Astrometric Positions of Irregular Satellites of Giant Planets from 23 Years of Observations

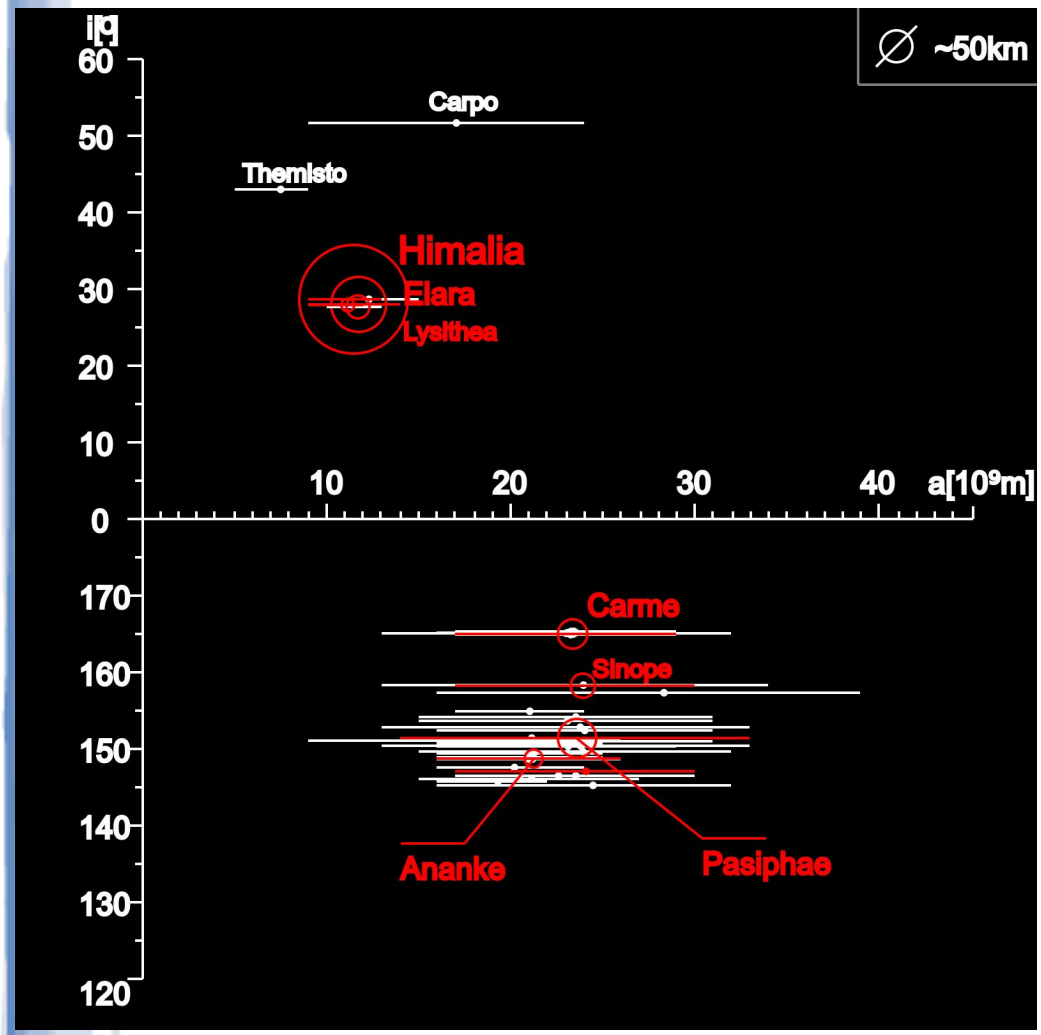
Altair Ramos Gomes Júnior

Marcelo Assafin
Roberto Vieira Martins
Júlio I. Bueno de Camargo
Felipe Braga Ribas
Bruno Eduardo Morgado
Alex Dias Oliveira
Gustavo Benedetti Rossi
Jean-Eudes Arlot
Yann Duchemin
Josselin Desmars
Valéry Lainey
William Thuillot
Alexandre Andrei
Dario N. da Silva Neto

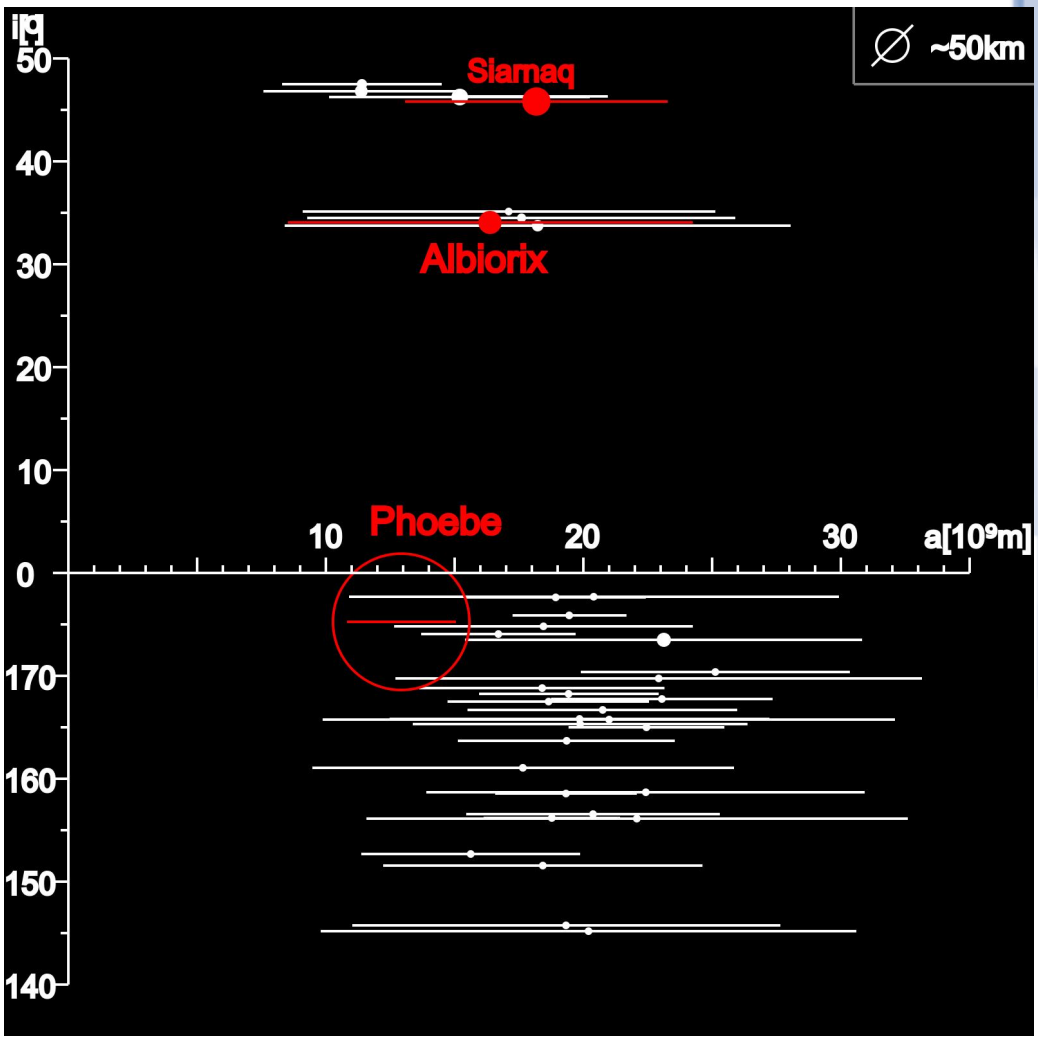
Goal

- Organize e reduce three database with images of the irregular satellites of the giant planets observed between 1992 e 2014 at OPD, OHP e ESO.
- Obtain precise positions from these observations which can be used to:
  - New numerical integrations of the orbits of these satellites.
  - Predict and observe stellar occultations by these objects.

Irregular Satellites



Satellites of Jupiter



Satellites of Saturn

Irregular Satellites

- Capture:
  - Gas Drag (Cuk & Burns, 2003);
  - 3-body interation (Nesvorný et al., 2007);
  - Collision (Sheppard, 2006).
- Orbital Evolution:
  - Origin of the orbital family of satellites (Nesvorný et al., 2004);

Observations

Telescope	Diameter	Number of CCDs	Filters	Number of Images	Time Span
OHP	1.2 m	1	Clear	2168	1998-2008
ESO	2.2 m	1	I	1500	2007-2009
OPD (PE)	1.6 m	9	Clear, U, B, V, R, I	1732	1992-2014
OPD (B&C)	0.6 m	11	Clear, U, B, V, R, I	2960	1995-2014
OPD (Zeiss)	0.6 m	9	Clear, B, V, R, I	106	1996-2014

Reduction Process

- Bias and flat-field calibration.
- PRAIA:
  - Extract data of the header of the images;
  - Detect objects in the image (x, y);
  - Identify catalogue reference stars;
    - UCAC4
  - Obtain (α,δ) from gnomonic projection;
  - Identify targets in the images.
    - JPL ephemeris.

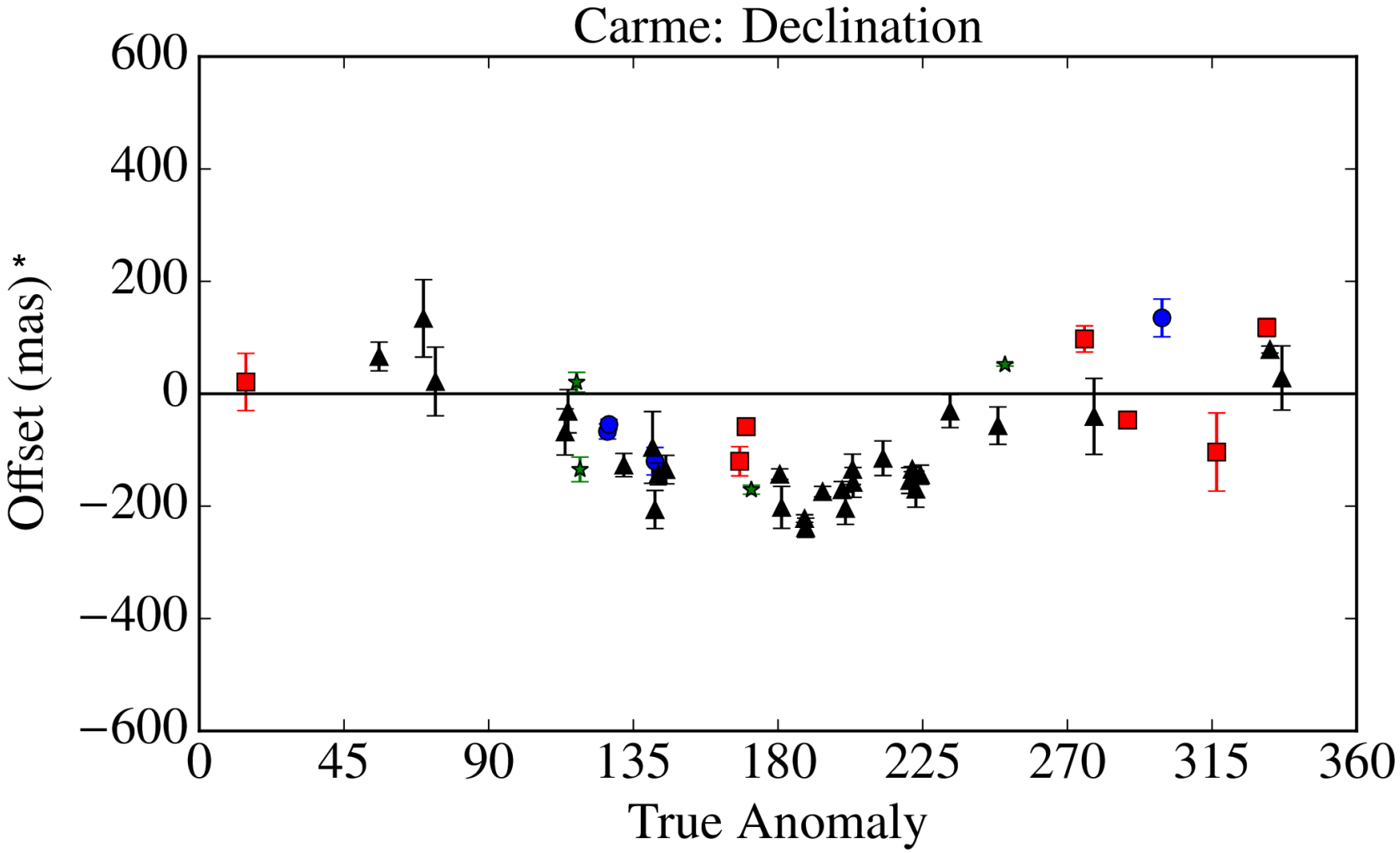
RESULTS

Results

Satélite	Diâm. (km)[3]	Mag V	OPD	OHP	ESO	Total	Jacobson*
Himalia	170	14	854	357	23	1234	1757
Elara	86	16	403	187	46	636	1115
Lysithea	36	18	60	84	90	234	431
Leda	20	19	6	48	44	98	178
Pasiphae	60	17	295	248	66	609	1629
Callirrhoe	9	21	9	-	16	25	95
Megaclite	5	22	-	-	10	10	50
Ananke	28	18	52	141	57	250	600
Praxidike	7	21	-	-	2	2	59
Carme	46	18	90	204	37	331	973
Sinope	38	18	41	169	11	221	854
Themisto	8	21	-	-	16	16	55
Phoebe	213	16	1239	516	32	1787	3479
Siarnaq	40	20	-	20	56	76	239
Paaliaq	22	21	-	-	11	11	82
Albiorix	32	20	-	-	46	46	137
Sycorax	150	21	-	-	35	35	237
Nereid	340	19	803	-	99	902	716

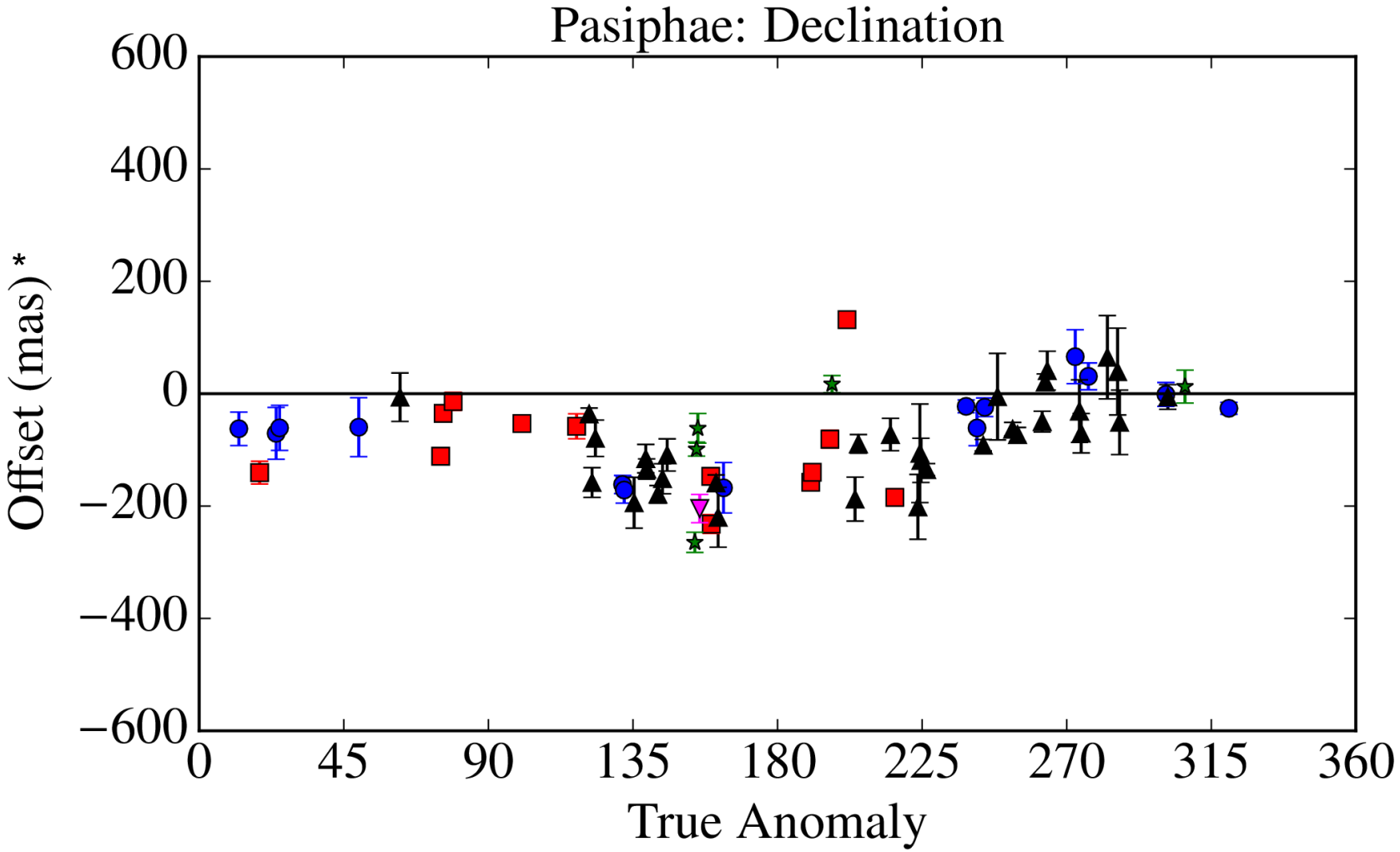
* Jacobson, R. A. et al, 2012, The Astronomical Journal

Results - Carme



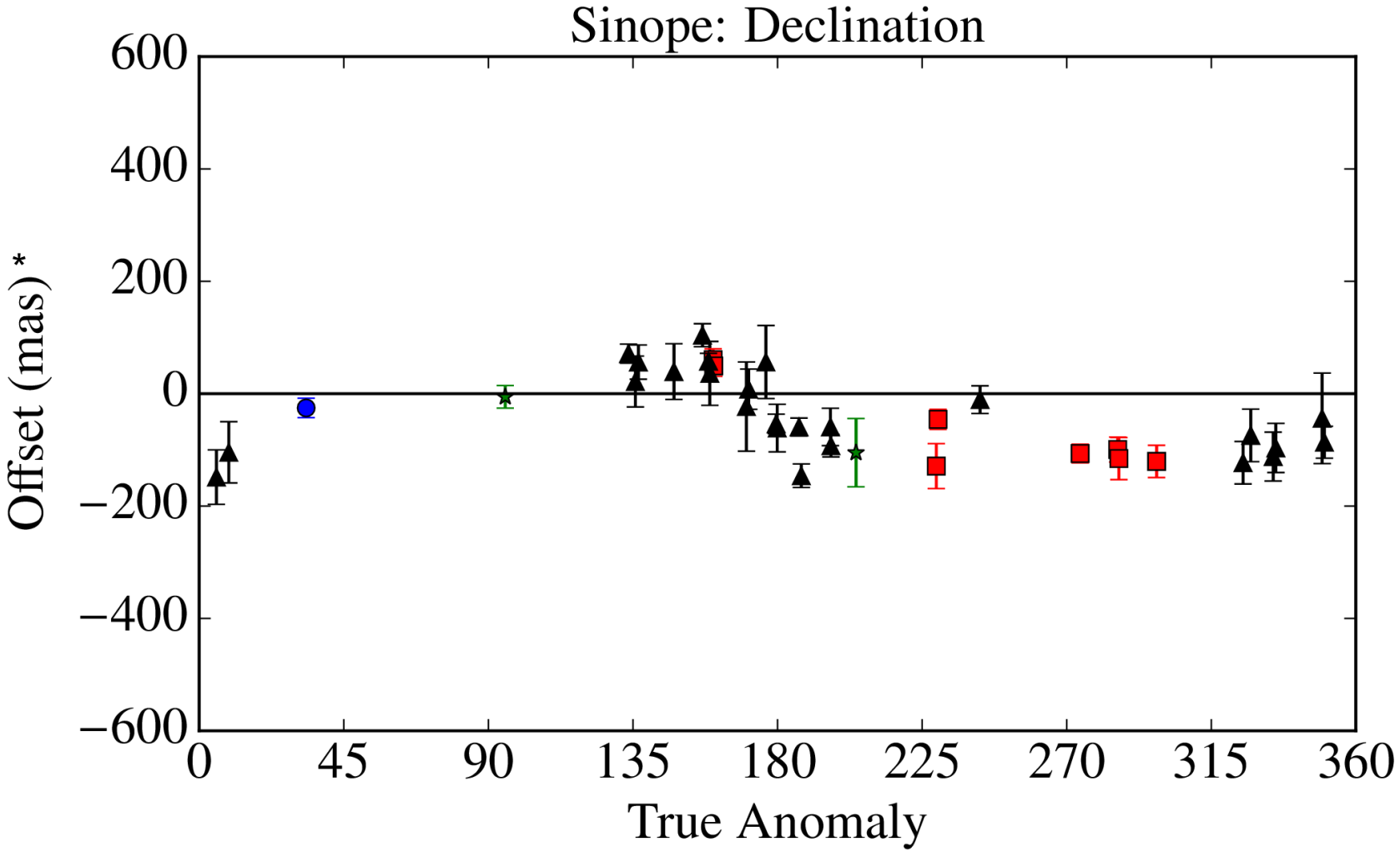
* Relative to JPL jup300 ephemeris

Results - Pasiphae



* Relative to JPL jup300 ephemeris

Results -Sinope



* Relative to JPL jup300 ephemeris

Results

A&A 580, A76 (2015)
DOI: 10.1051/0004-6361/201526273

Astronomy & Astrophysics

Astrometric positions for 18 irregular satellites of giant planets from 23 years of observations⋆,⋆⋆,⋆⋆⋆,⋆⋆⋆⋆

A. R. Gomes-Júnior[1], M. Assafin[1,4], R. Vieira-Martins[1,2,3,4], J.-E. Arlot[4], J. I. B. Camargo[2,3], F. Braga-Ribas[2,5], D. N. da Silva Neto[6], A. H. Andrei[1,2,4], A. Dias-Oliveira[2], B. E. Morgado[1], G. Benedetti-Rossi[2], Y. Duchemin[4,7], J. Desmars[4], V. Lainey[4], and W. Thuillot[4]

Conclusion

- We identified 8466 observations of irregular satellites, from which we obtained 6523 suitable astrometric positions.
- Position errors estimated of about 60-80 mas depending on brightness.
- All positions are available at the CDS

Next Steps

- Numerical Integration of the orbits of the Irregular Satellites.
- Predict and observe stellar occultations by these objects.
- Re-reduce the observations with GAIA catalogue.

Thank You