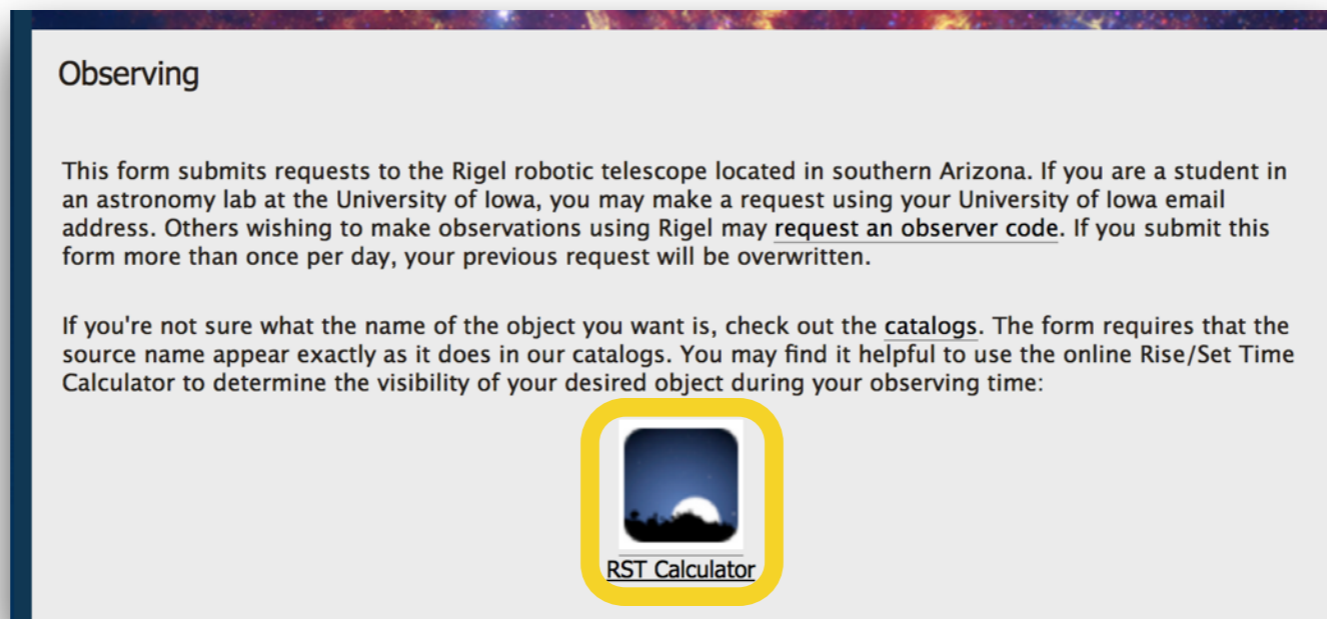
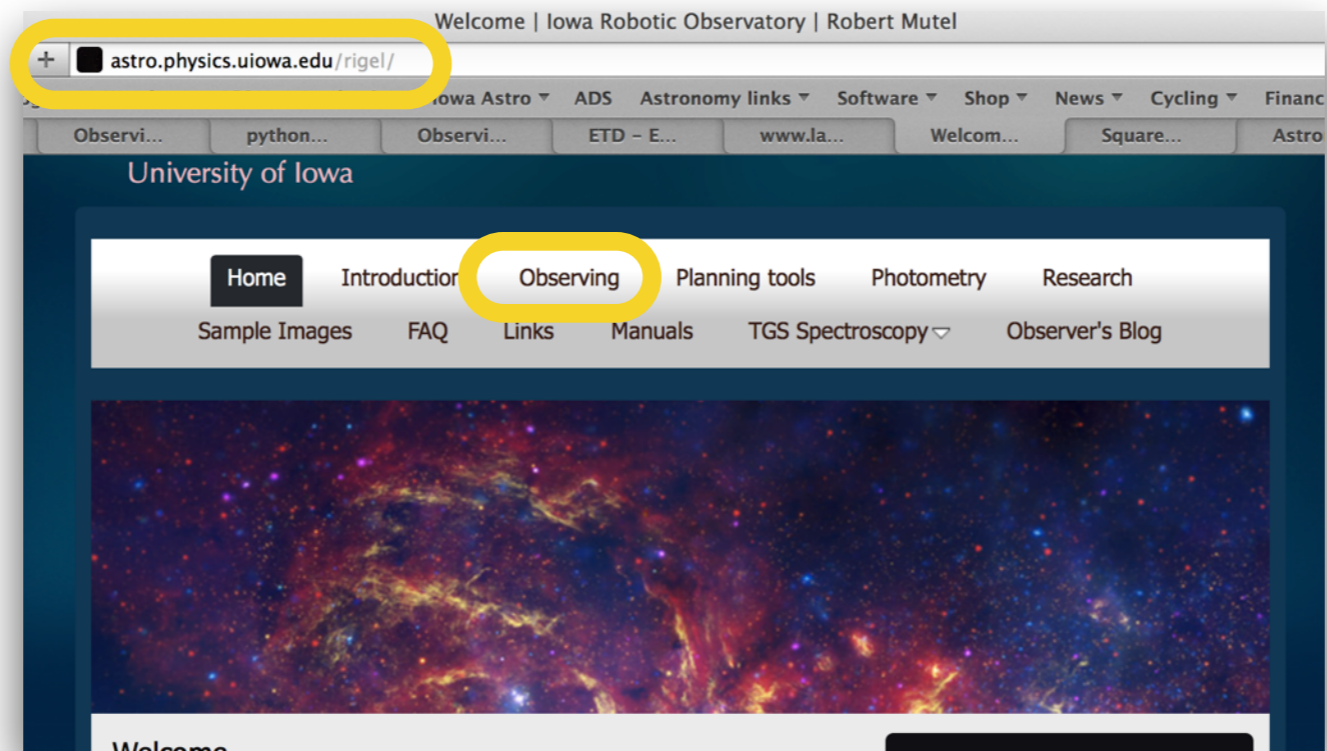


Exoplanet observing in 9 easy steps

Version 1.1 21 Oct 2014 RLM

Observing request planning (Steps 1-5)

Step 1: Determine the UT rise and set times for the date of observation. To do this, navigate to the Rigel telescope observing page and use the RST tool:



Enter any object name (e.g. Polaris) and optionally a date (defaults to the upcoming night), press Calculate.

Write down the **UT** times of dusk and dawn

Telescope rise/set time calculator

Telescope object rise/set time calculator

Enter the telescope, object name, and observation date. Generates an hourly list of elevations. Note: Asteroids and comets must be entered exactly as in catalog e.g., 6 Hebe, or C/2013 a1 (Siding Spring).

Observatory: Winer [Rigel] Van Allen

Object name (e.g. Algol, Jupiter, M57, 6 Hebe):

Enter Date (MM/DD/YYYY):

Observatory: Winer Observatory (Rigel telescope)
Object: polaris on 10/14/2014
RA(J2000): 2:31:49.09, Dec(J2000): 89:15:50.8

Astronomical dusk: 18:45:11 (MST), 01:45:11 (UT), 19:52:56 (LST)

Astronomical dawn: 05:32:08 (MST), 12:32:08 (UT), 06:41:39. (LST)

Note: If using Van Allen Observatory, click Van Allen here

Step 2: Navigate to the website

<http://var2.astro.cz/ETD>

Click on Transit Predictions

Enter coordinates for Winer Observatory (249 E long, 32 N lat)

Note: Van Allen Observatory:
269 E long, 41 N lat

Step 3: Click on desired UT date (defaults to UT date for upcoming evening), choose from list using following criteria:

Criteria:

1. Depth of eclipse should be >0.015 , preferably >0.02
2. Magnitude $V < 13.0$
3. Start time of eclipse > 1 hr after dusk
4. End of eclipse < 1 hr before dawn
5. Elevation > 15 deg for entire eclipse

Transits predictions for ELONGITUDE: 249° and LATITUDE: 32°

OBJECT		BEGIN (UT/h,A)	CENTER (DD.MM. UT/h,A)	END (UT/h,A)	D (min)	V (MAG)	DEPTH (MAG)	Elements Coords
CoRoT-1 b	Mon	11:04 49°SE 56944.9617	14.10. 12:14 55°S 56945.0100	13:23 54°S 56945.0582	139	13.6	0.0247	54159.4532+1.508969°E RA: 06 48 19.17 DE: -03 06 07.78
WASP-104 b	Leo	11:40 18°E 56944.9866	14.10. 12:33 30°E 56945.0233	13:26 41°E 56945.0600	105.72	11.12	0.0158	56406.11126+1.7554137°E RA: 10 42 24.61 DE: +07 26 06.3
XO-3 b	Cam	2:00 12°NE 56945.5836	15.10. 3:26 22°NE 56945.6437	4:53 33°NE 56945.7038	173	9.86	0.0048	54864.76684+3.1915289°E RA: 04 21 52.71 DE: +57 49 01.89
WASP-67 b	Sgr	3:19 34°SW 56945.6388	15.10. 4:16 27°SW 56945.6783	5:13 18°SW 56945.7178	113.76	12.5	0.0195	55824.3742+4.61442°E RA: 19 42 58.51 DE: -19 56 58.4
HAT-P-23 b	Del	3:46 65°SW 56945.6570	15.10. 4:51 52°W 56945.7024	5:56 38°W 56945.7478	130.75	12.43	0.0076	54852.26464+1.212884°E RA: 20 24 29.73 DE: +16 45 44.3
WASP-33 b	And	4:24 43°NE 56945.6835	15.10. 5:45 59°E 56945.7401	7:07 75°NE 56945.7967	163	8.3	0.0151	54163.22373+1.2198669°E RA: 02 26 51.08 DE: +37 33 02.5
Kepler-4 b	Dra	3:44 54°NW 56945.6559	15.10. 5:51 34°NW 56945.7444	7:59 15°NW 56945.8330	255	12.6	0.0009	54956.6127+3.21346°E RA: 19 02 27.7 DE: +50 08 8.7
HAT-P-37 b	Dra	4:47 43°NW 56945.6998	15.10. 5:57 32°NW 56945.7484	7:07 22°NW 56945.7969	139.8	13.23	0.0204	55642.14318+2.797436°E RA: 18 57 11.16 DE: +51 16 08.9
WASP-26 b	Cet	4:50 40°SE 56945.7015	15.10. 6:00 44°S 56945.7505	7:11 41°S 56945.7995	141	11.3	0.0108	55123.6379+2.7566°E RA: 00 18 24.7 DE: -15 16 02.3
WASP-6 b	Aqr	5:19 37°S 56945.7216	15.10. 6:37 33°SW 56945.7759	7:55 23°SW 56945.8302	156.4	11.9	0.0236	54596.43267+3.361006°E RA: 23 12 37.75 DE: -22 40 26.1
HAT-P-16 b	And	5:13 72°NE 56945.7174	15.10. 6:45 79°N 56945.7813	8:17 66°NW 56945.8452	184	10.8	0.0101	55027.59293+2.77596°E RA: 00 38 17.59 DE: +42 27 47.2

See next page for magnified view

In this example, there are two exoplanets (green highlight) that satisfy the criteria on previous page.

Dusk -dawn
01:45 UT - 12:32 UT
(from RST, slide 2)

Yellow boxes are
for previous night

Red boxes highlight
parameters that violate the
observing criteria on
previous page.

Green boxes are
good choices

**WASP-6-b has much deeper
eclipse (0.0236 vs 0.0151),
so we choose it.**

Transits predictions for ELONGITUDE: 249° and LATITUDE: 32°

OBJECT		BEGIN (UT/h,A)	CENTER (DD.MM. UT/h,A)	END (UT/h,A)	D (min)	V (MAG)	DEPTH (MAG)	Elements Coords
CoRoT-1 b	Mon	11:04 49°SE 56944.9617	14.10. 12:14 55°S 56945.0100	13:23 54°S 56945.0582	139	13.6	0.0247	54159.4532+1.508969*E RA: 06 48 19.17 DE: -03 06 07.78
WASP-104 b	Leo	11:40 18°E 56944.9866	14.10. 12:33 30°E 56945.0233	13:26 41°E 56945.0600	105.72	11.12	0.0158	56406.11126+1.7554137*E RA: 10 42 24.61 DE: +07 26 06.3
XO-3 b	Cam	2:00 12°NE 56945.5836	15.10. 3:26 22°NE 56945.6437	4:53 33°NE 56945.7038	173	9.86	0.0048	54864.76684+3.1915289*E RA: 04 21 52.71 DE: +57 49 01.89
WASP-67 b	Sgr	3:19 34°SW 56945.6388	15.10. 4:16 27°SW 56945.6783	5:13 18°SW 56945.7178	113.76	12.5	0.0195	55824.3742+4.61442*E RA: 19 42 58.51 DE: -19 56 58.4
HAT-P-23 b	Del	3:46 65°SW 56945.6570	15.10. 4:51 52°W 56945.7024	5:56 38°W 56945.7478	130.75	12.43	0.0076	54852.26464+1.212884*E RA: 20 24 29.73 DE: +16 45 44.3
WASP-33 b	And	4:24 43°NE 56945.6835	15.10. 5:45 59°E 56945.7401	7:07 75°NE 56945.7967	163	8.3	0.0151	54163.22373+1.2198669*E RA: 02 26 51.08 DE: +37 33 02.5
Kepler-4 b	Dra	3:44 54°NW 56945.6559	15.10. 5:51 34°NW 56945.7444	7:59 15°NW 56945.8330	255	12.6	0.0009	54956.6127+3.21346*E RA: 19 02 27.7 DE: +50 08 8.7
HAT-P-37 b	Dra	4:47 43°NW 56945.6998	15.10. 5:57 32°NW 56945.7484	7:07 22°NW 56945.7969	139.8	13.23	0.0204	55642.14318+2.797436*E RA: 18 57 11.16 DE: +51 16 08.9
WASP-26 b	Cet	4:50 40°SE 56945.7015	15.10. 6:00 44°S 56945.7505	7:11 41°S 56945.7995	141	11.3	0.0108	55123.6379+2.7566*E RA: 00 18 24.7 DE: -15 16 02.3
WASP-6 b	Aqr	5:19 37°S 56945.7216	15.10. 6:37 33°SW 56945.7759	7:55 23°SW 56945.8302	156.4	11.9	0.0236	54596.43267+3.361006*E RA: 23 12 37.75 DE: -22 40 26.1
HAT-P-16 b	And	5:13 72°NE 56945.7174	15.10. 6:45 79°N 56945.7813	8:17 66°NW 56945.8452	184	10.8	0.0101	55027.59293+2.77596*E RA: 00 38 17.59 DE: +42 27 47.2

Step 4: Calculate the observing parameters:

1. Determine UTSTART time: The eclipse start is 05:19:00, so subtract one hour to establish a good out-of-eclipse baseline: UTSTART = 04:19:00
2. Use R filter (this minimizes the effect of atmospheric extinction on the light curve)
3. Determine exposure time. Use the left table. In our example $V=11.9$, so $t \sim 90s$

Exposure time vs apparent magnitude

V mag	Exposure time (sec)
7	2
8	5
9	15
10	30
11	60
12	90

Time between image vs exposure time

exposure time (sec)	time between images (sec)
0 - 10	20
>10 - 30	40
>30 - 50	60
>50 - 70	80
>70 - 90	100
>90 - 110	120

4. Determine the number of images. To do this, add (at least) one hour end of the eclipse (04:19 UT start, 08:55 UT end). Hence, the total time is $08:55 - 04:19 = 4 \text{ h } 36\text{min} = 16,560 \text{ s}$
5. The exposure time is 90 s per image, so the time between images = 100 s (right table). In our example $90s + 10s = 100s$, so the number of images = $16560/100 = 166$.
5. Copy the coordinates from the table. In our example RA = 23:12:38 Dec = -22:40:26
6. Enter the UTStart time, number of images, and coordinates on the scheduling webpage.

WASP-6 b	5:19	15.10. 6:37	7:55	156.4	11.9	0.0236	54596.43267+3.361006*E
Aqr	37°S	33°SW	23°SW				RA: 23 12 37.75
	56945.7216	56945.7759	56945.8302				DE: -22 40 26.1

Step 5: Enter observing parameters on the Rigel web observing request form

Project Information:

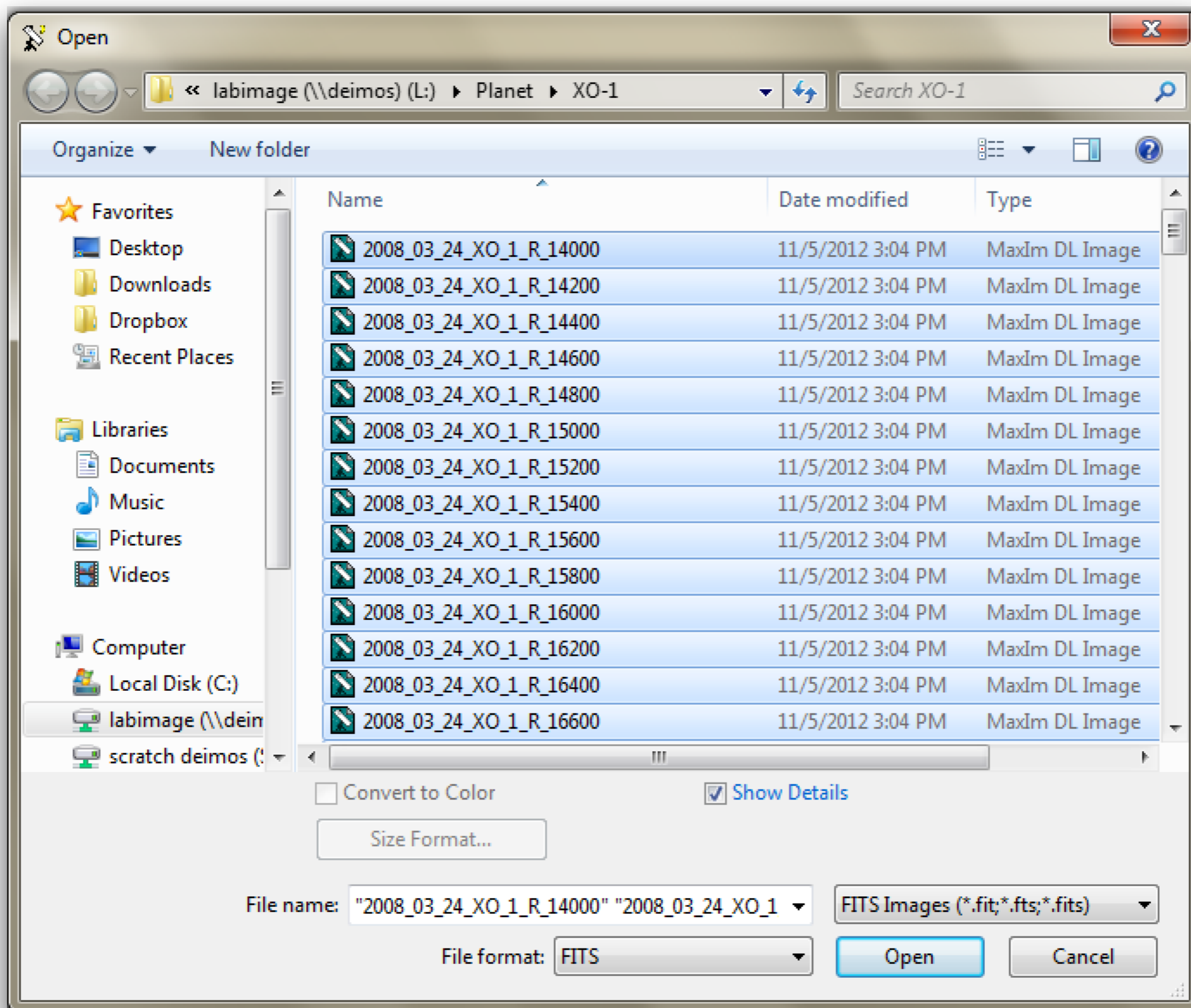
Project Title: *

	Target	Filter/Exposure	Advanced Options <input checked="" type="checkbox"/>
<input type="checkbox"/>	Object: <input type="text" value="WASP 6b"/> <input type="checkbox"/> Use <u>Catalog</u> Position RA: <input type="text" value="23:12:38"/> Dec: <input type="text" value="-22:40:26"/>	Filter: <input type="text" value="R (red)"/> Exposure: <input type="text" value="90"/>	Repeats: <input type="text" value="166"/> Delay: <input type="text"/> Start Time: <input type="text" value="04:19:00"/> <input type="text" value="UT"/> UTDate (MM/DD/YYYY): <input type="text" value="/19/2014"/>
<input type="checkbox"/>	Object: <input type="text"/> <input checked="" type="checkbox"/> Use <u>Catalog</u> Position	Filter: <input type="text" value="N (no filter)"/> Exposure: <input type="text" value="60"/>	Repeats: <input type="text" value="0"/> Delay: <input type="text"/> Start Time: <input type="text"/> <input type="text" value="LST"/> UTDate (MM/DD/YYYY): <input type="text"/>
<input type="checkbox"/>	Object: <input type="text"/> <input checked="" type="checkbox"/> Use <u>Catalog</u> Position	Filter: <input type="text" value="N (no filter)"/> Exposure: <input type="text" value="60"/>	Repeats: <input type="text" value="0"/> Delay: <input type="text"/> Start Time: <input type="text"/> <input type="text" value="LST"/> UTDate (MM/DD/YYYY): <input type="text"/>

[Add Row](#) [Delete Checked Row\(s\)](#)

Image analysis (Steps 6-9)

Step 6: After observing, load images (use Control-A to select all)



Step 7: Identify the exoplanet star on any image using the Astrometric tool on the Information window (in this example, the exoplanet is XO-1 with coordinates 16:02:11.85, +28:10:10.7)

The screenshot displays a software interface for astronomical image analysis. On the left, a window titled "2008_03_24_XO_1_R_42200" shows a dark field of stars. A bright star is circled in cyan. On the right, an "Information" window is open, displaying data for the selected star. The "Centroid" field is highlighted with a red box, showing the coordinates (163.679, 276.276) and their corresponding J2000 equatorial coordinates (16 02 11.85, 28 10 10.7, 13.876). The "Mode" is set to "Astrometric".

Field	Value
Cursor	(X= 164, Y= 275), Rad= 4, Rad2= 17 16 02 11.82 28 10 11.9
Centroid	(163.679, 276.276) 16 02 11.85 28 10 10.7 13.876
Image Star	
Catalog Star	

Mode: **Astrometric** [Calibrate <<]

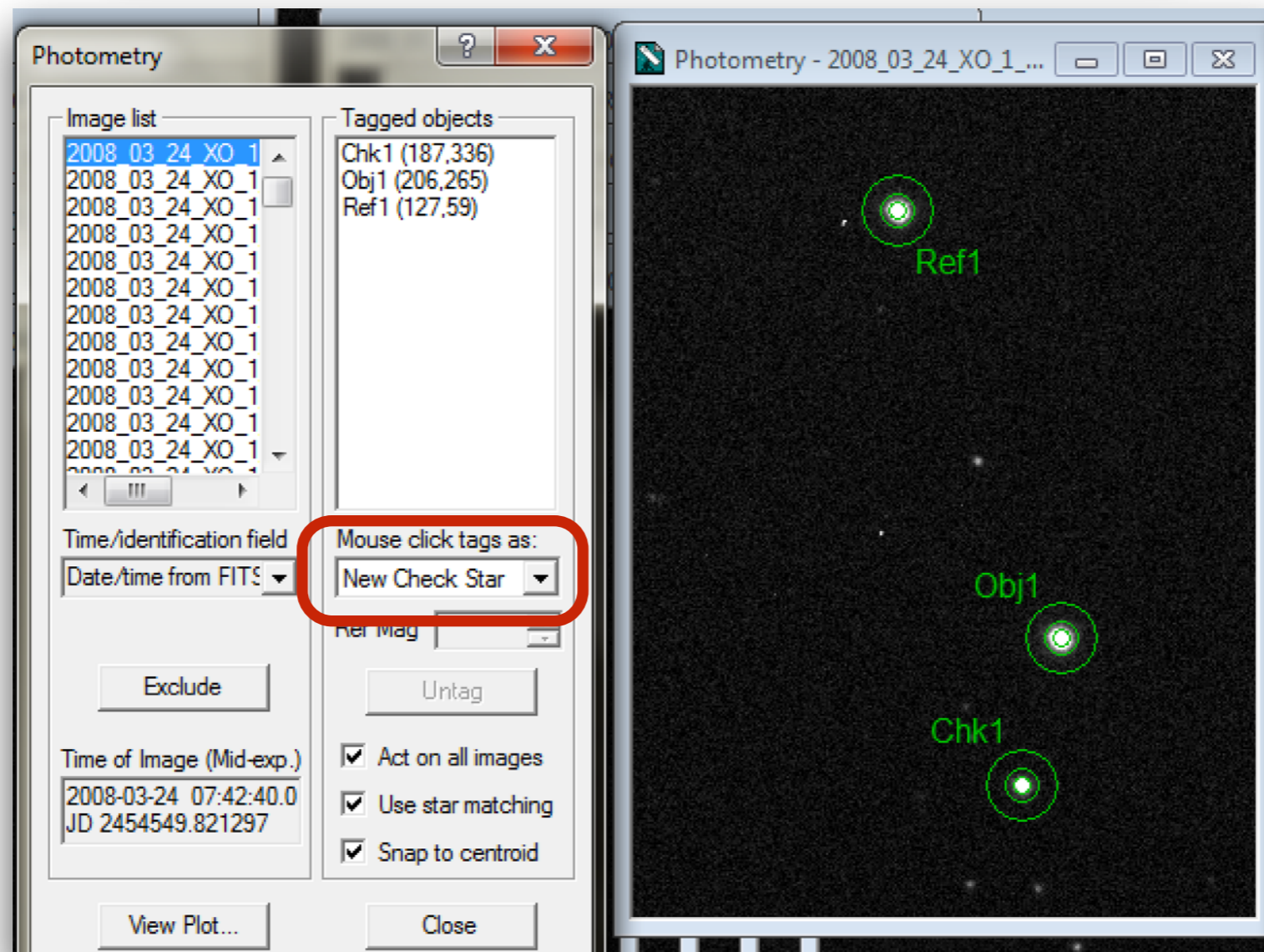
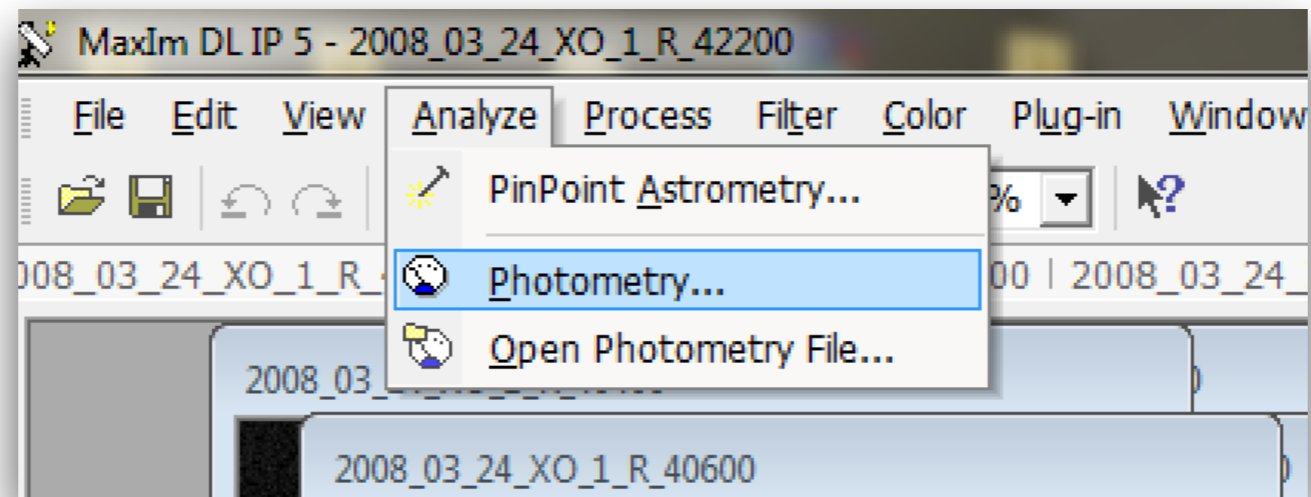
Magnitude Calibration

Intensity	116246	[Extract from image]
Exposure	60	[Set from FITS]
Magnitude	14.9	[Apply]

Spatial Calibration

Pixel scale X	0.988	<input checked="" type="checkbox"/> FITS scale [in use]
Set...	Y 0.987	Diagonal from [Start corner]

Step 8: Use photometry tool, select Target, reference, check star



Adjust scale to see target

