Observations of asteroids with ZA-320M and MTM-500M Pulkovo observatory telescopes for GAIA FUN SSO program

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Pulkovo observatory
Saint-Petersburg, Russia

ZA-320M

at Pulkovo observatory (Saint-Petersburg)

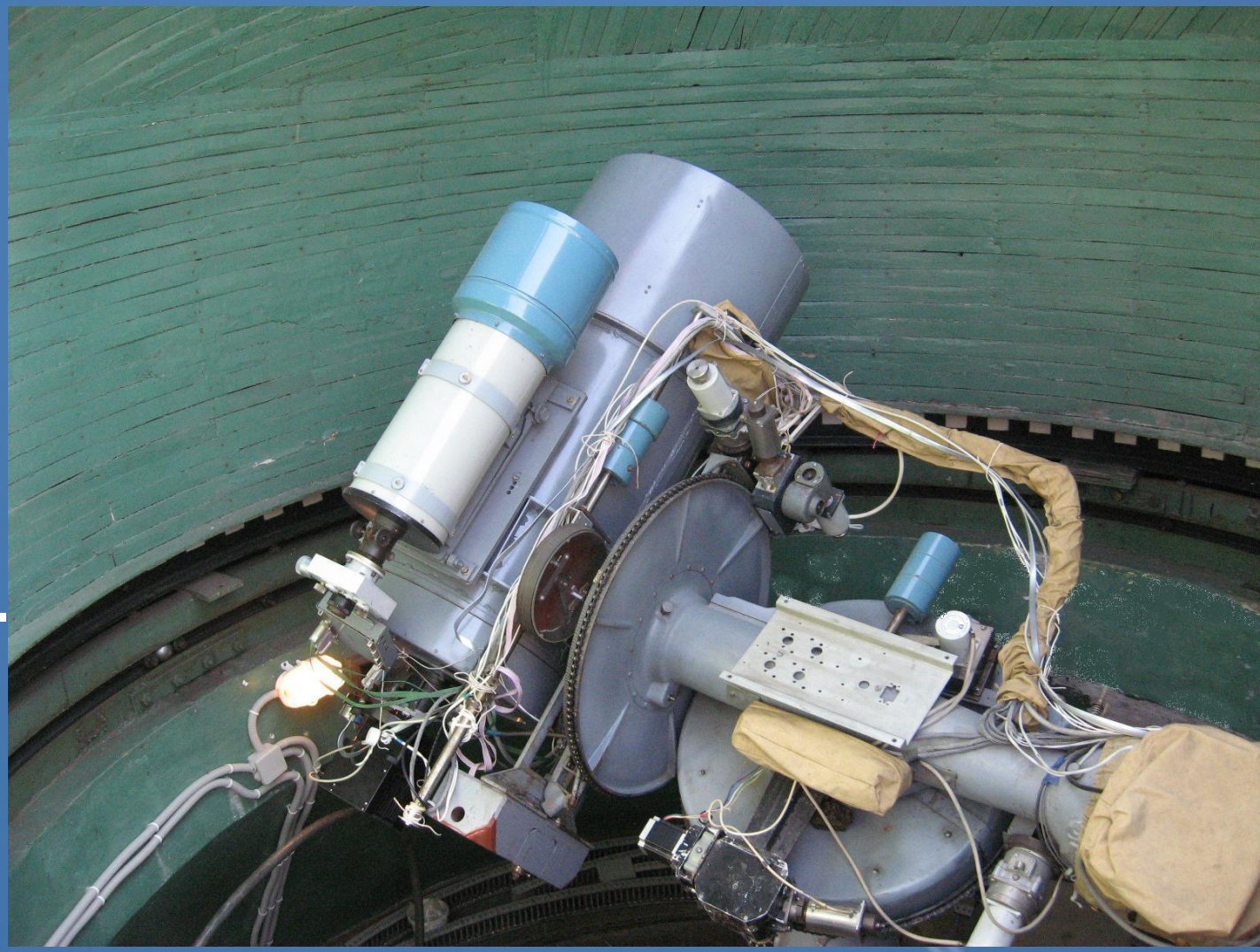
Cassegrain system

D **= 320 mm**
F **= 3200 mm**

CCD-camera
FLI IMG 1001E
1024 × 1024 pix.
24 × 24 μm

FoV ≈ 28′ × 28′

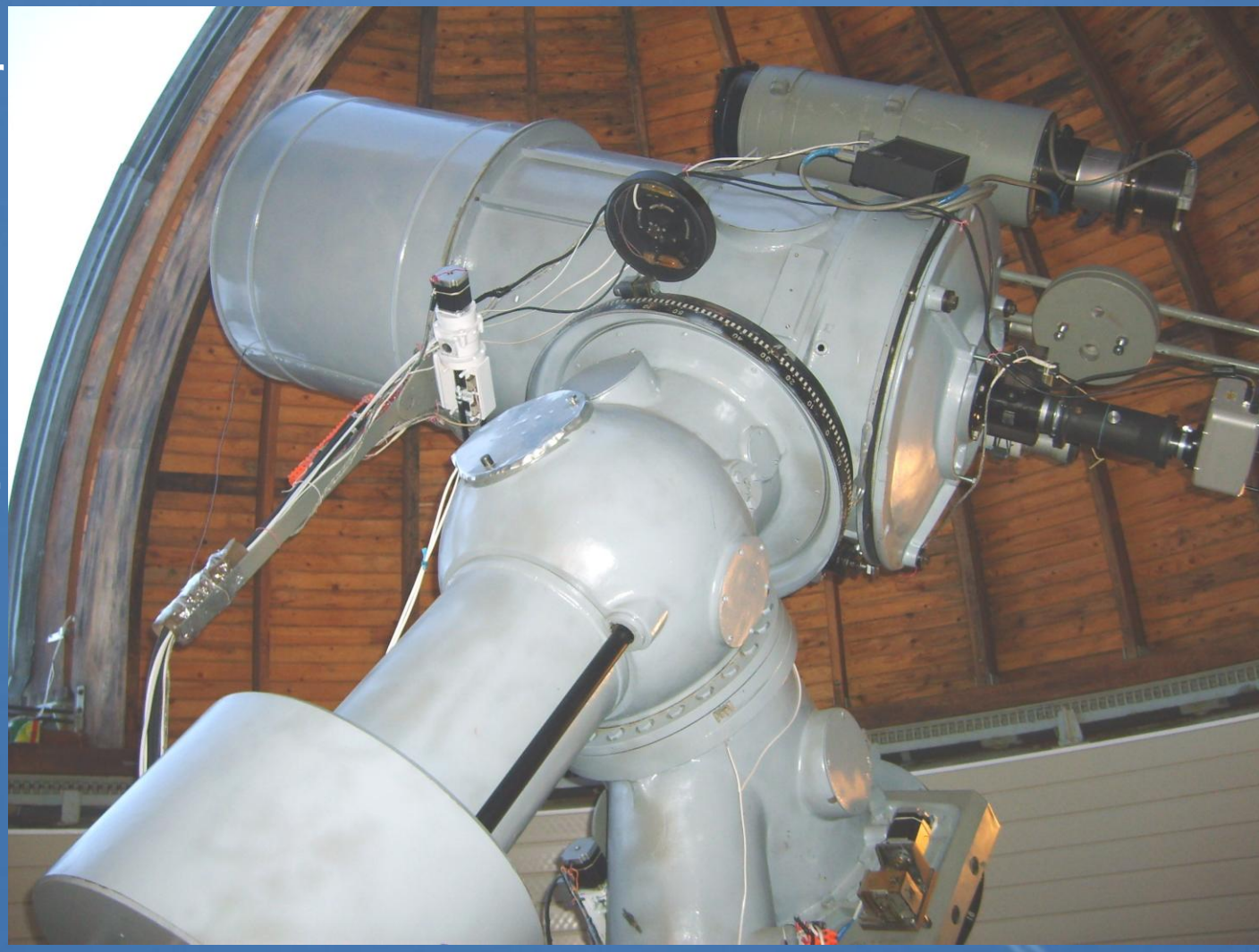
BVRI **filters**



MTM-500M

at Mountain astronomical station of Pulkovo observatory (Northern Caucasus, *h* = 2100 m)

Maksutov – Cassegrain system + extra lens corrector



***D* = 500 mm**
***F* = 4100 mm**

CCD-camera
SBIG STL 1001E
1024 × 1024 pix.
24 × 24 μm

FoV ≈ 21′ × 21′

***BVRI* filters**

APEX-II – CCD-frame processing software

- Calibration – fitting, synthesis and application of darks and flats
- Sky background smoothing
- Object detection using threshold algorithm
- Deblending
- Object center detection using PSF method
- Flux measurement using aperture or PSF methods
- Noise rejection
- Identification of measured objects with a reference catalogue (USNO-A2, USNO-B1, TYCHO-2, HIPPARCOS, UCAC-3, 2MASS, user's catalogues)
- Astrometric reduction using several methods
- Identification of unknown objects using EPOS module (asteroid and comet searching)
- Creation of report in standard format (e.g. MPC format)

EPOS

(Ephemeris Program for Objects of Solar System)

software for celestial-mechanics computations and visualization

2005 YU55

NEA, Potentially Hazardous

Approach to Earth in November 2011

Observations

09-20 of November 2011

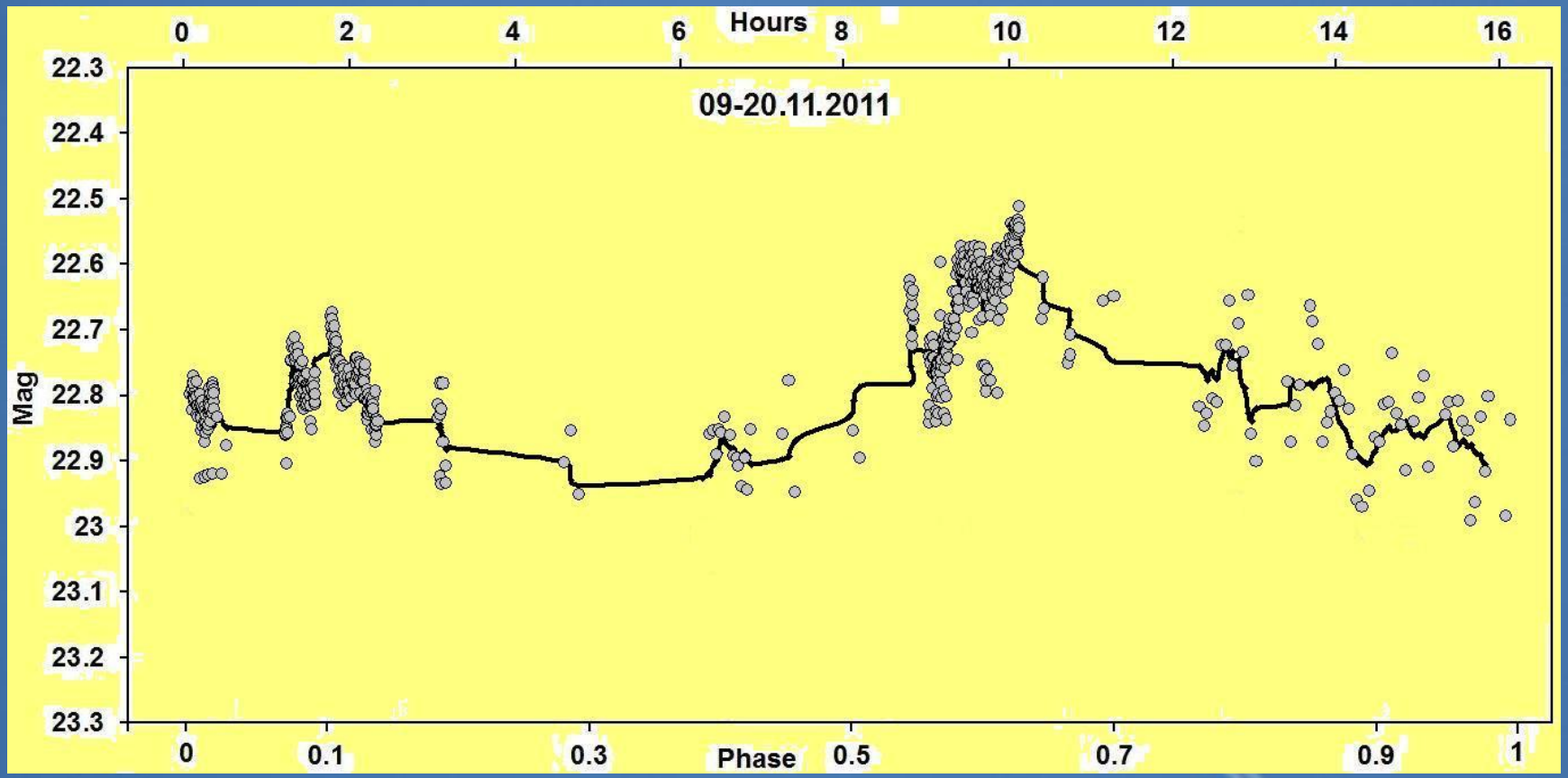
- **Light-curves to examine period of rotation**
- ***B V R I*** **to determine color-indices**
- **Astrometry to enhance the orbit**

2005 YU55

Determination of rotational period

Previous radar determination: *P* = 18 hours

(http://ssd.jpl.nasa.gov/sbdb.cgi?sstr=308635)

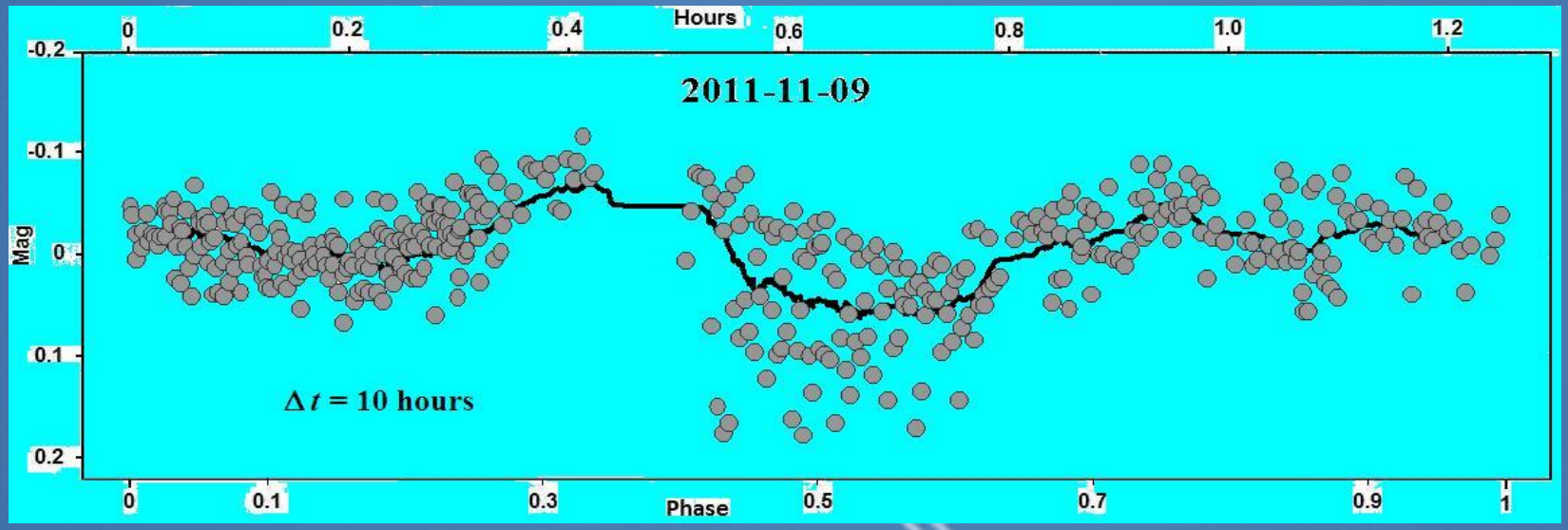


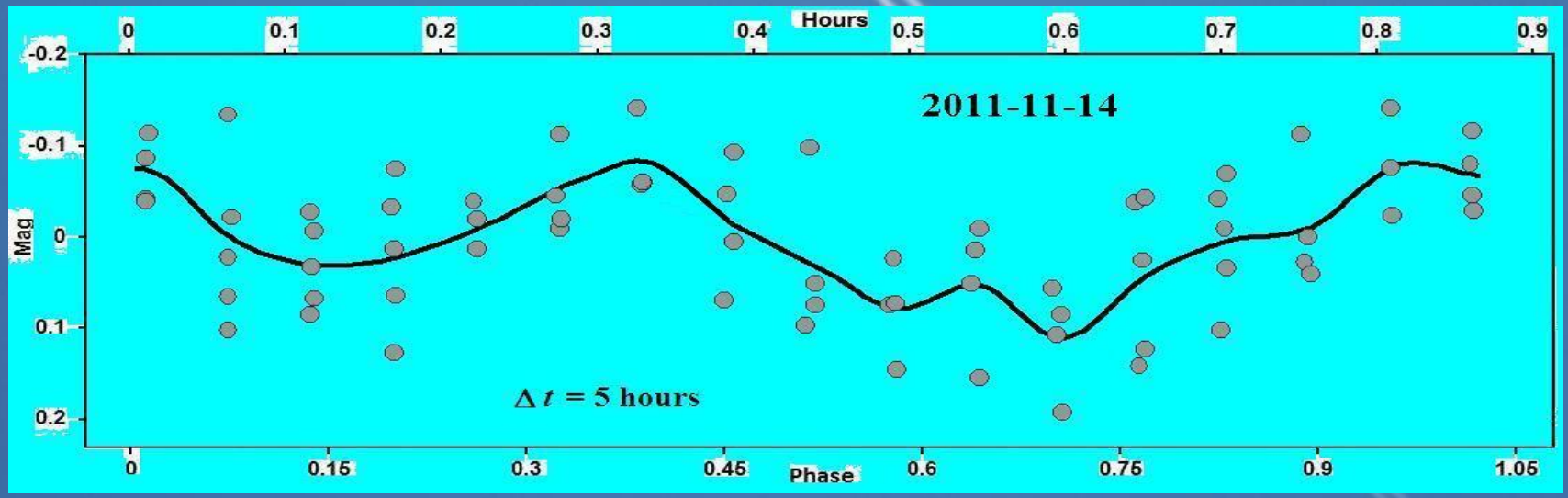
Our value: *P* = 16.3 ± 0.4 hours

2005 YU55

The strange small period

$P \approx 0.9 - 1.2$ hours, $\Delta m \approx 0.15^m$





2005 YU55
Color indices

$B–V = 0^m.67 \pm 0^m.07$

$V–R = 0^m.34 \pm 0^m.09$

$R–I = 0^m.30 \pm 0^m.07$

Effective color measured from spectrum (*Hicks et al.*, 2010; *Hicks et al.*, 2011):

$V–R = 0^m.37$

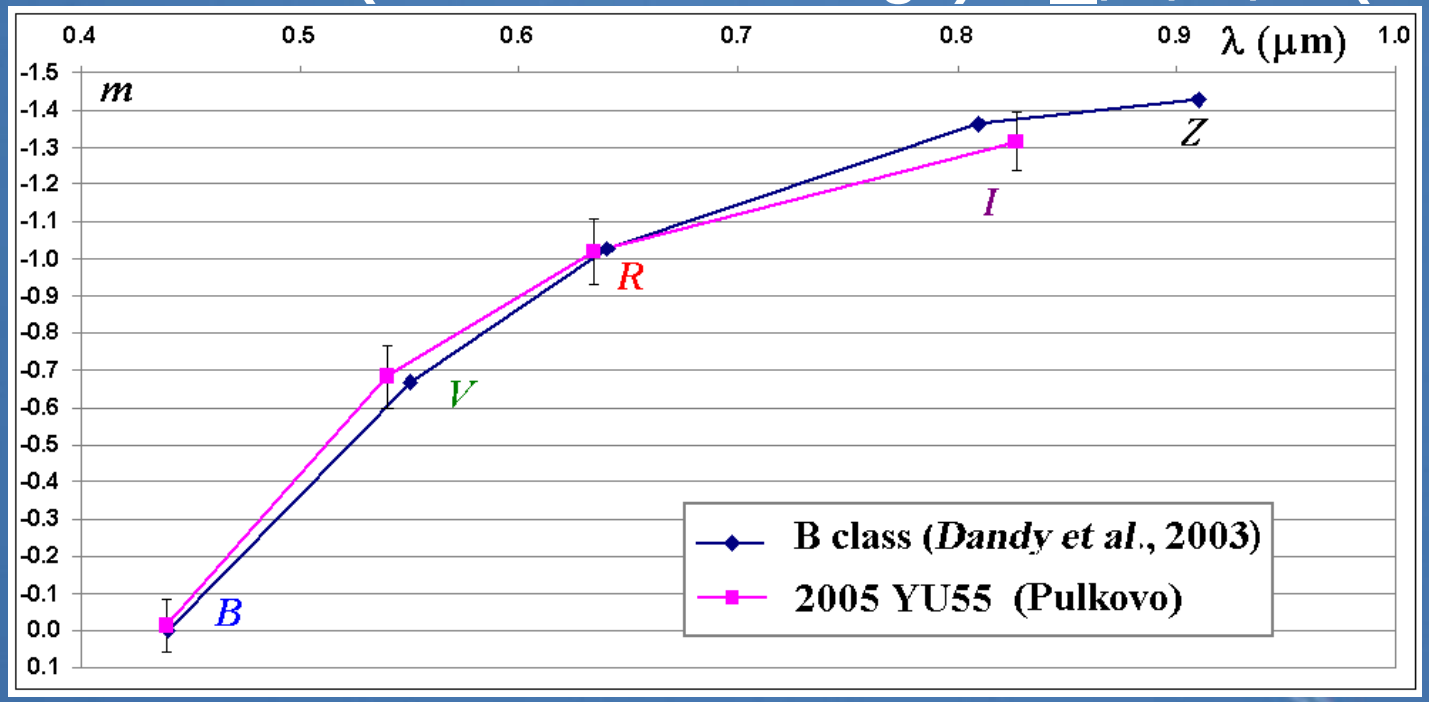
M.Hicks, K.Lawrence, L.Benner
Palomar Spectroscopy of 2001 FM129, 2004 FG11, and 2005 YU55
// The Astronomer's Telegram, # 2571, 2010

M.Hicks, J.Somers, T.Truong, S.Teague, C. Strojia
Broadband photometry of 2005 YU55: Solar phase behavior and absolute magnitude
// The Astronomer's Telegram, # 3763, 2011

2005 YU55
Classification

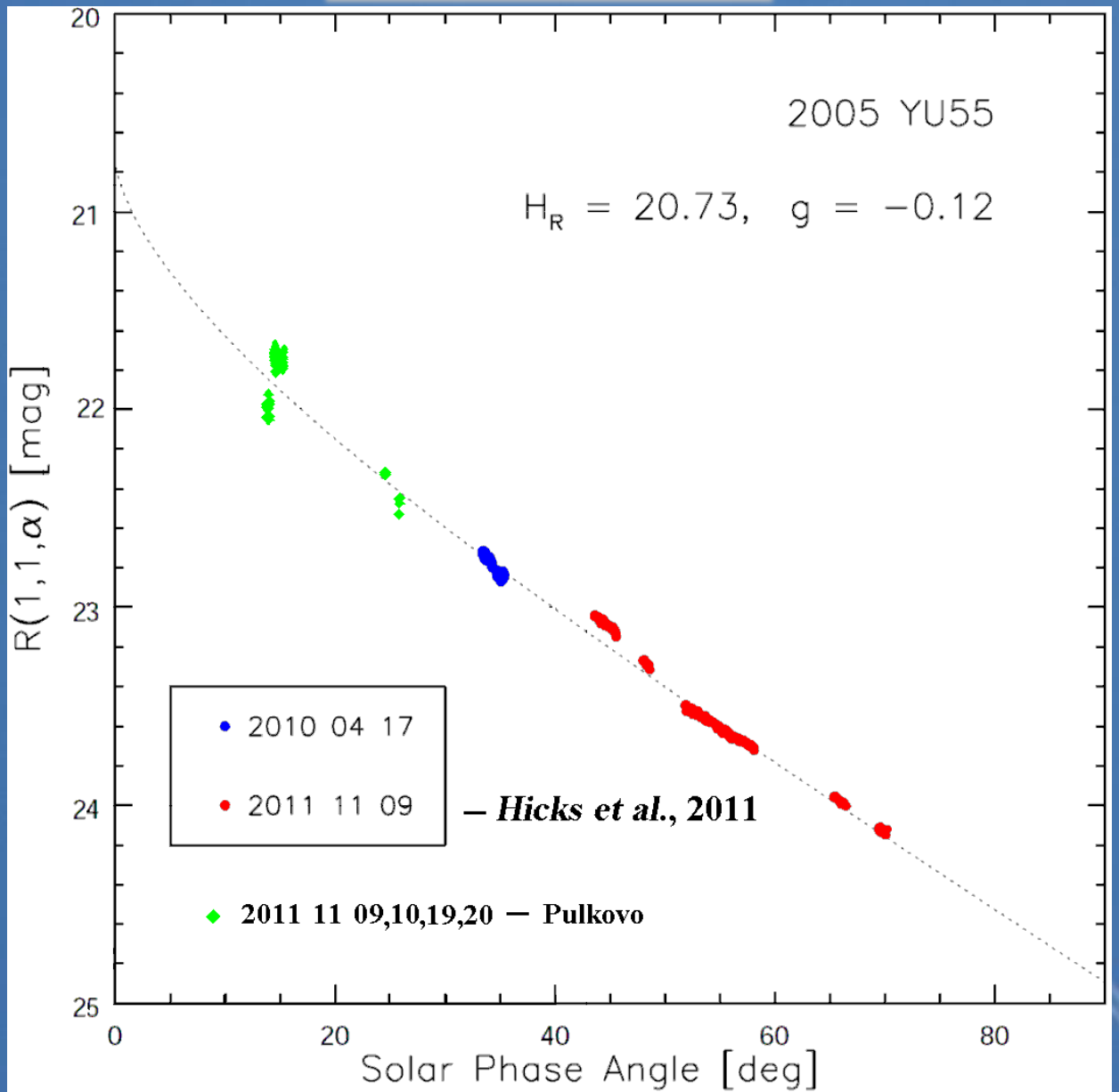
Hicks et al. **(2010) classification from spectrum – best analogs: C_{gh}, C, C_h (Bus), G (Tholen)**

Pulkovo wide-band photometry in λλ 0.44-0.83 μm – close to classes (flat in visible range): B, F, C, G (Tholen)



Dandy C.L., Fitzsimmons A., and Collander-Brown S.J.
Optical colors of 56 near-Earth objects: trends with size and orbit // Icarus. 2003. V. 163. P. 363–373.

2005 YU55
Phase curve



2005 YU55

Astrometry

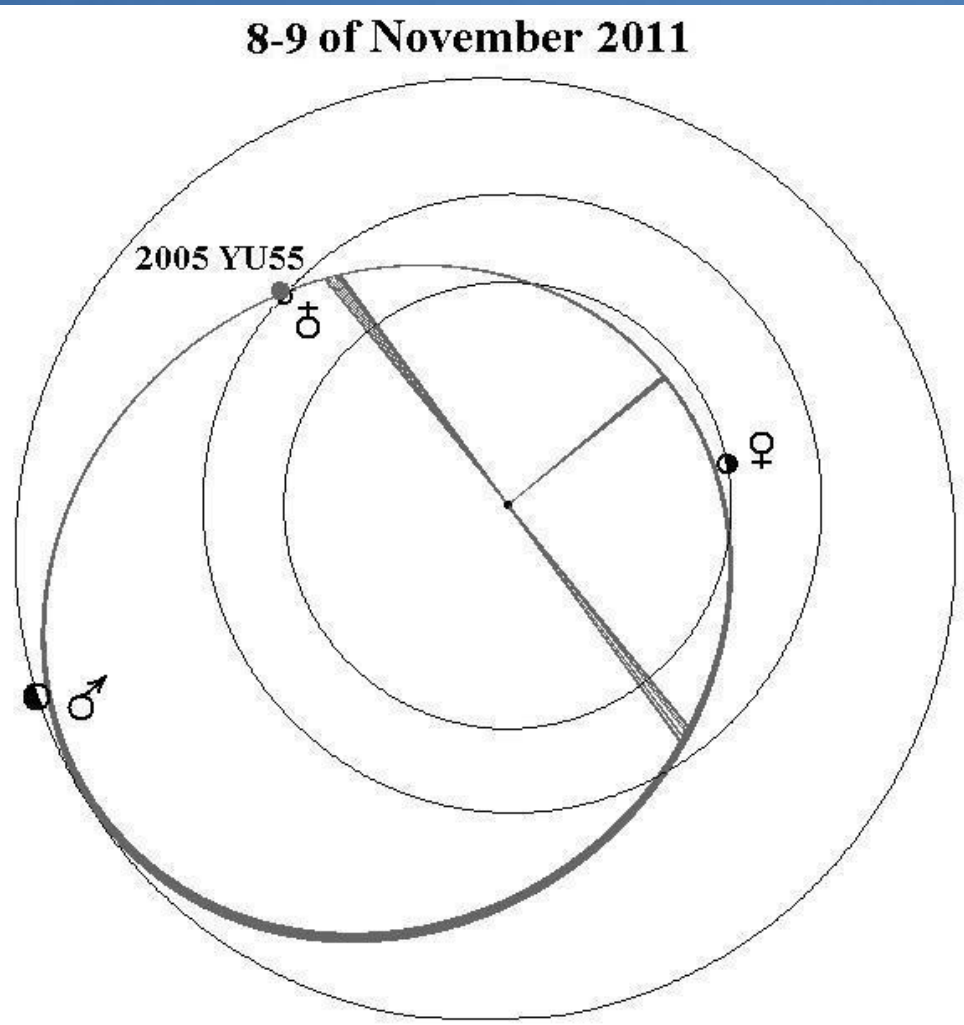
926 positions from our observations
Mean accuracy is:

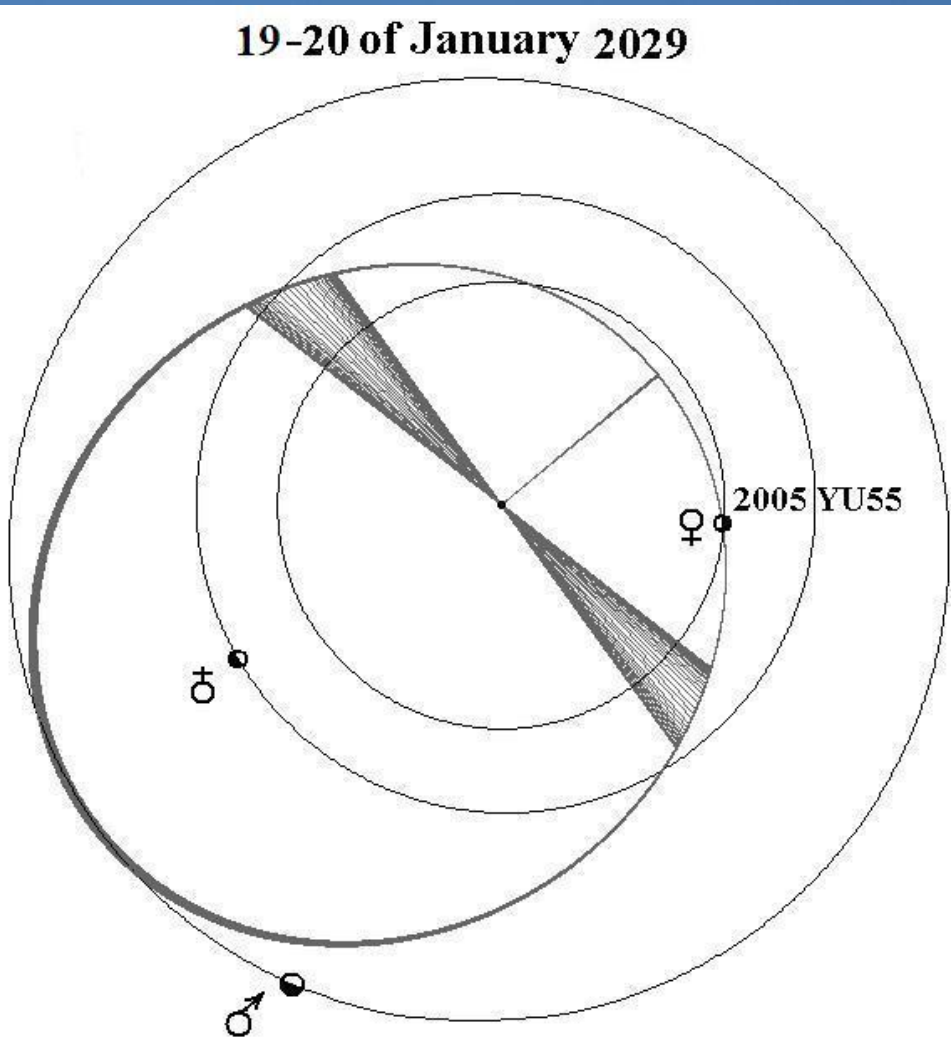
	σ_α	σ_δ
MTM-500	0″.33	0″.27
ZA-320	0″.36	0″.24

2005 YU55

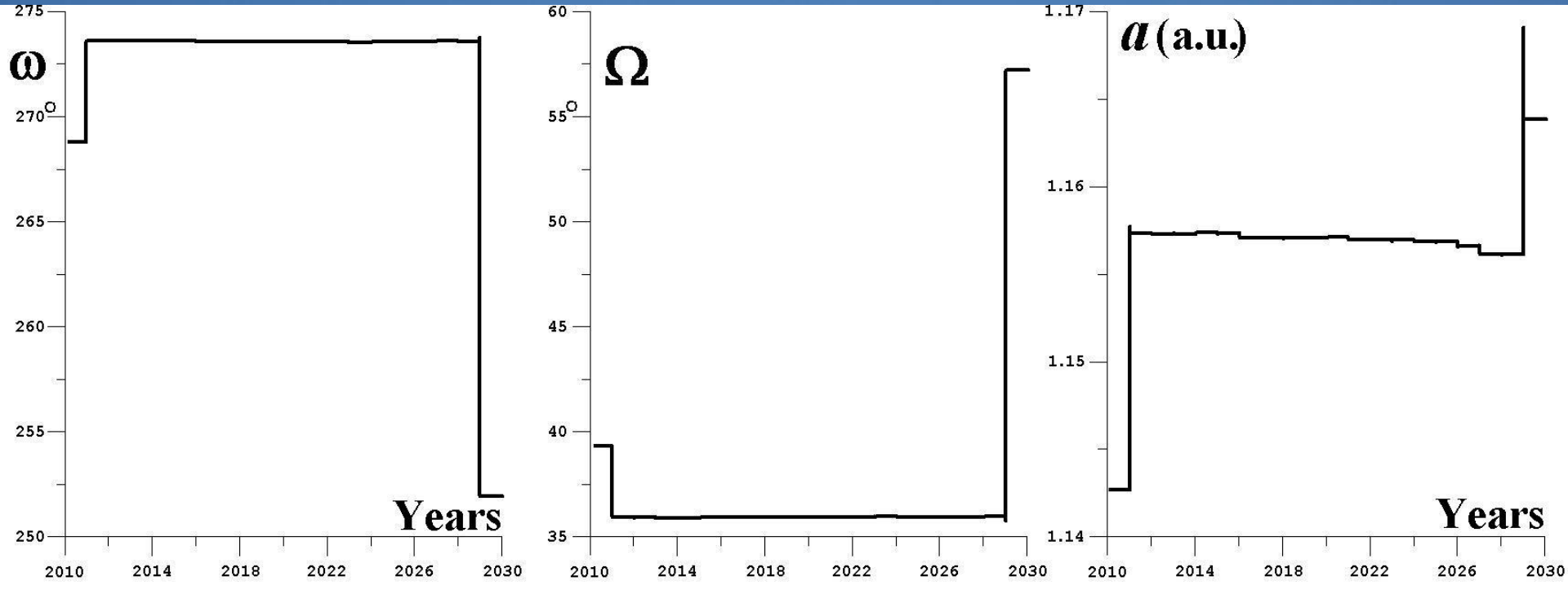
Orbit

The 2005 YU55 asteroid has approaches to Venus and Earth (and Mars orbit). During a close approach, it changes its orbit sharply.



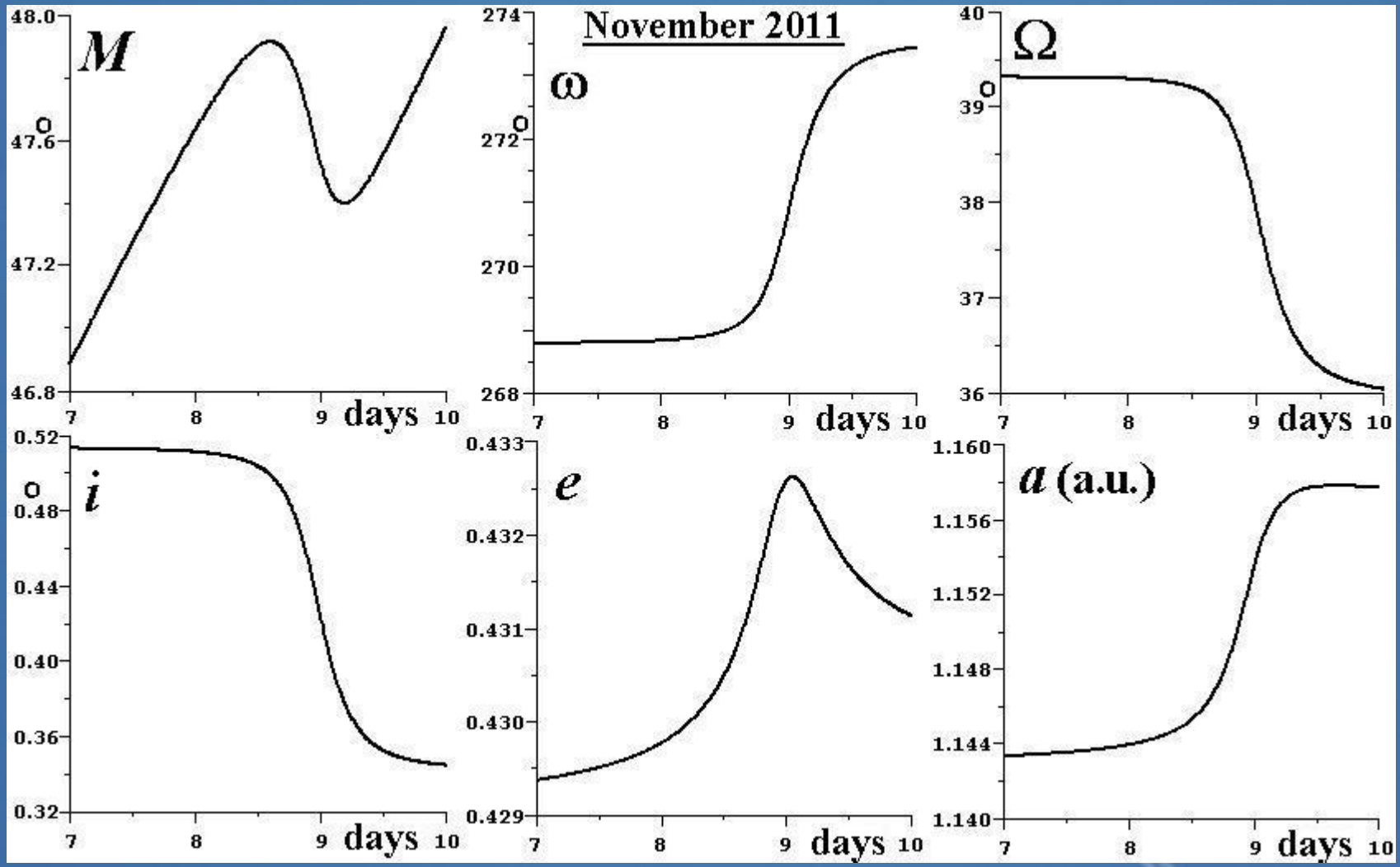


2005 YU55
Orbit



Evolution of the orbit elements during 2 approaches to planets (Earth – 8-th of November 2011 and Venus – 20-th of January 2029)

2005 YU55
Orbit



Evolution of the orbit elements during the approach to Earth
7 - 10 of November 2011

TP3522 = 2012 BS67

24 observations were made with MTM-500M on 2012-01-20 – about 1/3 of all observations in MPC database.

Mean accuracy ≈0″.2.

TP3522 = 2012 BS67

	Date (UT)	J2000 RA	J2000 Dec	Mag	Location	Ref
TP3522	C 2012 01 20.82432	11 06 02.47	+16 55 46.6	19.7 R	C20	MPS 410327
TP3522	C 2012 01 20.83178	11 06 02.63	+16 55 52.4	19.3 R	C20	MPS 410327
TP3522	C 2012 01 20.83572	11 06 02.71	+16 55 55.7	19.4 R	C20	MPS 410327
TP3522	C 2012 01 20.83950	11 06 02.76	+16 55 58.0	19.6 R	C20	MPS 410327
TP3522	C 2012 01 20.84304	11 06 02.84	+16 56 01.3	19.4 R	C20	MPS 410327
TP3522	C 2012 01 20.88397	11 06 03.77	+16 56 32.9	19.3 R	C20	MPS 410327
TP3522	C 2012 01 20.88752	11 06 03.80	+16 56 35.5	19.5 R	C20	MPS 410327
TP3522	C 2012 01 20.89114	11 06 03.87	+16 56 38.4	19.8 R	C20	MPS 410327
TP3522	C 2012 01 20.89483	11 06 03.97	+16 56 41.3	19.4 R	C20	MPS 410327
TP3522	C 2012 01 20.90193	11 06 04.12	+16 56 46.4	19.5 R	C20	MPS 410327
TP3522	C 2012 01 20.90547	11 06 04.19	+16 56 49.3	19.2 R	C20	MPS 410327
TP3522	C 2012 01 20.90901	11 06 04.25	+16 56 52.2	19.2 R	C20	MPS 410327
TP3522	C 2012 01 20.91255	11 06 04.31	+16 56 54.8	19.9 R	C20	MPS 410327
TP3522	C 2012 01 20.91609	11 06 04.40	+16 56 57.9	19.6 R	C20	MPS 410327
TP3522	C 2012 01 20.91964	11 06 04.47	+16 57 00.4	19.2 R	C20	MPS 410327
TP3522	C 2012 01 20.92318	11 06 04.54	+16 57 03.2	19.6 R	C20	MPS 410327
TP3522	C 2012 01 20.92672	11 06 04.61	+16 57 05.9	19.7 R	C20	MPS 410327
TP3522	C 2012 01 20.93039	11 06 04.69	+16 57 08.6	19.5 R	C20	MPS 410327
TP3522	C 2012 01 20.93393	11 06 04.80	+16 57 11.8	19.3 R	C20	MPS 410327
TP3522	C 2012 01 20.94101	11 06 04.91	+16 57 16.9	19.5 R	C20	MPS 410327
TP3522	C 2012 01 20.94456	11 06 04.97	+16 57 19.8	19.7 R	C20	MPS 410327
TP3522	C 2012 01 20.94810	11 06 05.04	+16 57 22.1	19.3 R	C20	MPS 410327
TP3522	C 2012 01 20.95164	11 06 05.11	+16 57 25.1	19.5 R	C20	MPS 410327
TP3522	C 2012 01 20.95518	11 06 05.19	+16 57 28.0	19.4 R	C20	MPS 410327

2012 QG42

(preliminary results)

$B–V = 0^m.76 \pm 0^m.16$

$V–R = 0^m.50 \pm 0^m.07$

$R–I = 0^m.22 \pm 0^m.07$

Supposed class – V (Tholen)

2012 QG42

(preliminary results)

About 250 observations with ZA-320 telescope.

Elements	Initial (JPL)	Improved (Pulkovo)		Improved (Pulkovo + MPC)	
Epoch	2456189.5	2456189.5	Corrections	2456189.5	Corrections
M	298.015083	298.014947	-0.000136	298.015010	-0.000073
ω	116.085767	116.085904	0.000137	116.085829	0.000062
Ω	344.949685	344.949697	0.000012	344.949688	0.000003
i	6.816120	6.816311	0.000191	6.816144	0.000024
e	0.37462048	0.37462078	0.00000030	0.37462048	0.00000000
a	1.025951851	1.025951904	0.000000053	1.025951835	-0.000000015
rms		0.428		0.389	
N_{obs}		219		1091	


Thank you
for your attention!