

Educational and scientific experiences on the collection and processing of exoplanet transit data

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Moletai Observatory

4.-11.08.2016.



Transits predictions for ELONGITUDE: 25.56320° and LATITUDE: 55.31600°

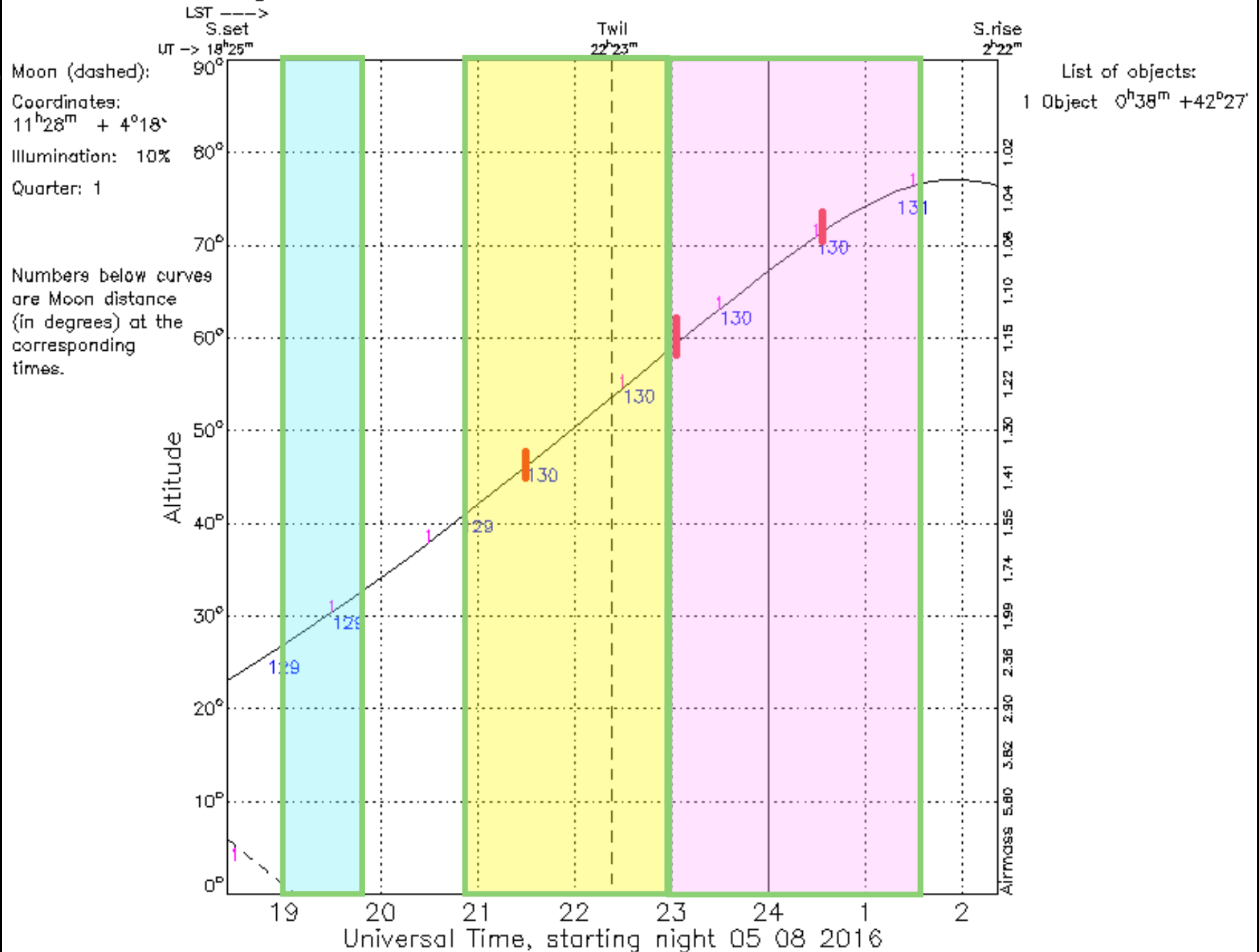
OBJECT		BEGIN (UT/h,A)	CENTER (DD.MM. UT/h,A)	END (UT/h,A)	D (min)	V (MAG)	DEPTH (MAG)	Elements Coords
WASP-103 b	Her	19:00 34°,S	05.08. 20:18 28°,SW	21:36 19°,SW	155.58	12.1	0.0129	56459.59957+0.925542*E RA: 16 37 15.57 DE: + 07 11 00.07
HAT-P-28 b	And	21:06 37°,E	05.08. 22:43 50°,E	0:19 62°,SE	193.1	13.03	0.0162	55417.59832+3.257215*E RA: 00 52 00.27 DE: +34 43 42.9
WASP-52 b	Peg	21:58 35°,SE	05.08. 22:52 40°,SE	23:47 43°,S	108.58	12	0.0290	55793.68143+1.7497798*E RA: 23 13 58.76 DE: +08 45 40.6
HAT-P-16 b	And	21:30 47°,E	05.08. 23:02 60°,E	0:34 72°,SE	184	10.8	0.0101	55027.59293+2.77596*E RA: 00 38 17.59 DE: +42 27 47.2
Kepler-19 b	Lyr	22:18 66°,SW	05.08. 23:59 53°,W	1:40 39°,W	201.91	11.898	0.0007	54959.70597+9.2869944*E RA: 19 21 41 DE: +37 51 06
KELT-1 b	And	22:53 62°,E	06.08. 0:10 71°,SE	1:27 75°,S	153.245	10.7	0.0066	55909.292797+1.217514*E RA: 00 01 26.92 DE: 39 23 01.7

Showing transits only more then 20 degrees above horizon in time of midtransit and sun more then 10 degrees bellow horizon for your observing place (ELONGITUDE: 25.56320° and LATITUDE: 55.31600°)


HAT-P-16

Altitudes, Observing site coordinates:


25.5632E 55.3160N, 1500 m above sea level



Query : coord 00 38 17.59 +42 27 47.2 (FK5, 2000, 2000), radius: 10 arcmin

Number of rows : 22 

Show entries

N	Identifier	<i>dist(asec)</i>	Otype	ICRS (J2000) RA	ICRS (J2000) DEC	Mag U	Mag B	Mag V
1	TYC 2792-1700-1 	<i>0.32</i>	*	00 38 17.5616	+42 27 47.249		11.38	10.91
2	HAT-P-16b	<i>0.33</i>	Pl	00 38 17.56	+42 27 47.2			
3	TYC 2792-1778-1	<i>150.07</i>	*	00 38 18.377	+42 25 17.38		13.17	11.96
4	TYC 2792-1737-1	<i>166.39</i>	*	00 38 13.065	+42 30 25.88		12.23	10.89
5	5C 3.49	<i>222.86</i>	Q?	00 38 07.4	+42 24 35		20.7	
6	TYC 2792-1654-1	<i>232.15</i>	*	00 37 58.181	+42 29 15.43		12.78	12.78
7	NVSS J003807+422413	<i>241.09</i>	Rad	00 38 07.4	+42 24 14			
8	MLA 67	<i>254.72</i>	EmO	00 38 39.3	+42 29 12			
9	MLA 57	<i>269.27</i>	EmO	00 38 20.6	+42 23 20			
10	TYC 2792-1220-1	<i>292.21</i>	*	00 38 26.912	+42 23 13.83		11.87	10.93

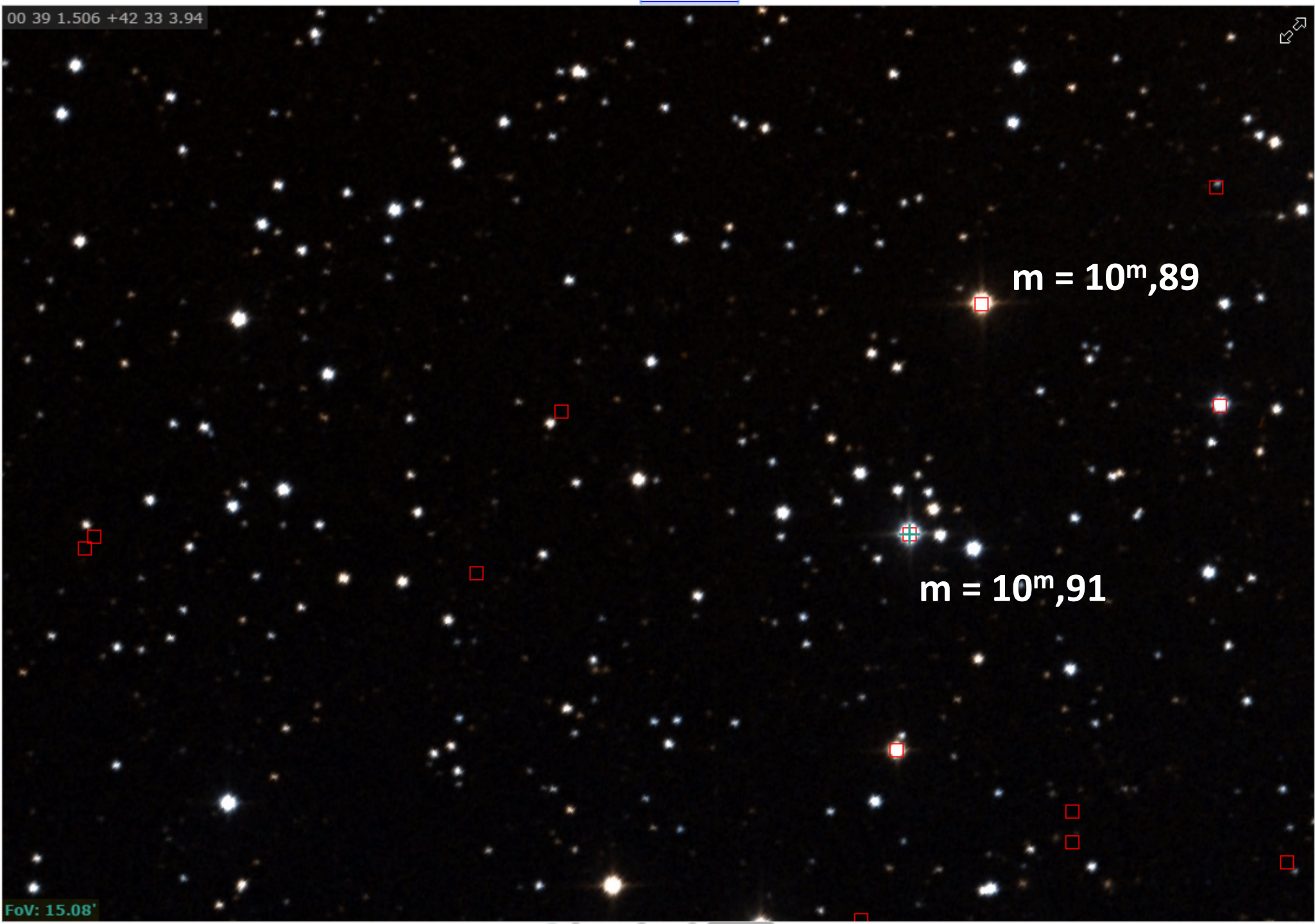
00 39 1.506 +42 33 3.94



$m = 10^m,89$

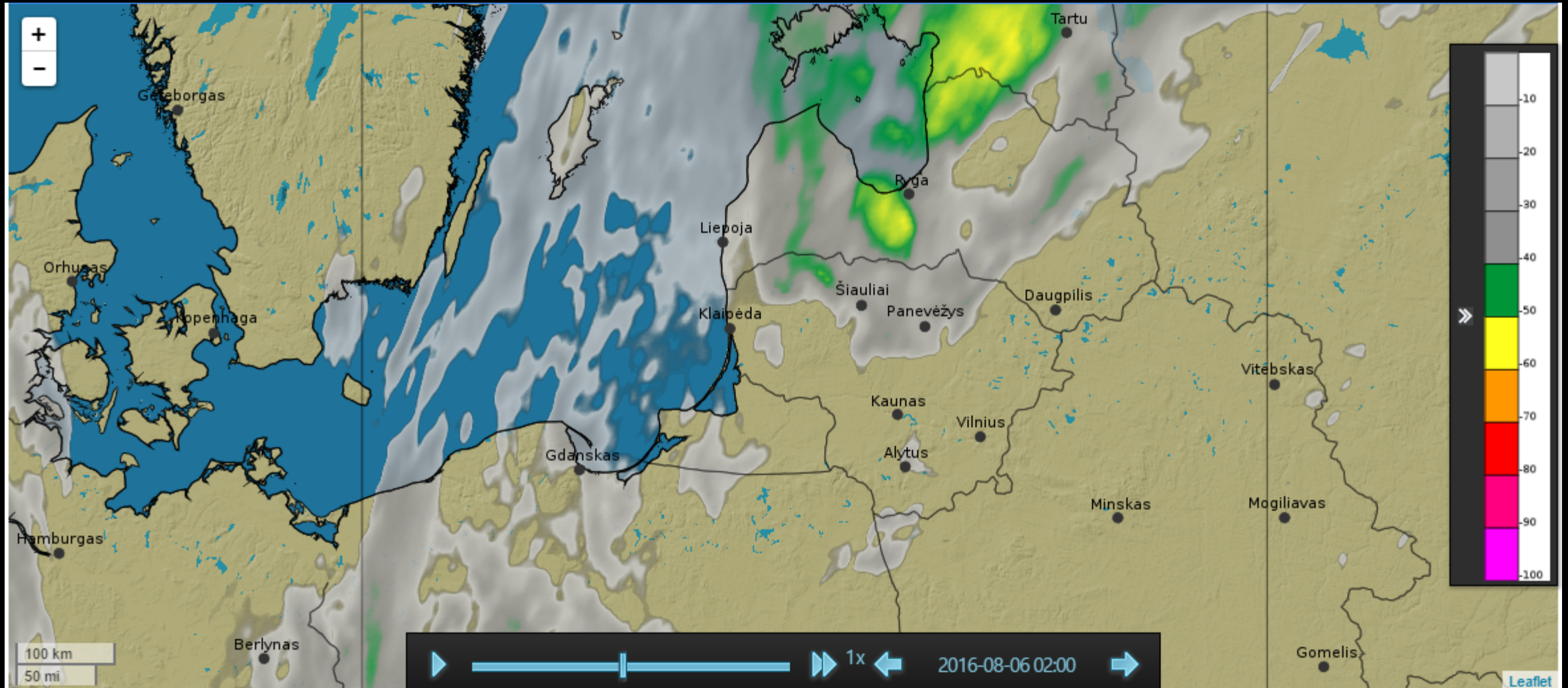
$m = 10^m,91$

FoV: 15.08'

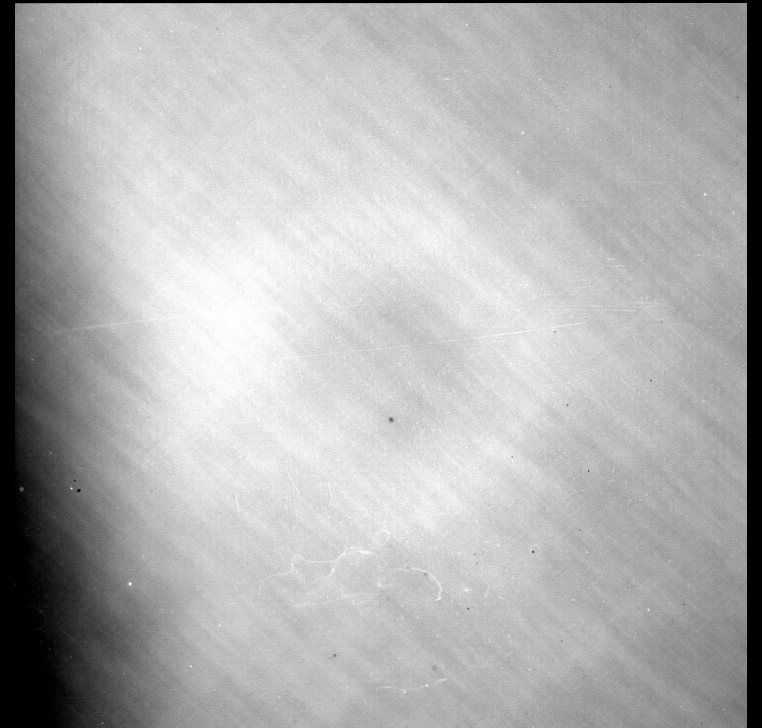
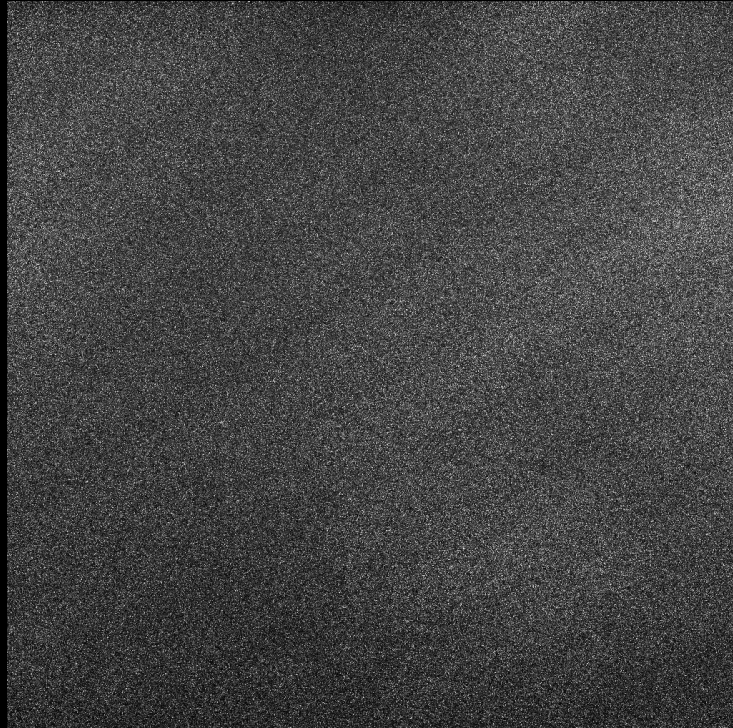
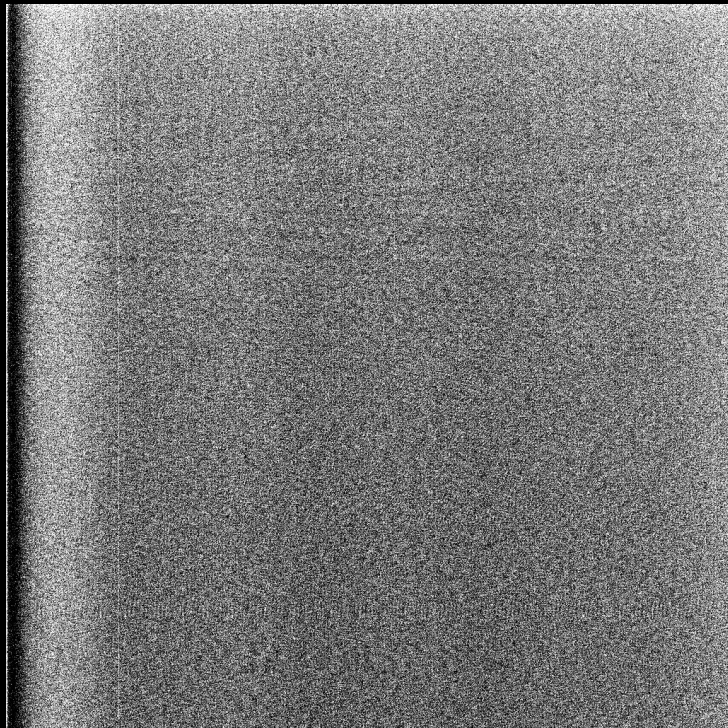


Weather conditions

Mostly clear; intermittent clouds



Bias, dark, flat



Weather effect (Clouds)

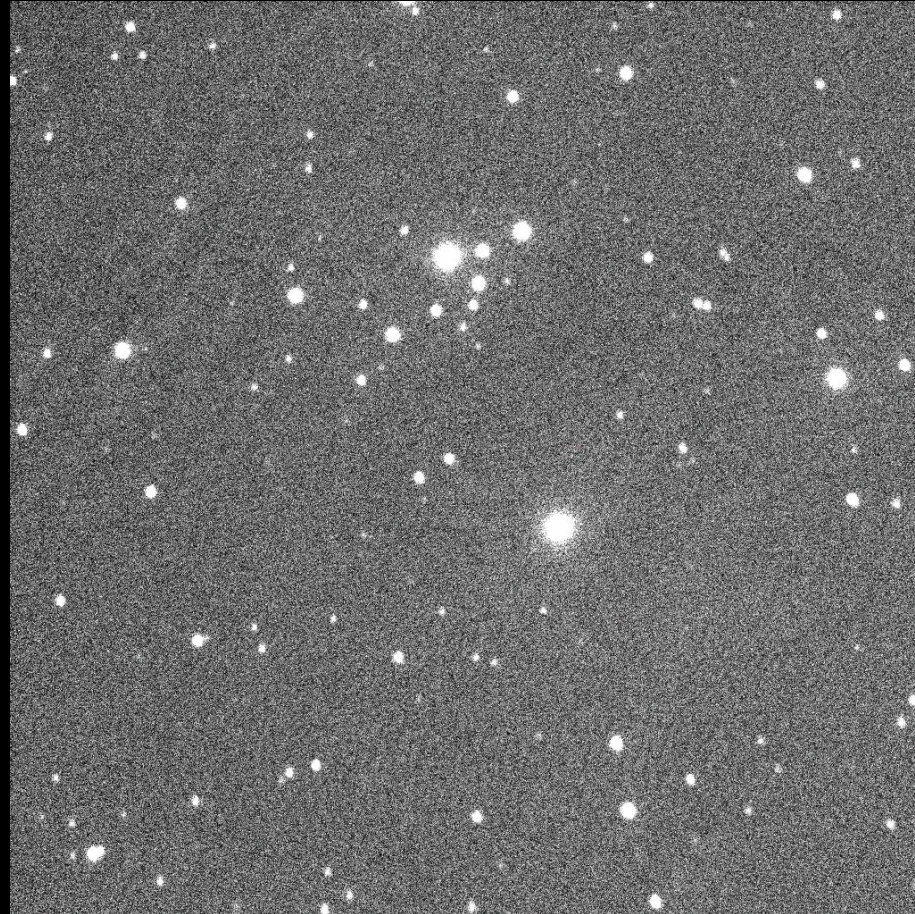
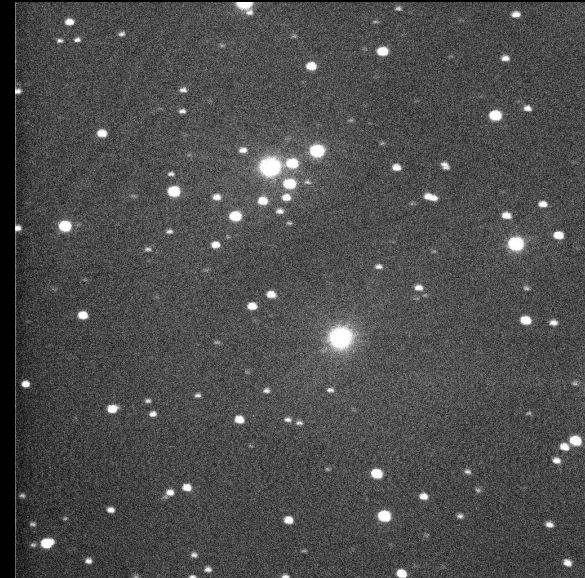
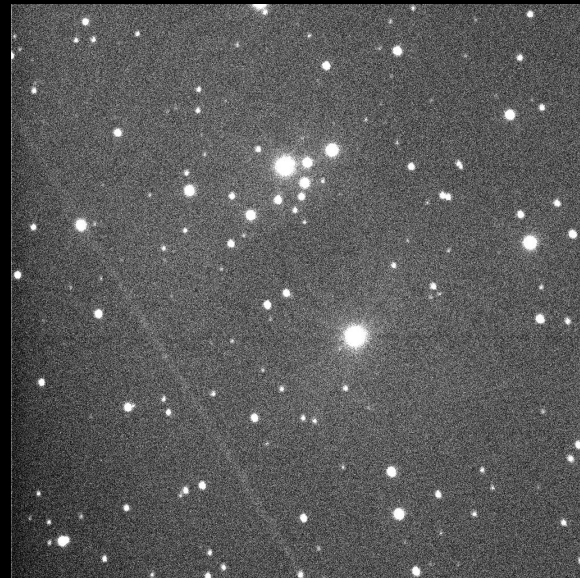
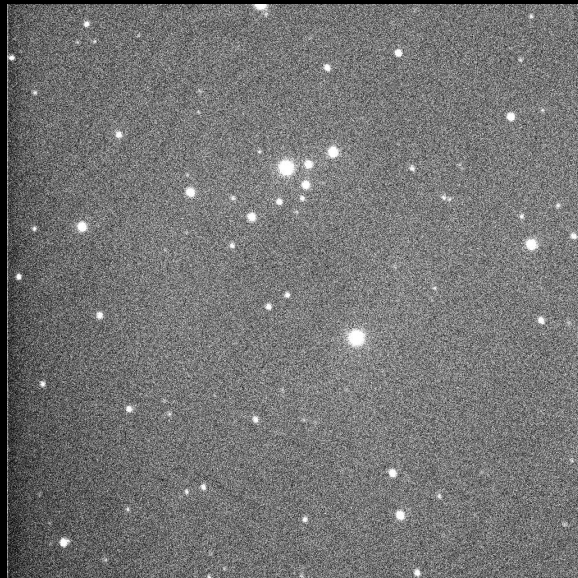
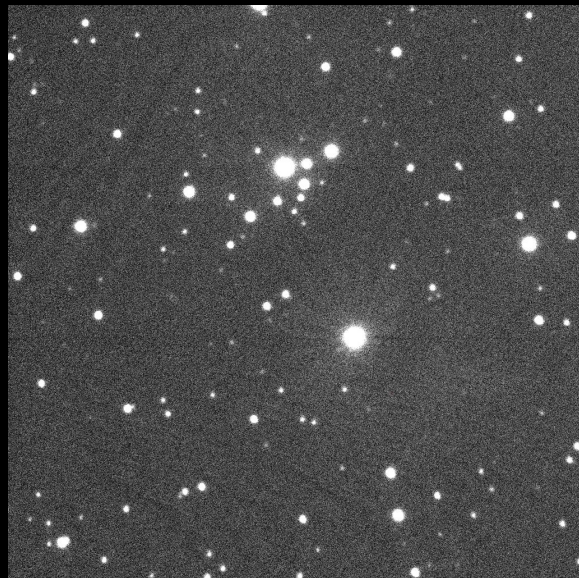
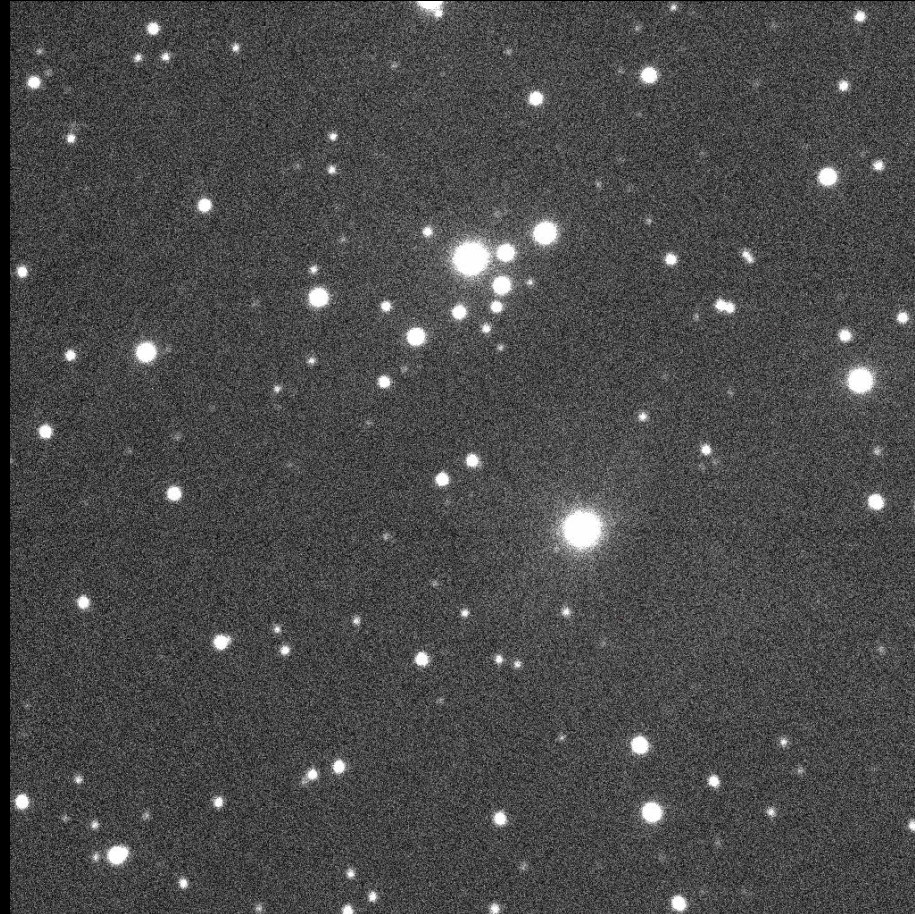


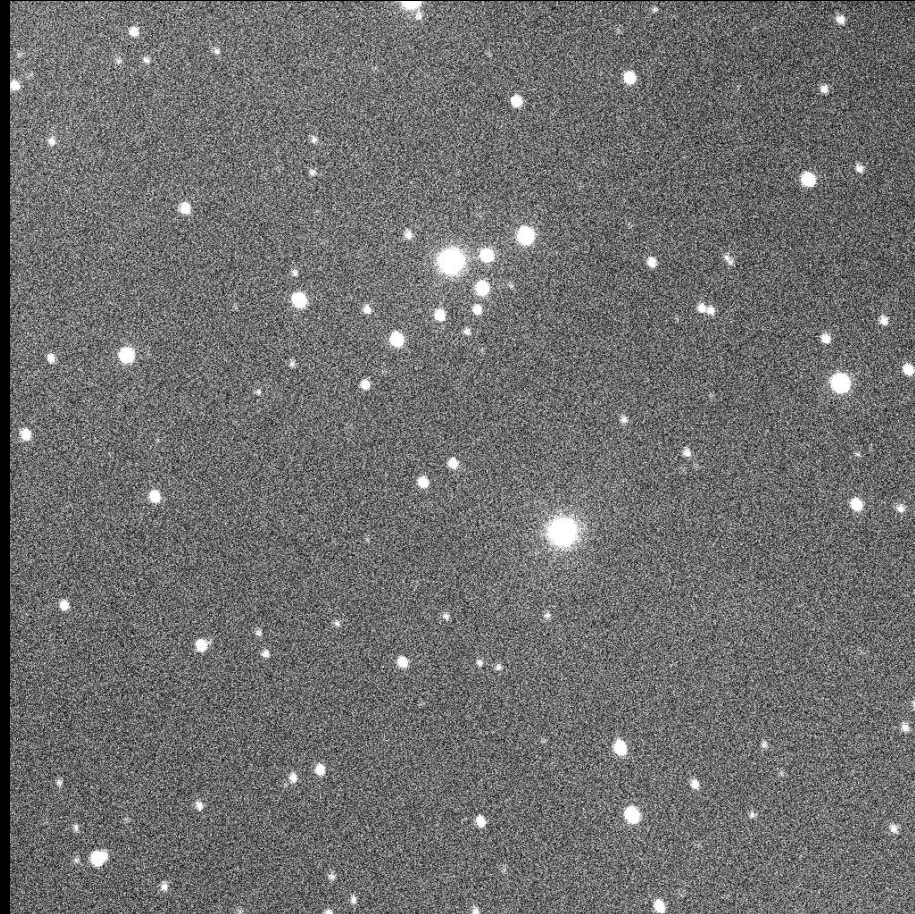
Image quality



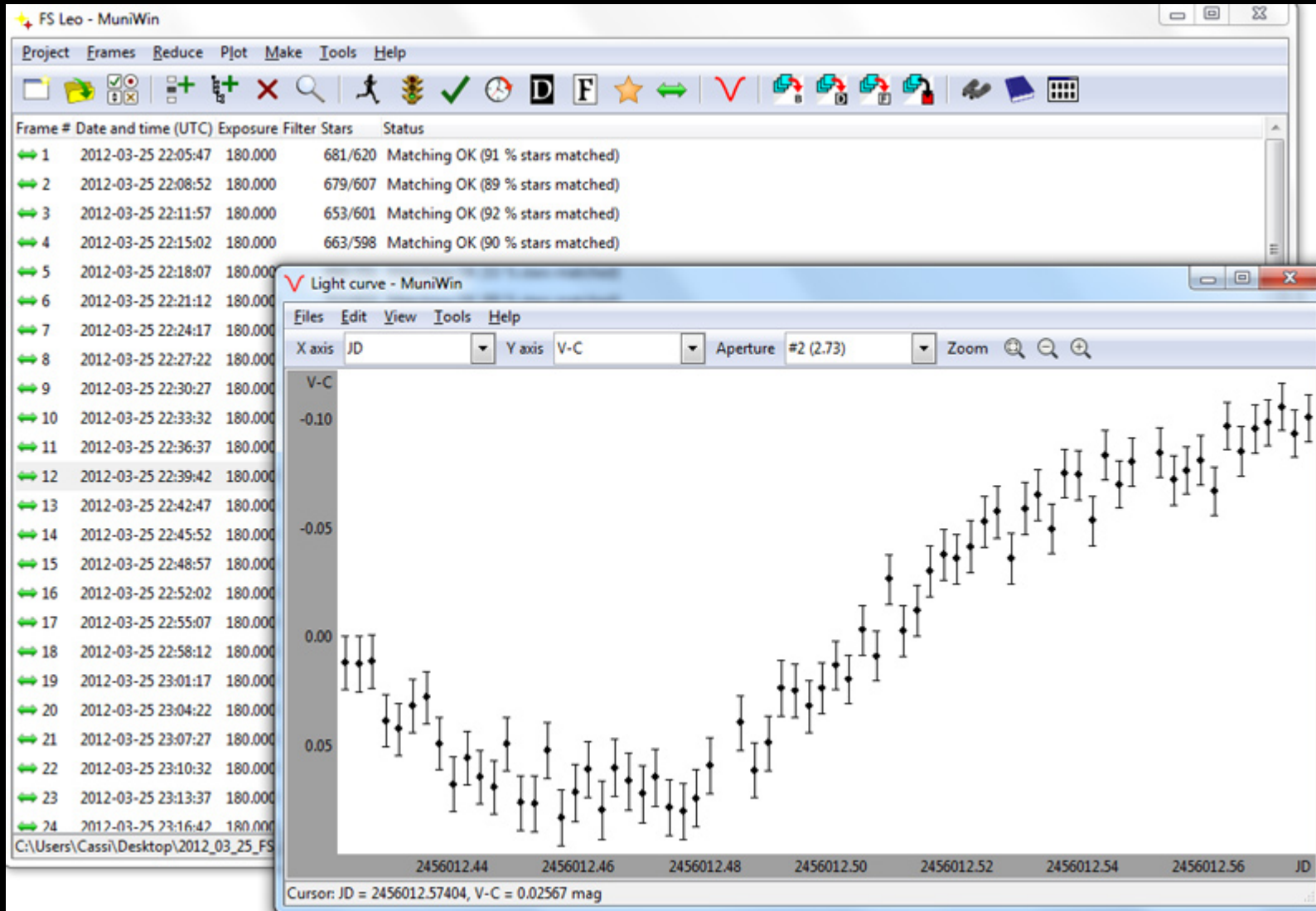
Manual Tracking (Wobble)



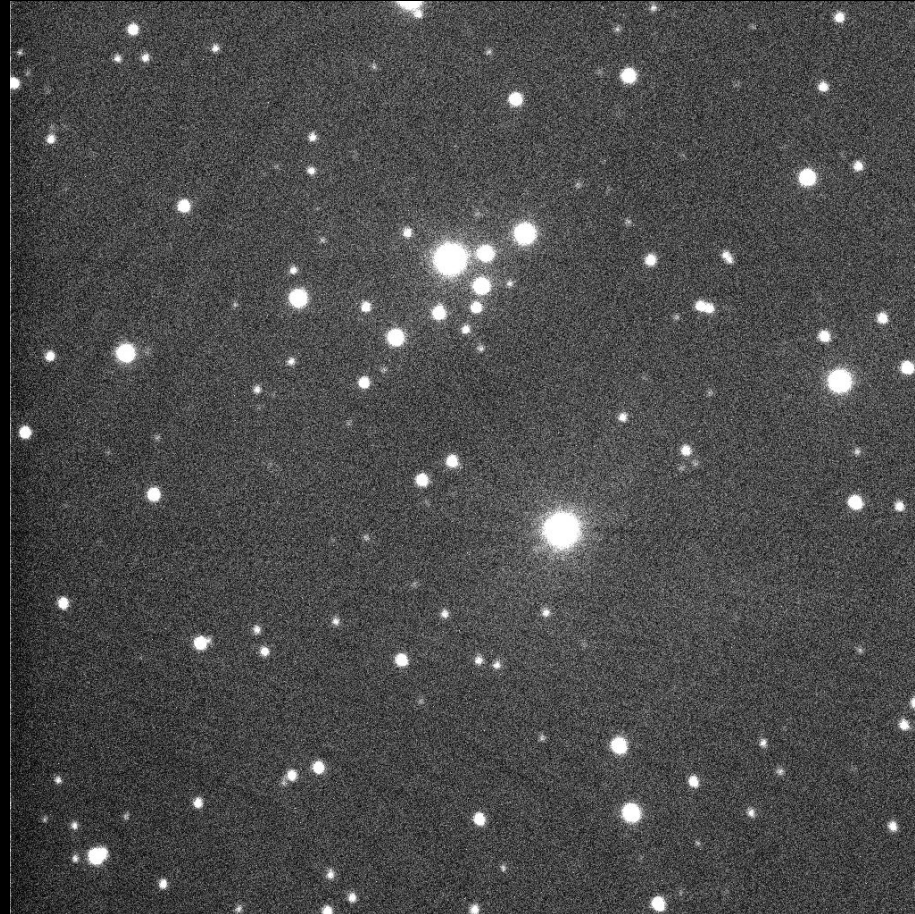
We lost our star.



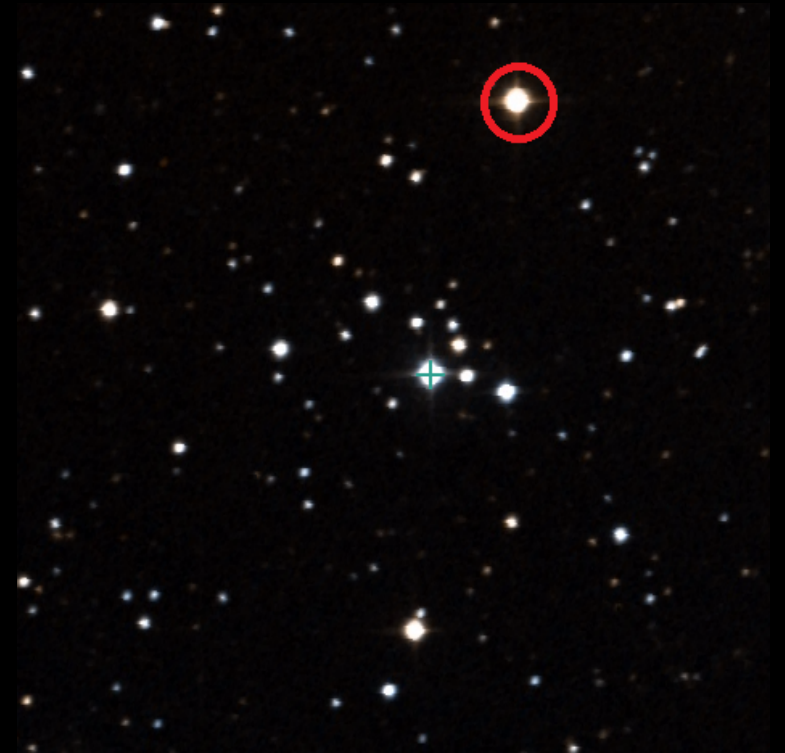
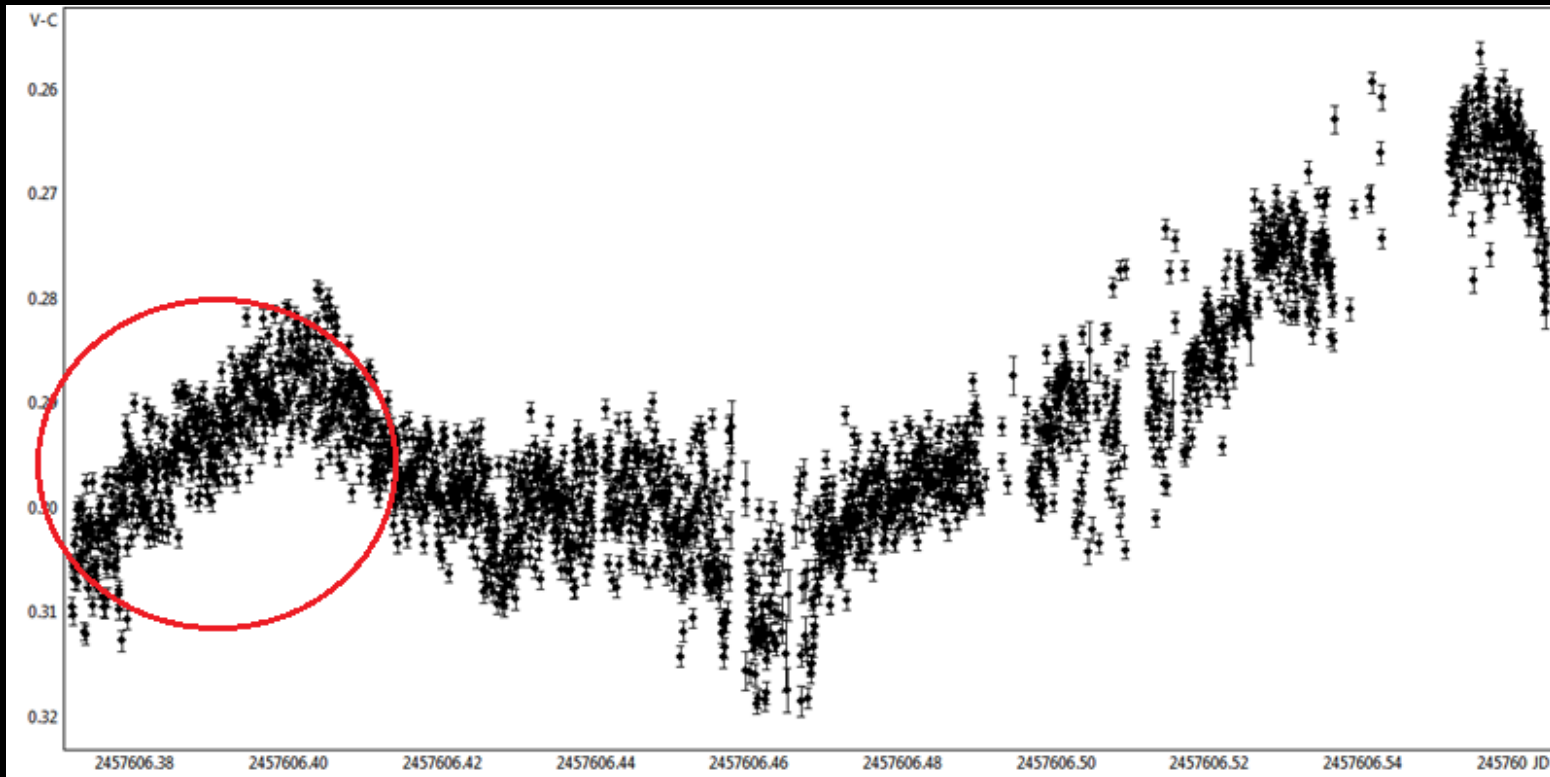
Processing the data with *Muniwin*



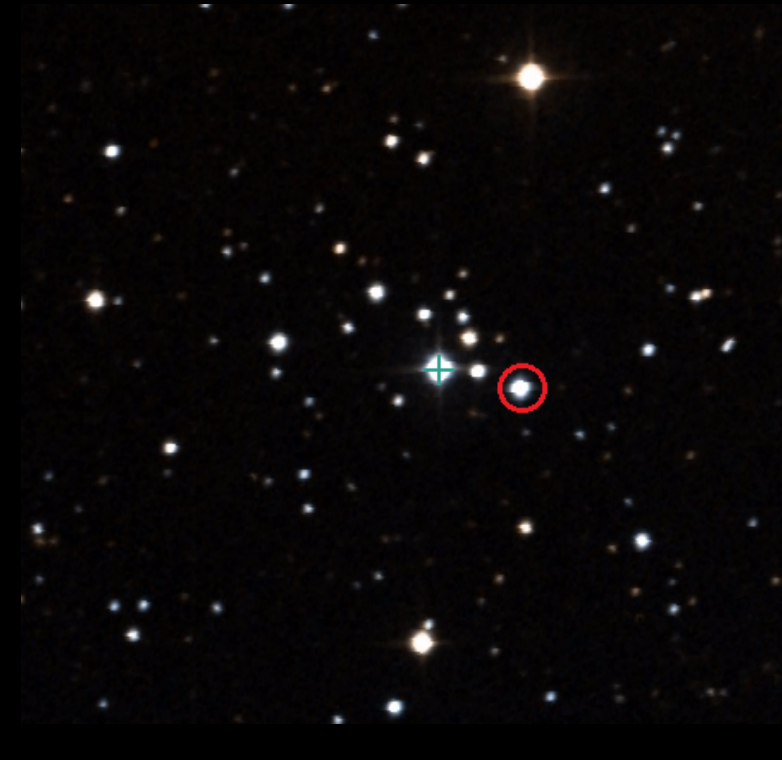
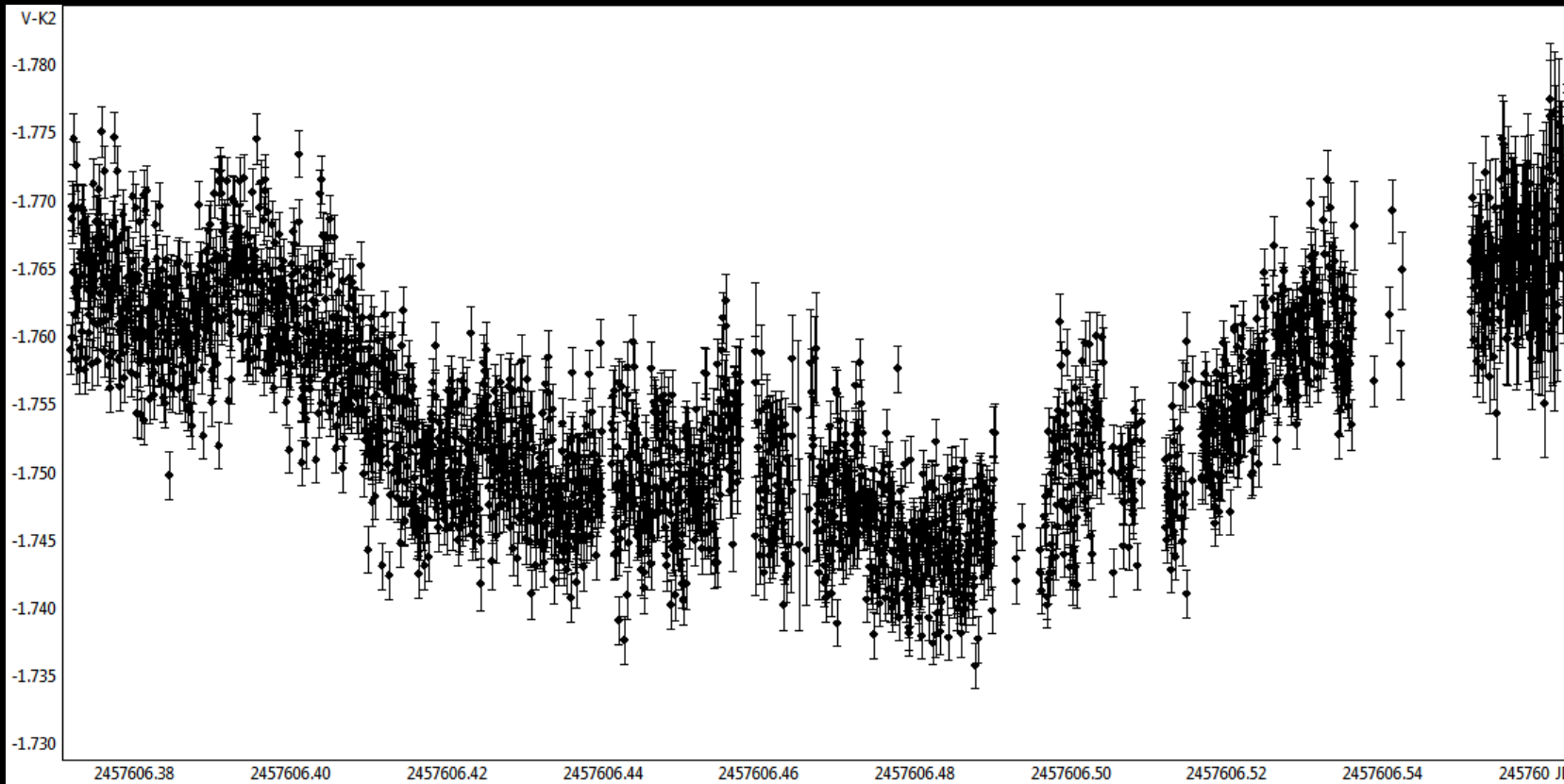
Unreduced/Reduced image



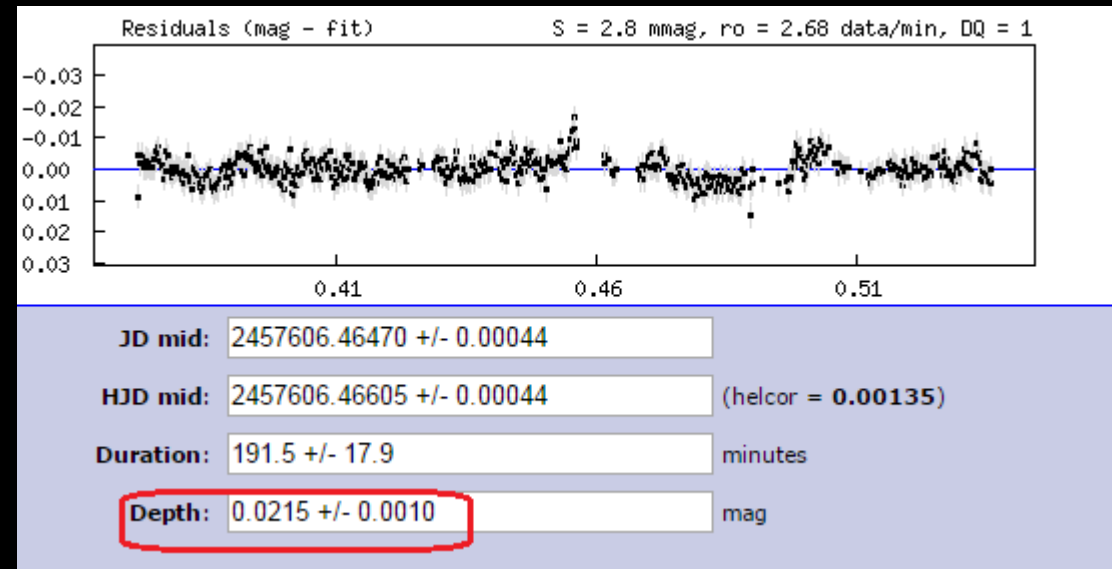
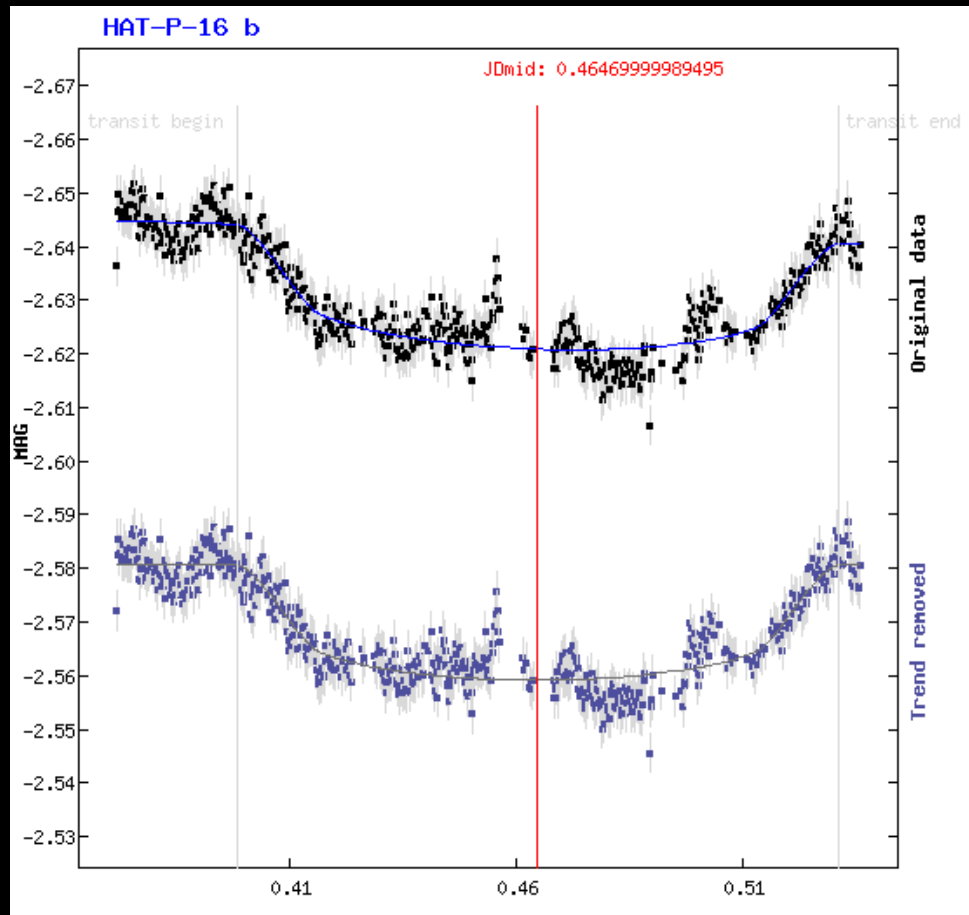
Different colour comparison star.



Same colour, lower magnitude.



Fitting in ETD.



Exo-planet radius.

From the transit depth measurement we have the planet/star ratio:

$$\frac{R_p}{R_*} = \sqrt{\Delta F}$$

$$\Delta m = \Delta F \quad \Delta F \equiv \frac{(f_{\text{no-transit}} - f_{\text{transit}})}{f_{\text{no-transit}}} = \left(\frac{R_p}{R_*}\right)^2$$

$$R_p = \sqrt{\Delta F} R_* = \sqrt{0.0215 \pm 0.0010} R_* \rightarrow \text{between } 0.1431 R_* \text{ and } 0.1500 R_*$$

R_p accuracy depends on depth accuracy.






Expected Transit Depth:

OBJECT	DEPTH (MAG)
HAT-P-16 b	0.0101

$R_p = 0.10049 R_*$. According to the site.







Values from data base.

Planet HAT-P-16 b

Name	HAT-P-16 b
Discovered in	2010
Mass	4.193 (\pm 0.094) M_J
Mass* $\sin(i)$	—
Semi-Major Axis	0.0413 (\pm 0.0004) AU 
Orbital Period	2.77596 (\pm 3e-06) JD 
Eccentricity	0.036 (\pm 0.004)
ω	214.0 (\pm 8.0) deg 
T_{peri}	—
Radius	1.289 (\pm 0.066) R_J 
Inclination	86.6 (\pm 0.7) deg 
Update	2013-07-22
Detection Method	Primary Transit

Star

HAT-P-16

Name	HAT-P-16
Distance	235.0 (\pm 10.0) pc 
Spectral type	F8
Apparent magnitude V	10.8
Mass	1.218 (\pm 0.039) M_{Sun} 
Age	2.0 (\pm 0.8) Gyr 
Effective temperature	6158.0 (\pm 80.0) K 
Radius	1.237 (\pm 0.054) R_{Sun} 
Metallicity [Fe/H]	0.17 (\pm 0.08) 
Detected Disc	—

Jupiter / Radius

69,911 km



Earth
6.371K km



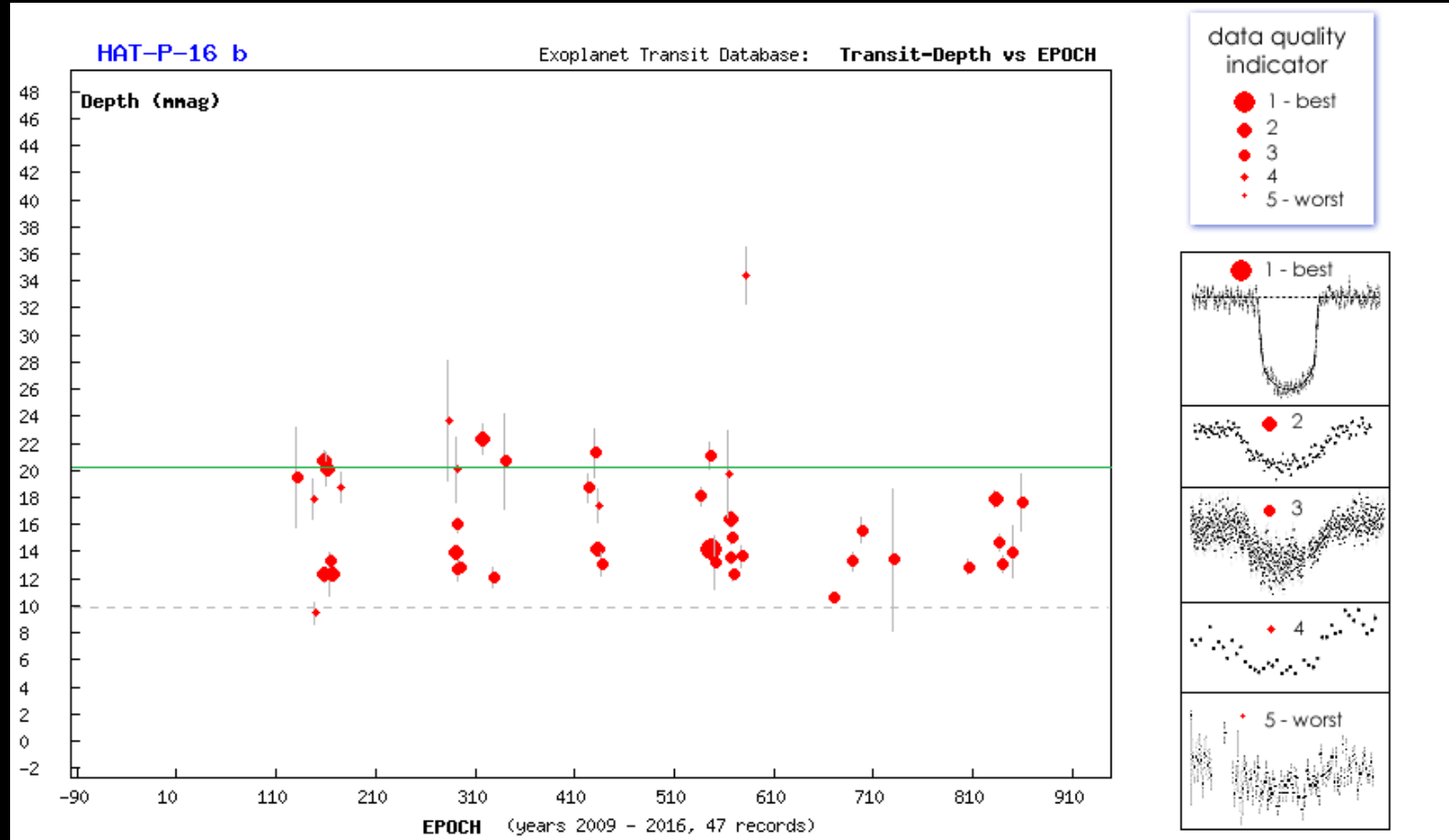
Saturn
58.232K km



Sun
695.7K km

$$R_p = \frac{0.1004 * 1.289}{1.237} = 0.1047 R_*$$

Comparing data with previous observations.

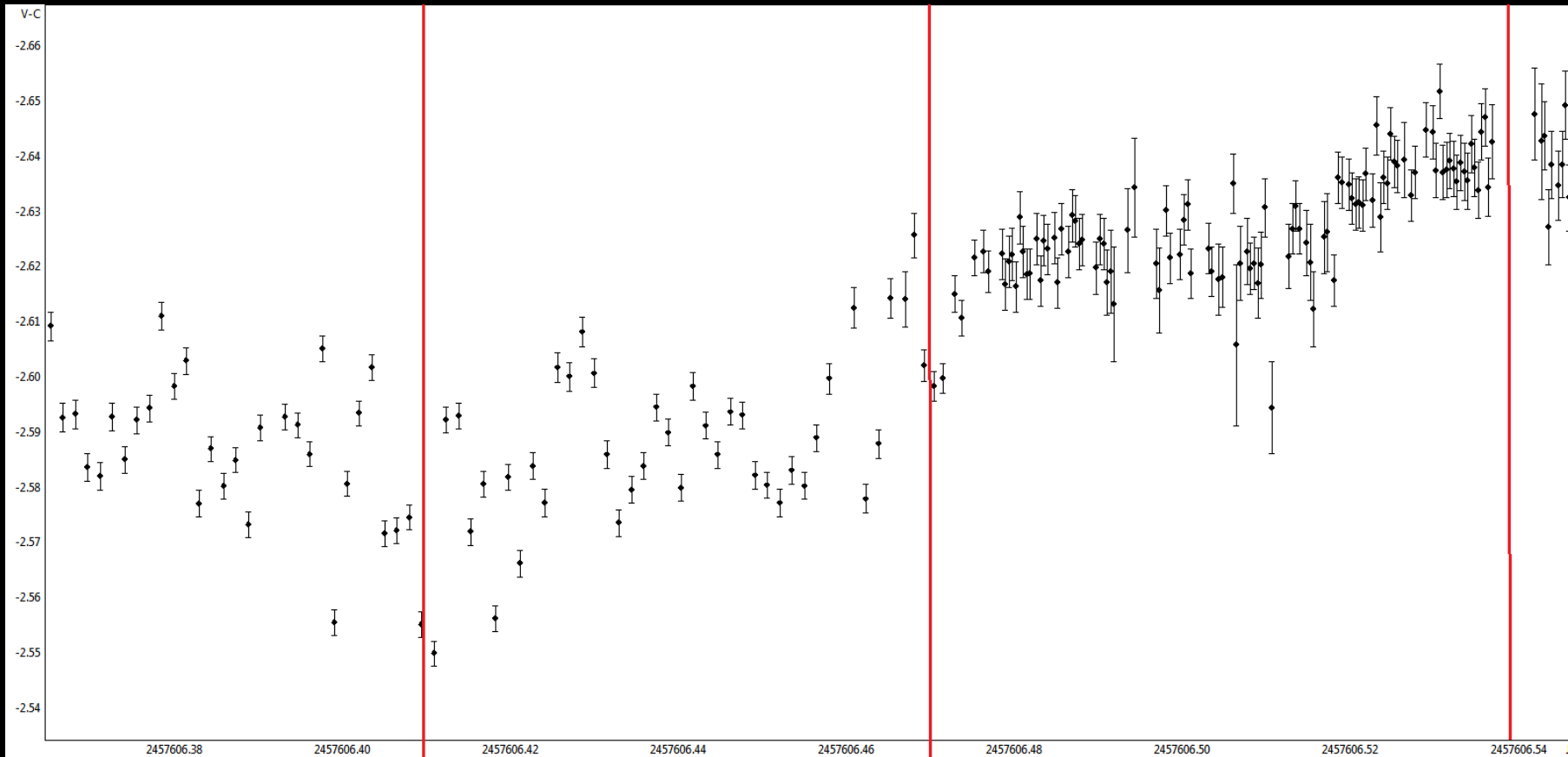


Green line – our measured depth value.

Data comparison with the smaller telescope...



HAT-P-16 Smaller telescope.



Half of the transit is ruined.

No way to tell where transit starts.

I marked transit end inaccurately because due to clouds there was no way to tell where it ended exactly.