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On visual encounters between asteroids and background stars

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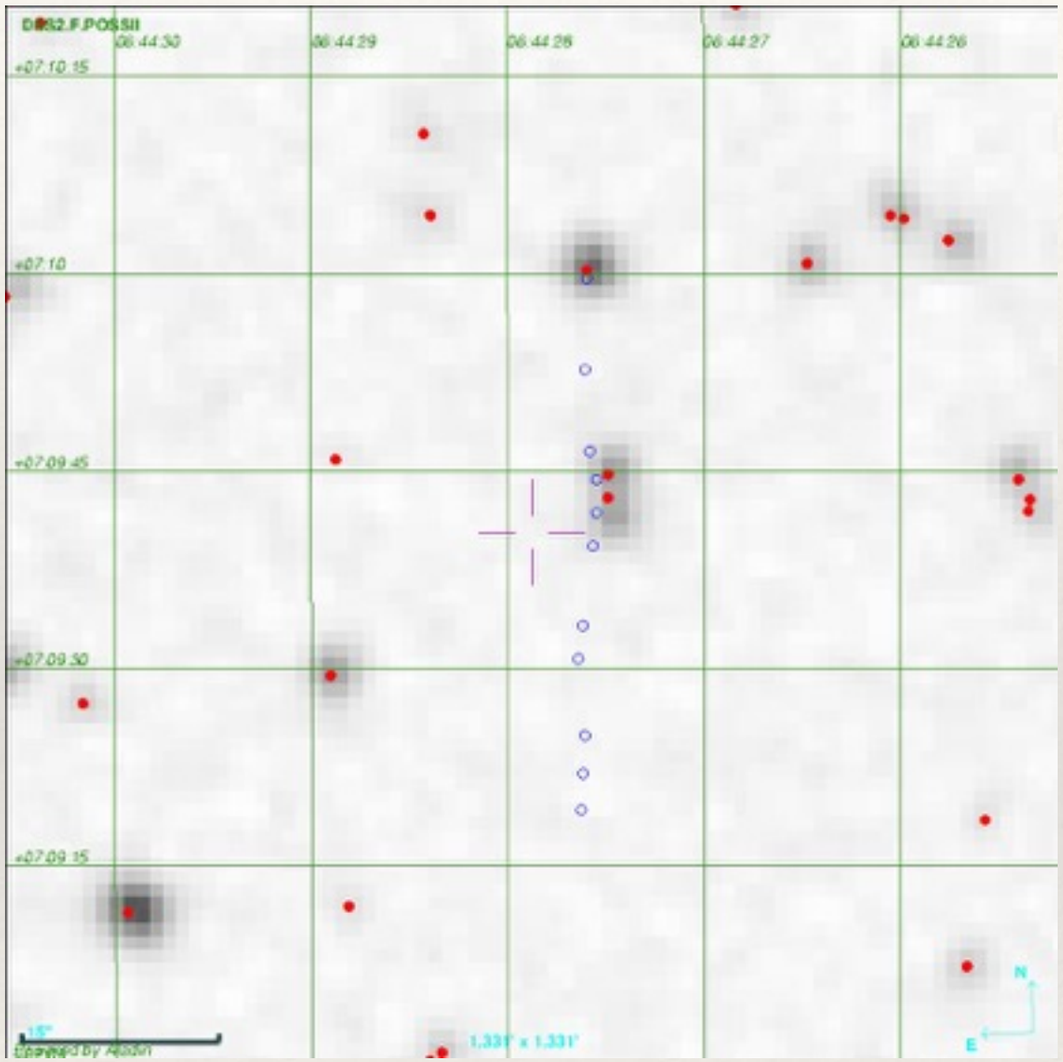
Outline

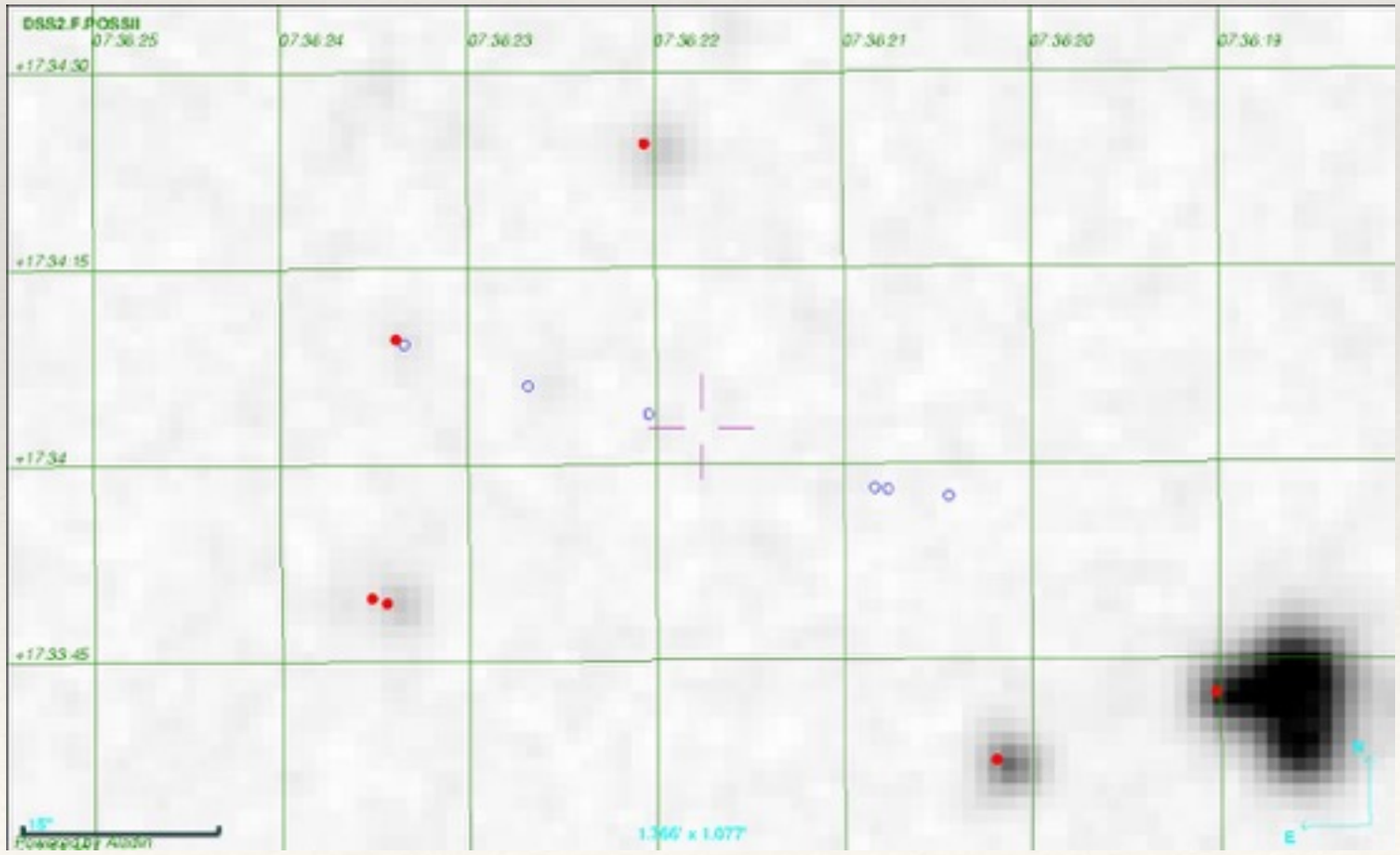
- Motivation
- MPC Observational Notes
- Statistics of cross identifying asteroid positions with USNO-B1.0 and UCAC4 catalogs
- Visual close encounters of PHA (99942) Apophis with stars
- Estimation of systematical bias
- Conclusions

Motivation



star

asteroid image asteroid



MPC Observational Notes

- There are 40 alphabetic notes available: www.minorplanetcenter.net/iau/info/ObsNote.html

MPC Notes	Code	Total number since 1988
Involved with star	I	16245
crowded star field	c	129
Measurement difficult	M	60
poor image	p	36
Position uncertain	P	0
Uncertain image	U	11
unconfirmed image	u	0

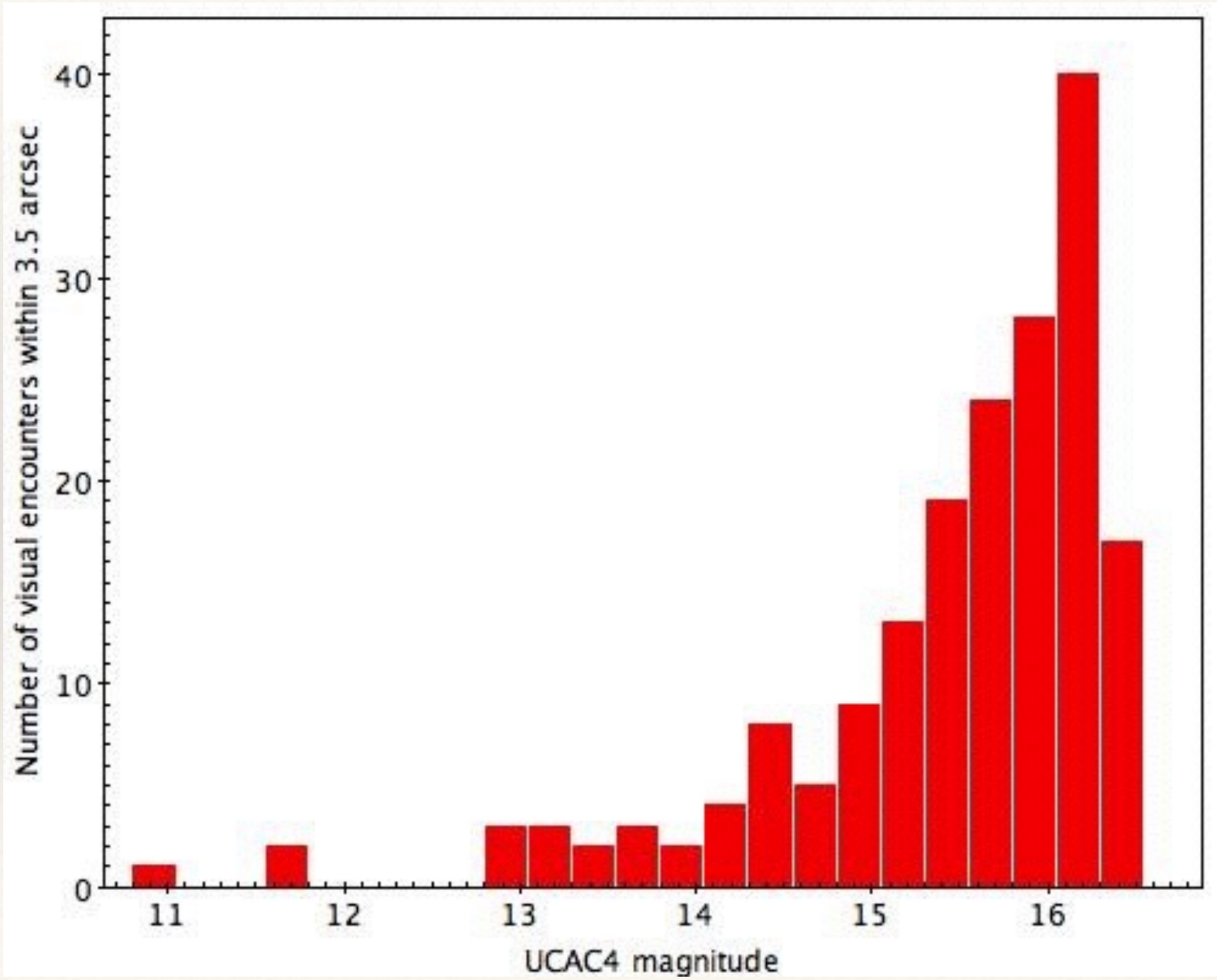
MPC Observational Notes

- Problems with the alphabetical notes:
- Most of them require human inspection or characterisation of the images/measurements;
- If there are more then two notes, which one is important to give? Only one is allowed!
- How to use them quantitively in orbital fitting? Discard the observation entirely?

Statistics of visual encounters with stars (all numbered asteroids)

Distance limit, arcsec	USNO-B1.0	Identif. USNO-B1.0 search with ON	UCAC4	Identif. UCAC4 search with ON
1.0	188298	34	14	0
1.5	417047	52	23	0
2.0	723056	83	46	0
2.5	1108474	130	76	0
3.0	1572919	198	121	0
3.5	2109278	257	183	0
		788		826

UCAC4 stars involved

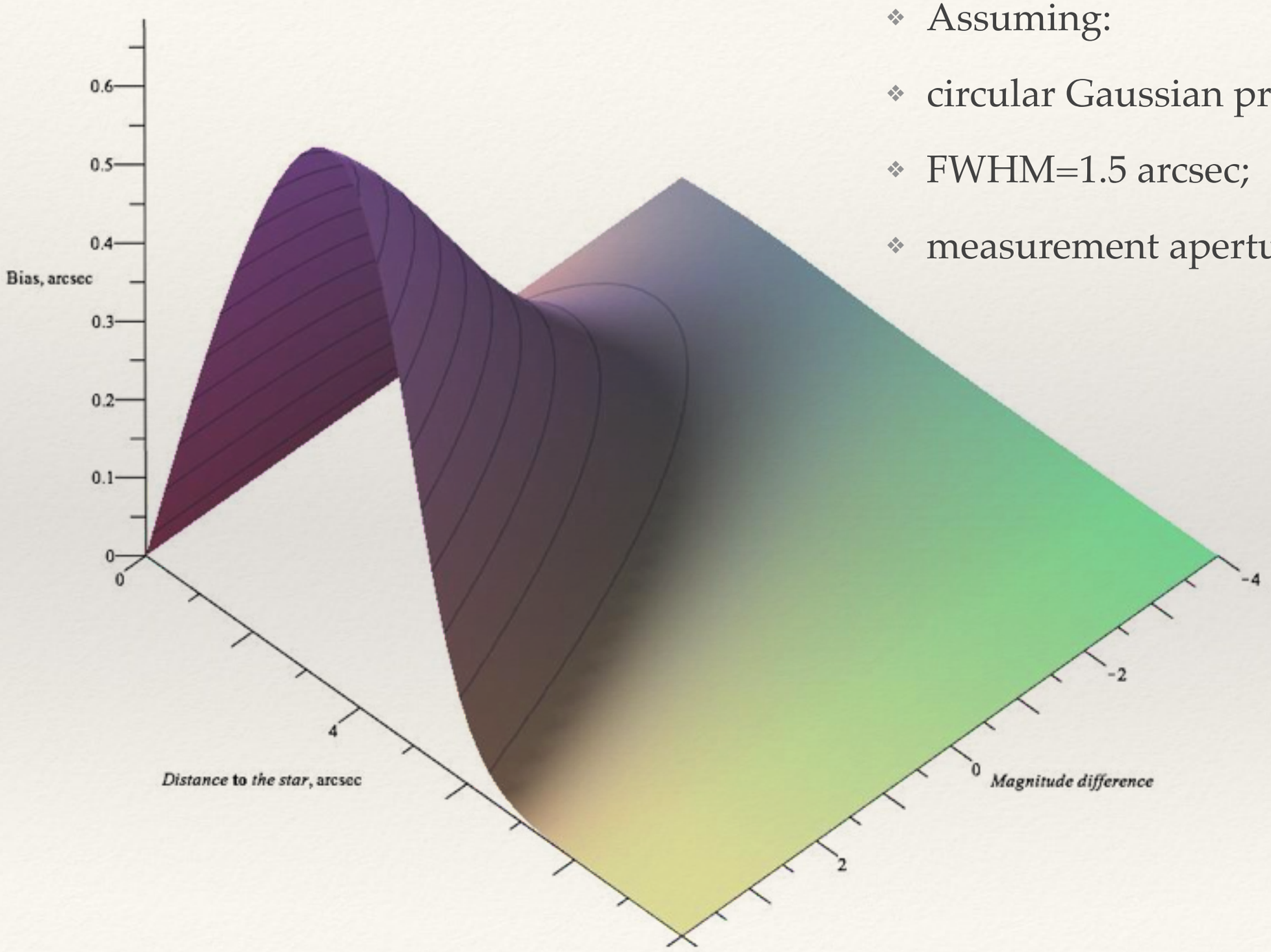


Visual encounters of (99942) Apophis

Distance limit, arcsec	USNO-B1.0	UCAC4
1.0	22	0
1.5	41	0
2.0	70	0
2.5	121	0
3.0	178	0
3.5	232	0

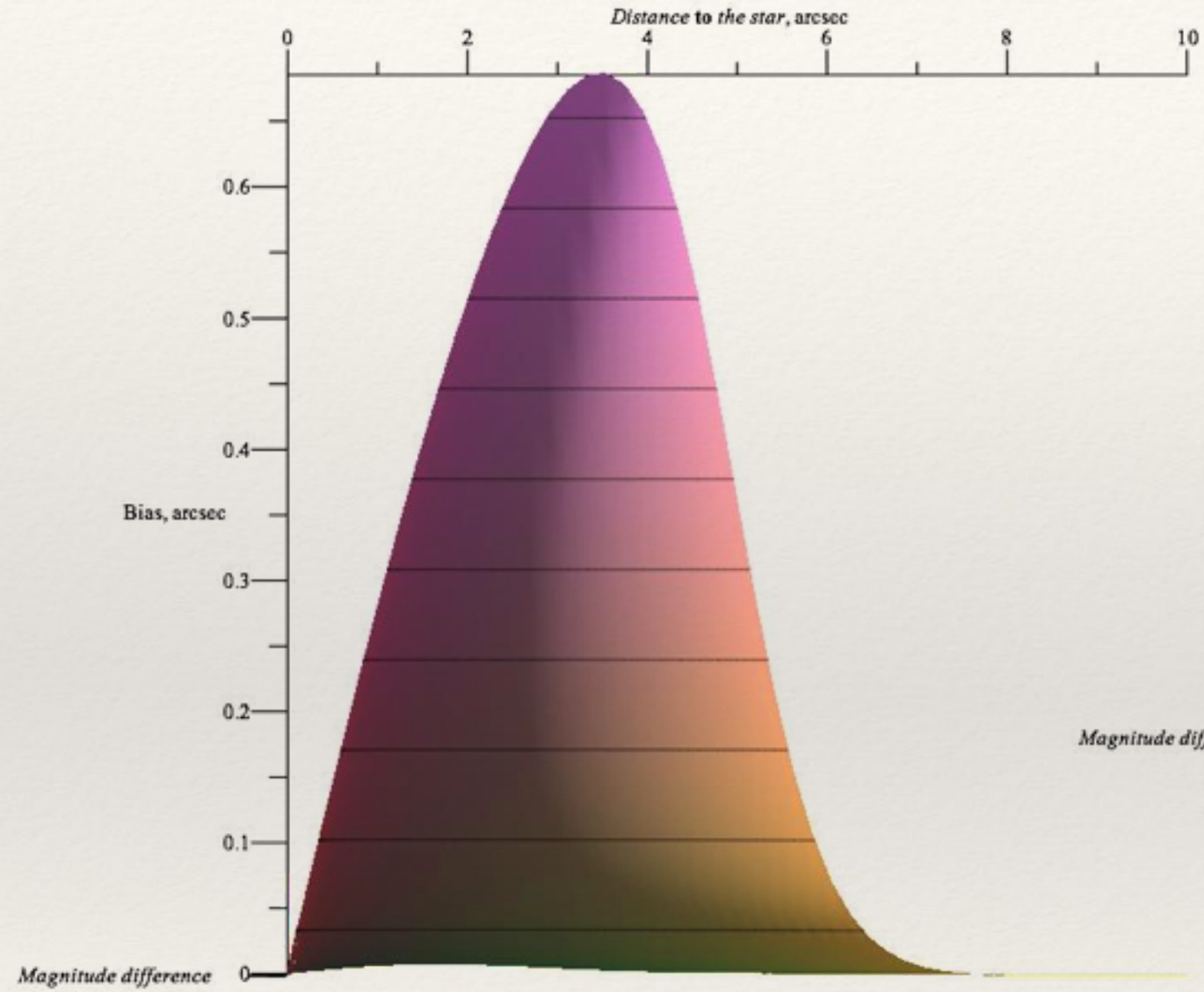
Only ONE observatory H21 reported ONE observation as being involved with star in 2012…

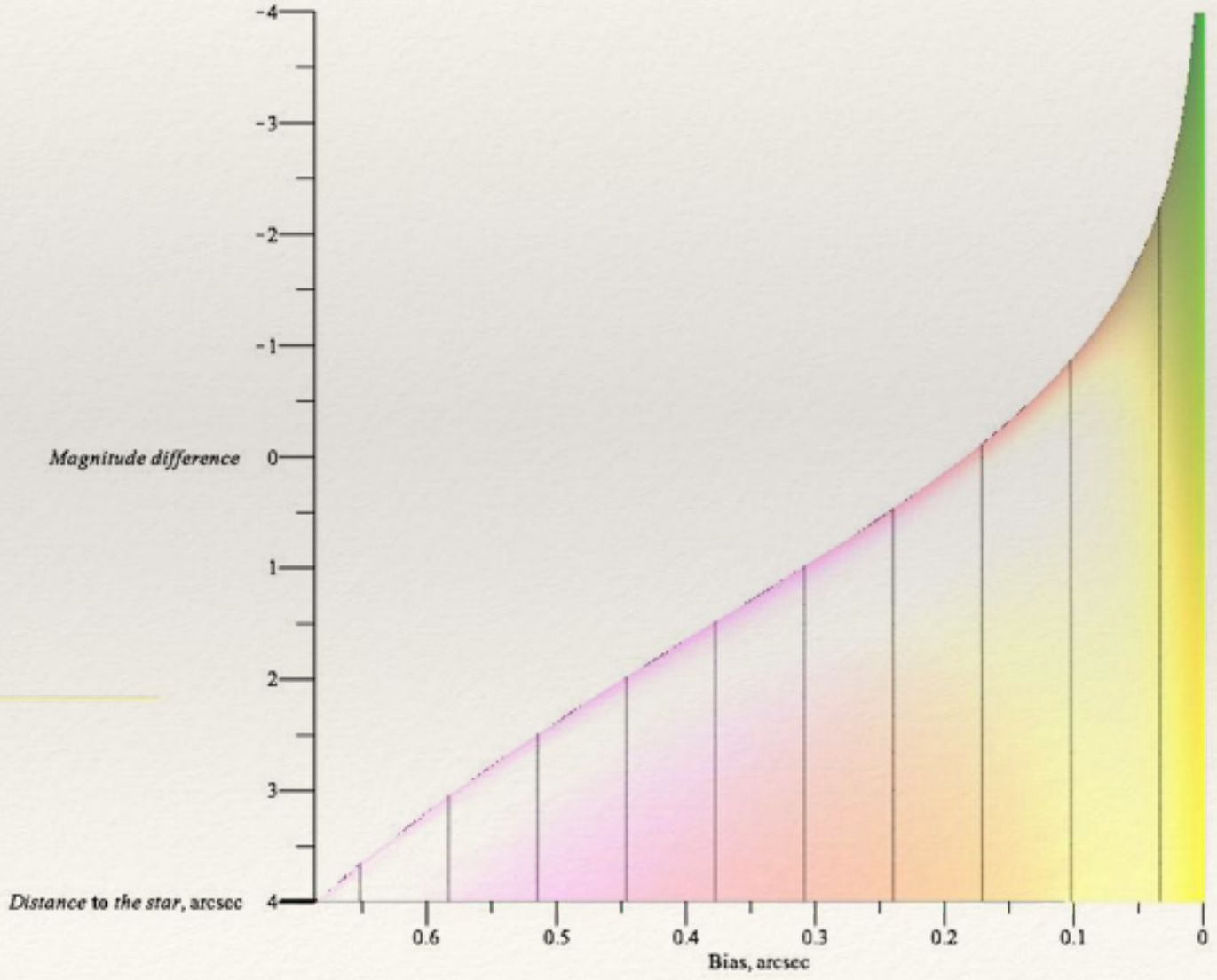
Estimation of bias



- Assuming:
- circular Gaussian profiles;
- FWHM=1.5 arcsec;
- measurement aperture R=1.5 arcsec.

Estimation of bias, slices





FWHM

- Atmospheric seeing;
- Diameter of telescope;
- Focusing of telescope;
- Wavelength band of observations;
- Optical aberrations over the field of view

- Recommendations:
- Astrometric reduction at the stage of image processing must detect visually close stars;
- Report of observational notes on the difficulties with observations/measurements is necessary

Conclusions

- Modelling of closely placed images of stars is necessary for improving astrometric reduction;
- It is necessary to report observational notes about difficulties in observations/measurements as this is the only way to give warning using the MPC format;
- Cases of close visual encounters of asteroids with the stars of USNO-B1.0 catalogue should not be considered in the orbital fitting while information about stars is not available.