Photometry of Variable stars from Dome A, Antarctica

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Lunch Talk

Outline

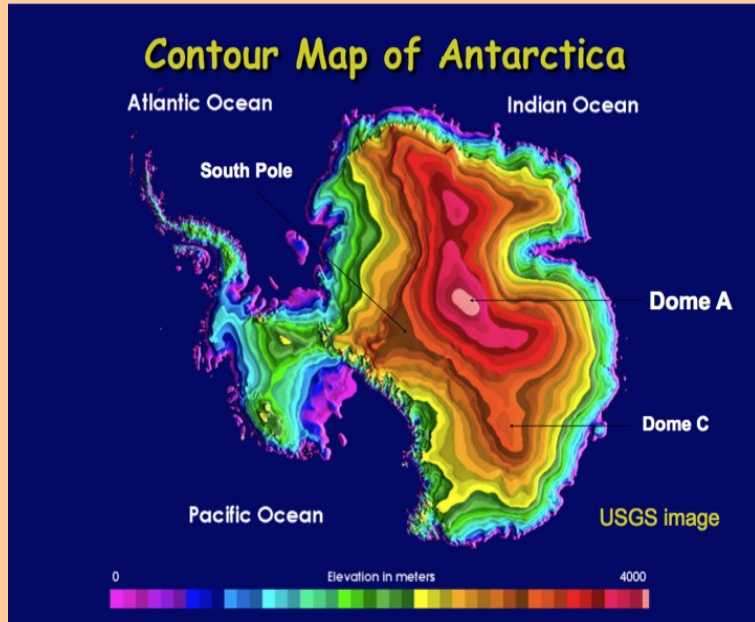Introduction to Dome A and CSTAR

Observations in i band

Catalog from 2008 observations

Search for variability and periodic variability

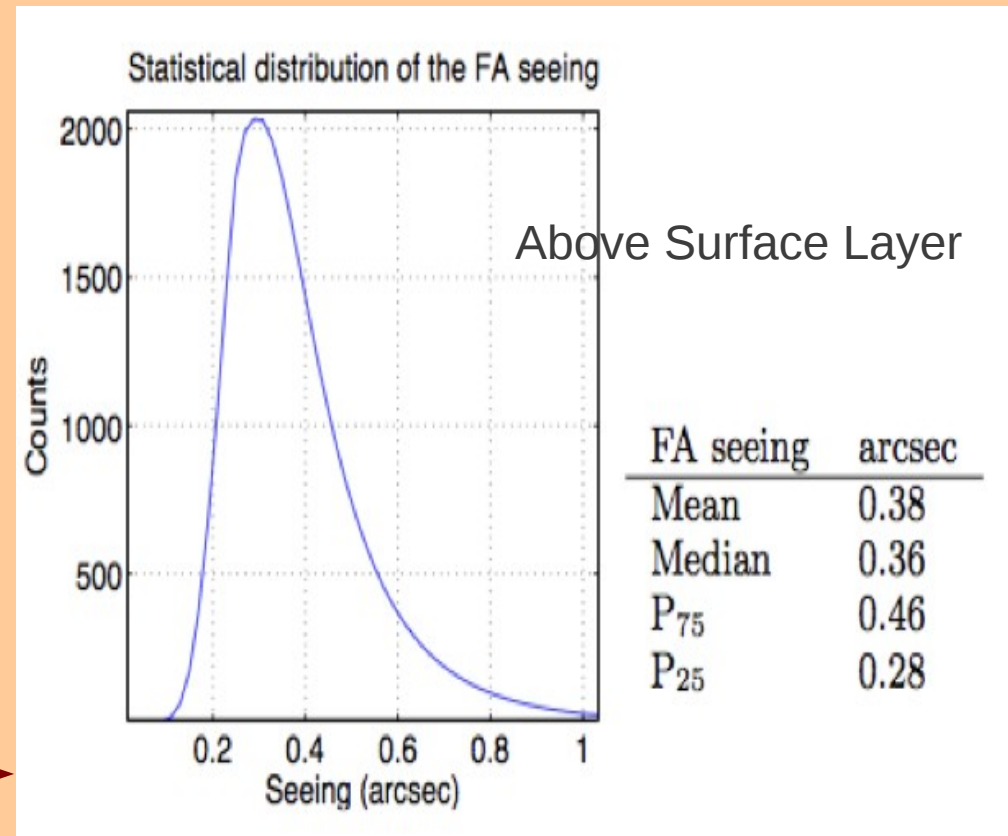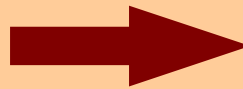Typical light curves of various variables

Conclusions

Introduction to Dome A

Contour Map of Antarctica — USGS image

Location (80°22'S 77°21E)

Elevation: 4,091 meters

Lowest Temp.:   -82.5°C

Dome C: 3,233 meters

Statistical distribution of the FA seeing

Above Surface Layer

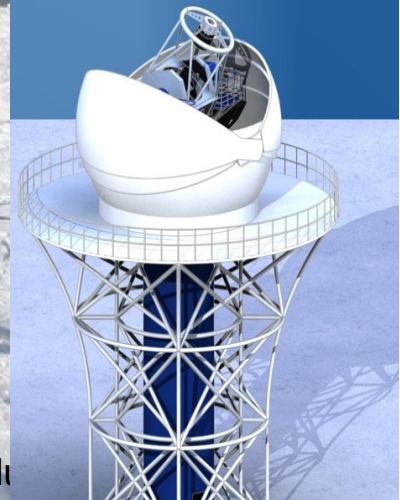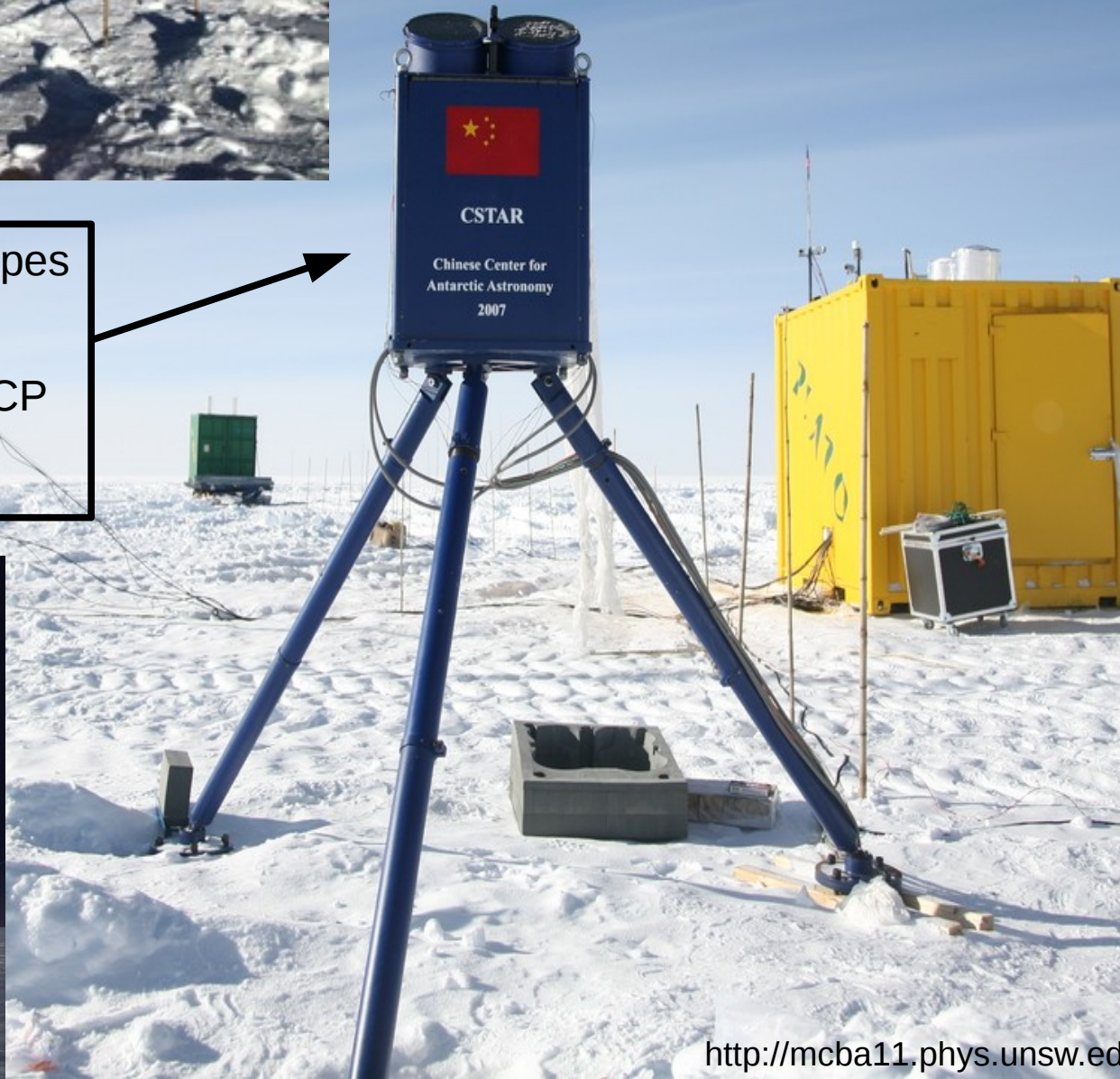| FA seeing	arcsec
Mean	0.38
Median	0.36
P_{75}	0.46
P_{25}	0.28

Aristidi et al. 2009, Astro-ph.IM,0904.2982

Chinese Small Telescope ARray
CSTAR

Four 10-cm telescopes (gri filters + "clear")

Fixed pointing to SCP

20-40s integration

Observations in i band

Month 2008	# images	Total exp. time (hr)
March	14345	64.4
April	51390	316.4
May	71665	398.1
June	110358	613.1
July	40082	222.7
Total	287840	1614.7

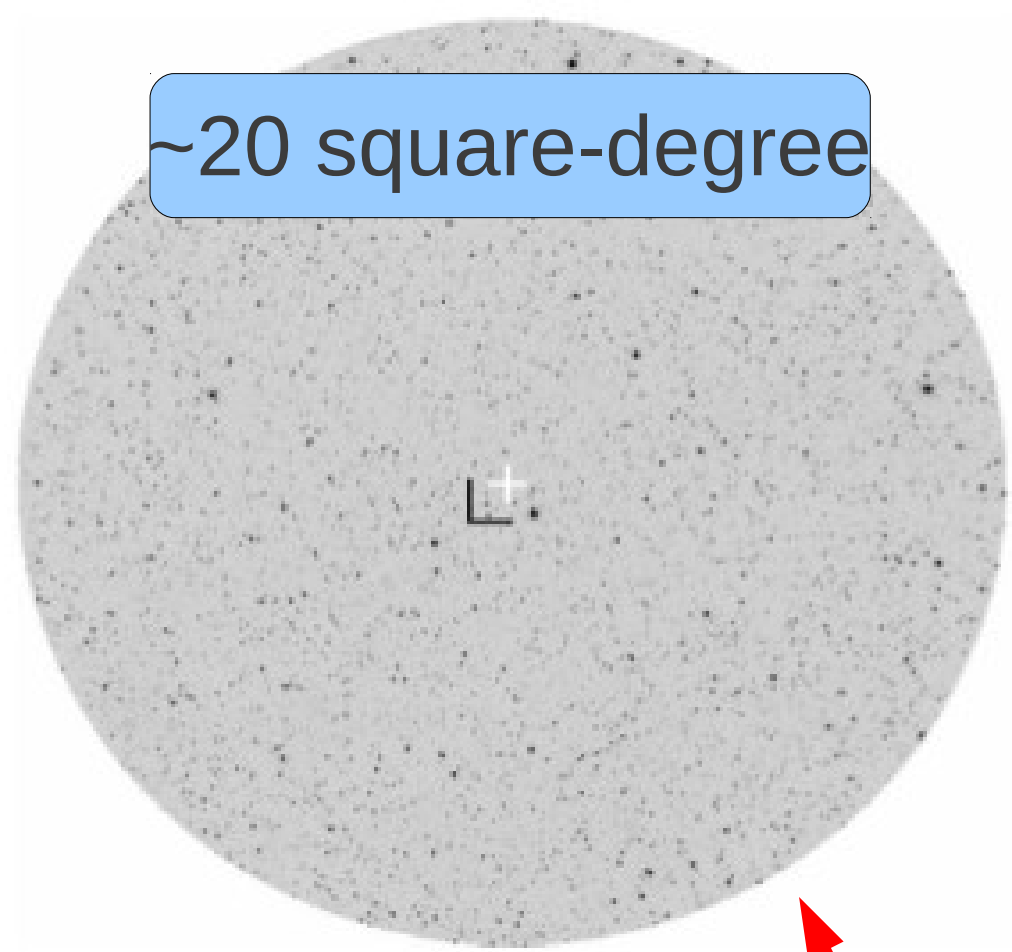| Month 2010	# images	Total exp. time (hr)
March	1587	17.6
April	31110	345.7
May	39651	405.8
June	69509	579.2
July	97310	631.1
August	73088	406.0
September	30098	167.2
Total	**342353**	**2552.6**

Wang et al. 2011, AJ

Wang et al. 2013, AJ

Catalog

2011, AJ, 142, 155 荣获
" 2011 年度极地科学优秀
论文二等奖"

~20 square-degree

vizier.u-strasbg.fr/viz-bin/VizieR?-source=J/AJ/142/155

Portal   Simbad   VizieR   Aladin   X-Match   Other   Help

Catalog Selection Page

Search Criteria

Keywords
- J/AJ/142/155

Tables   Add

J/AJ/142/155
..table3
..table6

Radmm IR opt UV X Y   Variable stars photometry from Dome A (Wang+, 2011)   2011AJ....142..155W **ReadMe+ftp**

J/AJ/142/155   **Similar Catalogs**

☐ J/AJ/142/155/table3   (c) Variable stars observed *(157 rows)*

☐ J/AJ/142/155/table6   Fourier analysis of variable star candidates *(639 rows)*

☐   Reset All   Query selected Tables   Join selected Tables

ALL

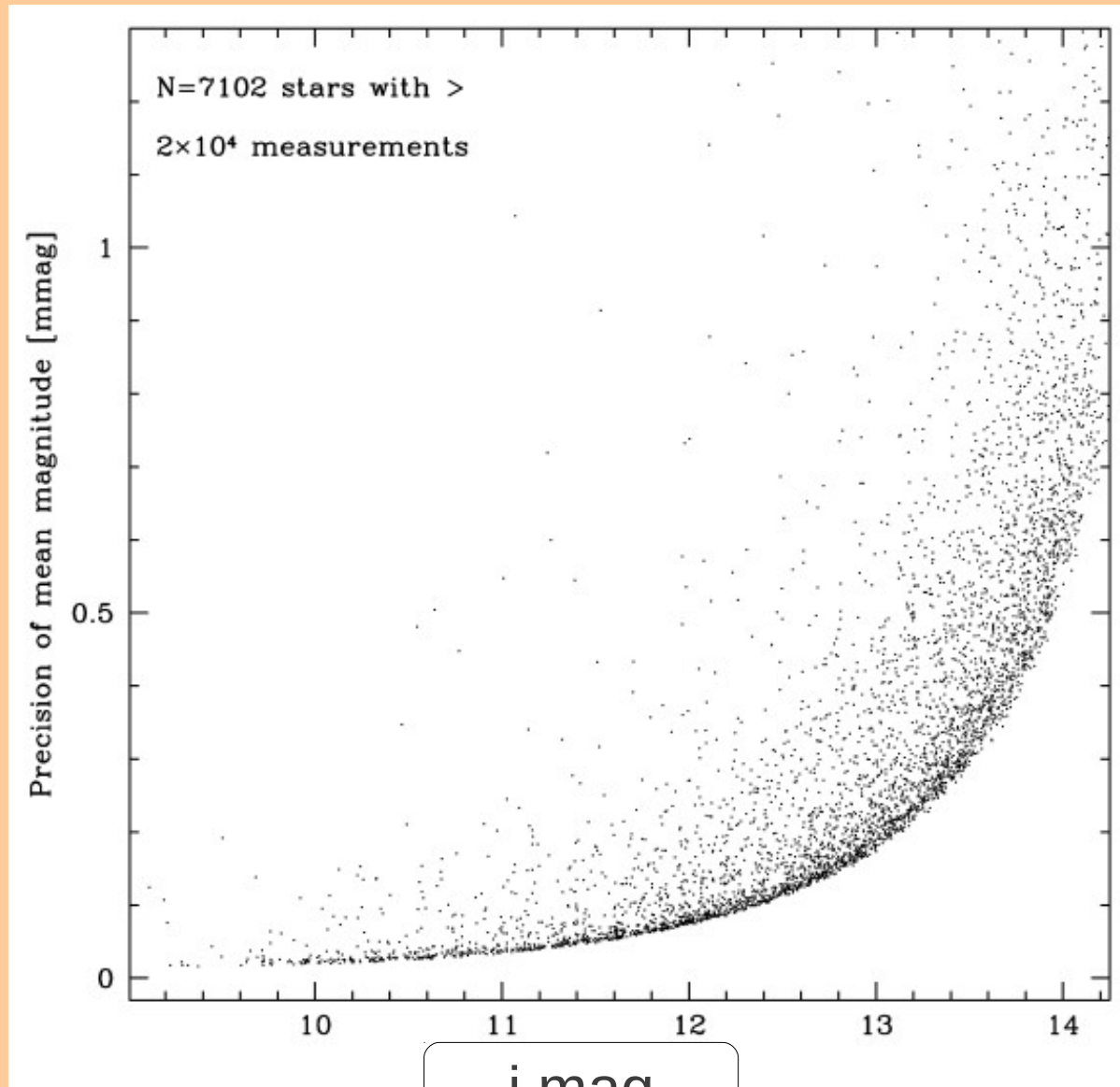(c) indicates tables which contain celestial coordinates

ging the VizieR Service

© UDS/CNRS
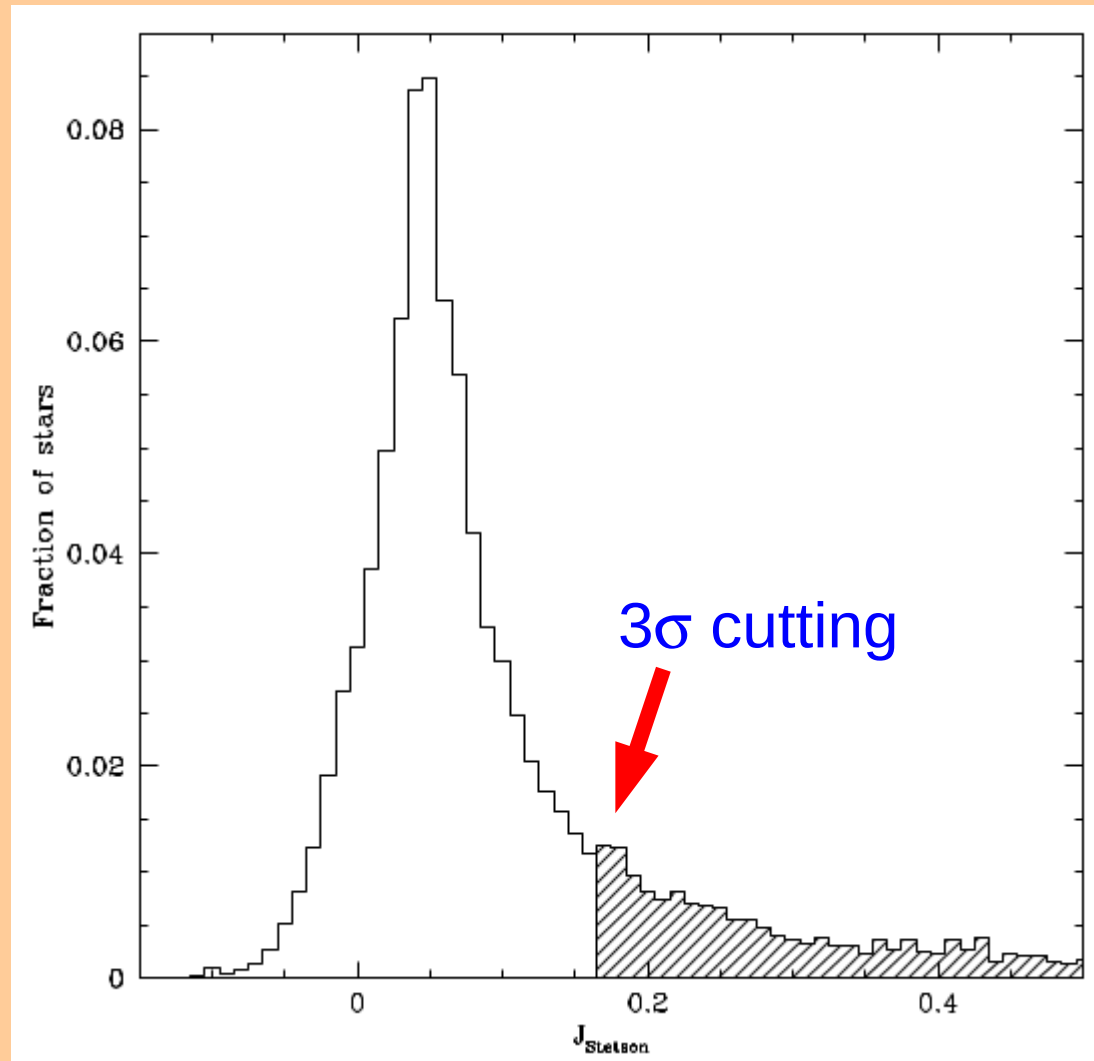✉ Contact

Preferences

max: 50

Photometry precision

Precision of mean magnitude [mmag]

i mag

Search for Variability
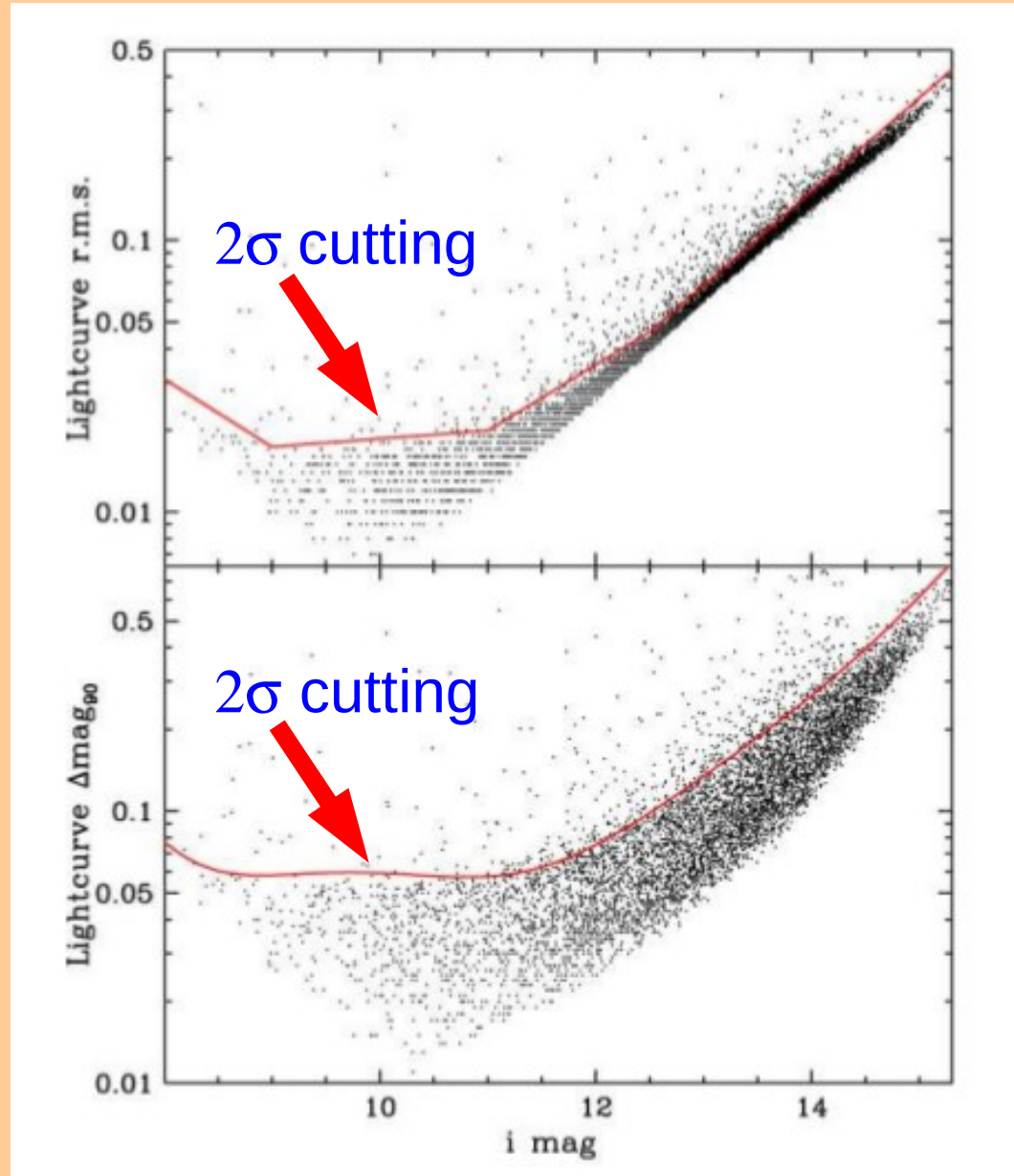
1 Welch-Stetson variability index J (Stetson 1996)

3σ cutting

Search for Variability

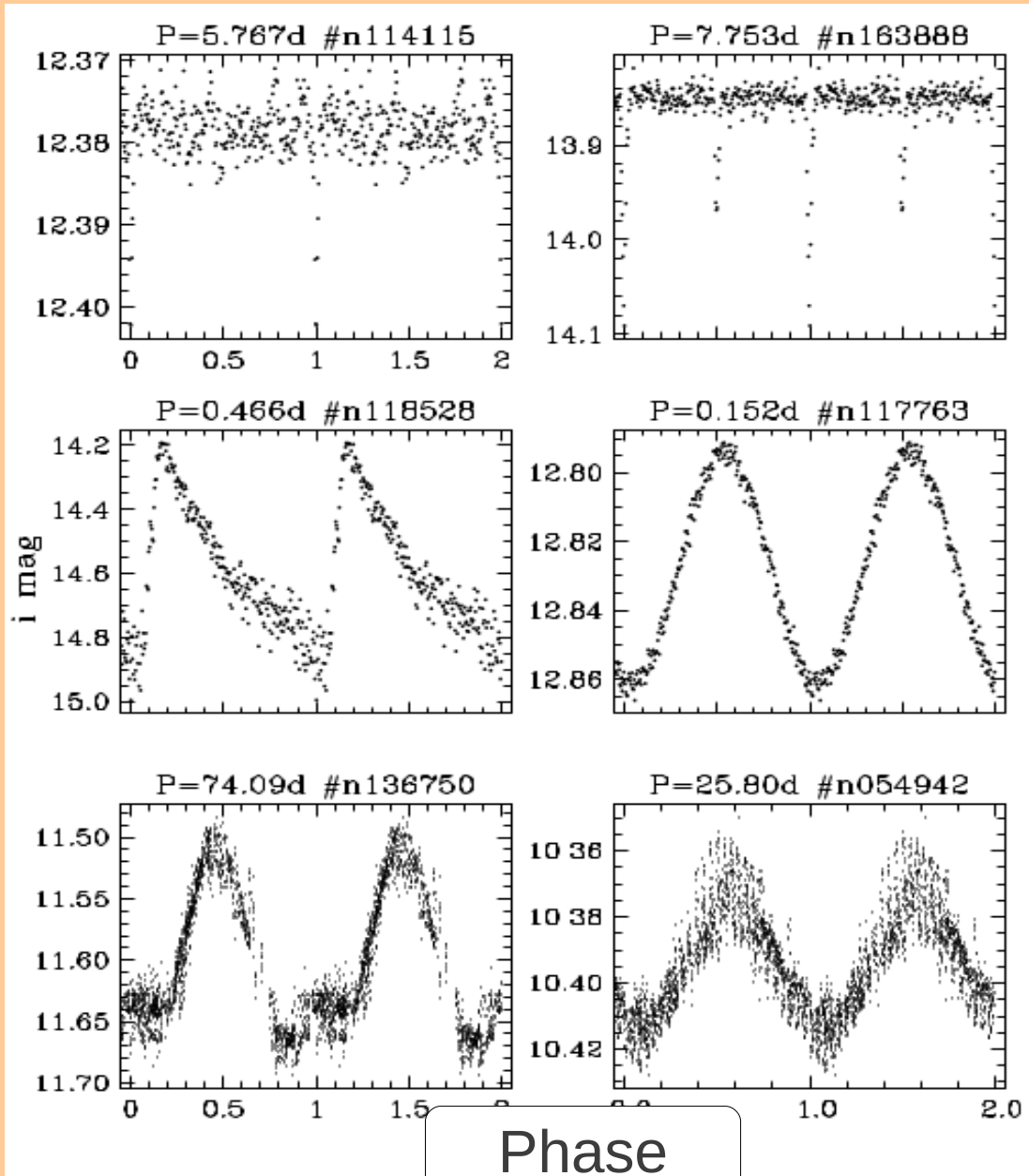2 $r.m.s.$

3 $\triangle i_{90}$

44 variables

2σ cutting

2σ cutting

Search for periodic variability

Lomb-Scargle method: 136

Box-fitting algorithm: 8

i mag

Phase

Variable star catalog

Photometry from Dome A

TABLE 3
VARIABLE STARS

ID			R.A.	Dec.	i	Δi_{90}	J	Period		T_0^3	Class[4]	Note[5]
2010	2008	GSC	(J2000.0)[1]		(mag)			(d)	Src[2]	(d)		
n010320	. . .	S742000016	12:04:48.75	−87:23:06.0	8.79	0.18	9.68	. . .	. . .	. . .	IR	A
n012443	001707	S74D000321	12:32:42.91	−87:26:22.9	11.10	0.55	9.95	0.338544	LS	785.6824	EC	A
n012506	. . .	S3Y9000067	11:44:32.67	−87:27:35.9	10.89	0.12	2.07	31.447988	LS	. . .	MP	
n015318	003125	S3YM000469	10:43:46.63	−87:25:10.1	9.69	0.09	3.32	3.602742	LS	. . .	MP	
n015705	. . .	S3YM000358	10:04:32.92	−87:13:44.7	10.97	0.08	0.65	19.081678	LS	. . .	MP	
n016257	003697	S742000061	12:08:11.93	−87:35:39.9	11.56	0.08	0.75	26.567900	LS	. . .	MP	
n016505	003850	S742000043	12:34:25.12	−87:34:37.7	10.14	0.06	1.59	17.251594	LS	. . .	MP	A
n017573	004463	S3YM000518	10:40:16.05	−87:29:29.8	11.16	0.06	0.58	0.869262	LS	785.7941	ED	
n017781	. . .	S74D000351	13:21:24.66	−87:29:48.4	12.41	0.10	0.25	4.822329	LS	. . .	MP	
n020508	. . .	S74D000440	13:01:58.40	−87:39:56.3	9.01	0.16	3.11	5.798380	LS	786.5008	ED	
n023757	. . .	S3YM000018	09:51:32.15	−87:28:32.7	13.24	0.18	0.20	0.240900	LS	785.4140	PR	
n024696	009171	S3YM000662	10:12:54.85	−87:38:22.9	14.10	0.77	1.29	0.591726	LS	785.4091	RL	A
n025073	. . .	S3YN000420	09:29:27.99	−87:21:39.6	9.01	0.32	18.03	. . .	. . .	. . .	IR	A
n025734	009952	S742000182	12:43:30.67	−87:53:30.9	11.30	0.20	2.89	23.819339	LS	. . .	MP	A
n027942	011616	S3Y9000240	10:56:28.86	−87:55:21.0	11.97	0.08	0.55	27.282715	LS	. . .	MP	
n028073	011709	S742000246	12:41:44.27	−87:58:28.5	11.37	0.07	0.77	2.951167	LS	787.1734	PR	
n028235	011796	S742000286	12:21:35.82	−88:00:14.5	12.20	0.26	0.90	1.892910	LS	786.9435	ES	

67 newly-detected variables
121 stars in common with Wang et al. 2011
35 out of 46 previous-known variables detected in the same field
4x more variables than comparable surveys (188/46)

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# Variable types statistics

Variable star fraction: 2.1% (188/9125)

90% are dominated by post-main-sequence stars due i <12 mag(Robin et al. 2003)

Variable Type	N	%
Multi-periodic	57	30.3
Unclassified periodic	47	25.0
Eclipsing binaries	35	18.6
Irregular/long-term	28	14.9
δ Sct	8	4.3
RR Lyr	7	3.7
γ Dor	3	1.6
Transit-like	3	1.6

Eclipsing binaries and unclassified periodic variables are a mix of evolved and main-sequence objects due to broader magnitude distribution

Typical light curves of various variables
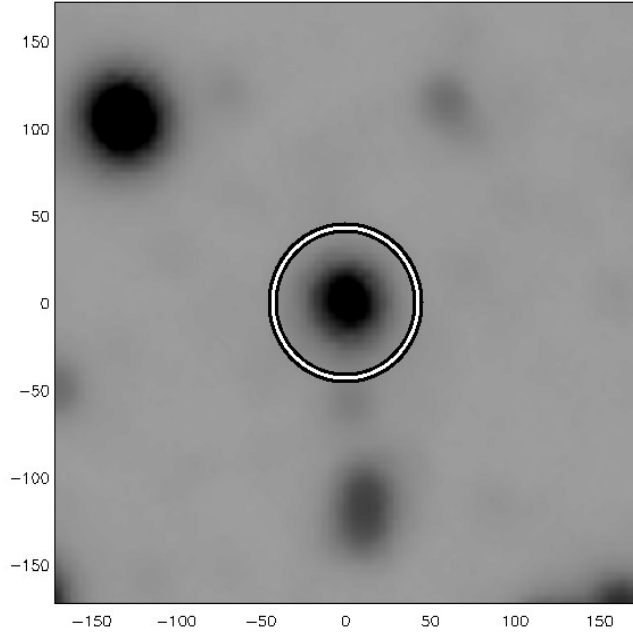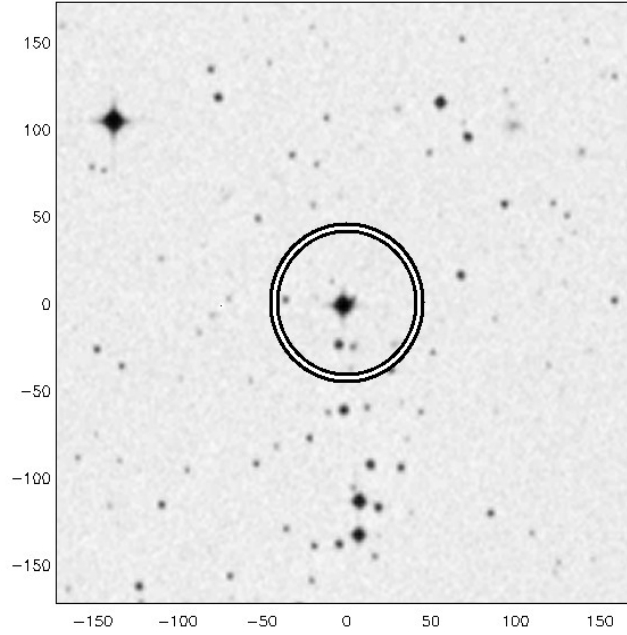
CSTAR 062640   DSS B   DSS R
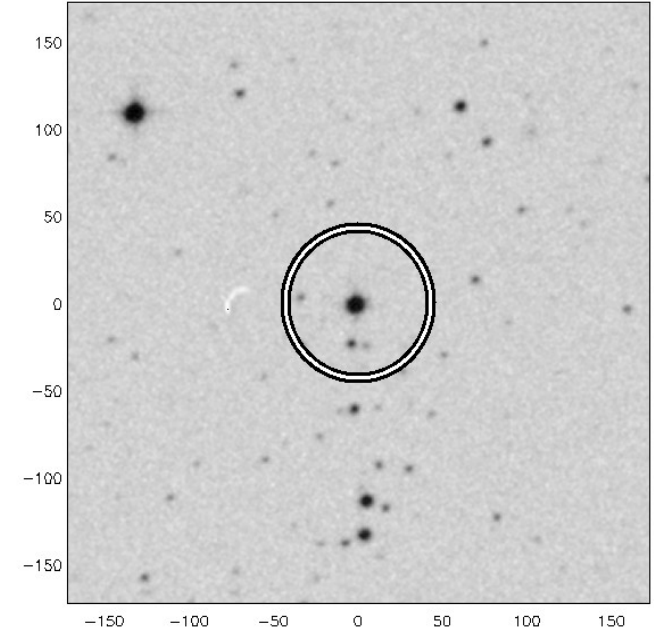
Class=EC   mmag = 12.00   rms = 0.17   dmag_90 = 0.43   J= 5.22
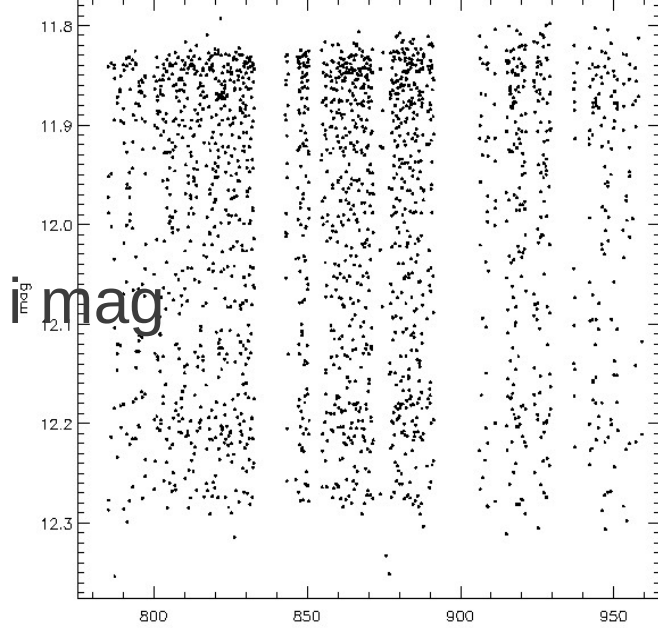
P= 0.2671 SNR=4278.4 src=LS
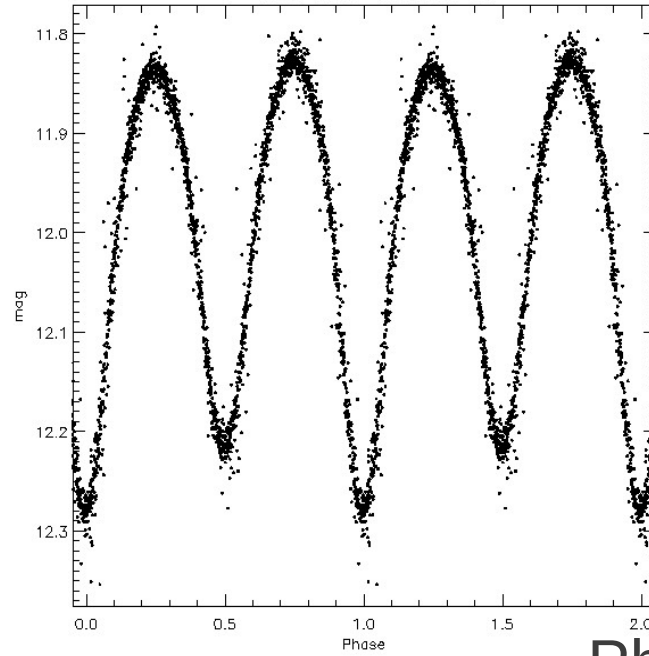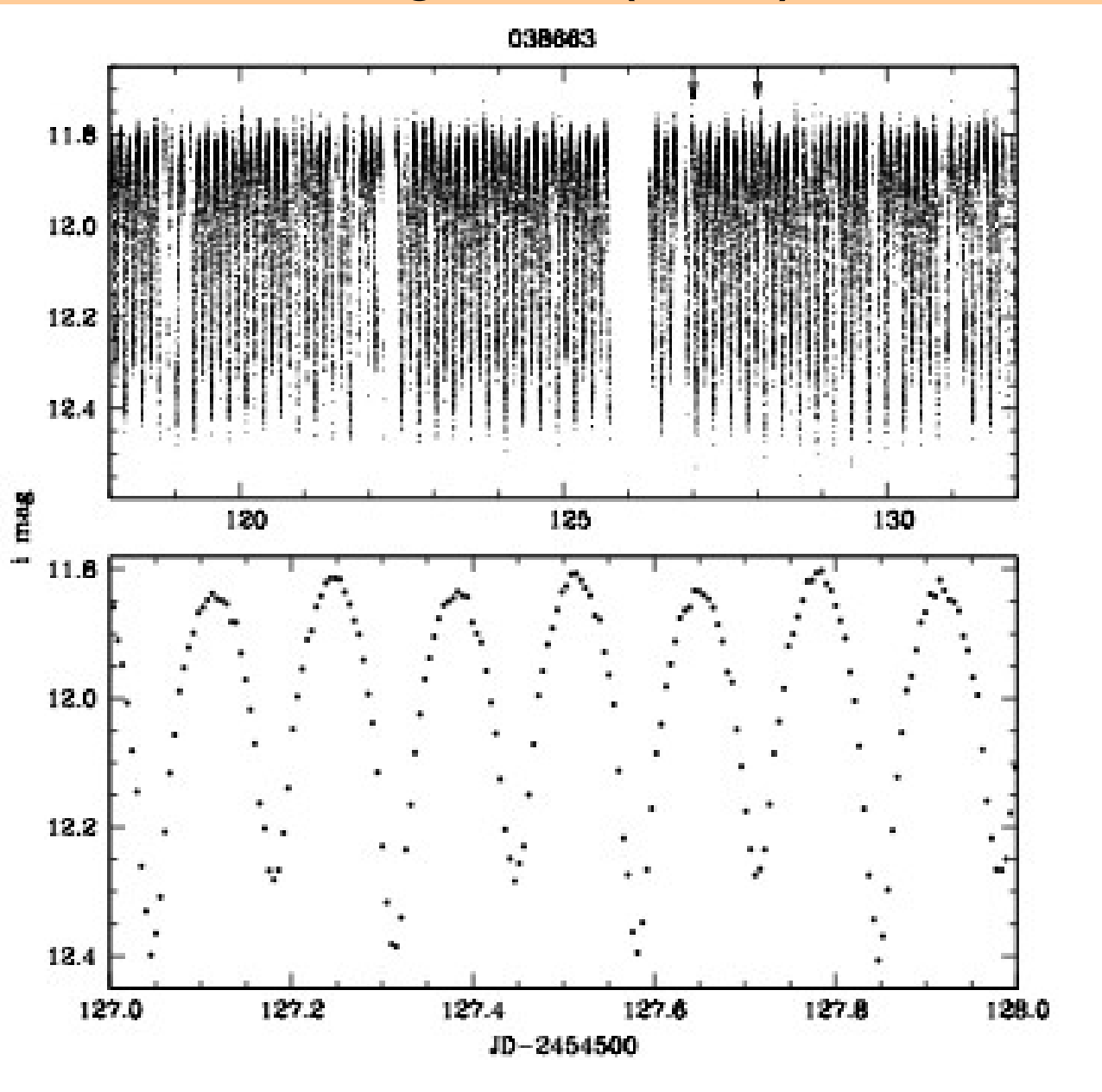
i mag

JD-2454500

Phase
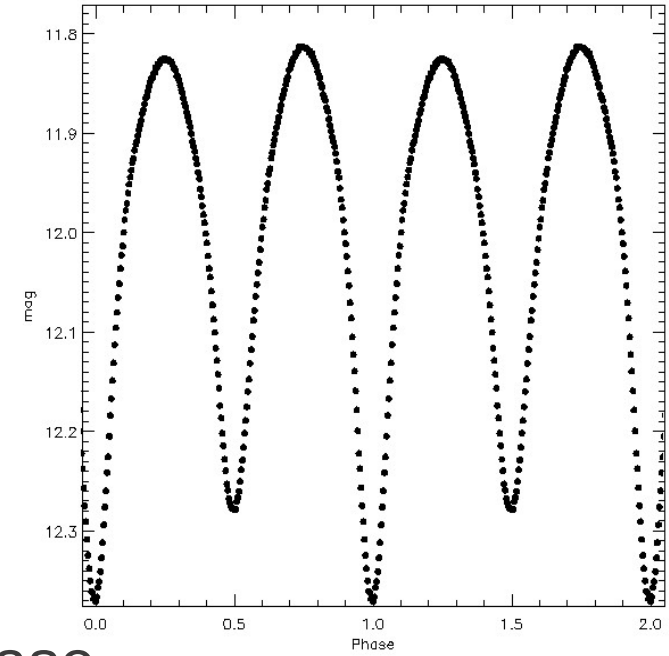
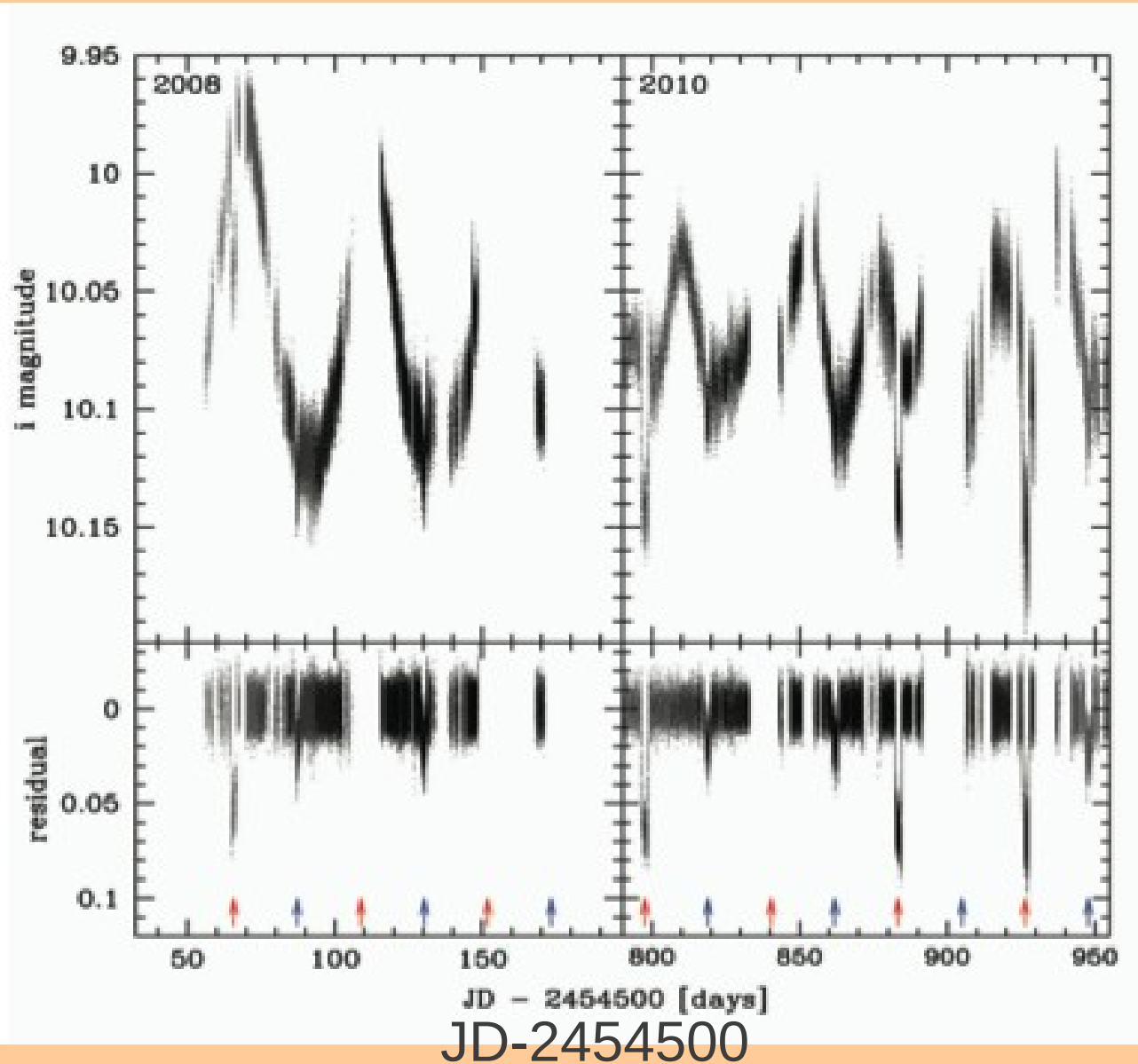# The same binary system
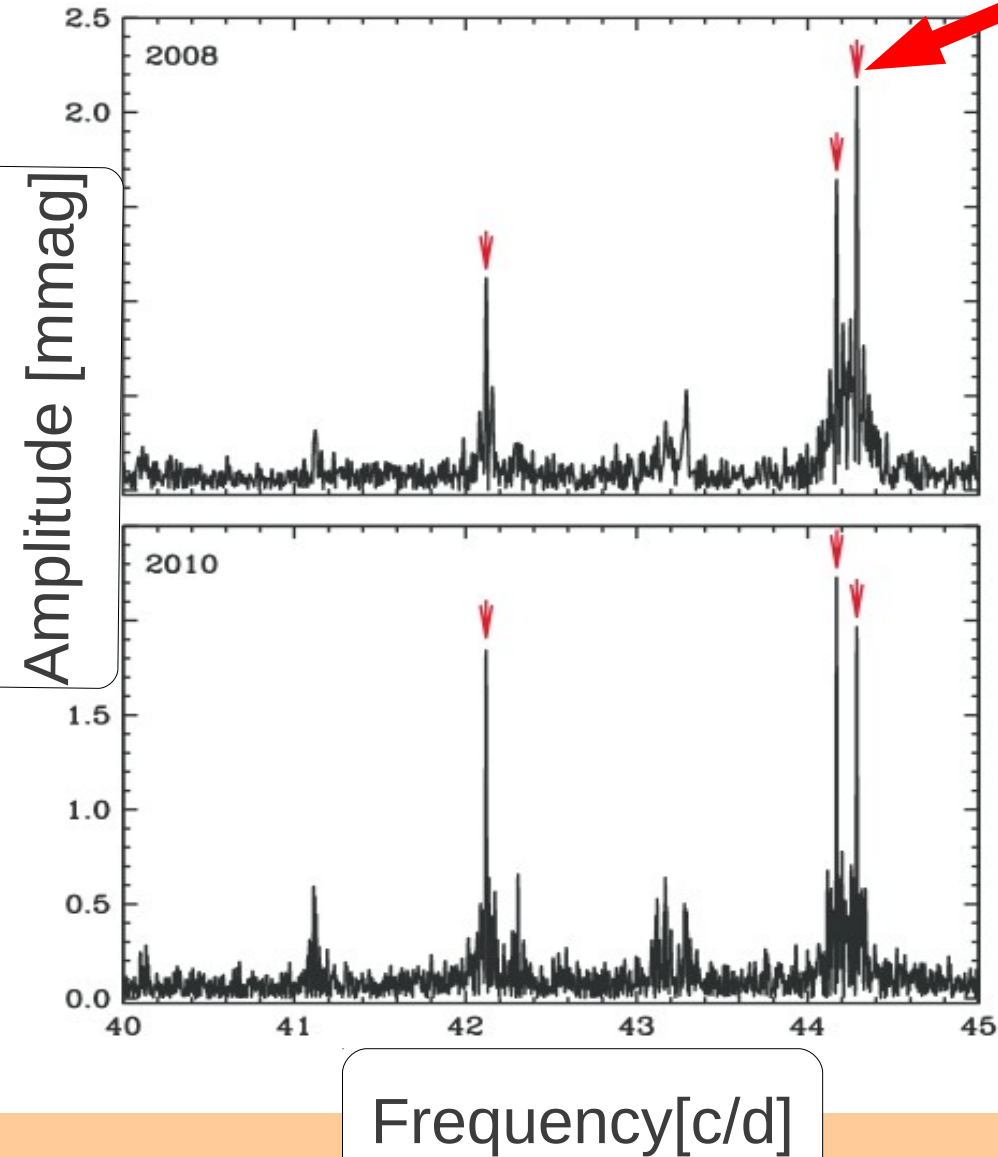## Wang et al. (2011)

i mag

JD-2454500

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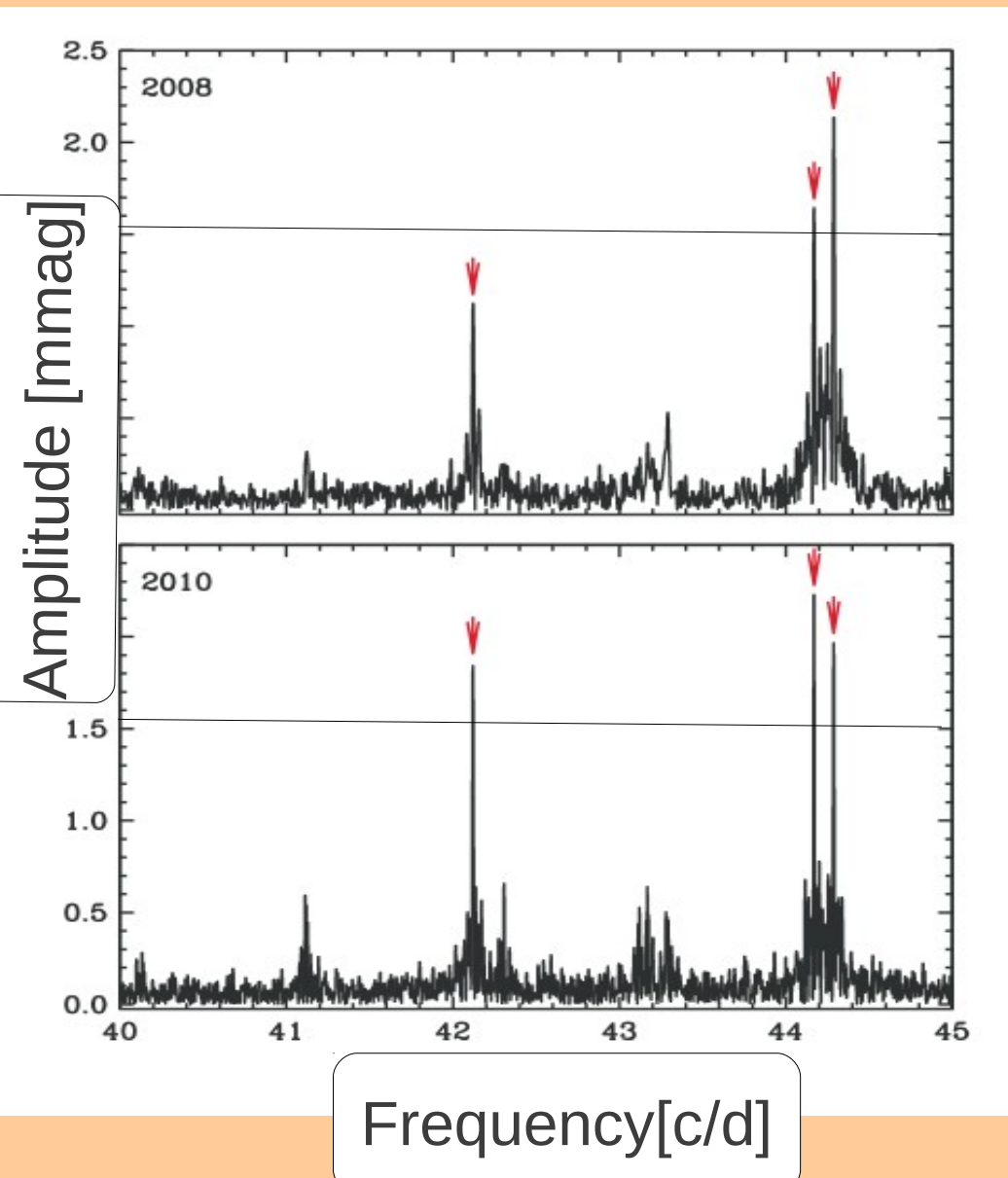# Special system (Pulsation+Binary ?)
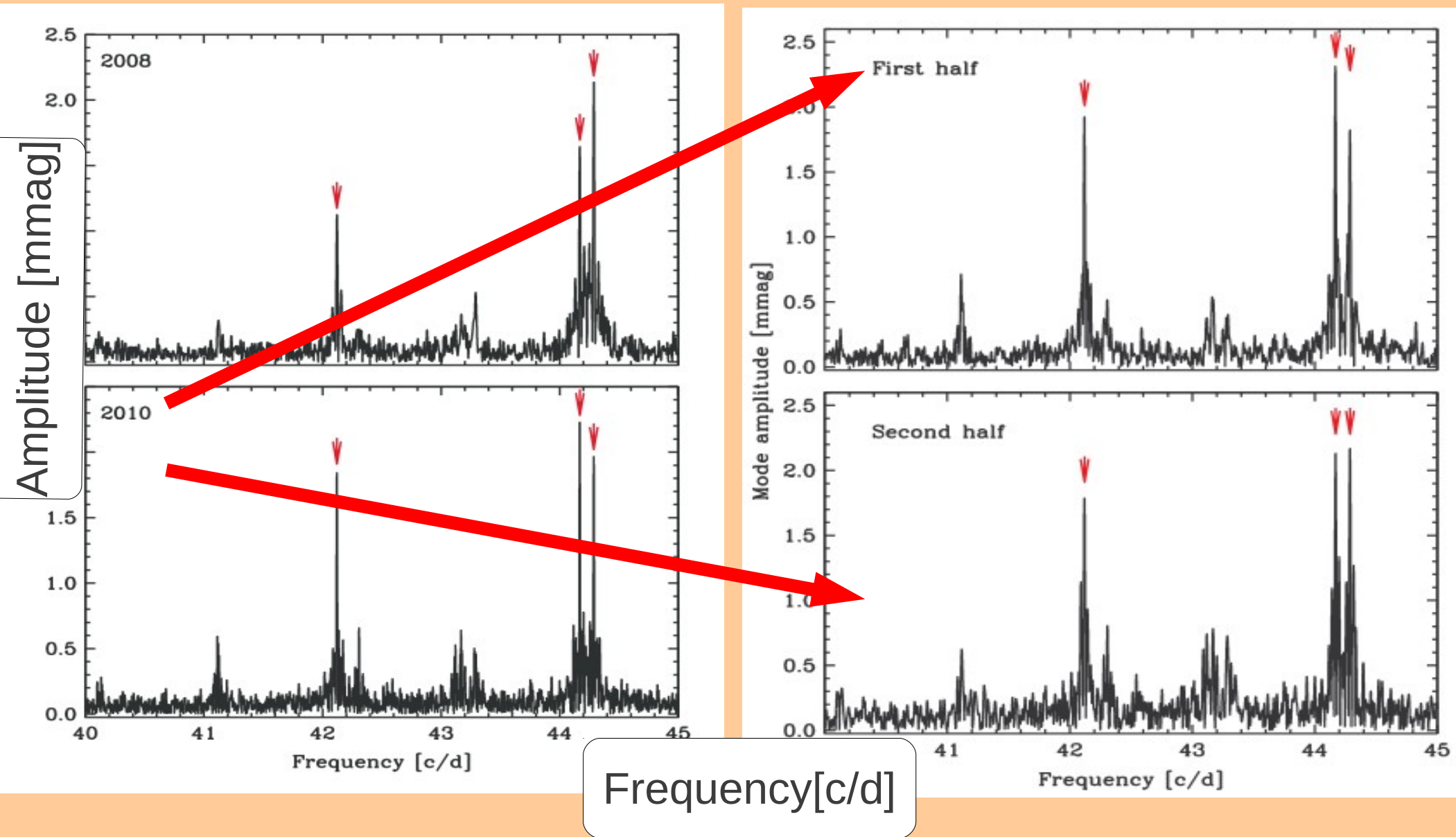
i mag

Residual

JD-2454500

A short variable: Fourier analysis main period=32 min

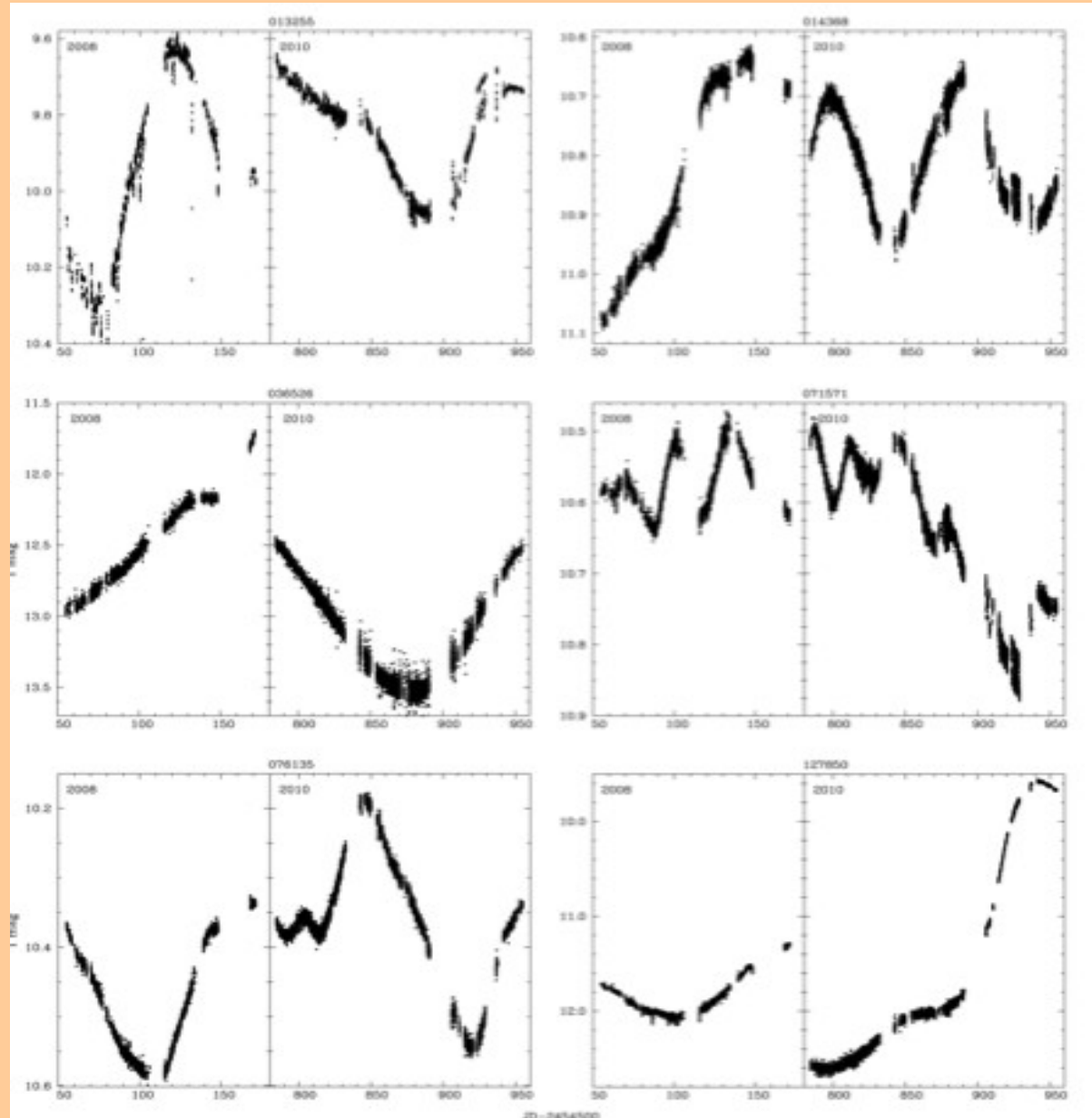# A short variable: Fourier analysis main period=32 min

A short variable: Fourier analysis main period=32 min

6 long variables

i mag

Time

Conclusions

High-precision, long-term photometry from Dome A is
   possible

About 180 days of time-series photometry data were
   acquired in 2010, while 128 days compared to that in
   2008

Long duration of winter night yields 4x more variables than
   comparable surveys from temperate sites

Variability fraction of 2.1% is consistent with expectation for
   a survey with a photometric limit of ~0.02 mag.

Thanks for your coming!
Thanks for the lunch box!

http://mcba11.phys.unsw.edu.au/~plato/gallery.html