

Pro-Am Observation of Asteroids

WSAAG Meeting

2014 July 16

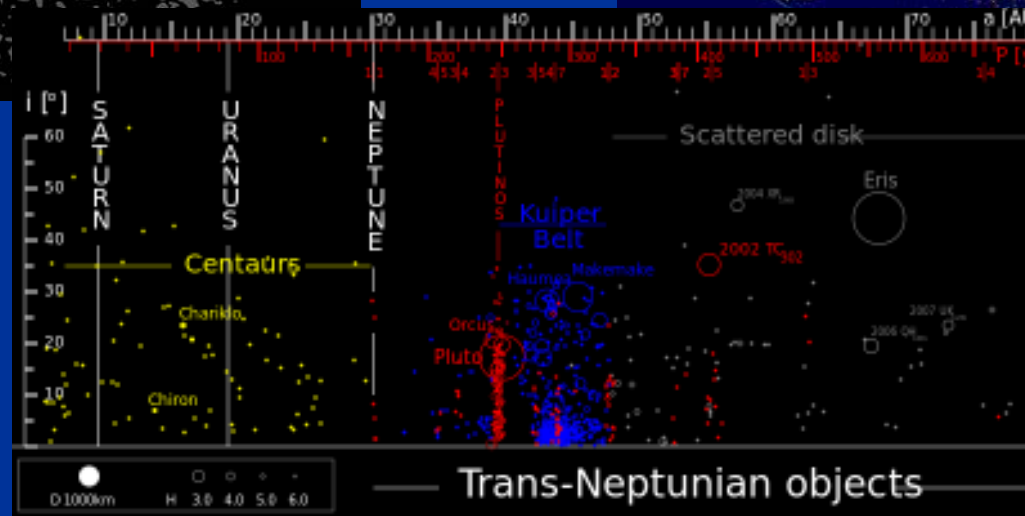
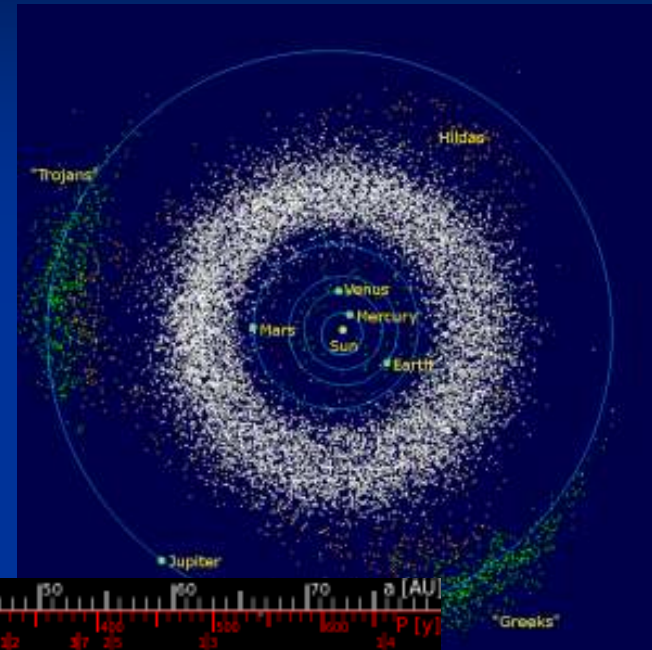
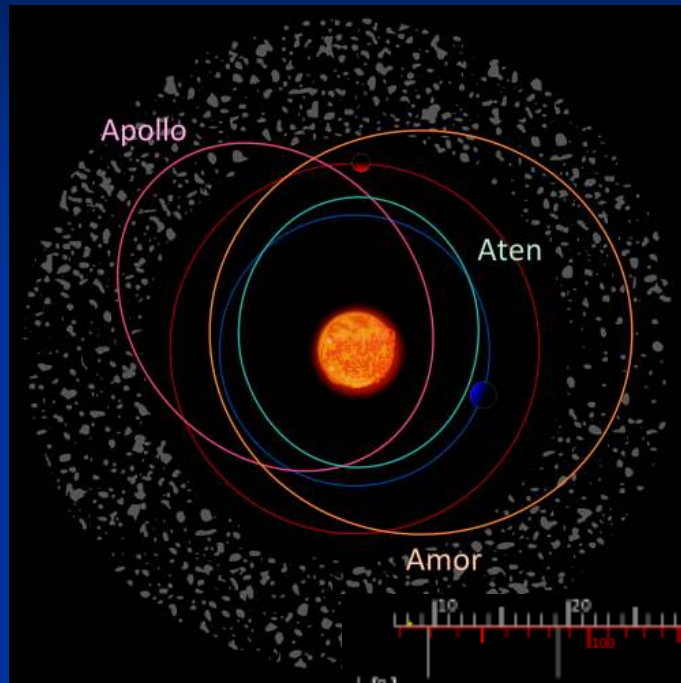
Dave Gault

Team Occultation

Asteroids? – think potatoes in space...



Types Asteroids



Perhaps the public perception of Asteroids



Methods of Observing Asteroids



WIKIPEDIA
The Free Encyclopedia

Astrometry

Astrometry is the branch of [astronomy](#) that involves [precise measurements of the positions and movements of stars and other celestial bodies](#). The information obtained by astrometric measurements [provides information on the kinematics](#) and physical origin of our [Solar System](#) and our galaxy, the [Milky Way](#).


Photometry

Photometry is a technique of [astronomy](#) concerned with [measuring the flux, or intensity of an astronomical object's electromagnetic radiation](#).^[1] Usually, photometry refers to measurement over large [wavelength](#) bands of [radiation](#); when not only the amount of radiation but also its spectral distribution are measured, the term

Occultation

An **occultation** is an event that occurs when one object is hidden by another [object that passes between it and the observer](#). The word is used in [astronomy](#) (see below). It can also refer to any situation wherein an object in the foreground blocks from view ([occults](#)) an object in the background. In this general sense, occultation applies to the visual scene observed from low-flying aircraft (or [computer-generated imagery](#)) wherein foreground objects obscure distant dynamically, as the scene changes over time.

Who wants observations of Asteroids?

**The International Astronomical Union
Minor Planet Center**
The nerve center of asteroid detection in the Solar System

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What is the Minor Planet Center?

The Minor Planet Center, or MPC, is the single worldwide location for receipt and distribution of positional measurements of minor planets, comets and outer irregular natural satellites of the major planets. The MPC is responsible for the identification, designation and orbit computation for all of these objects. This involves maintaining the master files of observations and orbits, keeping track of the discoverer of each object, and announcing discoveries to the rest of the world via electronic circulars and an extensive website. The MPC operates at the Smithsonian Astrophysical Observatory, under the auspices of Division F of the International Astronomical Union (IAU).

All of the MPC's operating funds come from a NASA's Near-Earth Object Observations program grant. Much of the computer equipment that the MPC uses was provided by the Tamkin Foundation.

The MPC accomplishes this work with a staff of 6 full-time employees.

Staff

The MPC has 6 full-time employees.

Tim Spahr, MPC Director
Tim obtained astronomy and physics degrees from The University of Arizona in 1992, followed by MS and PhD from The University of Florida in 1998. Working with longtime friend Carl Hergenrother, Tim helped develop a minor planet survey using the Catalina Schmidt and old

Running Tallies

Near-Earth Objects Discovered

THIS MONTH:	13
THIS YEAR:	643
ALL TIME:	11220

Minor Planets Discovered

THIS MONTH:	1848
THIS YEAR:	24917
ALL TIME:	645148

Comets Discovered

THIS MONTH:	2
THIS YEAR:	28
ALL TIME:	3804

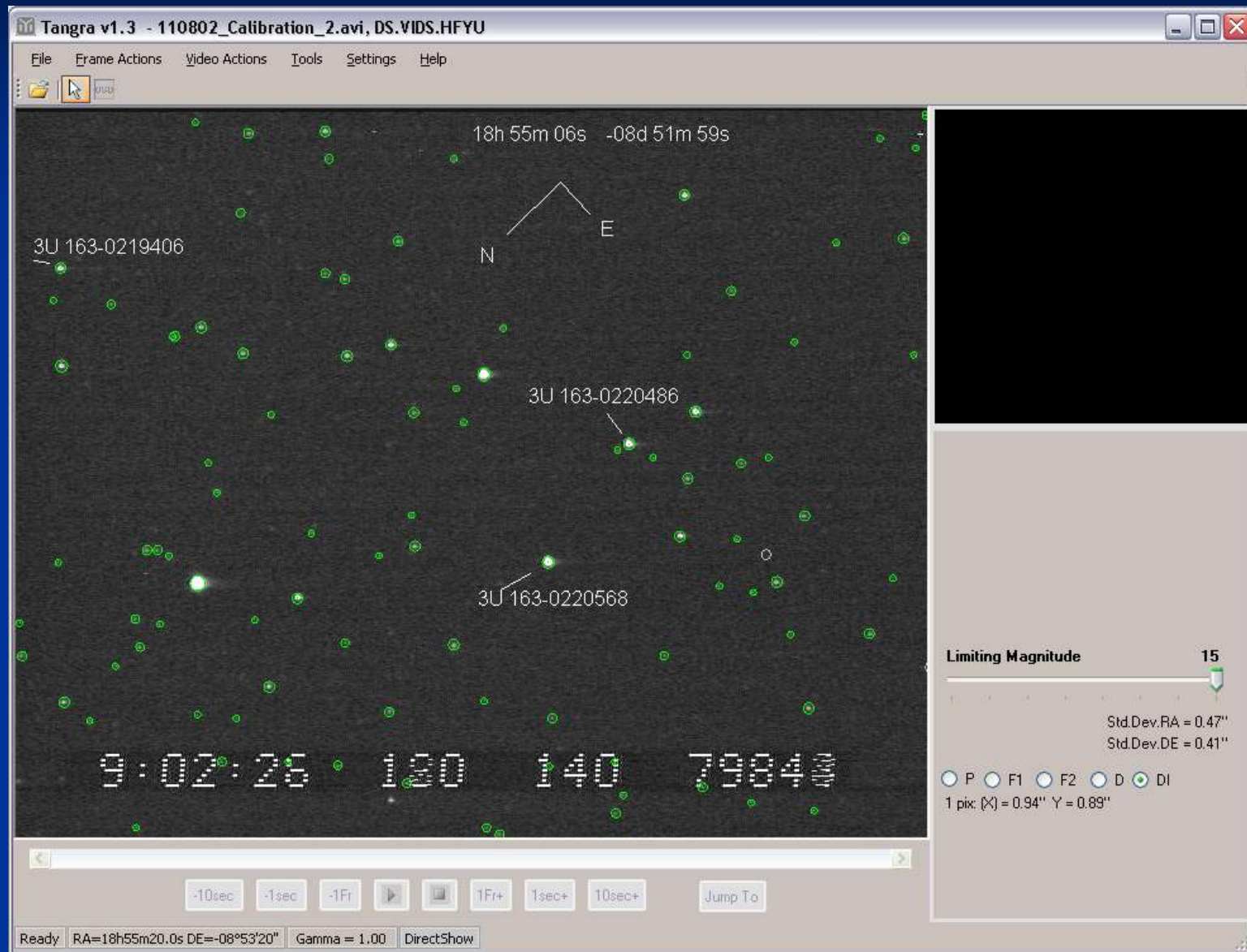
Observations

THIS MONTH:	201533
THIS YEAR:	5.6 million
ALL TIME:	112.9 million

Astrometry

How to make observations of Asteroids and Comets

Step 1 – System Calibration



Step 2 – Accreditation Observations

Tangra v1.0 - 1289-1206.avi, AVI.VIDS.HFYU

File Frame Actions Video Actions Tools Settings Help

100929_Reports - Reports

File Edit Format View Help

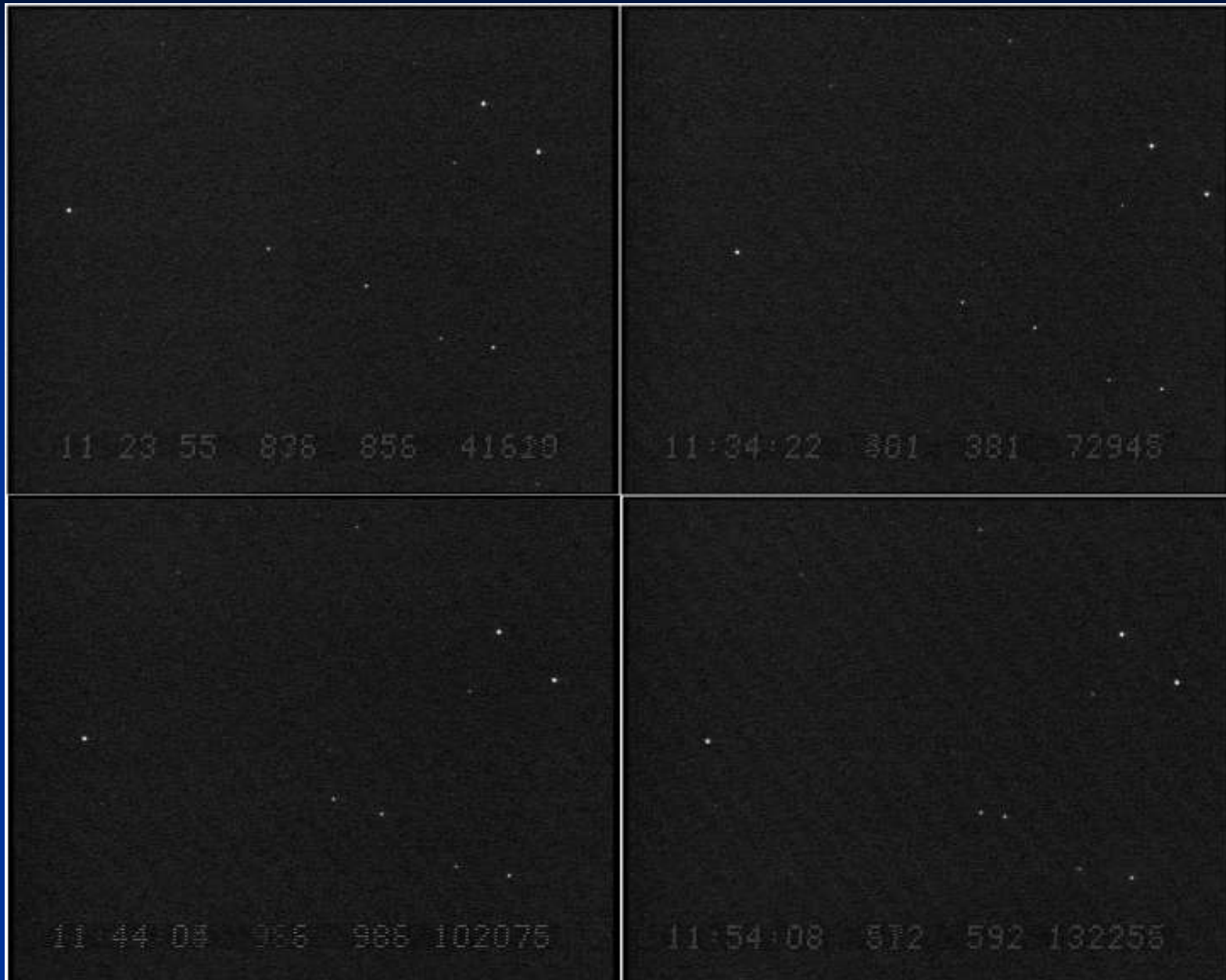
COM KIM
COM D. Gault, 31 Booker Rd, Harkesbury Heights, N.S.W. 2077, Australia
COM [daveg@tpg.com.au]
COM D. Gault
HKA D. Gault
TEL 0.25-8 f/6.0 reflector + CCD
HRT UCAC3
COM Kurius Observatory, Harkesbury Heights
COM Long. 150 38 29 E, Lat. 33 59 53 S, Alt. 106 m HRT 04
ACE 100929_Report
ACD daveg@tpg.com.au

01289	C2010 09 25.50087	19 12 48.80	-20 37 22.5	14.7	3000
01289	C2010 09 25.50547	19 12 48.84	-20 37 22.7	14.9	3000
01289	C2010 09 25.52744	19 12 50.11	-20 37 21.7	15.4	3000
00446	C2010 09 25.49469	19 15 56.66	-25 20 24.9	13.0	3000
00446	C2010 09 25.52989	19 15 56.43	-25 20 22.2	13.8	3000
00479	C2010 09 25.49164	19 11 59.48	-07 52 13.8	13.3	3000
00479	C2010 09 25.52600	19 12 00.18	-07 52 19.2	13.3	3000
00654	C2010 09 25.48703	19 15 13.71	-13 57 24.9	13.4	3000
00654	C2010 09 25.51799	19 15 14.61	-13 57 22.9	13.3	3000
00679	C2010 09 25.48427	19 15 00.58	-21 01 56.6	13.6	3000
00679	C2010 09 25.52327	19 15 02.91	-21 01 52.0	13.7	3000
00679	C2010 09 25.41684	19 15 46.11	-21 00 26.1	13.6	3000
00679	C2010 09 25.47323	19 15 46.82	-21 00 29.9	13.9	3000
00654	C2010 09 25.41993	19 15 42.20	-13 56 28.5	13.3	3000
00654	C2010 09 25.47597	19 15 48.96	-13 56 24.2	13.4	3000
00479	C2010 09 25.42303	19 12 19.72	-07 54 44.9	13.3	3000
00479	C2010 09 25.47811	19 12 20.89	-07 54 53.5	13.4	3000
00446	C2010 09 25.49062	19 16 47.12	-25 15 01.5	13.1	3000
00446	C2010 09 25.51242	19 16 51.51	-25 14 21.7	12.7	3000
01289	C2010 09 25.41221	19 13 24.64	-30 37 03.1	15.9	3000
01289	C2010 09 25.46903	19 13 27.66	-30 37 00.6	14.3	3000
01289	C2010 09 25.50947	19 13 30.45	-30 37 00.0	14.9	3000

1289] Kuttaissi
m = 15.7
X = 369.6
Y = 314.6
RA = 19 12 48.87
DE = -20 37 23.0
Std.Dev RA = 0.21"
Std.Dev DE = 0.17"
FWHM = 2.96
Detection = 0.66
Multi-Frame Astrometry

Quadratic Fit (60 Stars) RA=19h12m48.8s DE=-20°37'21" Gamma = 1.00 Frame: 115

Step 3a – Make Observations



Step 3b – Analyse Observations

Tangra v1.0 - 101017_1998TU3-A.avi, DS.VIDS.HFYU

File Frame Actions Video Actions Tools Settings Help

(66146) 1998 TU3

Linear Fit (9 Stars) RA=01h13m42.9s DE=-32°10'07" Gamma = 1.00 Frame: 642 DirectShow

101022_Report.obs - Notepad

File Edit Format View Help

OD E28
CON D. Gault, 22 Booker Rd, Hawkesbury Heights, N.S.W. 2777, Australia
CON [daveg@tpg.com.au]
OBS D. Gault
MEA D. Gault
TEL 0.25-m f/5.0 reflector + CCD
NET UCAC2
AC2 davegee@tpg.com.au

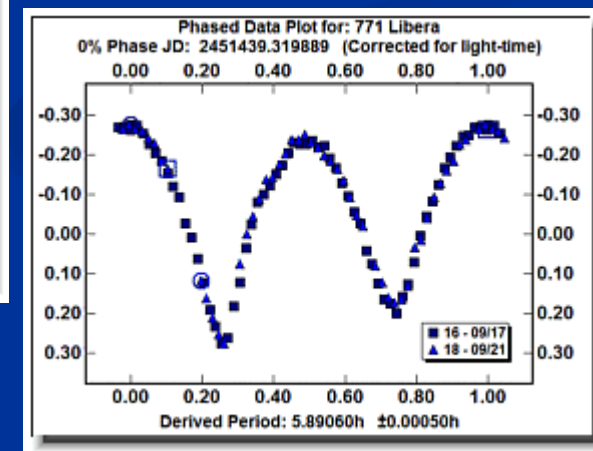
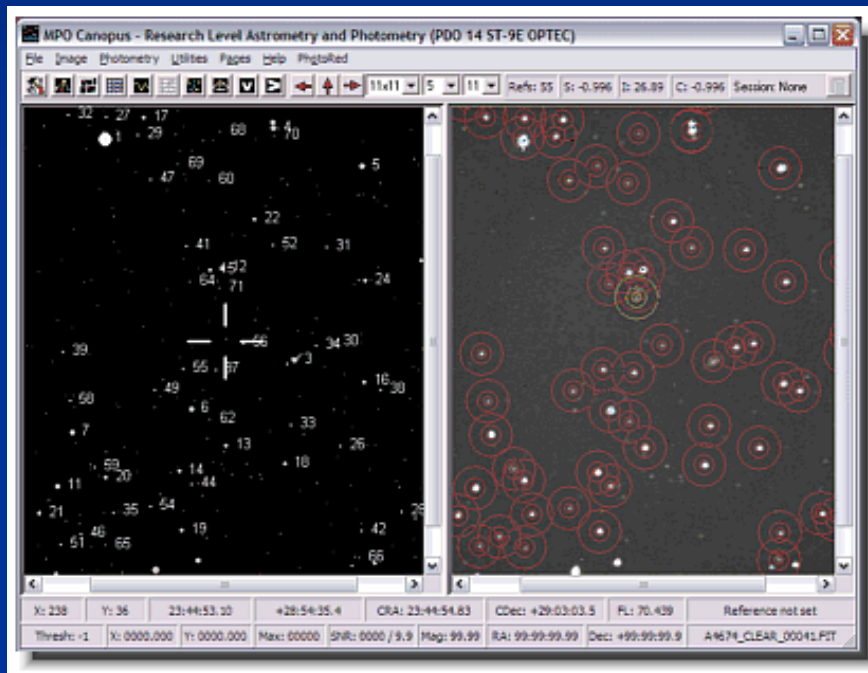
K10R12F	C2010 09 8.46646	22 44 14.29	-07 46 06.2	13.3 R	E28
K10R12F	C2010 09 8.47025	22 43 59.06	-07 57 56.7	13.2 R	E28
K10R12F	C2010 09 8.47714	22 43 30.28	-08 19 59.3	13.4 R	E28
K10R12F	C2010 09 8.47902	22 43 22.23	-08 26 06.8	13.3 R	E28
66146	C2010 10 17.47495	01 13 38.67	-32 16 47.4	12.2 R	E28
66146	C2010 10 17.48221	01 13 35.03	-32 17 06.6	12.2 R	E28
66146	C2010 10 17.48897	01 13 31.67	-32 17 24.3	12.1 R	E28
66146	C2010 10 17.49595	01 13 28.20	-32 17 42.3	12.0 R	E28
66146	C2010 10 17.50419	01 13 24.07	-32 18 04.0	12.1 R	E28

Add To MPC Report File

Selected Object Measurements

Photometry of Asteroids

Photometric Observing of Asteroids



3D Models of Asteroids



DAMIT

Database of Asteroid Models from Inversion Techniques

What is DAMIT?


DAMIT (pronounced /ˈdæmt/ or /ˈdʌmt/, abbreviation of Database of Asteroid Models from Inversion Techniques) is a database of three-dimensional models of asteroids that were computed using inversion techniques. The database and its web interface is operated by The Astronomical Institute of the Charles University in Prague, Czech Republic.


A paper describing DAMIT has been published by Ďurech et al. (2010), *DAMIT: a database of asteroid models*, A&A, 513, A46, ADS: 2010A&A...513A..46D, preprint (PDF 1.4 MB).

(20) Massalia
JD: 2456852



Interactive service for asteroid models






38 Luetitia
JD=2455023.2934

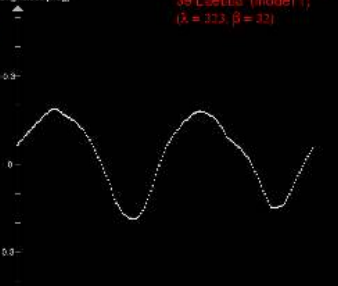
$\lambda = 323^\circ$
 $\beta = 32^\circ$

Aspect = 37°

P = 5.130238 h



38 Luetitia (model 1)
($\lambda = 323$, $\beta = 32$)




Sum Phase = 140505.02930
P = 5.130238 h

38 Luetitia
JD=2454536.2934


$\lambda = 323^\circ$
 $\beta = 32^\circ$

Aspect = 37°

P = 5.130238 h



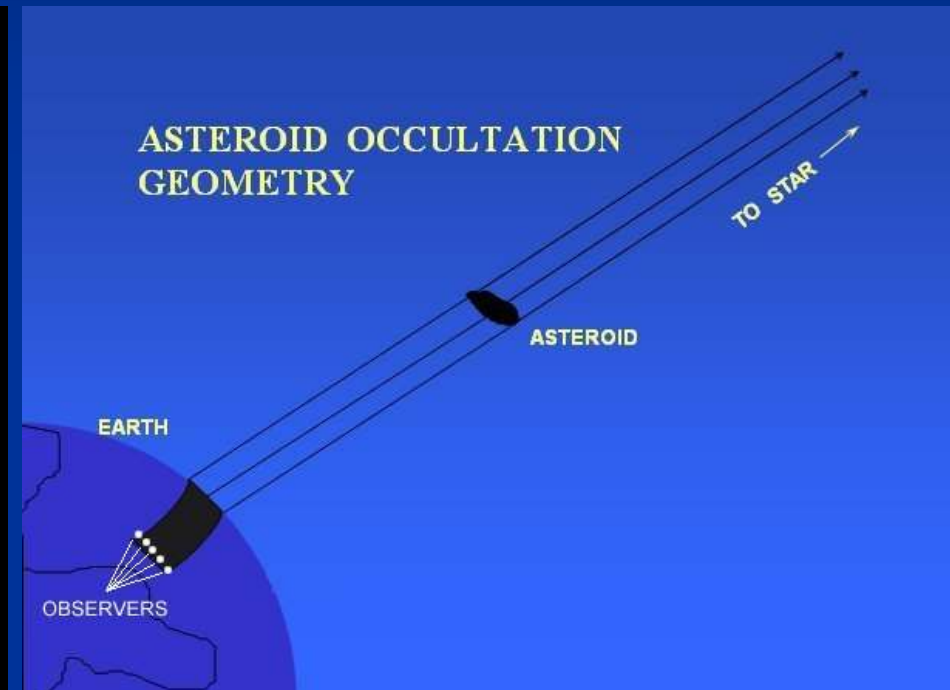
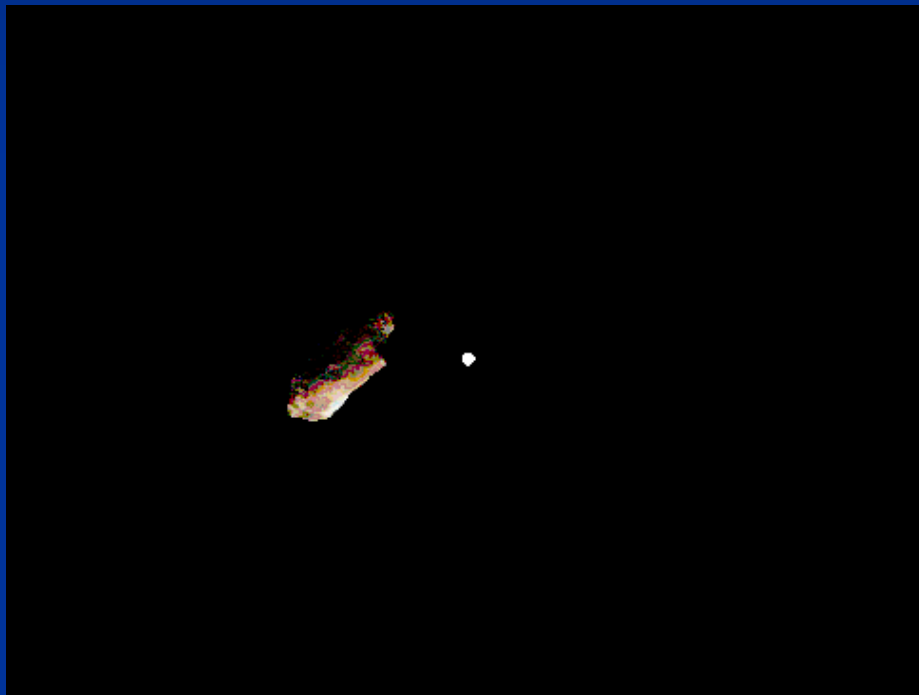
38 Luetitia (model 1)
($\lambda = 323$, $\beta = 32$)



Sum Phase = 140505.02930
P = 5.130238 h

Observations of Asteroids Occultations

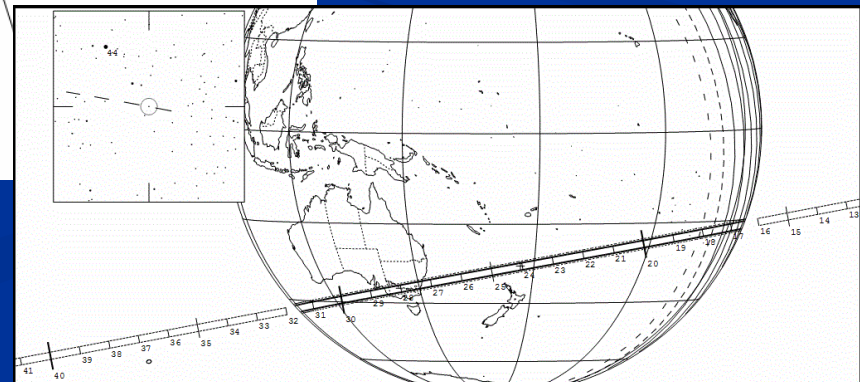
Observing Asteroids – During Stellar Occultation



Predicting Occultation Events Using Occult4

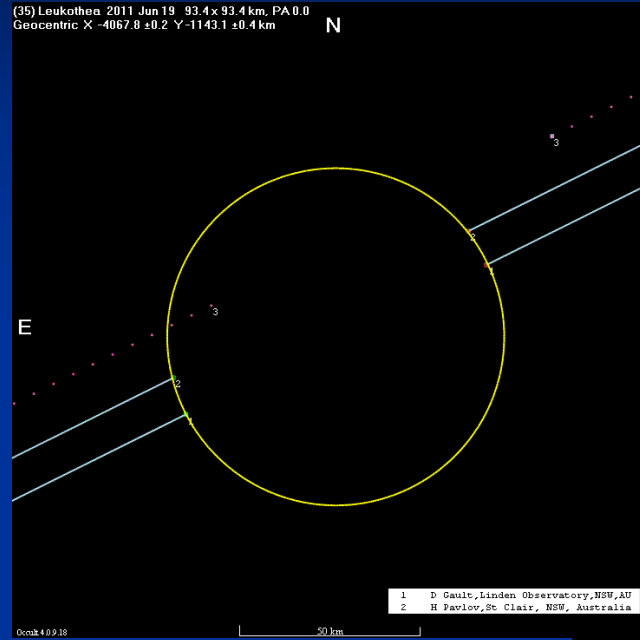
139 Juewa occults TYC 0003-00687-1 on 2013 Aug 31 from 14h 16m to 14h 32m UT

Star:	Max Duration = 14.3 secs	Asteroid:
Mv = 10.3 Mp = 10.6 Mr = 10.1	Mag Drop = 2.6 (2.3x)	Mag = 12.8
RA = 0 23 35.6539 (J2000)	Sun : Dist = 152 deg	Dis = 170km, 0.101"
Dec = 1 18 52.983	Moon: Dist = 97 deg	Parallax = 3.771"
[of Date: 0 24 20, 1 23 37]	: illum = 21 %	Hourly dRA = -1.665s
Prediction of 2013 Aug 13.0	E 0.033"x 0.024" in PA 79	dDec = -4.72"



Results

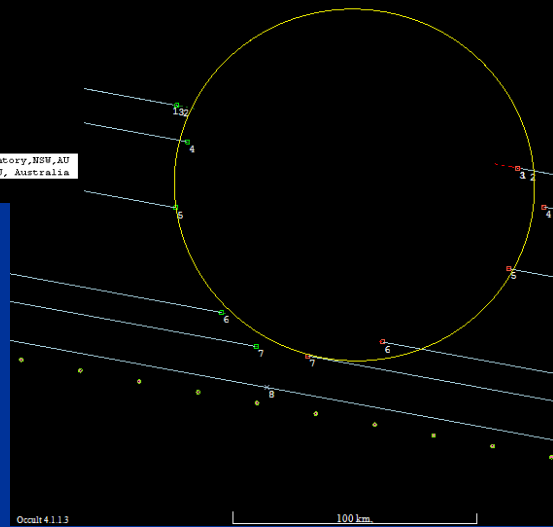
(35) Leukothea 2011 Jun 19 93.4 x 93.4 km, PA 0.0
Geocentric X -4067.6 ± 0.2 Y -1143.1 ± 0.4 km



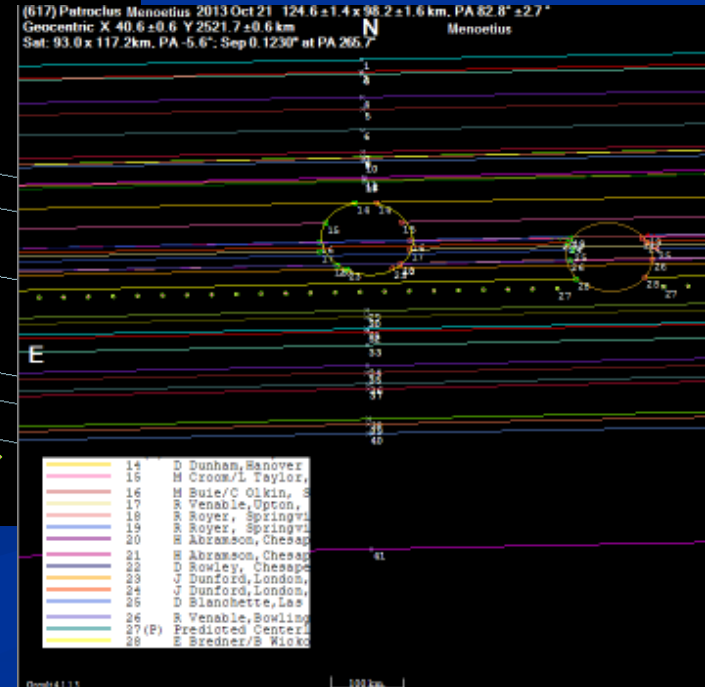
2013 Aug 31 147.9 ± 2.1 x 143.9 ± 8.6 km, PA 79.0° ± 38.8°
X -1643.8 ± 1.1 Y -3647.9 ± 3.7 km

- 1 R Horvat, Linden Observatory, NSW, AU
- 2 P Nosworthy, Linden Observatory, NSW, AU
- 3 T Dobosz, Linden Observatory, NSW, AU
- 4 H Pavlov, St Clair, NSW, Australia
- 5 T Barry, Werrington NSW, AUS
- 6 D Gault, Marulan, N.S.W. Australia
- 7 D Herald, Murrumbateman, NSW, AU
- 8 (M) D Herald, 5 km north of Hall, NSW, AU
- 9 (P) Prediction, April 08

- 1 D Gault, Linden Observatory, NSW, AU
- 2 H Pavlov, St Clair, NSW, Australia

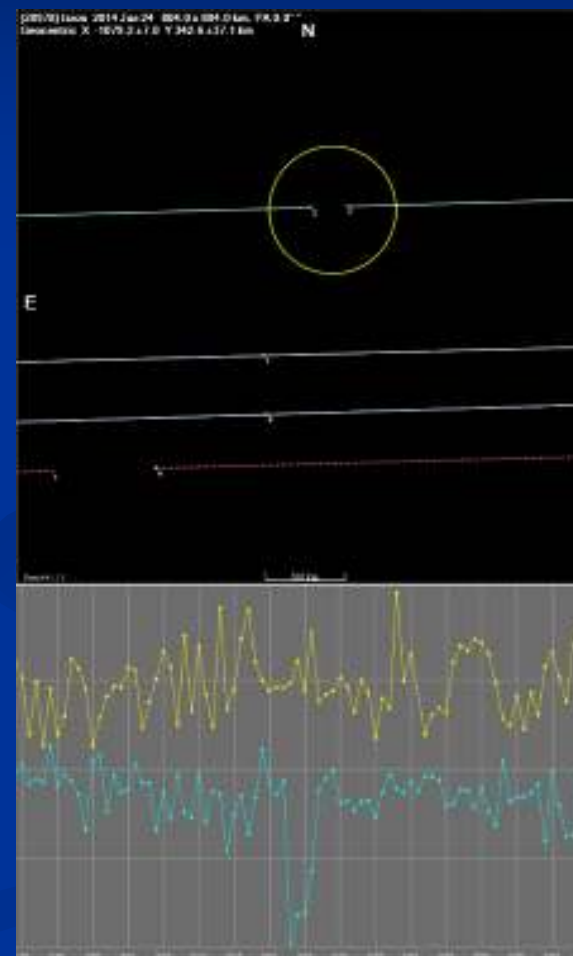
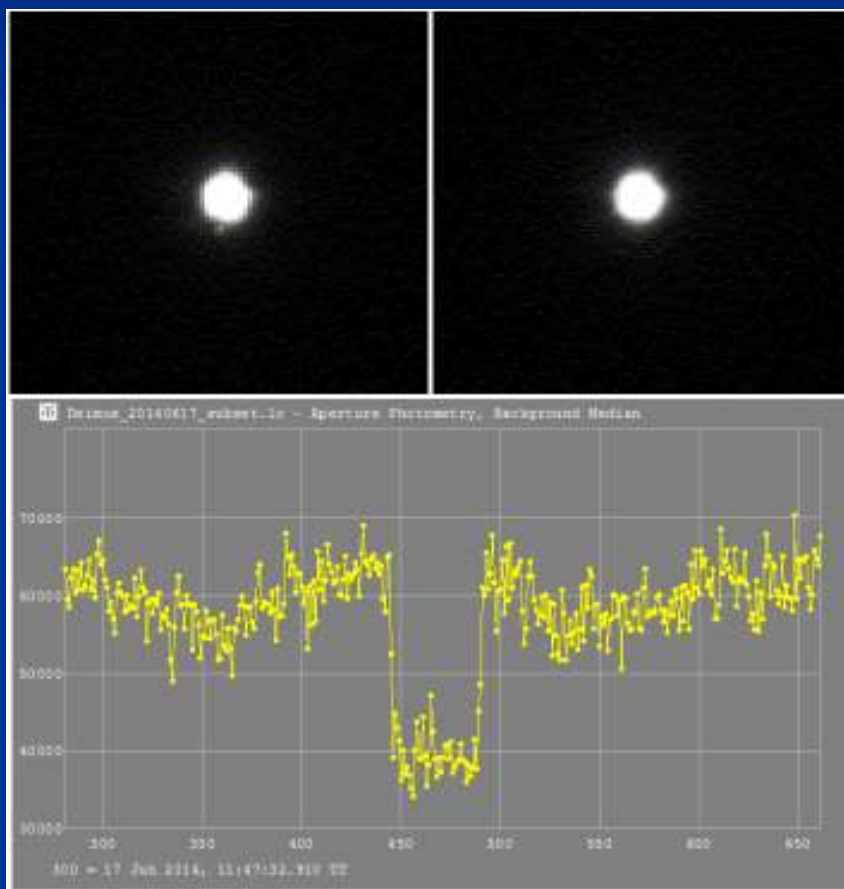


(617) Patroclus Menoetius 2013 Oct 21 124.6 ± 1.4 x 98.2 ± 1.6 km, PA 82.8° ± 2.7°
Geocentric X 40.6 ± 0.6 Y 2521.7 ± 0.6 km
Sat: 93.0 x 117.2 km, PA -5.6°, Sep 0.1230" at PA 265.7°



- 14 D Dunham, Hannover
- 15 M Croome/J. Taylor
- 16 M Buie/C. Olkin
- 17 R Venable, Opton
- 18 R Royer, Springville
- 19 R Royer, Springville
- 20 E Abramson, Chesapeake
- 21 E Abramson, Chesapeake
- 22 D Rowley, Chesapeake
- 23 J Dunford, London
- 24 J Dunford, London
- 25 D Blanchette, Las Vegas
- 26 R Venable, Bowling Green
- 27 (P) Predicted Center
- 28 E Sredner/S. Wicks

Results from Bill Hanna of Alice Springs



Results from South America

