IOTA · ES

A total lunar occultation with multiple contacts

Dietmar Büttner

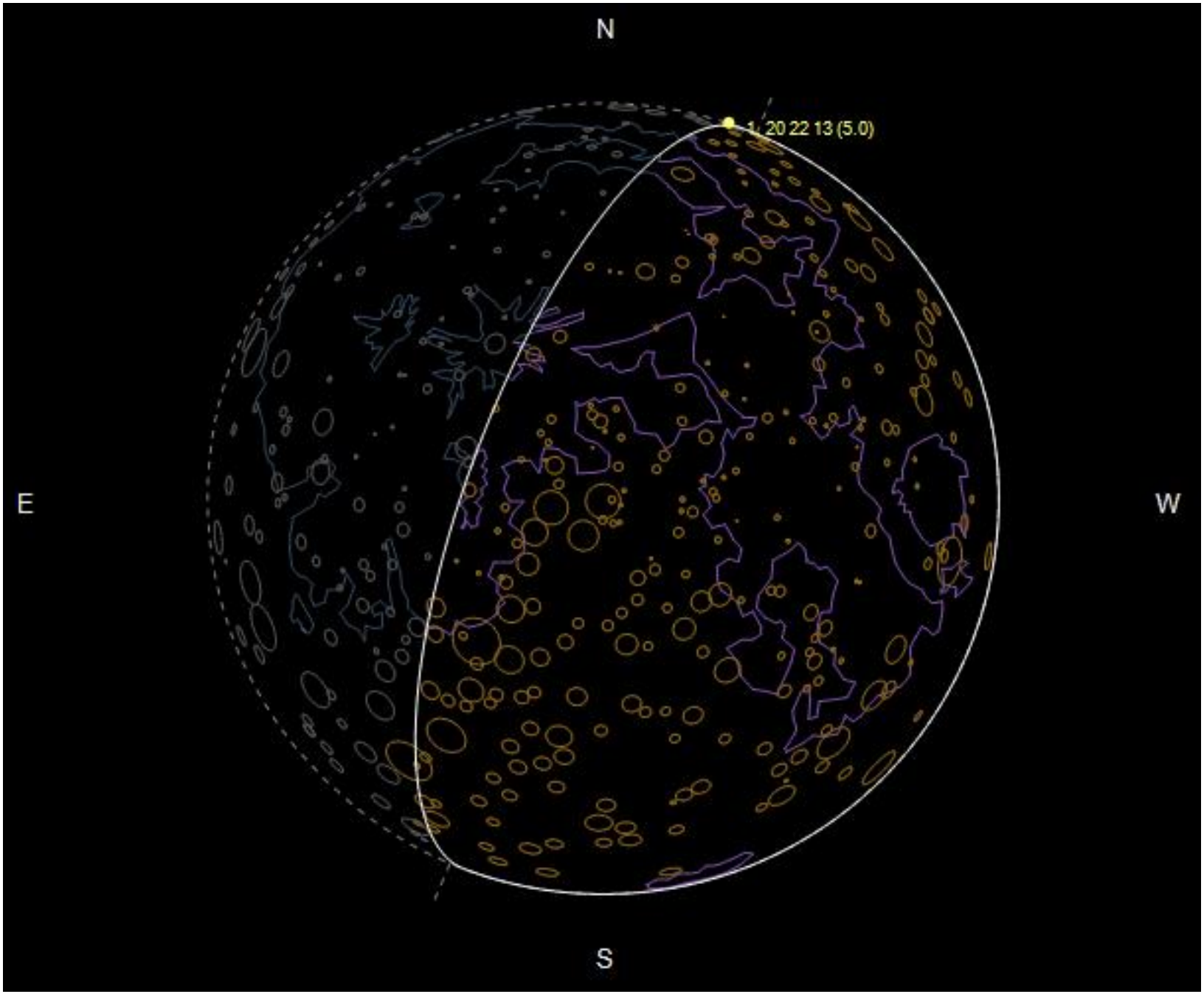
2017 September 16
ESOP 36

Event

Total lunar occultation
Date: 2013 Nov 11

Star: ZC3320, mag 4.4
Moon: waxing, 0.67 sunlit, altitude 29°

Phase: one disappearance at dark limb predicted


N
E
W
S
1 20 22 13 (5.0)

Location, instrument and observer

Refractor: 100 mm (4 inch)

Location: Chemnitz (Germany)
about 35 km away from Freiberg

Observer: Dietmar Büttner

Observation

Method: visual

Expected: one disappearance at dark limb

Actually seen:

Three contacts within 0,9 seconds
(DD – RD – DD)

A surprise!

Reliability

Is it possible to resolve 3 contacts within 0,9 s visually?

It is a challange, but it is possible.

It is impossible to time such a sequence exactly.

But it is possible to distinguish that more than one event occured.

Expertise of the observer within 40 years

Nearly **800** visual total occultation **timings.**

About **100 grazing** occultation contact **timings**.

Several thousand flash timings of rotating / tumbling artifical earth satellites.

Long lasting experience with fast event sequences.

Excluding possible causes

Bright lunar limb: events occured at dark limb

Observing conditions: favourable conditions (stability, transparancy)

Duplicity of the star:
should have been 2 or 3 disappearance contacts

In fact seen:
disappearance – reappearance - disappearance

Probable cause

A very special lunar limb geometry

Distance to northern graze limit: 18 km

Path of the star relative to the profile:
very steep
much to steep to produce multiple contacts
from a 'normal' (typical) profile

Investigation

using

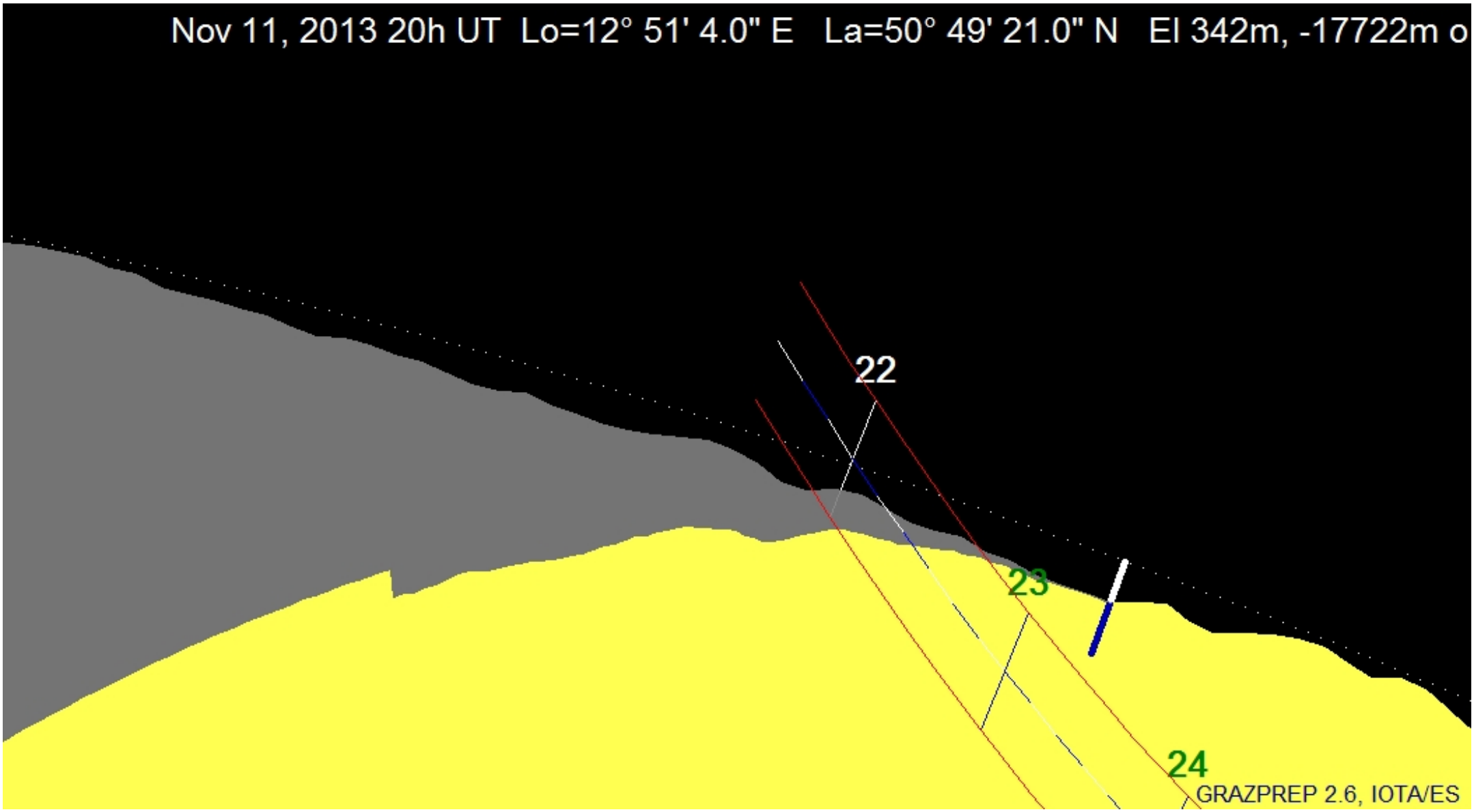
GRAZPREP
OCCULT

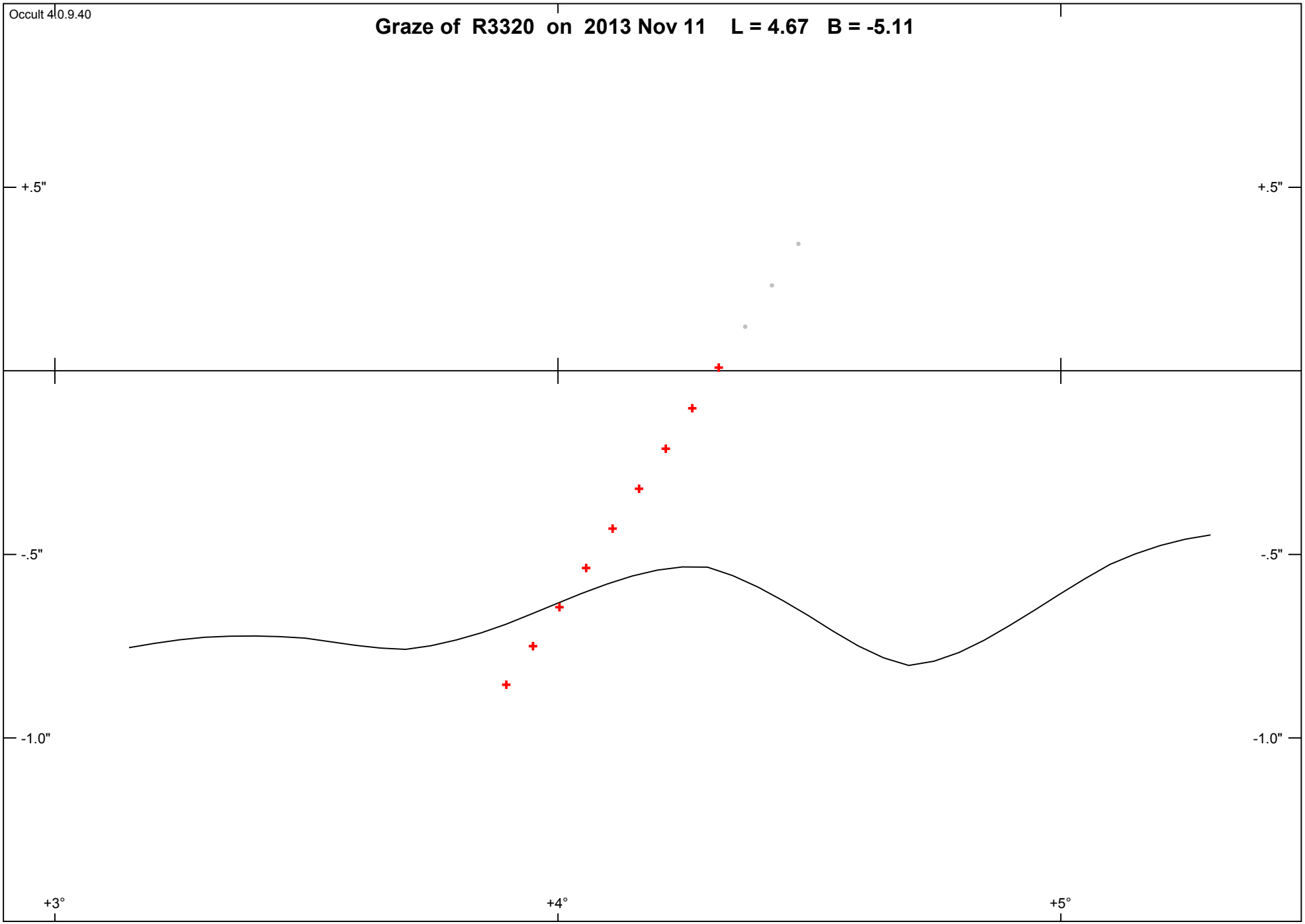
Kaguya lunar limb profiles
LRO lunar limb profiles

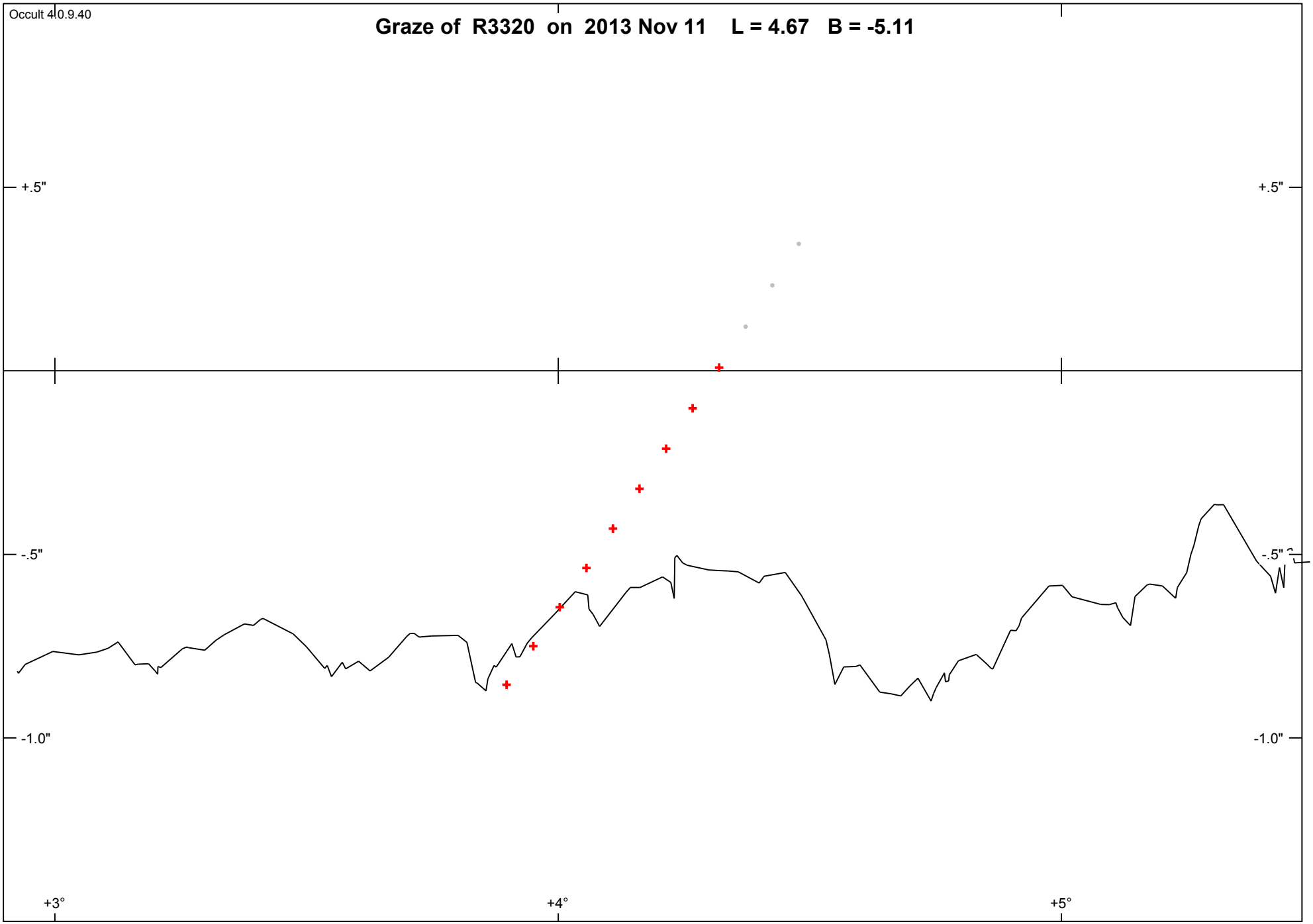
Our knowledge in 2013

OCCULT
with
Kaguya low and medium res lunar limb profiles

GRAZPREP
with
Kaguya low res lunar limb profiles


Nov 11, 2013 20h UT Lo=12° 51' 4.0" E La=50° 49' 21.0" N El 342m, -17722m o
22
23
24
GRAZPREP 2.6, IOTA/ES


Occult 4.0.9.40
Graze of R3320 on 2013 Nov 11 L = 4.67 B = -5.11
+.5"
+.5"
-.5"
-.5"
-1.0"
-1.0"
+3°
+4°
+5°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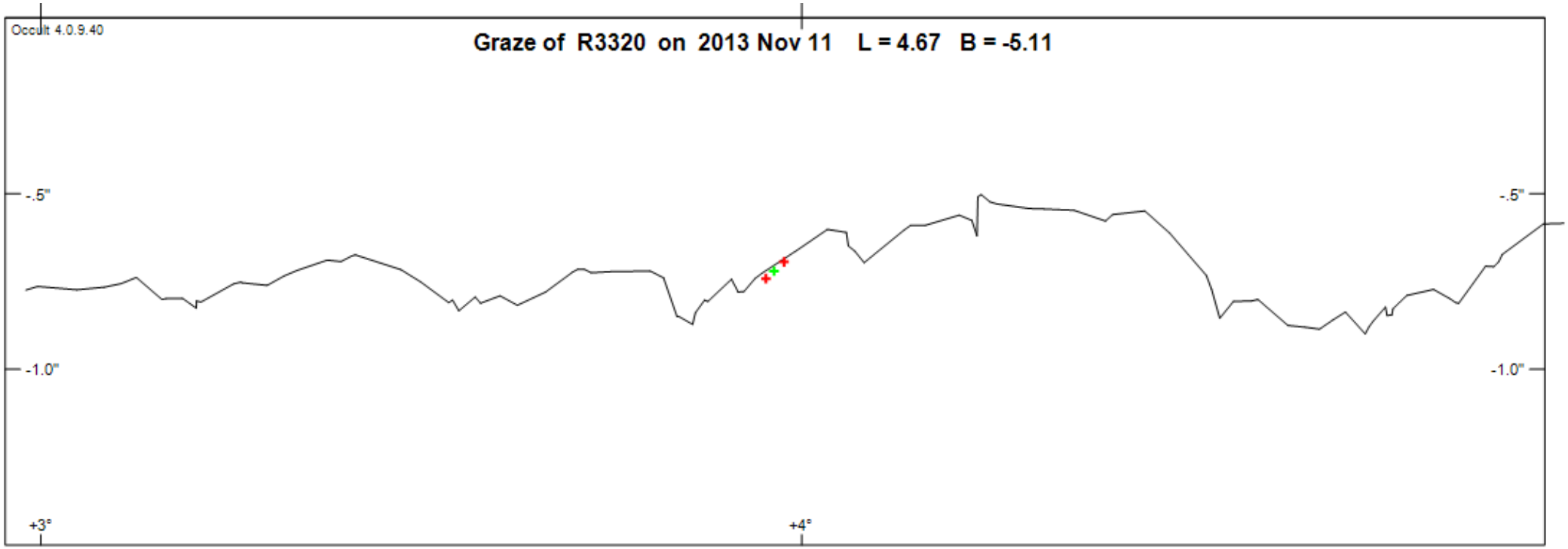
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Graze of R3320 on 2013 Nov 11 L = 4.67 B = -5.11
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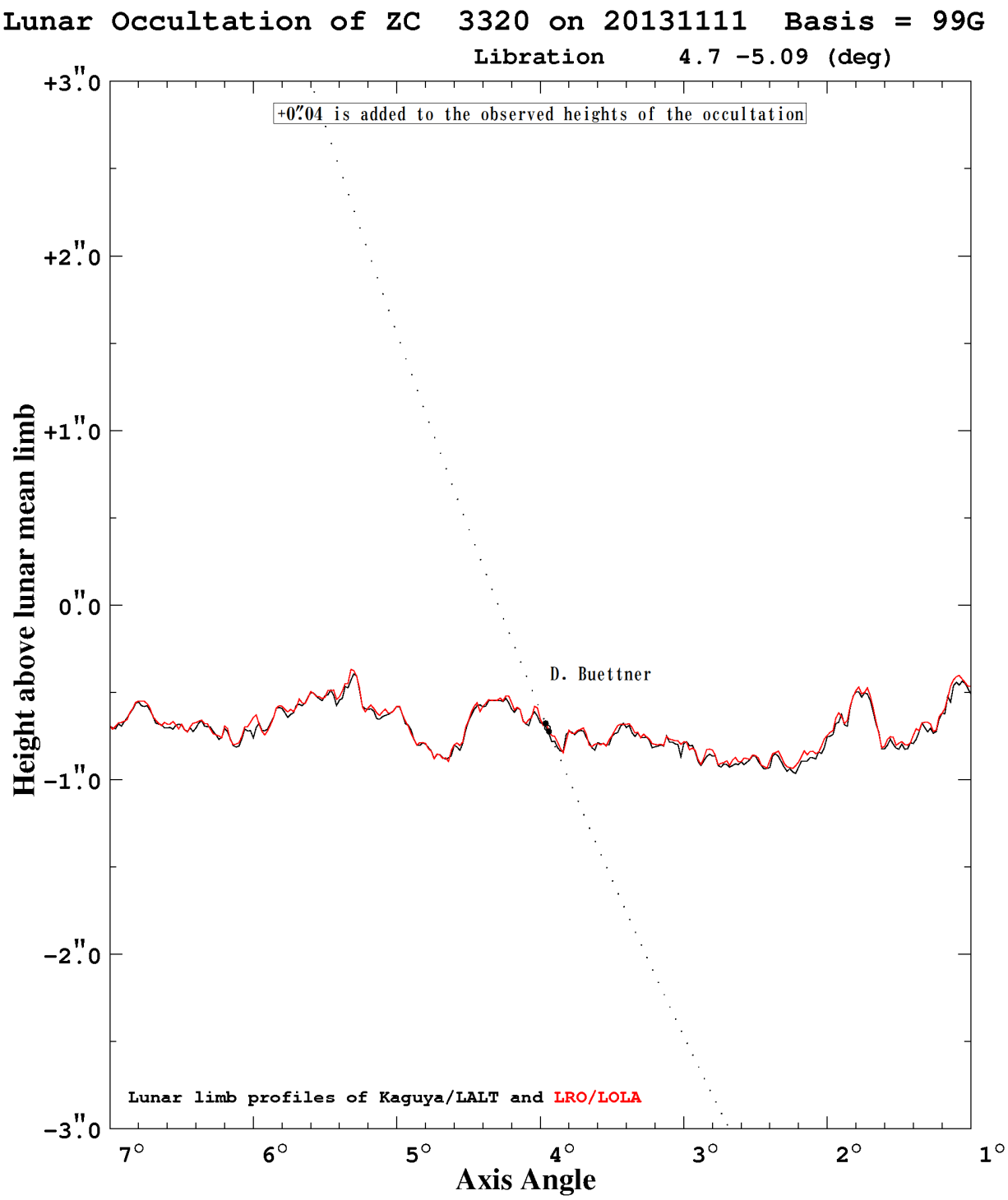
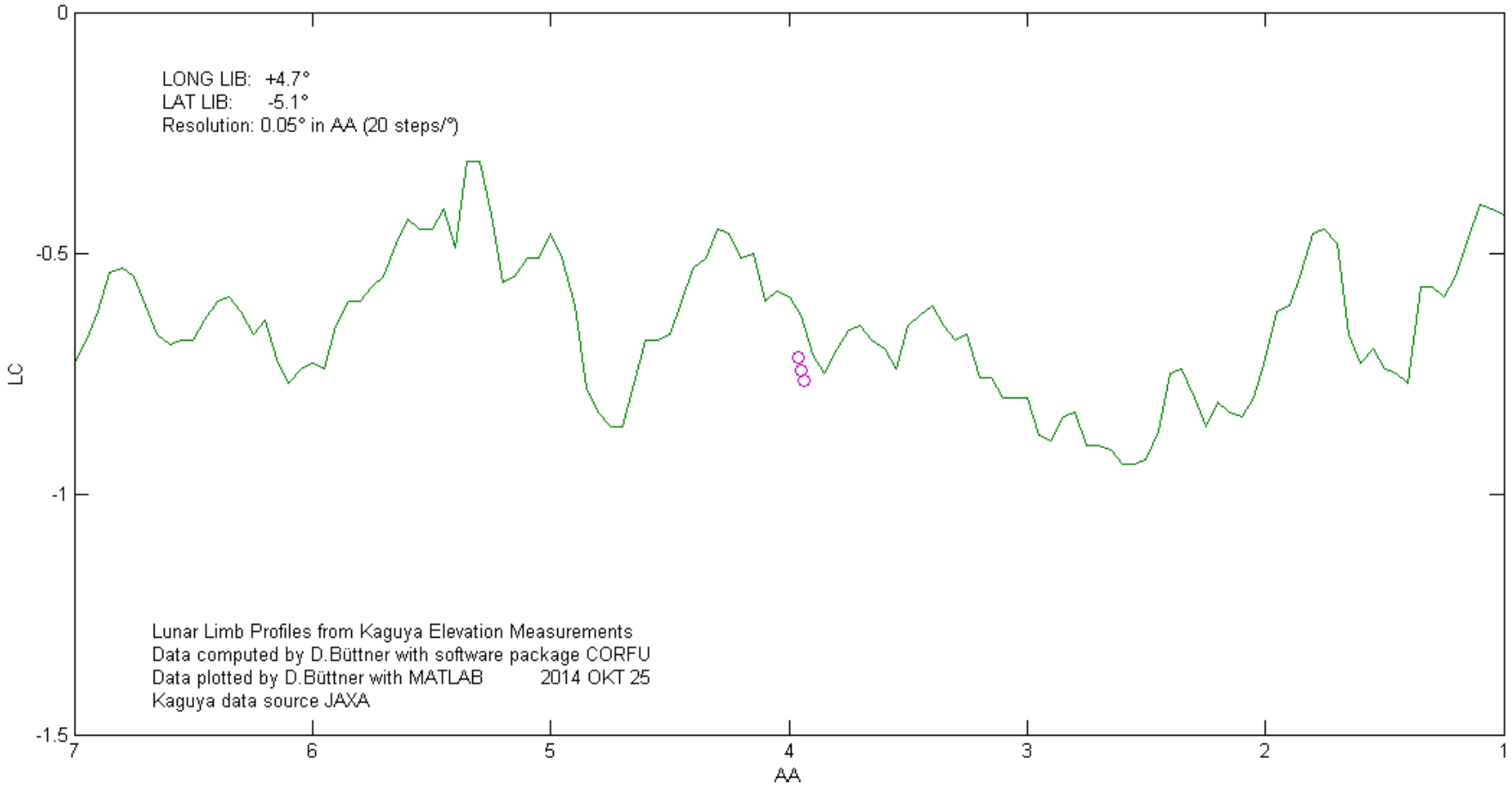

Lunar Occultation of ZC 3320 on 20131111 Basis = 99G
Libration 4.7 -5.09 (deg)
+0".04 is added to the observed heights of the occultation
+3".0
+2".0
+1".0
0".0
-1".0
-2".0
-3".0
Height above lunar mean limb
D. Buettner
Lunar limb profiles of Kaguya/LALT and LRO/LOLA
7°
6°
5°
4°
3°
2°
1°
Axis Angle

Our knowledge in 2014

LUNLIMB and GRAZPREP

with

Kaguya high res lunar limb profiles

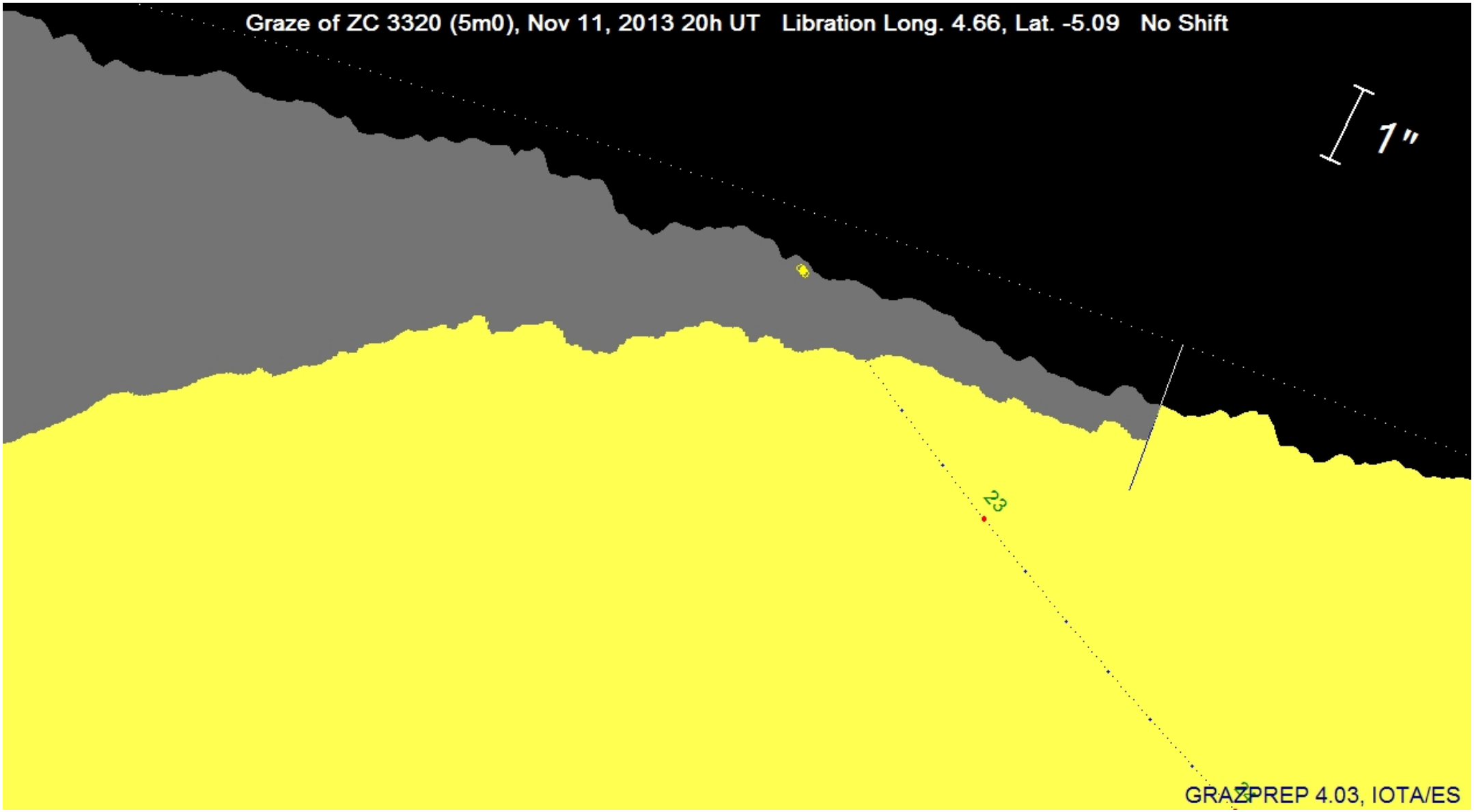

LONG LIB: +4.7°
LAT LIB: -5.1°
Resolution: 0.05° in AA (20 steps/°)
Lunar Limb Profiles from Kaguya Elevation Measurements
Data computed by D.Büttner with software package CORFU
Data plotted by D.Büttner with MATLAB 2014 OKT 25
Kaguya data source JAXA
LC
AA
0
-0.5
-1
-1.5
7
6
5
4
3
2
1

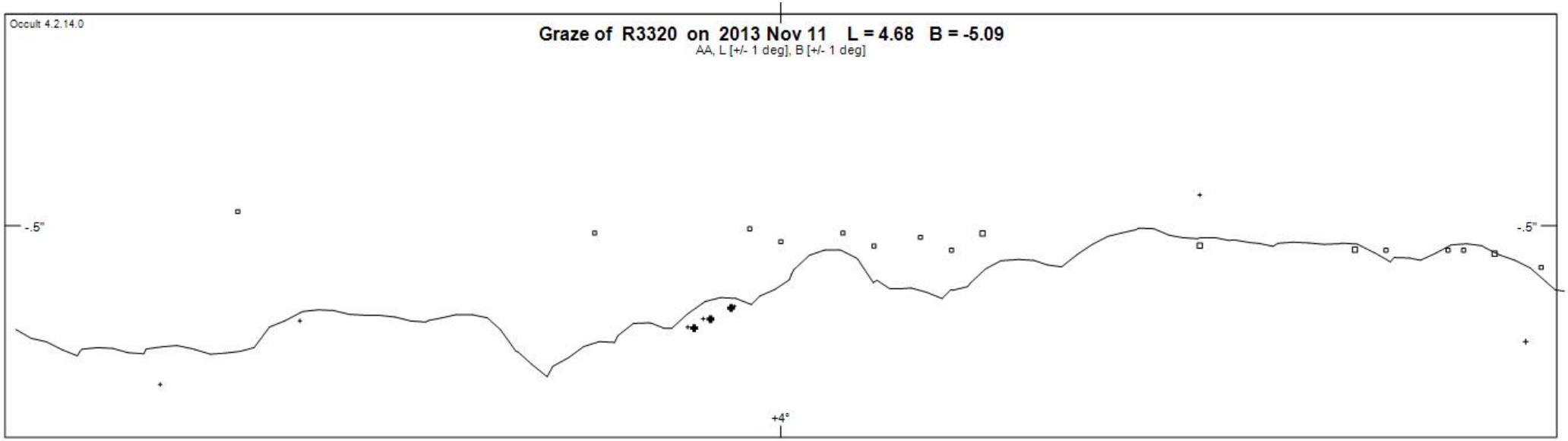
Our knowledge in 2016

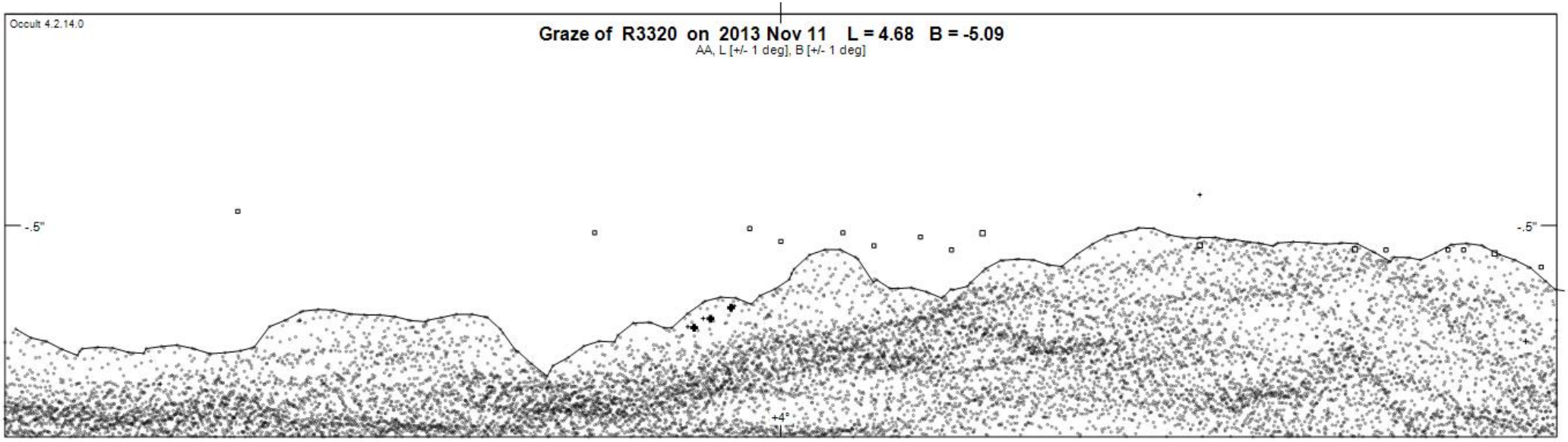
OCCULT and GRAZPREP

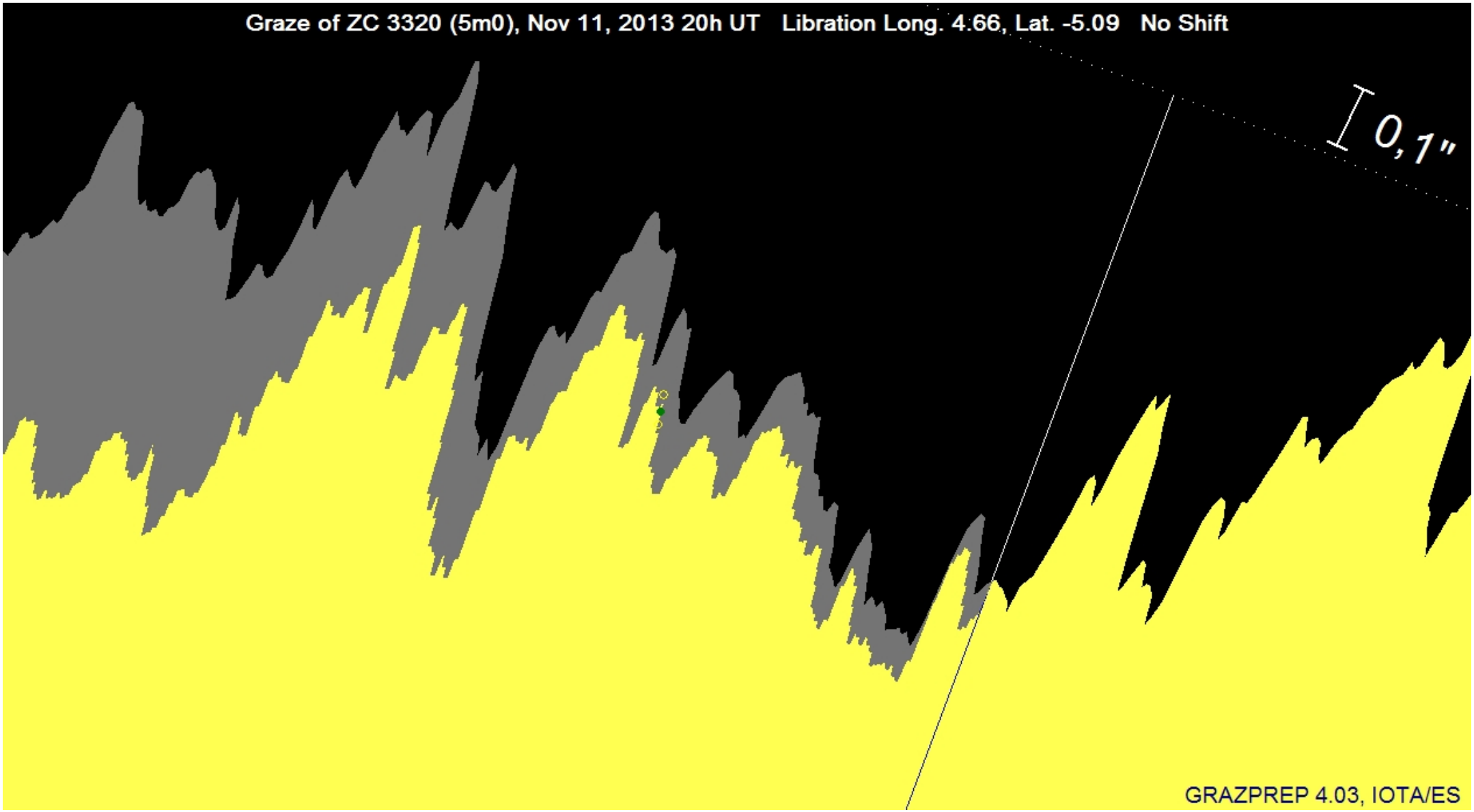
with

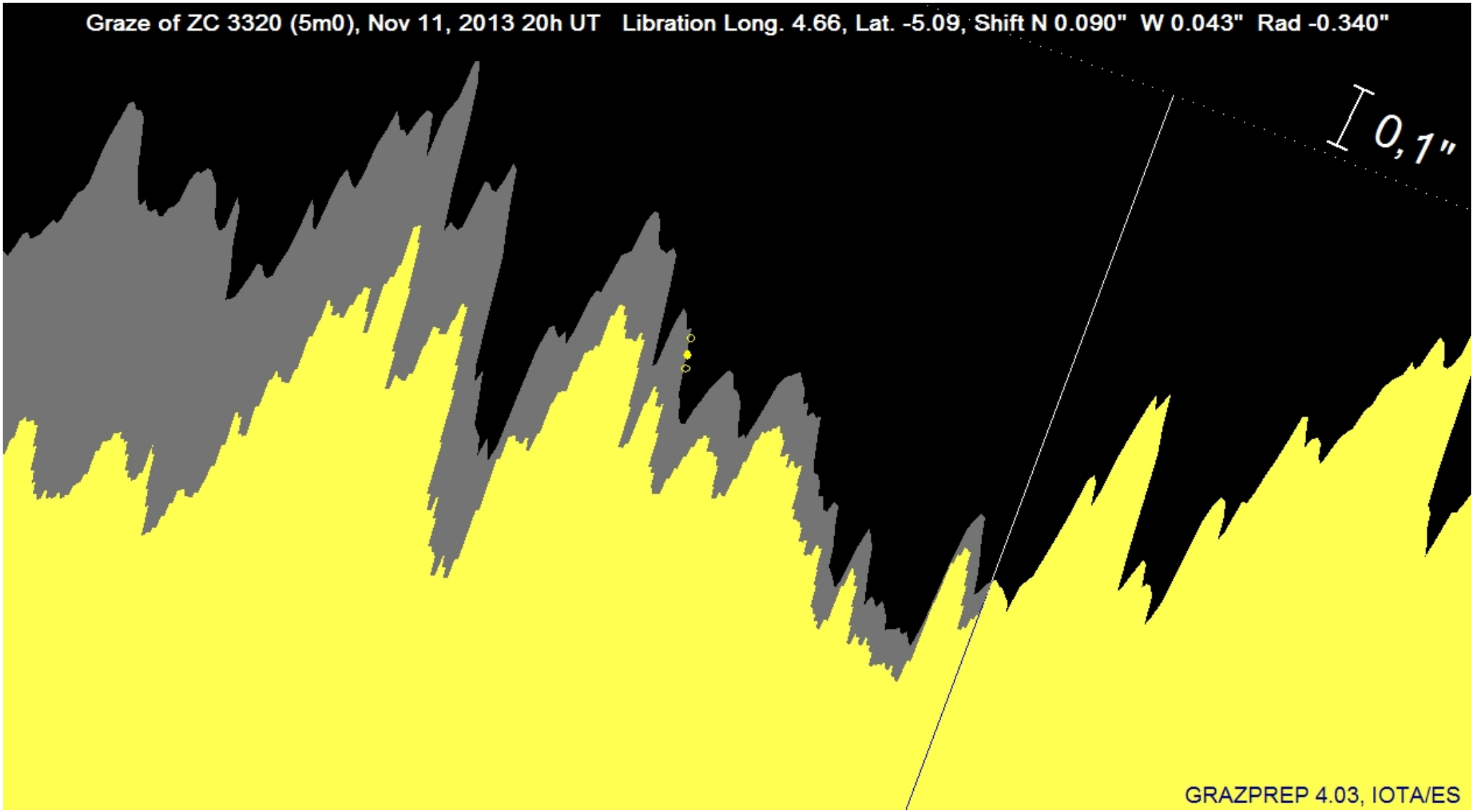
LRO high res lunar limb profiles


Graze of ZC 3320 (5m0), Nov 11, 2013 20h UT Libration Long. 4.66, Lat. -5.09 No Shift
1"
23
GRAZPREP 4.03, IOTA/ES


Occult 4.2.14.0
Graze of R3320 on 2013 Nov 11 L = 4.68 B = -5.09
AA, L [+/- 1 deg], B [+/- 1 deg]
-.5"
-.5"
+4°


Occult 4.2.14.0
Graze of R3320 on 2013 Nov 11 L = 4.68 B = -5.09
AA, L [+/- 1 deg], B [+/- 1 deg]
-.5"
-.5"
+4°


Graze of ZC 3320 (5m0), Nov 11, 2013 20h UT Libration Long. 4.66, Lat. -5.09 No Shift
0,1"
GRAZPREP 4.03, IOTA/ES


Graze of ZC 3320 (5m0), Nov 11, 2013 20h UT Libration Long. 4.66, Lat. -5.09, Shift N 0.090" W 0.043" Rad -0.340"
0,1"
GRAZPREP 4.03, IOTA/ES

Conclusion

The observed three contacts were caused by a very special local lunar limb geometry in the region of the events.

Summary 1

Visual observations may yield reliable results, even if (of course) CCD observations should be prefered.

Summary 2

We do have very powerful tools and data sets to predict events and to evaluate observations (**GRAZPREP**, **OCCULT**, **limb profiles**) as provided **by amateur astronomers!**

The end

Thank you for your attention!

Dietmar Büttner