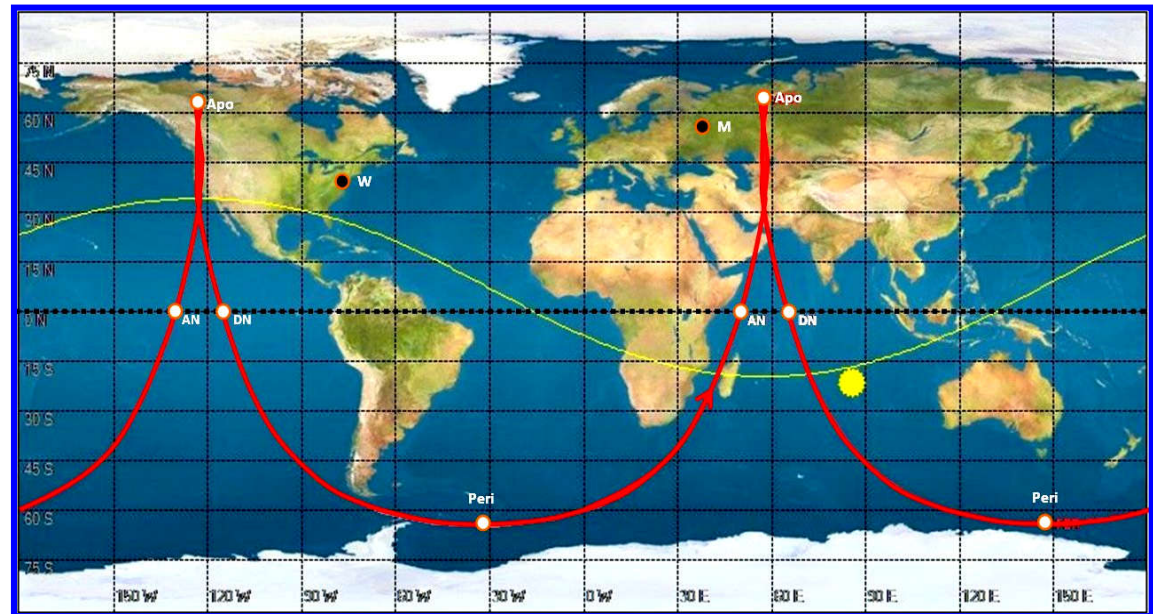
Moon

Sun

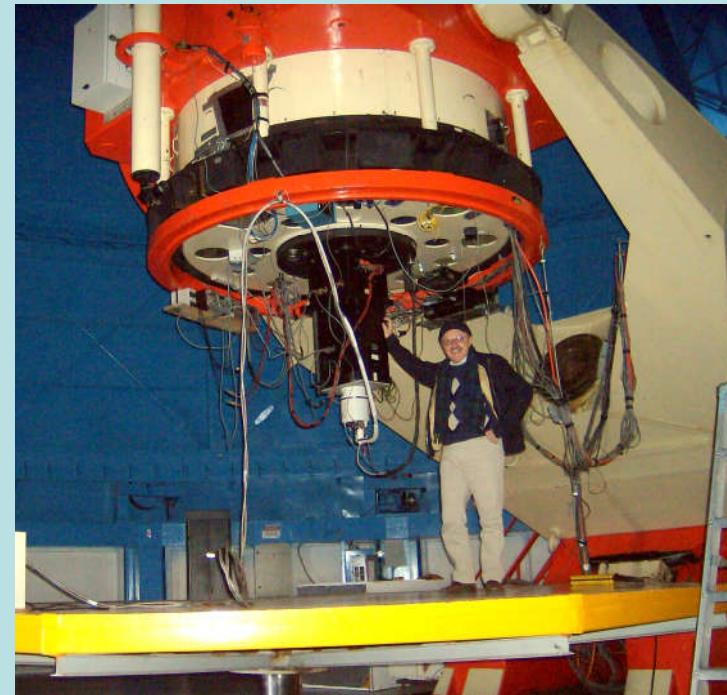
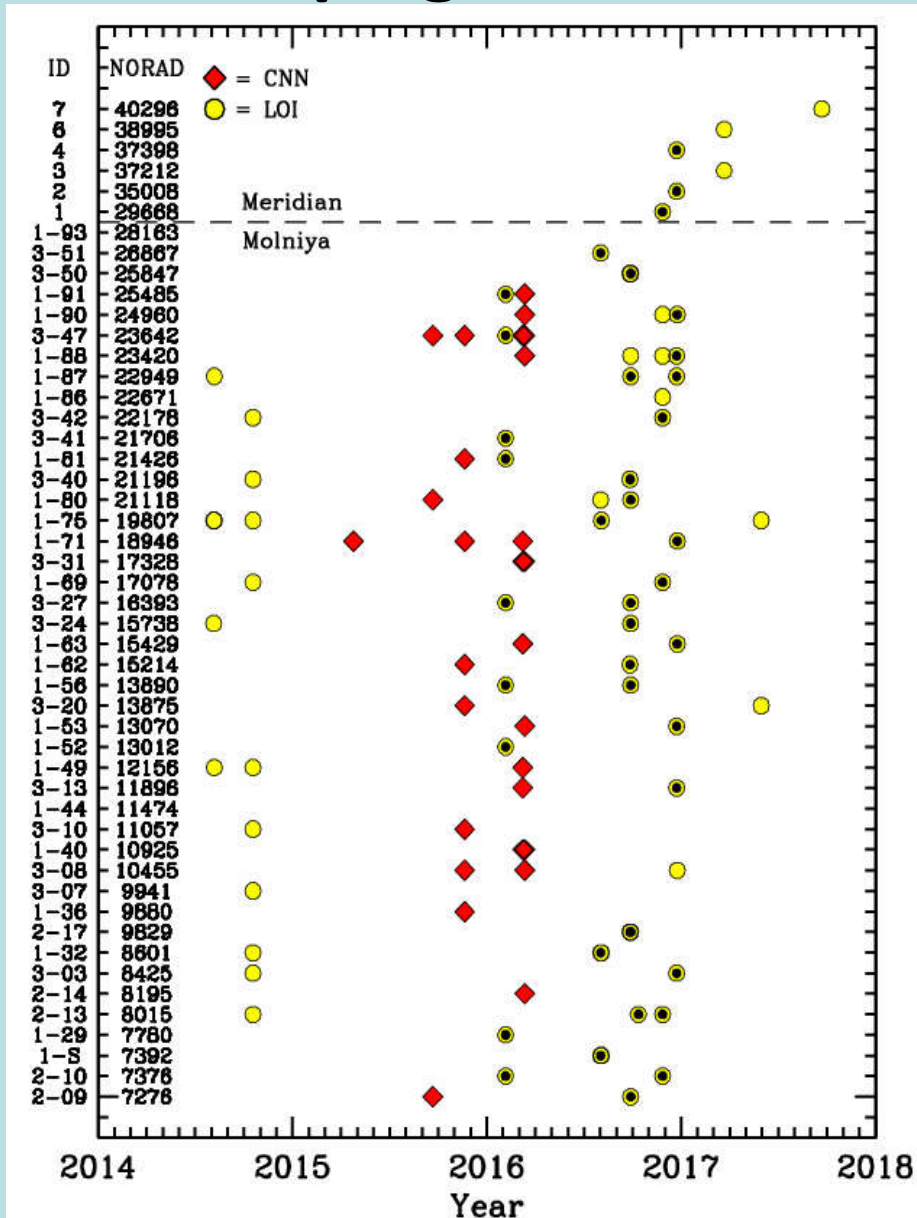
J_2

$$\dot{\omega} \propto (4 - 5 \sin^2 i)$$

$$i = 63.4^\circ$$



The ITA-MEX observing campaign (2014-17)



❖ **43 orbiting satellites**
(5 decayed yet)

❖ **Two telescopes:**

ITA: @Loiano

13 nights w/ 1.52m "G.B. Cassini"

MEX: @Cananea, Sonora

5 nights w/ 2.12m "G. Haro"

INAOE

The Molniya spacecraft

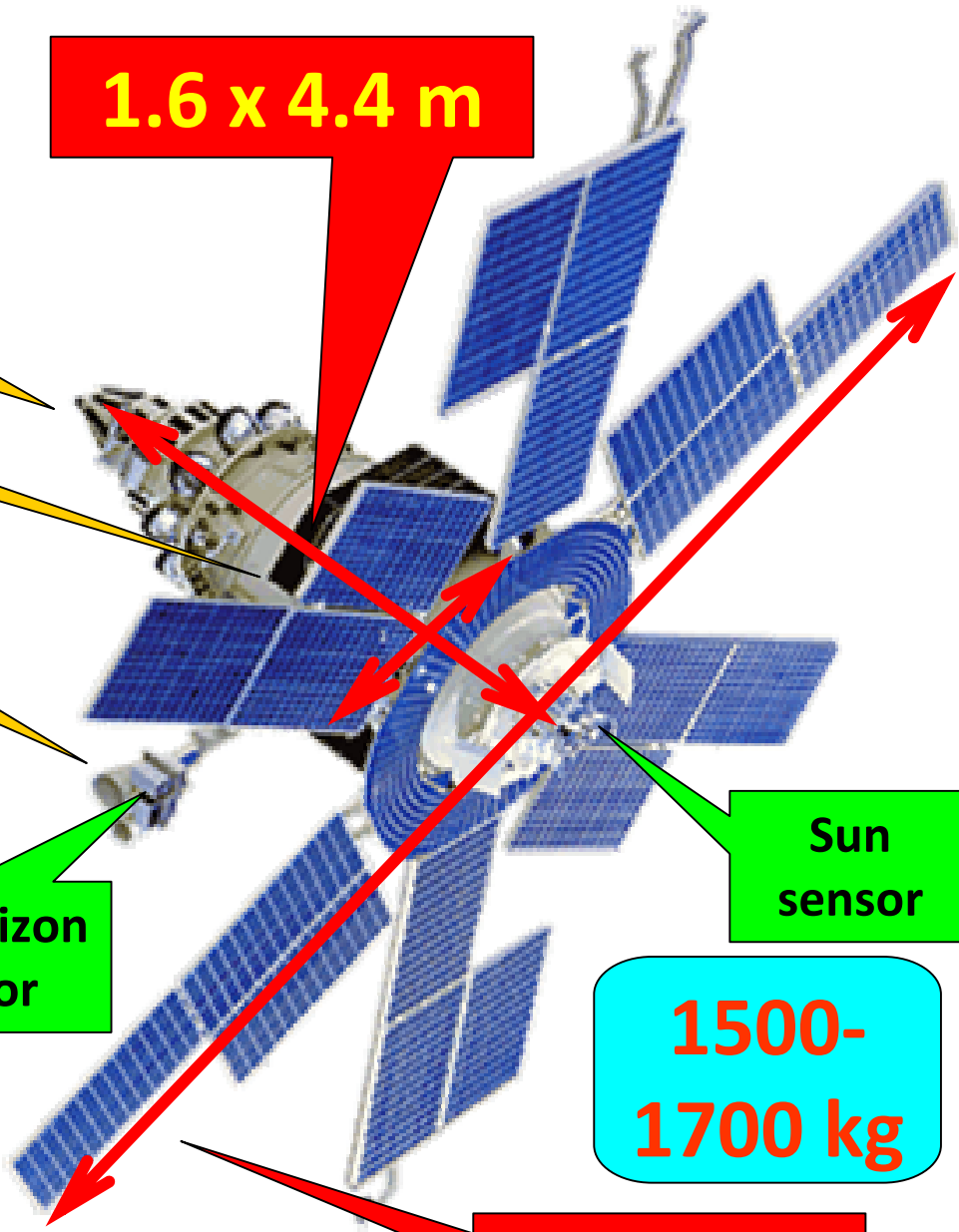
1.6 x 4.4 m

**KDU-414 thruster
(Nitric Acid+UDMH)**

**Reaction
Wheel**

KAUR Bus

**Two Steerable
antennas**

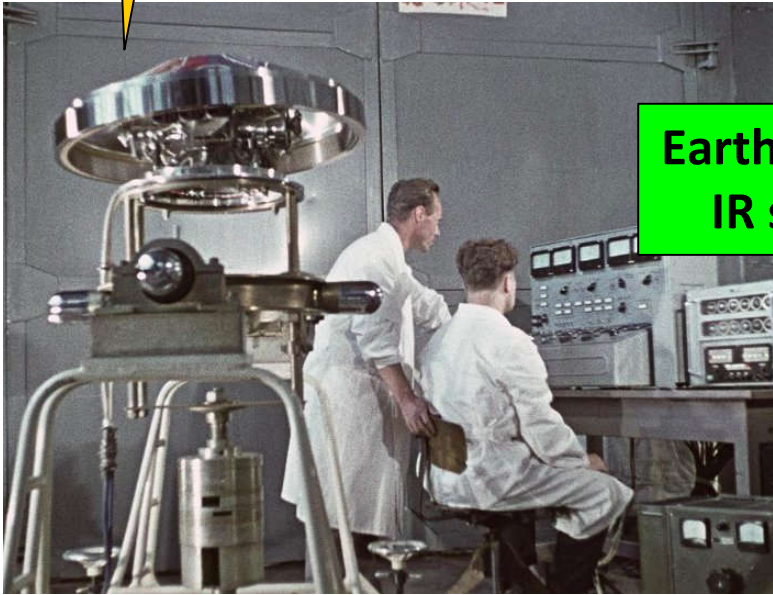


**Sun
sensor**

**1500-
1700 kg**

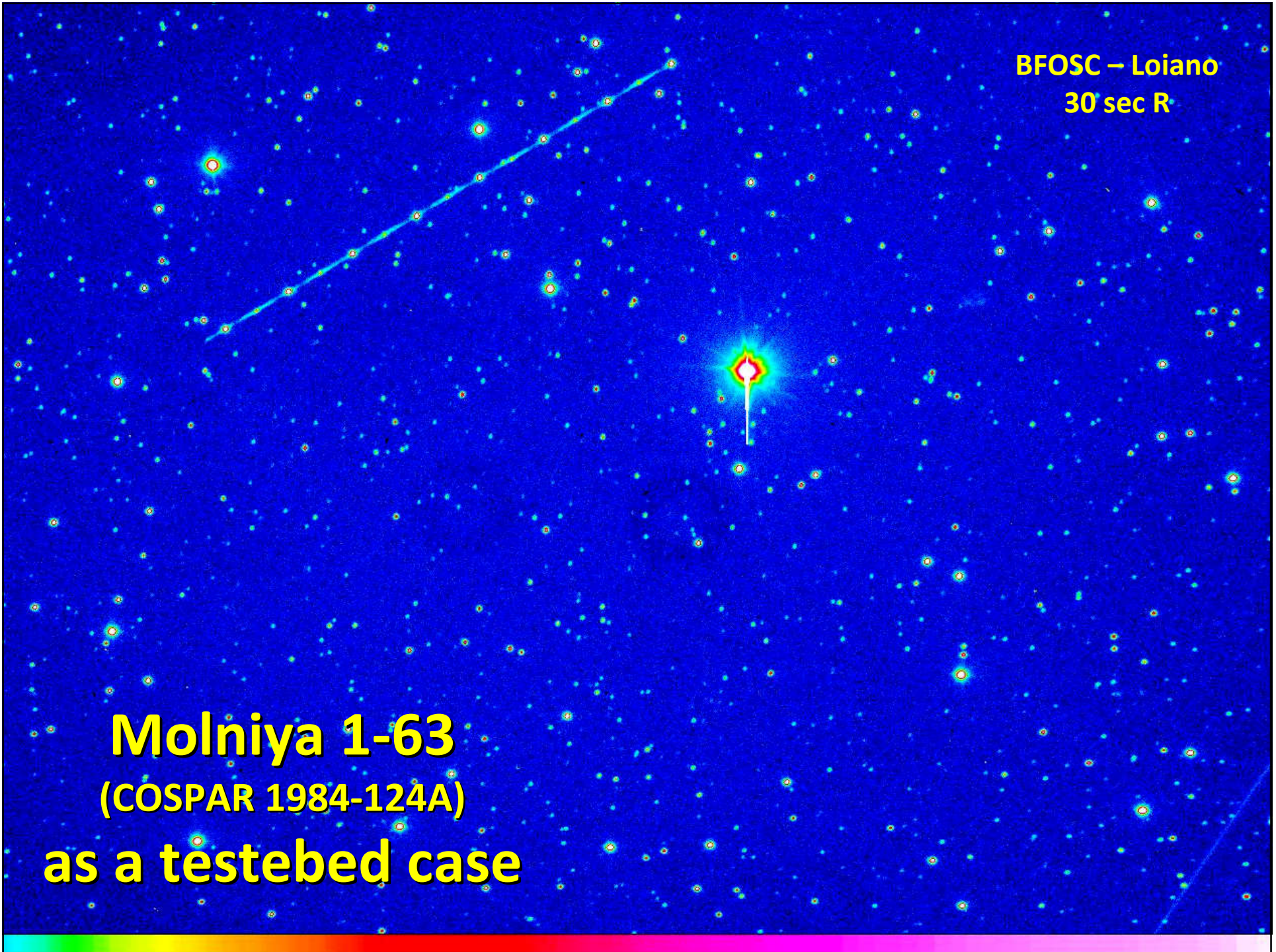
8.2 m

**Earth-horizon
IR sensor**

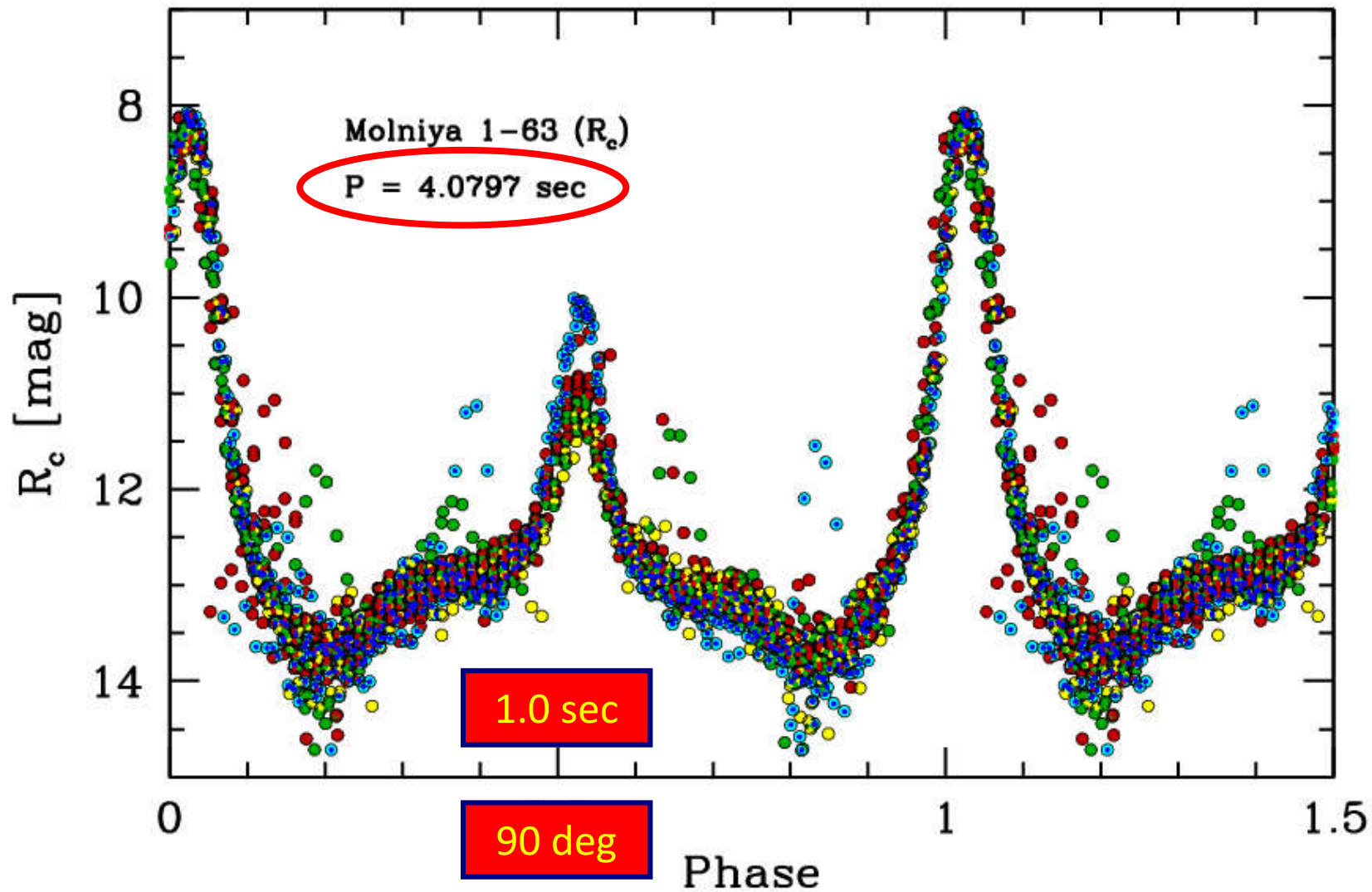


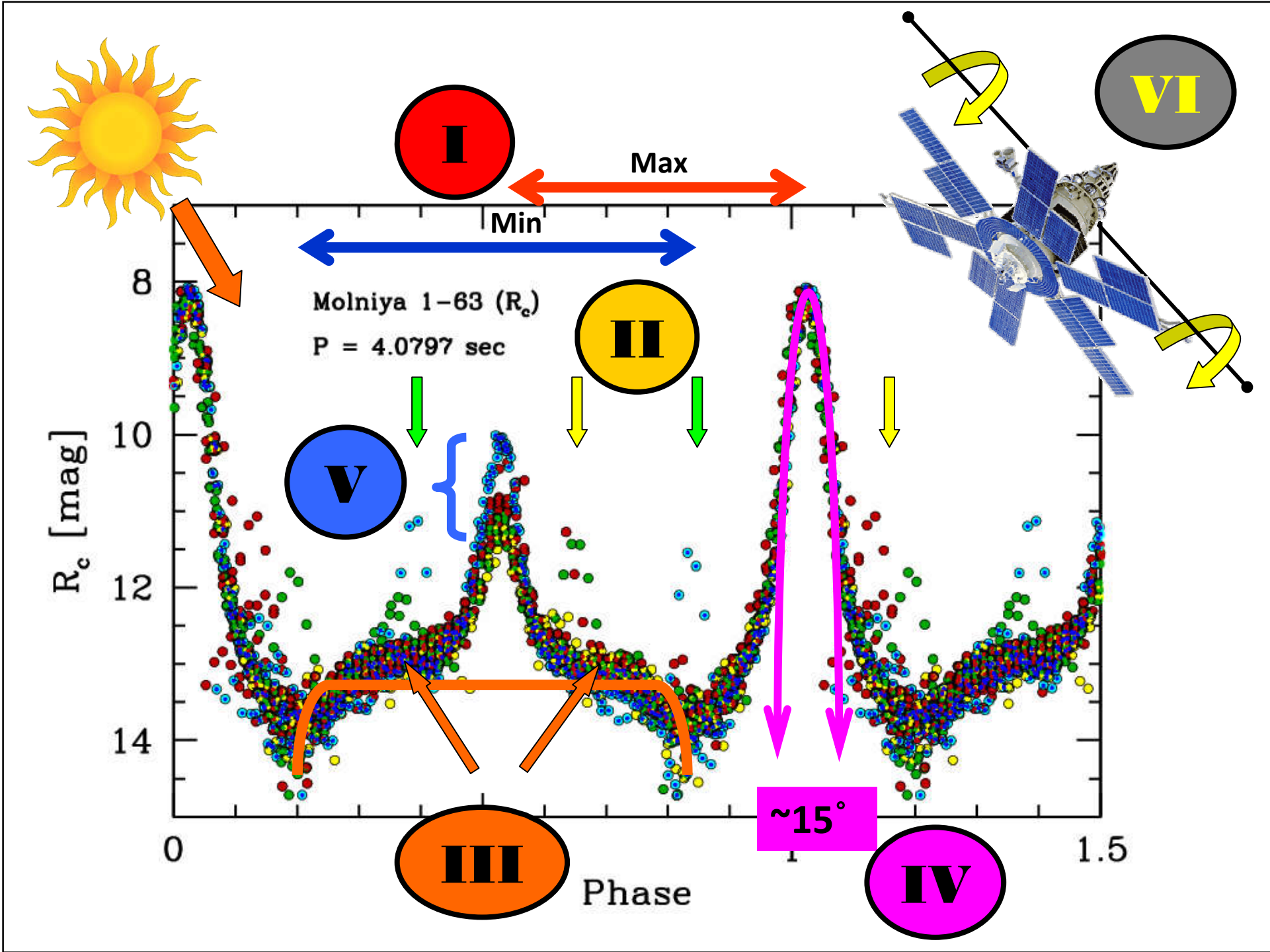
BFOSC – Loiano
30 sec R

Molniya 1-63
(COSPAR 1984-124A)
as a testbed case

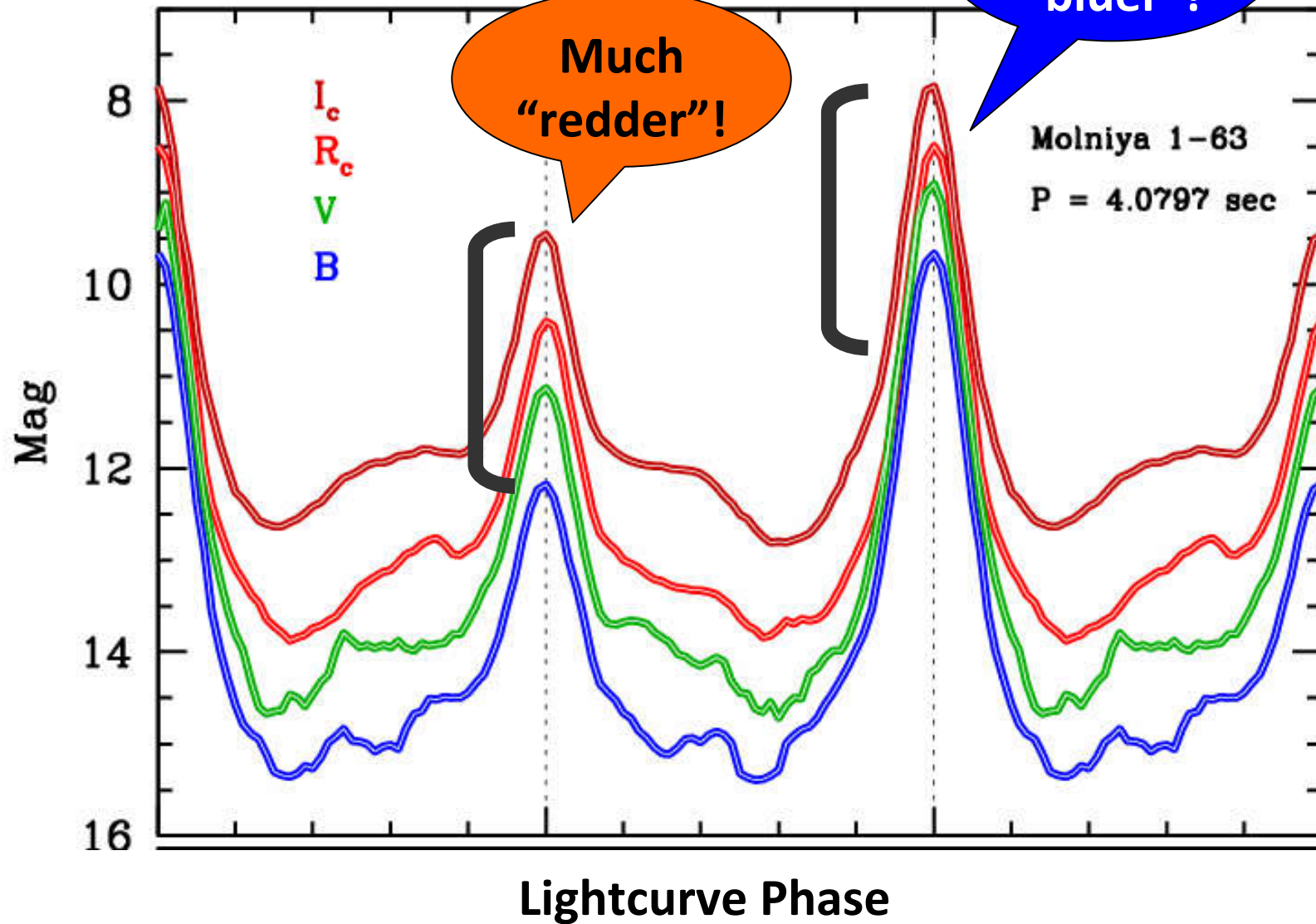


The Molniya 1-63 lightcurve





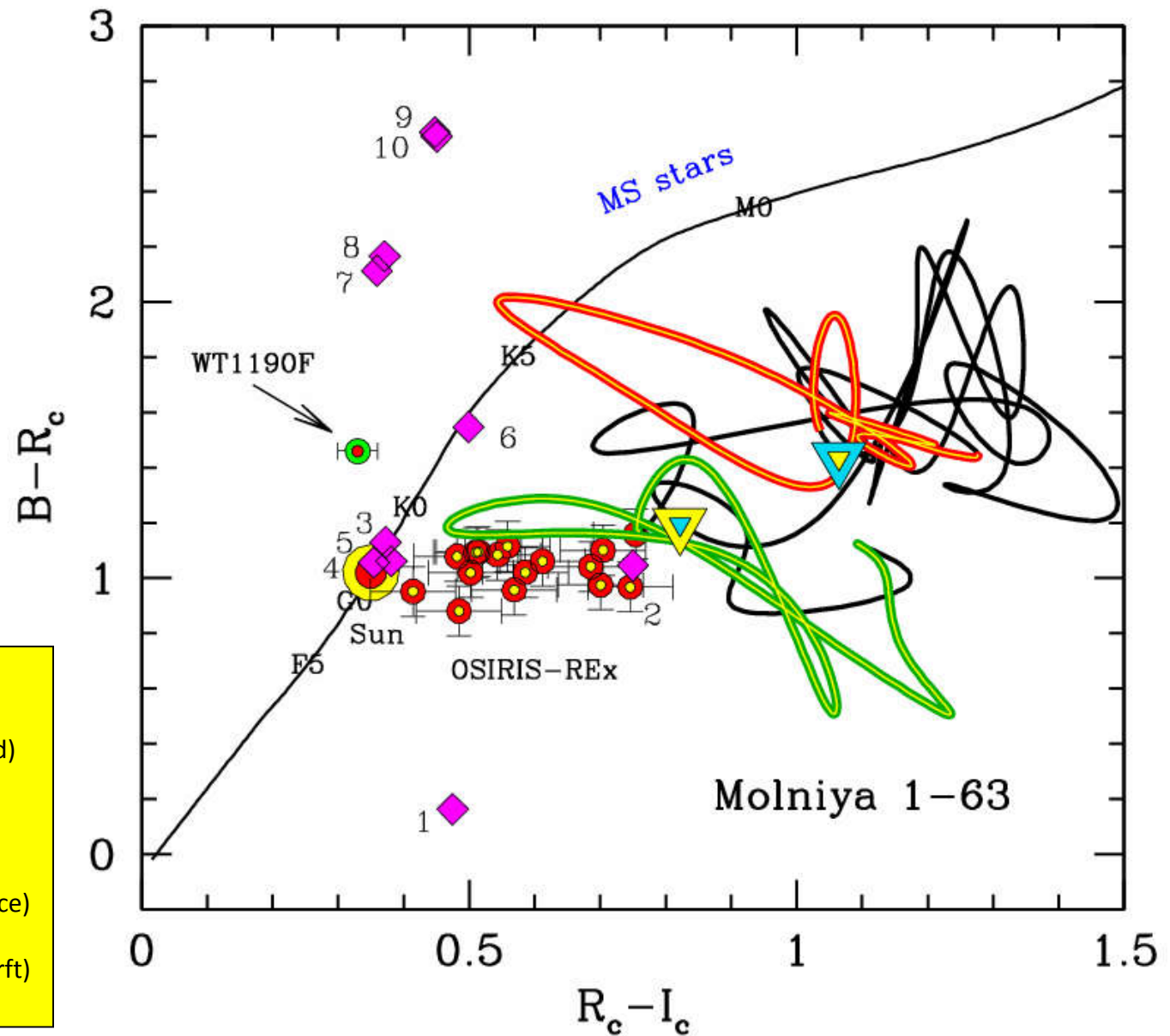
Color & Physical texture



Colors & Physical texture

Cowardin et al. (2010)

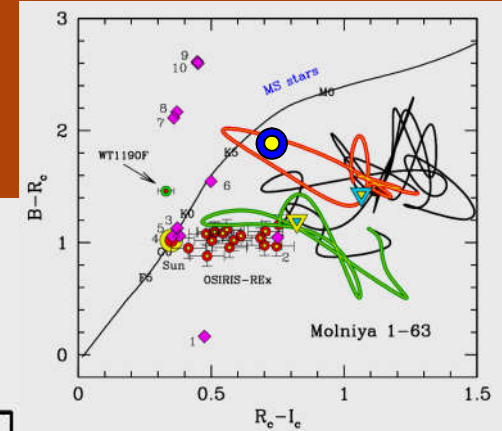
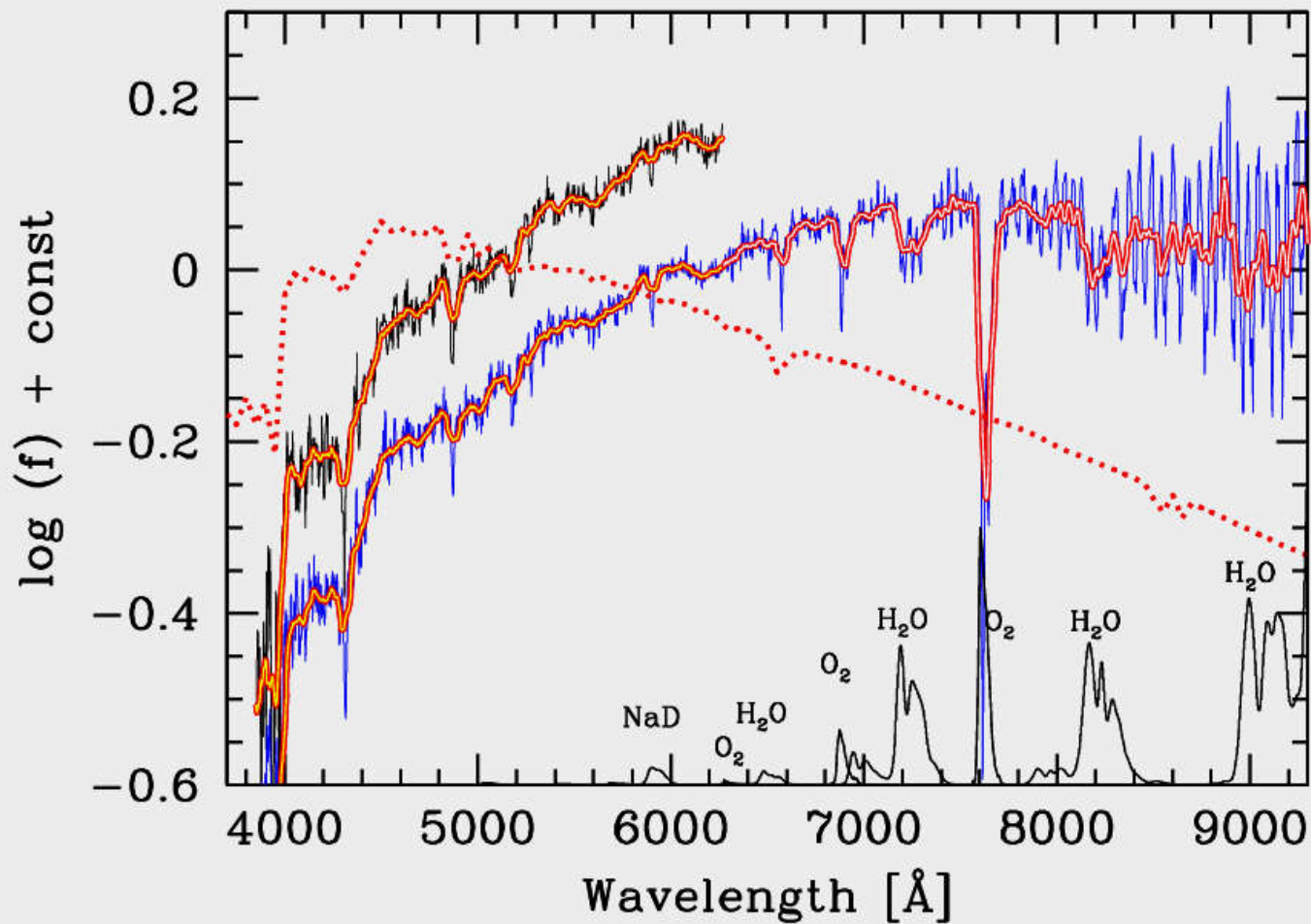
- 1 = GaAs solar panel
- 2 = std solar panel**
- 3 = MLI (Al+Cu Kapton sandwiched)
- 4 = Al Kapton (inner side)**
- 5 = Al Kapton (outer side)**
- 6 = Mylar
- 7 = Al backing solar cell (facing space)
- 8 = Cu Kapton (facing space)
- 9 = Al backing solar cell (facing sprcft)
- 10 = Cu Kapton (facing spacecraft)



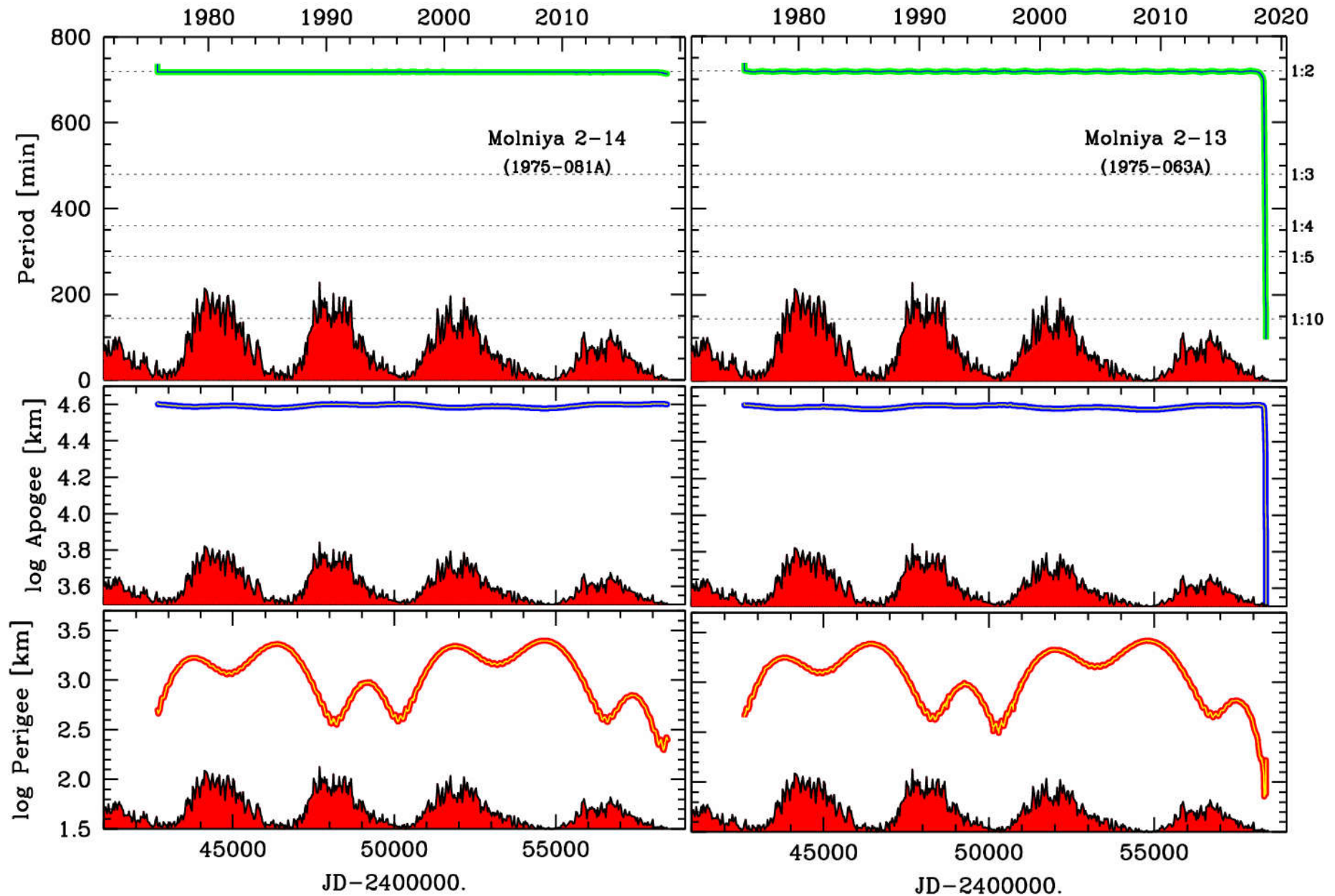
Spectral reflectance

Molniya 1-91 ($\phi = 91^\circ$)
1998-054A
(B-V)=1.153

Molniya 3-41 ($\phi = 45^\circ$)
1991-065A
(B-V)=1.182 (V-R_c)=0.746
(V-I_c)=1.464



Fooled by Randomness - I



Fooled by Randomness – II

