

# Astrophysics at NARIT and potential for collaborations in Antarctica





# 2.4-m Thai National Telescope (TNT)





# 2.4-m Thai National Telescope (TNT)

- 2457m elevation, Nov-Apr dry season
- 2.4m alt-az Ritchey-Chretien, f/10
- Two Nasmyth foci
- Nasmyth 1 with derotator, 4 ports, autoguider, fiber feeds
- imagers and spectrographs, visitor instruments
- Erected 2012, Inaugurated 2013
- Cycle 3, 2015-16
- Call for Proposals (August), TAC
- Thai & International applicants



# NARIT's Other Telescopes

Vast experience in procurement, installation and operation of 0.5-m class telescopes with CCDs & Spectrographs.

a) Public Regional Observatories

b) PROMPT (Panchromatic Robotic Optical Monitoring and Polarimetry Telescopes)

c) NEO 70-cm

d) Thai Robotic Telescope Network (TRTN)

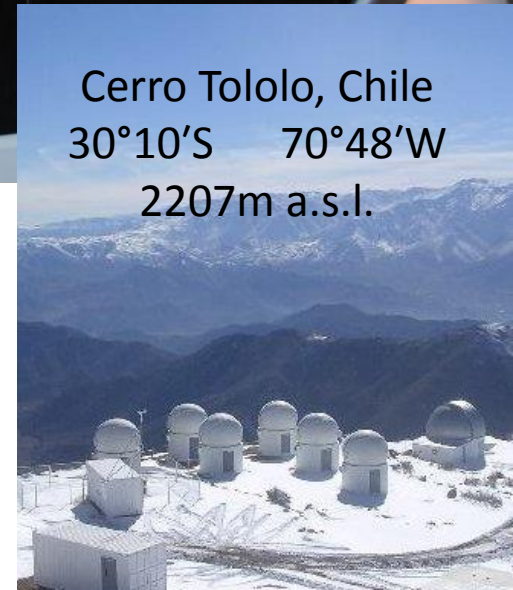


# The Thai Southern Hemisphere Observatory (PROMPT8)

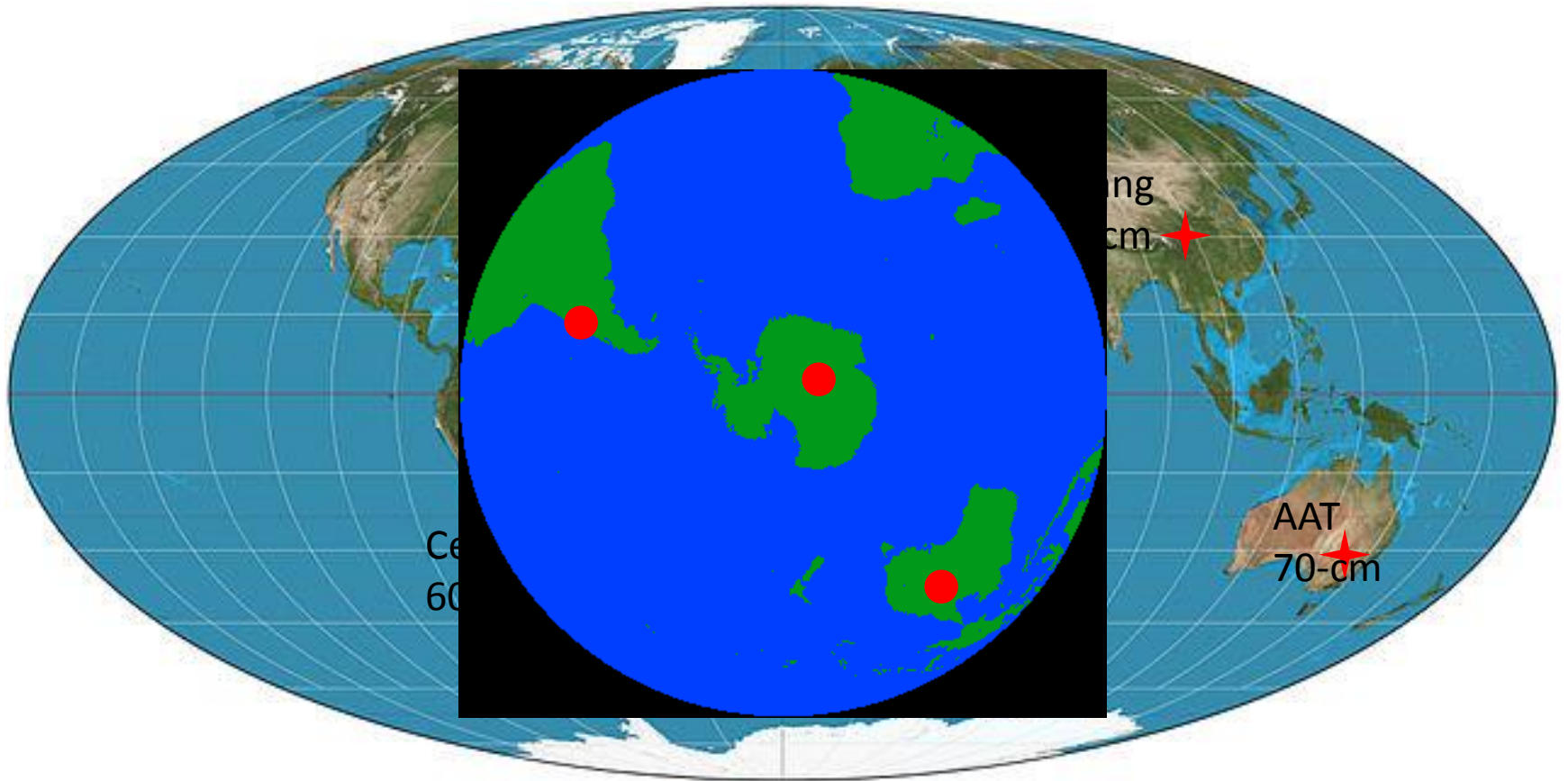
**2015: Polarimetry**

1. Telescope1: Planewave CDK24 (24" f/6.8)
2. Telescope2: Takahashi FSQ 106 (refractor telescope)
3. Mount: Astro-Physics 3600GTO (with Precision Encoder)
4. CCD1: Apogee U42 (imaging, 2048 x 2048, back illuminated)
5. CCD2: Apogee U47 (polarimeter, 1024 x 1024, back illuminated)
6. Dome: 16ft Astrohaven clamshell

Cerro Tololo, Chile  
30°10'S 70°48'W  
2207m a.s.l.



# Participation in Robotic Telescopes



Expansion with 1-2 more to form the “Thai Robotic Telescopes Network”

# Astrophysical Research at NARIT

- 4 Thai PhDs, 3 senior + 2 junior foreign researchers, PostDocs, assistants, students
- Many international collaborations at national and institutional level
- Group expected to increase by  $\sim 2$  researchers/year in 2016-18
- Possibility to hire foreign research assistants and long-term visitors
- Binary Stars, Cataclysmic Variables, Lunar Occultations, High Time Resolution, Evolved Stars, Young Stars, Exoplanets, Asteroseismology, AGNs, Cosmology, Pulsars, Jupiter, Microquasars, Meteorites, Trans-Neptunian Objects, (History of Astronomy, Outreach)
- Areas in expansion: Radioastronomy, High-Performance Computing, Infrared



Boonrucksar Soonthornthum



Puji Irawati



Andrea Richichi



Utane Sawangwit



David Mkrtichian



Jia Jia, He



Saran Posyachinda



Wayne Orchiston



Phrudth Jaroenjittichai



Thawicharat Sarotsakulchai



Ram Kesh Yadav



Open PostDoc



# NARIT Collaborations

## MoUs & Projects

- Sino-Thai & YNO
- SEAAN & PH, RI
- KASI
- (NAOJ)
- UK Universities
- UNC
- MU Ukraine
- MPIfR Germany
- Argentina
- (India)





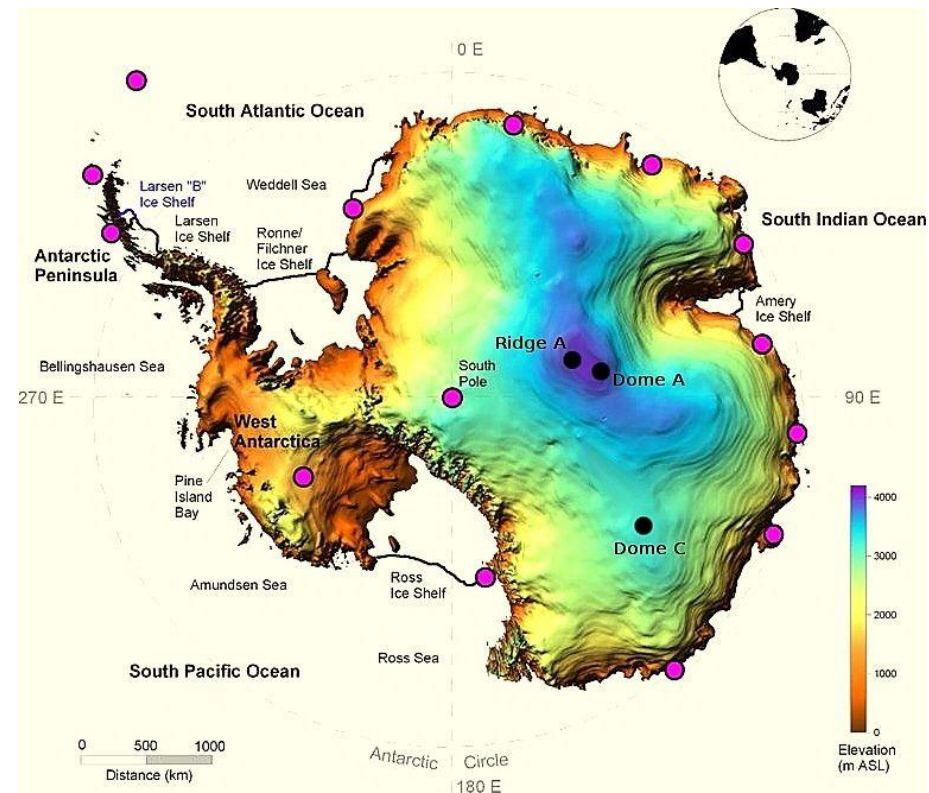
# What can NARIT bring to Astronomy from Antarctica?

## Previous expertise

- D. Mkrtychian, candidate for 2<sup>nd</sup> Ukrainian expedition to “Vernadsky”, install small telescope
- A. Richichi, member of ESO/ESA panel on ALADIN, exo-zodi Darwin precursor facility from Dome C, long-baseline interferometry

## Possible contributions

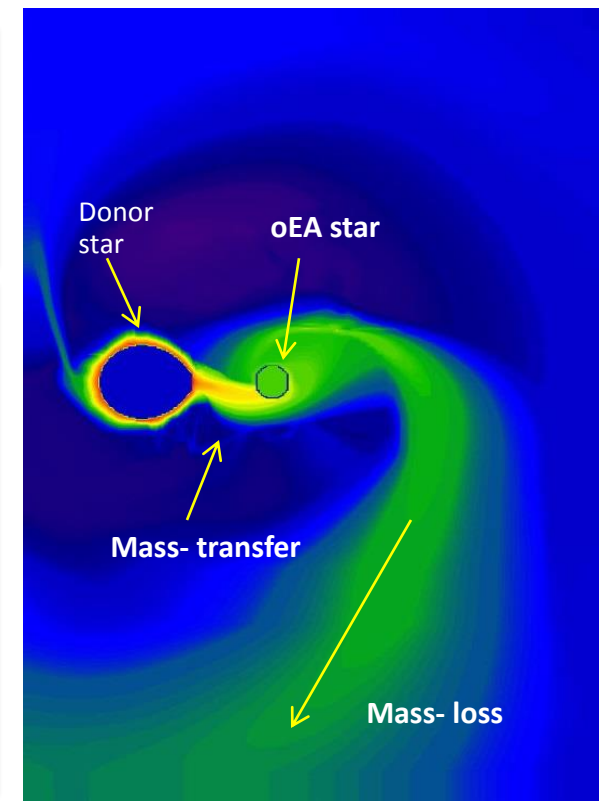
- Robotic operations
- HPC, Center for data analysis
- Infrastructure ? Telescope or IR detector ?
- manpower ?
- Follow-up from TRTN (and TNT ?)



# Thai Southern Sky Survey for oEA Stars (THASSOS)

PI: Dr. David Mkrtychian

- **Aims of project :** detection and asteroseismology of oscillating mass-accreting components of Algols (oEA stars)
- **oEA class:** discovered by D. Mkrtychian's group (2002)
- **Start:** 2013 (so far 16 objects observed)
- **Telescopes:** NARIT's southern sky Prompt-8 and Skynet network robotic telescopes.
- **Spectroscopic support:** Thai Nat. Tel. (TNT), 2.4m, MRES
- **Space support:** Canadian MOST space telescope (2013)



oEA star science with Antarctic telescopes

- Antarctic winter long-term, high-quality wide field photometry in selected areas is well suitable for asteroseismology of oEA and other pulsating stars.
- Spectroscopic support: 2.4m TNT, NARIT
- Polarimetry support: 0.6m PROMPT-8 tel., NARIT



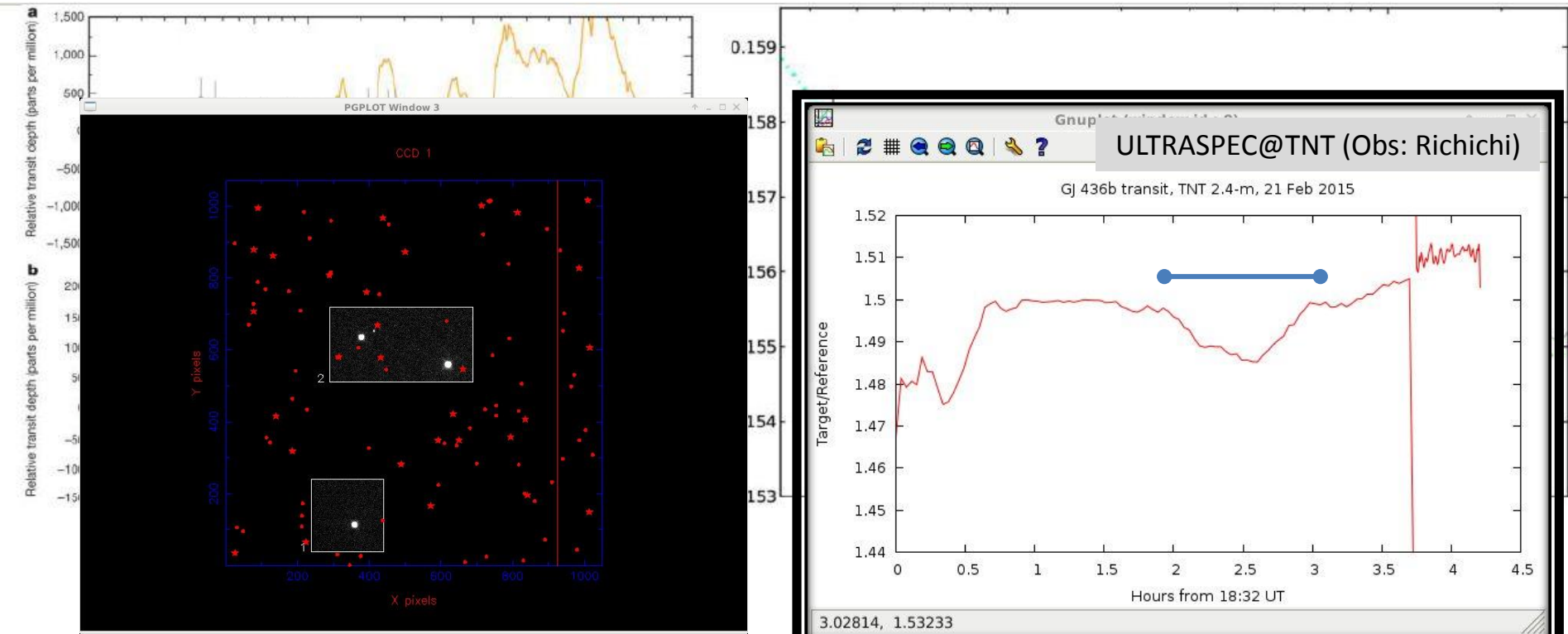
# Exoplanet Transits

**GJ436b** (“hot Neptune”), TNO 2.4-m February 21 & March 17, 2015

Characterize the atmosphere from comparing transit depth in UV and optical.

Project with Ivanov (ESO Chile), Anderson (Keele UK) et al.

Two transits allocated each on VLT (U) and TNT (g’).



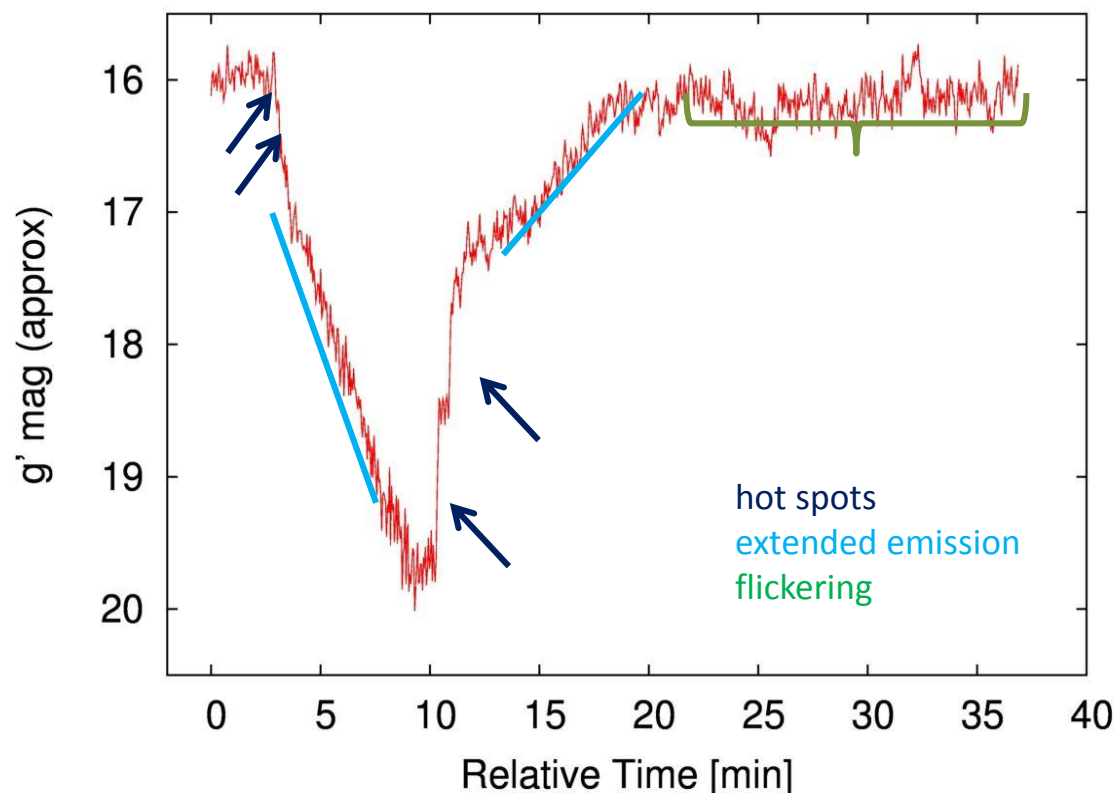
- 45 known transiting exoplanets with  $\text{Dec} < -25^\circ$
- options: round-the-clock monitoring from several telescopes distributed in longitude, or single survey telescope in Antarctica. Latter preferable for homogeneity, but subject to long “summer skies”. Both are probably needed.
- long-term monitoring needed for multiple planets and any O-C variations
- high-accuracy needed to characterize atmospheres
- simultaneous monitoring by RV, asteroseismology, etc, possible from sites in Chile, Australia, S. Africa



UZ For (polar)  
28-Dec-2013

(EB proposal: Irawati, Slowikowska, Richichi,  
Soonthornthum, Zejmo)

$g'$  filter, subwindow mode,  $\Delta t = 2.6$  s  
raw data reduction with 1 field reference star  
with ULTRACAM pipeline v9.11  
approximate photometry from ETC calculator



High time resolution allows us to study details of the system and of the individual stars. Follow-up with accurate GPS timings can prove the presence of an exoplanet from O-C residuals (below, from Perryman et al 2001)

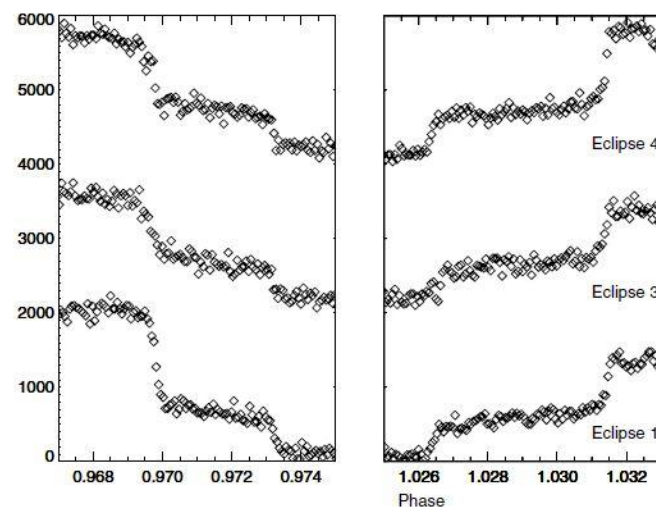


Figure 8. The white light ingresses and egresses of eclipses 1, 3 and 4 at 0.5 s time resolution (see Table 1). Each successive eclipse is displaced vertically by 2000 count  $s^{-1}$ . Orbital phase is with respect to the updated ephemeris given by equation (2).

# Occultations of Trans-Neptunian Objects

## Examples of recent & future events from Antarctica

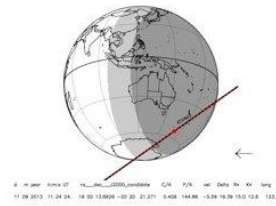
Chariklo: Star WFI, NIMA ephem

Offset (mas): 0.0 0.0

-CHARIKLO- dots each minute -DE432 NIMA- offsets (mas) 0.0 0.0

Chariklo: Star WFI, ESOjun-JPL#15

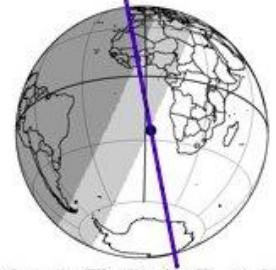
Offset (mas): -877.0 -80.0



d m year h:m:s UT ra\_dec\_j2000\_candidate C/A P/A vel Delta R\* K\* long  
20 07 2016 16 35 40.0 18 21 43.0925 -34 05 42.080 0.290 191.85 -20.30 14.47 12.8 0.0 88  
Credits: Rio Team & B. Sicardy

d m year h:m:s UT ra\_dec\_j2000\_candidate C/A P/A vel Delta R\* K\* long  
15 09 2013 20 43 8. 16 44 58.0263 -38 21 9.816 0.342 147.88 16.06 14.72 14.9 11.3 -55.

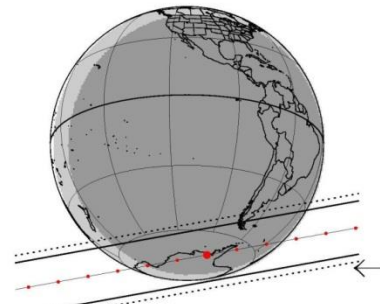
-2005CC79- dots each 1000km or 89.13s <> offsets (mas) -817.0 -199.0



d m year h:m:s UT ra\_dec\_j2000\_candidate C/A P/A vel Delta R\* K\* long  
17 01 2014 08 23 28.0 13 01 22.1866 -28 24 34.299 0.029 79.16 11.22 23.27 17.6 14.8 -2  
Credits: Rio Team & B. Sicardy

Pluto: Star WFI, DE413-Bule-JIBC ephem.

Offset (mas): -111.0 191.0

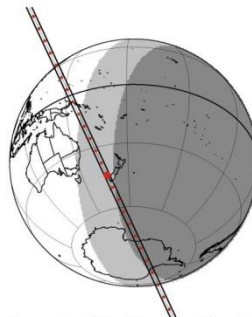


d m year h:m:s UT ra\_dec\_j2000\_candidate C/A P/A vel Delta R\* K\* long  
18 07 2015 06 46 00. 18 58 52.6395 -20 48 25.354 0.228 169.79 -23.51 31.91 14.3 12.5 -113.

Chariklo: Star WFI, NIMA ephem

Offset (mas): 0.0 0.0

-2007OR10- dots each 1000km or 39.15s <> offsets (mas) -61.0 -362.0

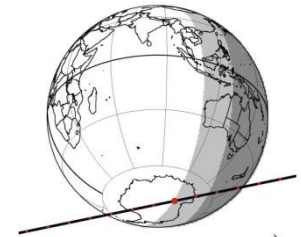


d m year h:m:s UT ra\_dec\_j2000\_candidate C/A P/A vel Delta R\* K\* long  
08 08 2013 07 21 53. 16 43 2.0218 -39 13 6.224 0.148 245.16 -11.55 14.09 14.9 11.7 -177.

d m year h:m:s UT ra\_dec\_j2000\_candidate C/A P/A vel Delta R\* K\* long  
04 08 2013 08 16 07.0 22 20 57.9550 -13 27 18.527 0.090 160.40 -25.54 85.92 19.5 16.0 -72  
Credits: Rio Team & B. Sicardy

Amycus: Star WFI, ESOjun-JPL#3

Offset (mas): -605.0 175.0



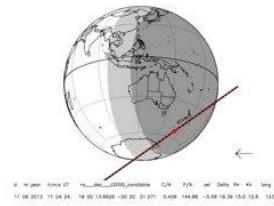
d m year h:m:s UT ra\_dec\_j2000\_candidate C/A P/A vel Delta R\* K\* long  
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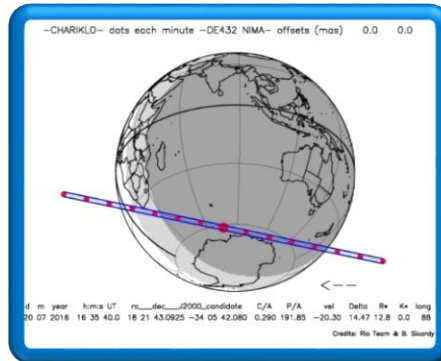
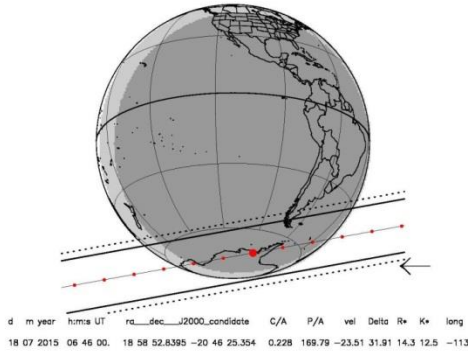
# Occultations of Trans-Neptunian Objects

## Examples of recent & future events from Antarctica

Chariklo: Star WFI, ESOjun-JPL#15 Offset (mas): -877.0 -80.0



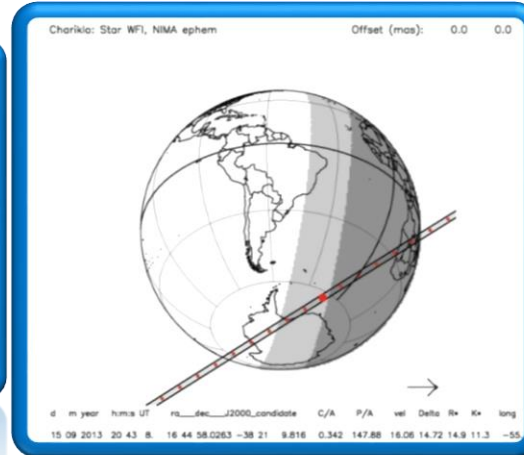
Pluto: Star WFI, DE413-Bule-JIBC ephem. Offset (mas): -111.0 191.0



-CHARIKLO- dots each minute -DE432 NIMA- offsets (mas) 0.0 0.0

d	m	year	h	m	s	UT	ra	dec	J2000	candidate	C/A	P/A	vel	Delta	R*	K*	long
20	07	2016	16	35	40.0	18	21	43.0825	-34	05	42.080	0.290	191.85	-20.30	14.47	12.8	0.0

Credits: Rio Team & B. Sicardy

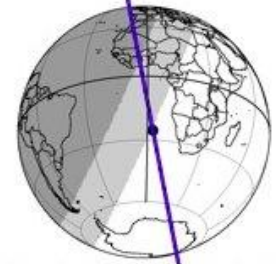


Chariklo: Star WFI, NIMA ephem

Offset (mas): 0.0 0.0

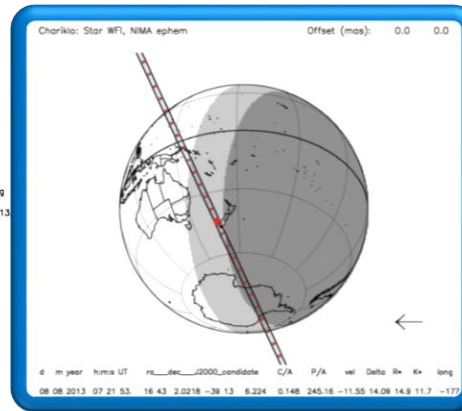
d	m	year	h	m	s	UT	ra	dec	J2000	candidate	C/A	P/A	vel	Delta	R*	K*	long
15	09	2013	20	43	8.	16	44	58.0283	-38	21	9.816	0.342	147.88	16.06	14.72	14.9	-55

-2005CC79- dots each 1000km or 89.13s <> offsets (mas) -817.0 -199.0



d	m	year	h	m	s	UT	ra	dec	J2000	candidate	C/A	P/A	vel	Delta	R*	K*	long
17	01	2014	08	23	28.0	13	01	22.1866	-28	24	34.289	0.029	79.18	11.22	22.27	17.6	14.8

Credits: Rio Team & B. Sicardy

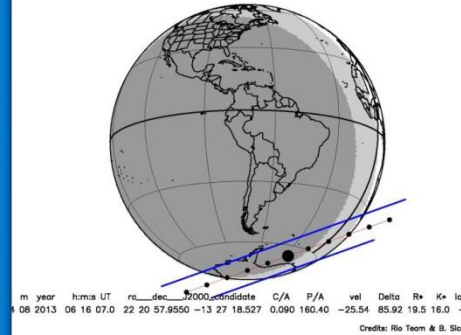


Chariklo: Star WFI, NIMA ephem

Offset (mas): 0.0 0.0

d	m	year	h	m	s	UT	ra	dec	J2000	candidate	C/A	P/A	vel	Delta	R*	K*	long
08	08	2013	07	21	53.	16	43	2.0218	-38	13	6.224	0.148	245.16	-11.55	14.09	14.9	-177

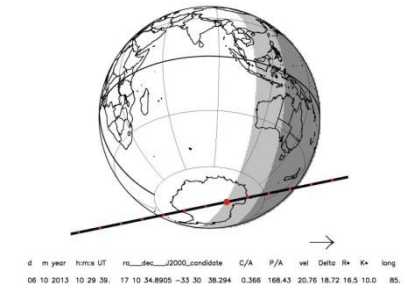
-2007OR10- dots each 1000km or 39.15s <> offsets (mas) -61.0 -362.0



d	m	year	h	m	s	UT	ra	dec	J2000	candidate	C/A	P/A	vel	Delta	R*	K*	long
08	2013	08	16	07.0	22	20	57.8550	-13	27	18.527	0.090	160.40	-25.54	85.92	19.5	16.0	

Credits: Rio Team & B. Sicardy

Amycus: Star WFI, ESOjun-JPL#3 Offset (mas): -605.0 175.0



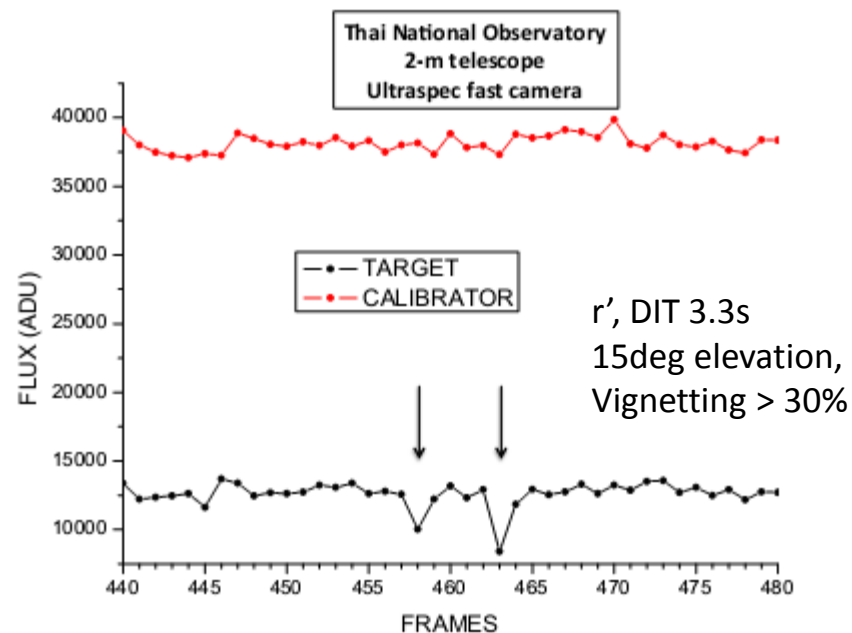
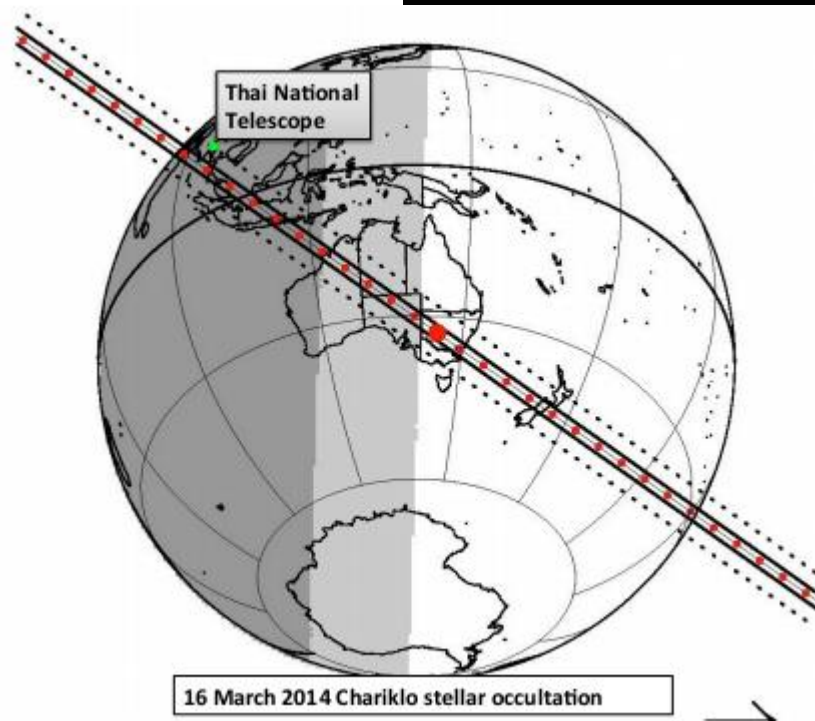
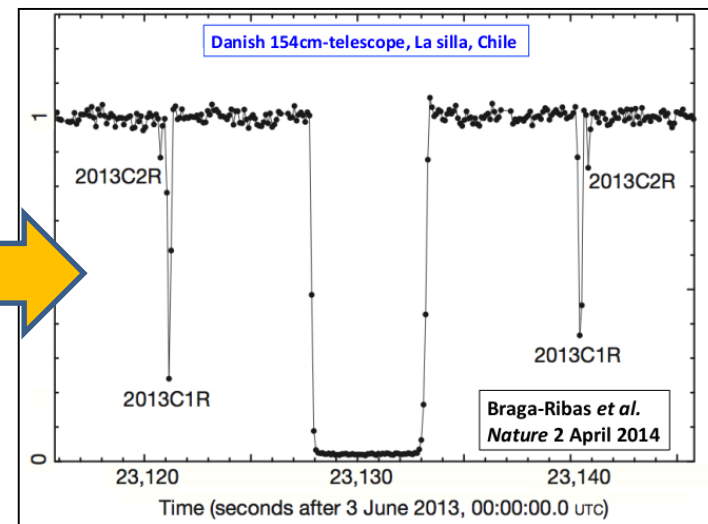
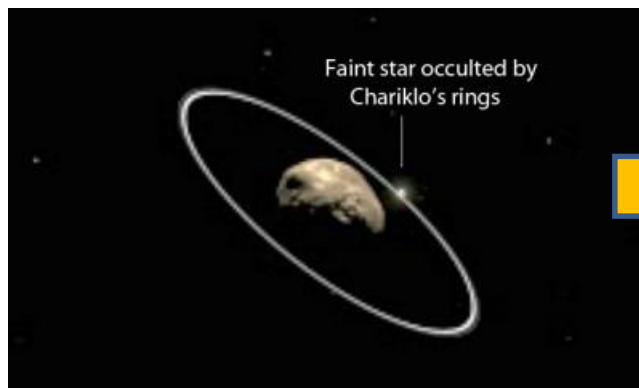
d	m	year	h	m	s	UT	ra	dec	J2000	candidate	C/A	P/A	vel	Delta	R*	K*	long
06	10	2013	10	29	39.	17	10	34.8905	-33	30	38.294	0.366	168.43	20.76	18.72	16.5	10.0

85.

# Centaur object (10199) Chariklo

## Stellar occultation by Trans-Neptunian Object

(proposal: Richichi, Sicardy,  
Braga-Ribas; observer: Irawati)







# Long-term commitment of Thailand to Antarctic Astronomy

- Strong support from the Royal Family, sciences in general, astronomy in particular
- Financial support from the Government
- Involvement in Arctic (Svalbard)
- Strong wish of involvement in Antarctic  
Dome A  
Dome C
- Collaboration for an Antarctic Evryscope
- Funding for 2016, more in 2017-18.
- Contributing with human resources (incl. students), archive and data analysis
- Glad to organize future meetings.

# Conclusions and Prospects

- NARIT is a leading astronomical institute in SE Asia, with a small but active and expanding science group with many diverse interests
- NARIT researchers are strongly motivated to contribute to astronomy from Antarctica
- Experience in imaging, spectroscopy, robotic operation; solar-system, exoplanets, stellar astrophysics and cosmology.
- Possibility to provide human resources, infrastructure.
- NARIT is keen to establish international collaborations.
- Researchers from other institutes are warmly invited to collaborate with NARIT researchers and visit us.
- Opportunities for students (thesis projects, internships).
- Shared projects welcome.
- Possibility to organize/host Schools.

<http://www.narit.or.th/en/>

<http://www.narit.or.th/en/index.php/research>