The size distribution of TNOS and the implications for the discovery of large members and the prediction of occultations

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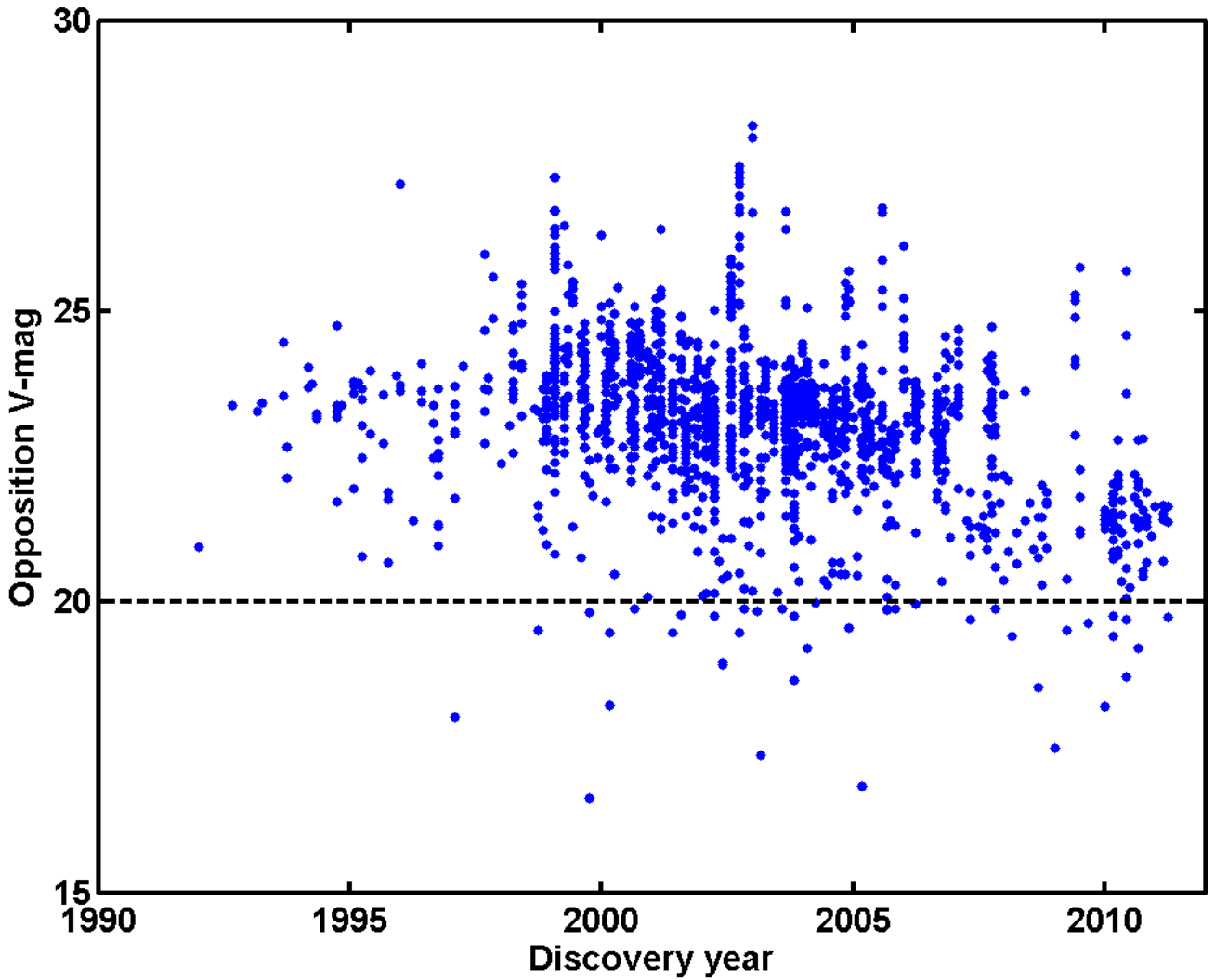
Apologies

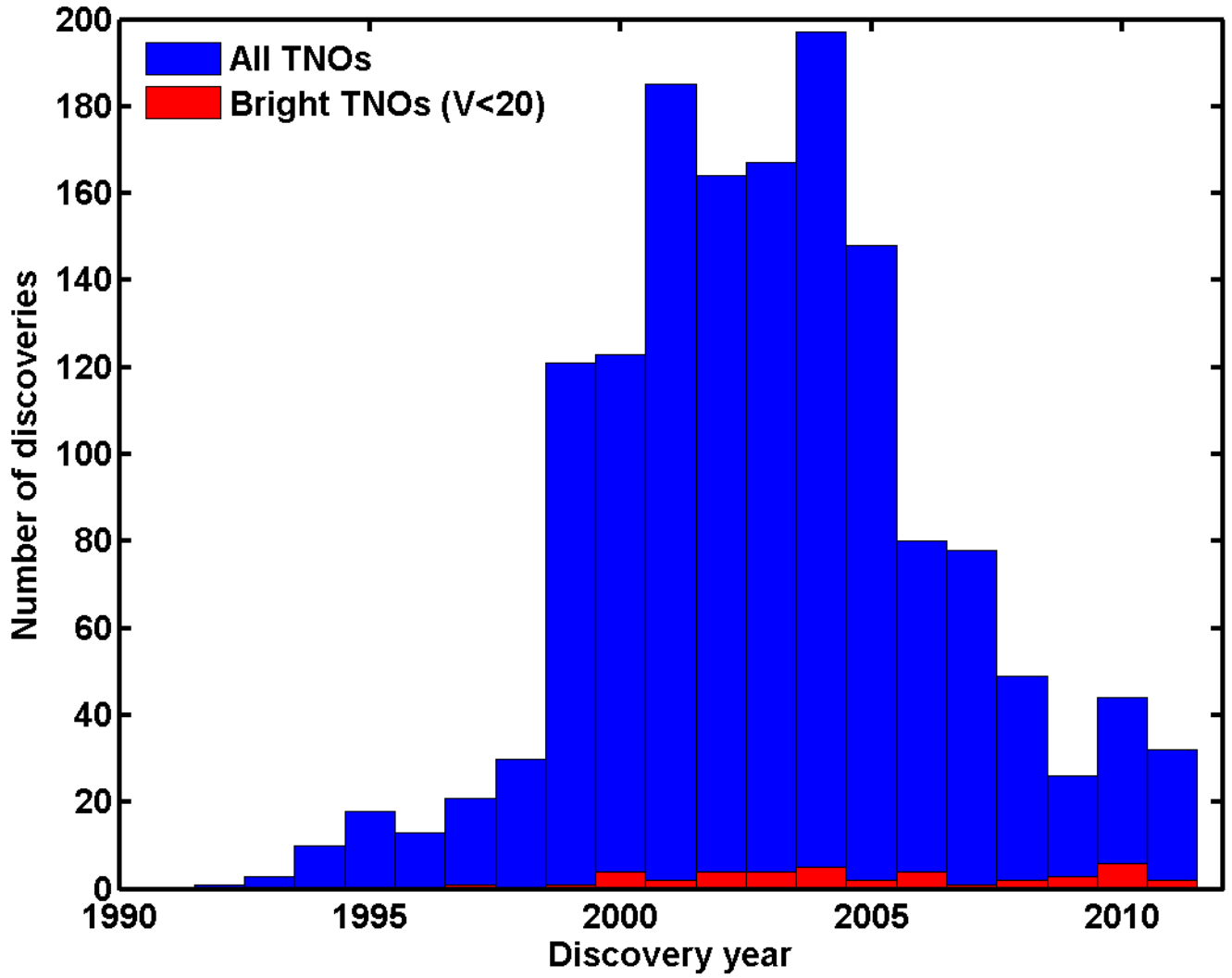
- For the FAAAAR TOOO late registration to the Workshop
- + Eastern
- + Two events in the **S.A.G.A.O**

To be in line with today

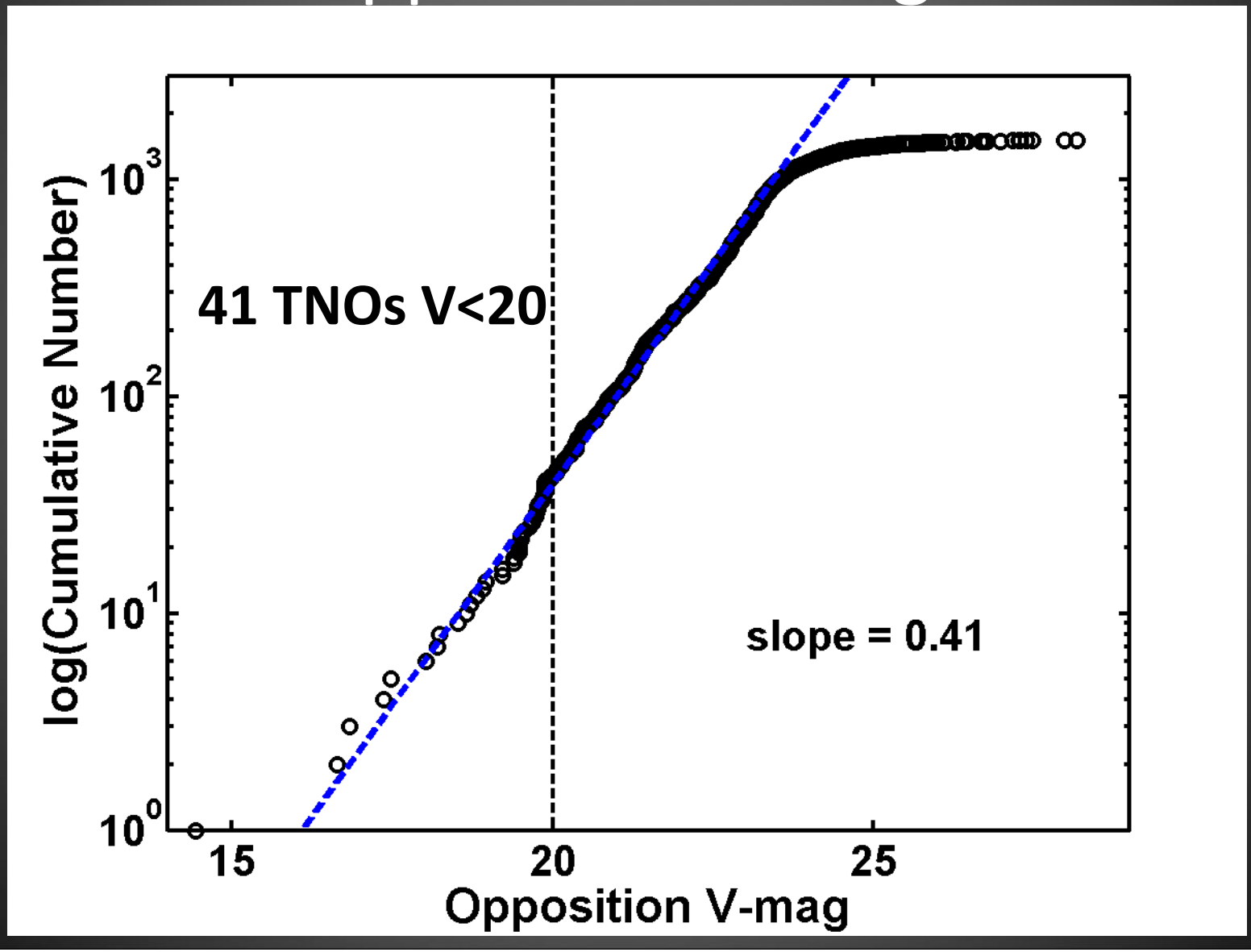
Discovery Opposition V-mag



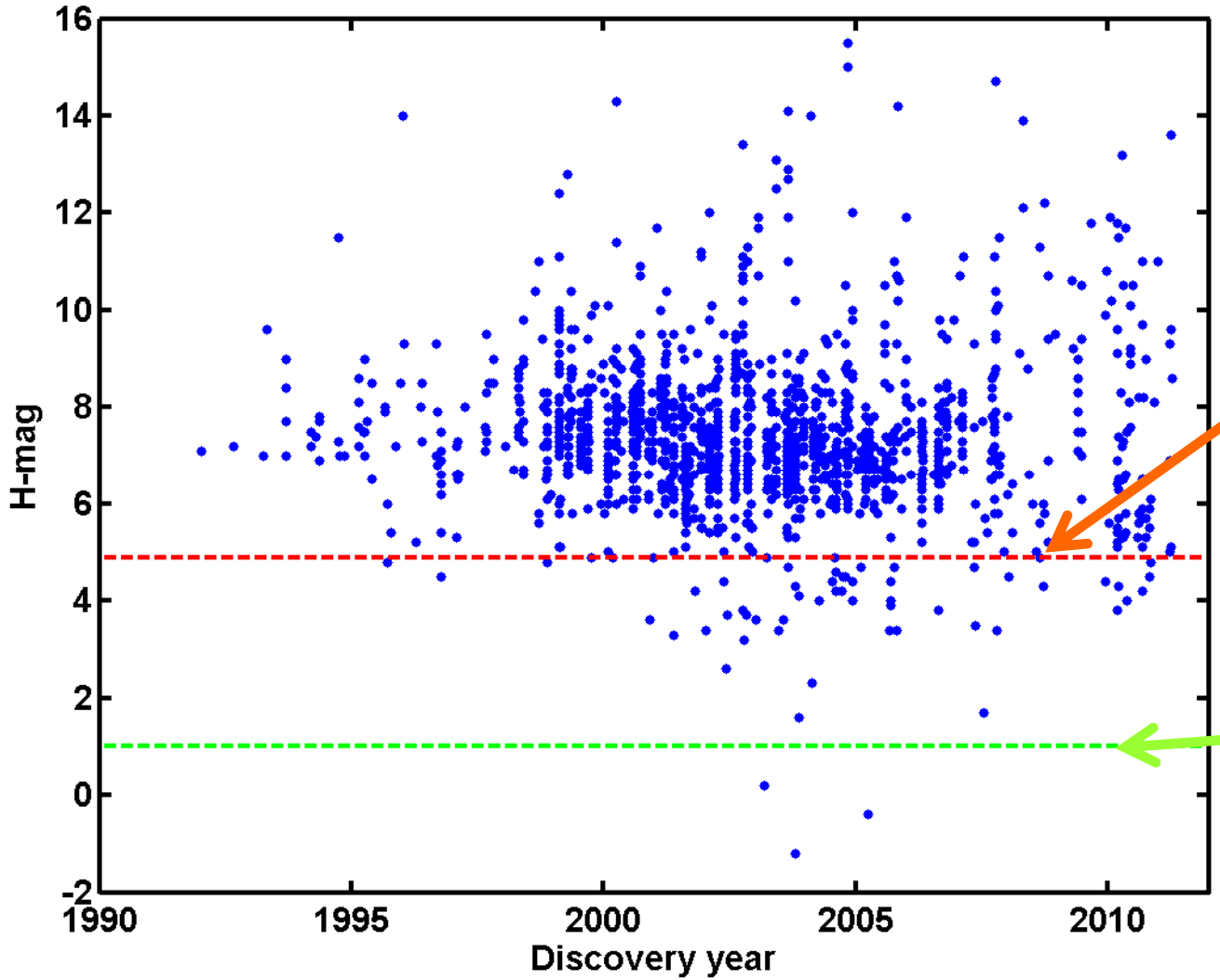
Discovery Opposition V-mag



Cumulative Distribution Opposition V-mag



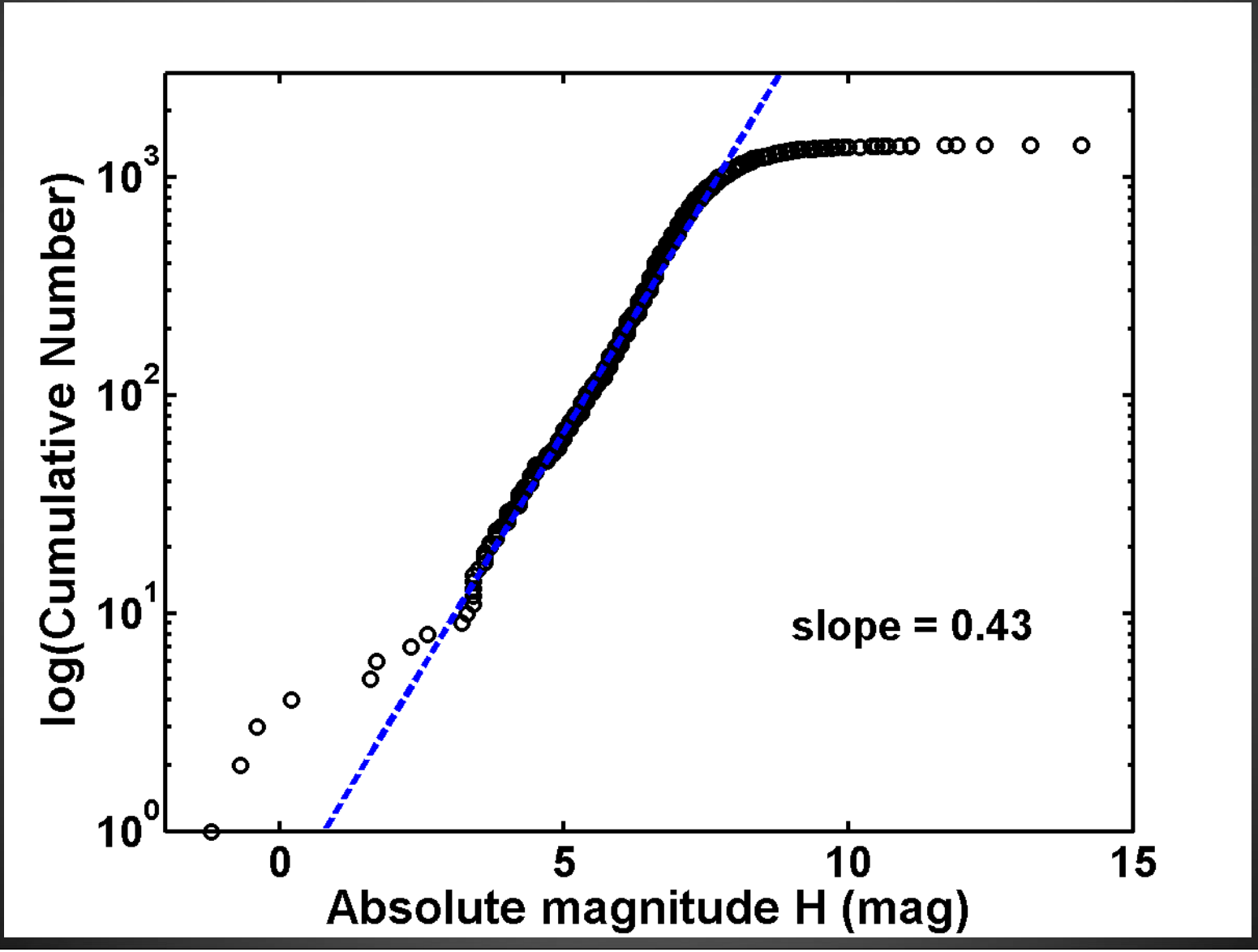
Discovery
Absolute H-mag



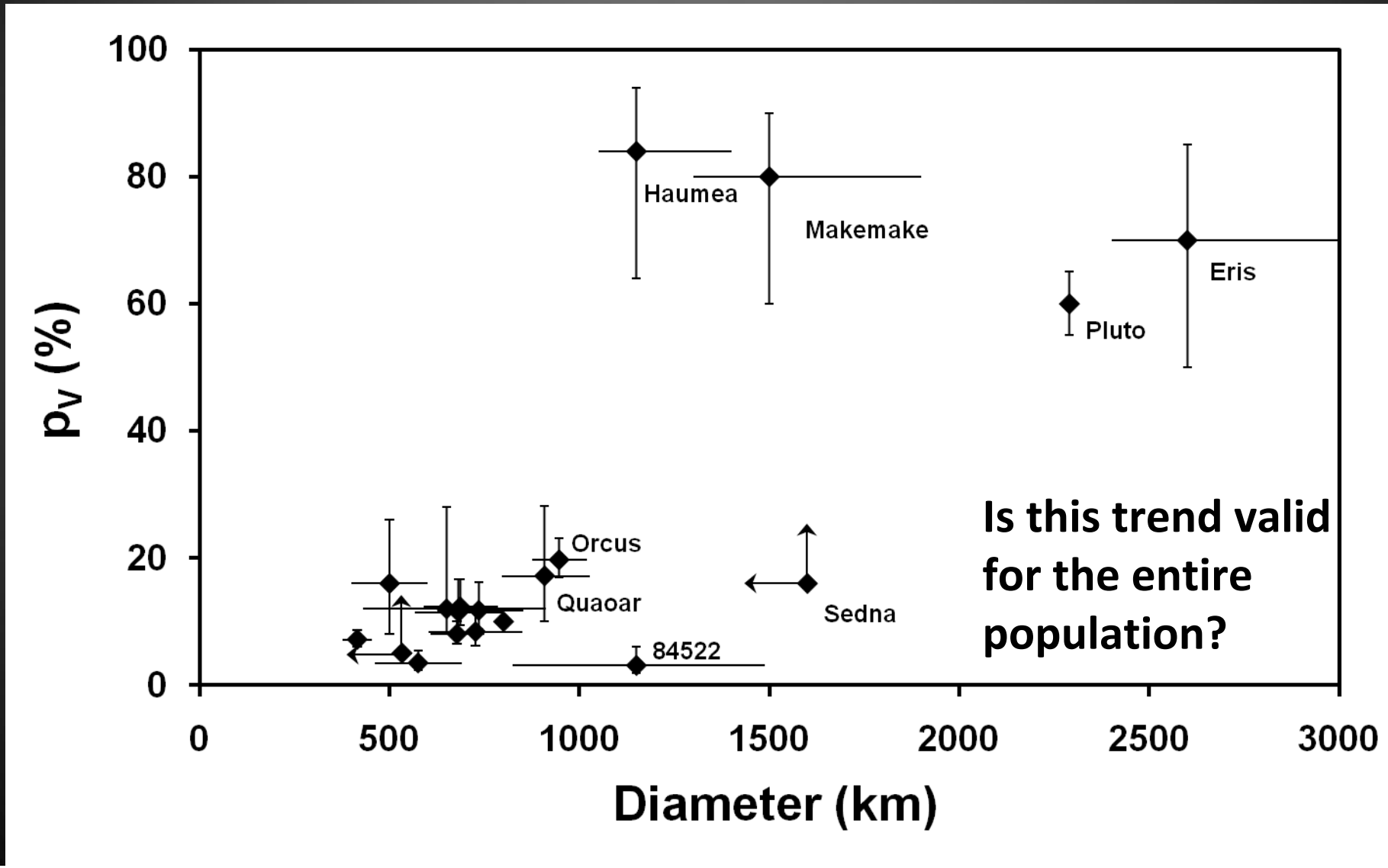
Limit of "dwarf planets" based on geophysical considerations
(Tancredi & Favre 2008)

Limit of plutoids according to IAU

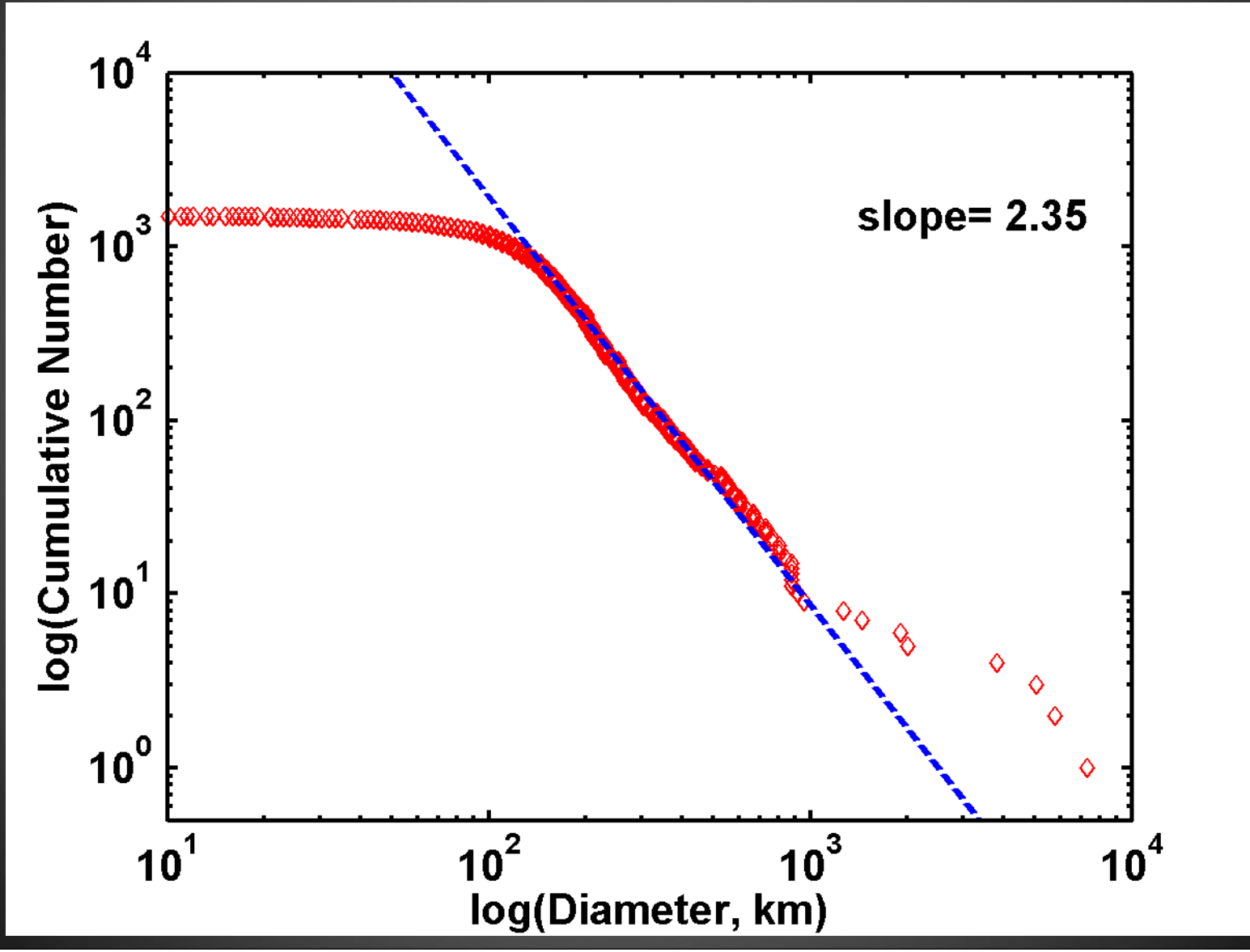
Cumulative Distribution Absolute H-mag



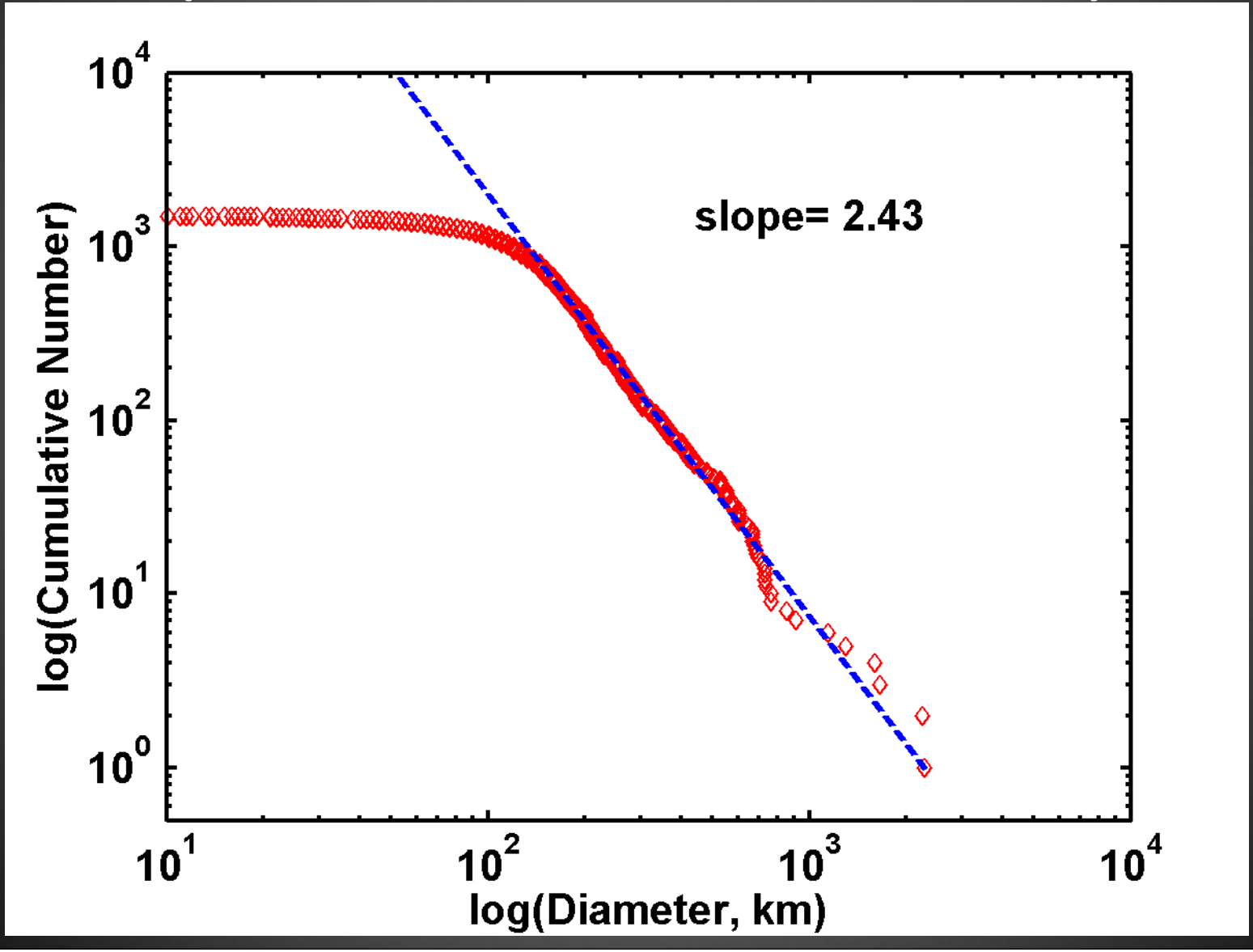
From H-mag to sizes
few known albedos



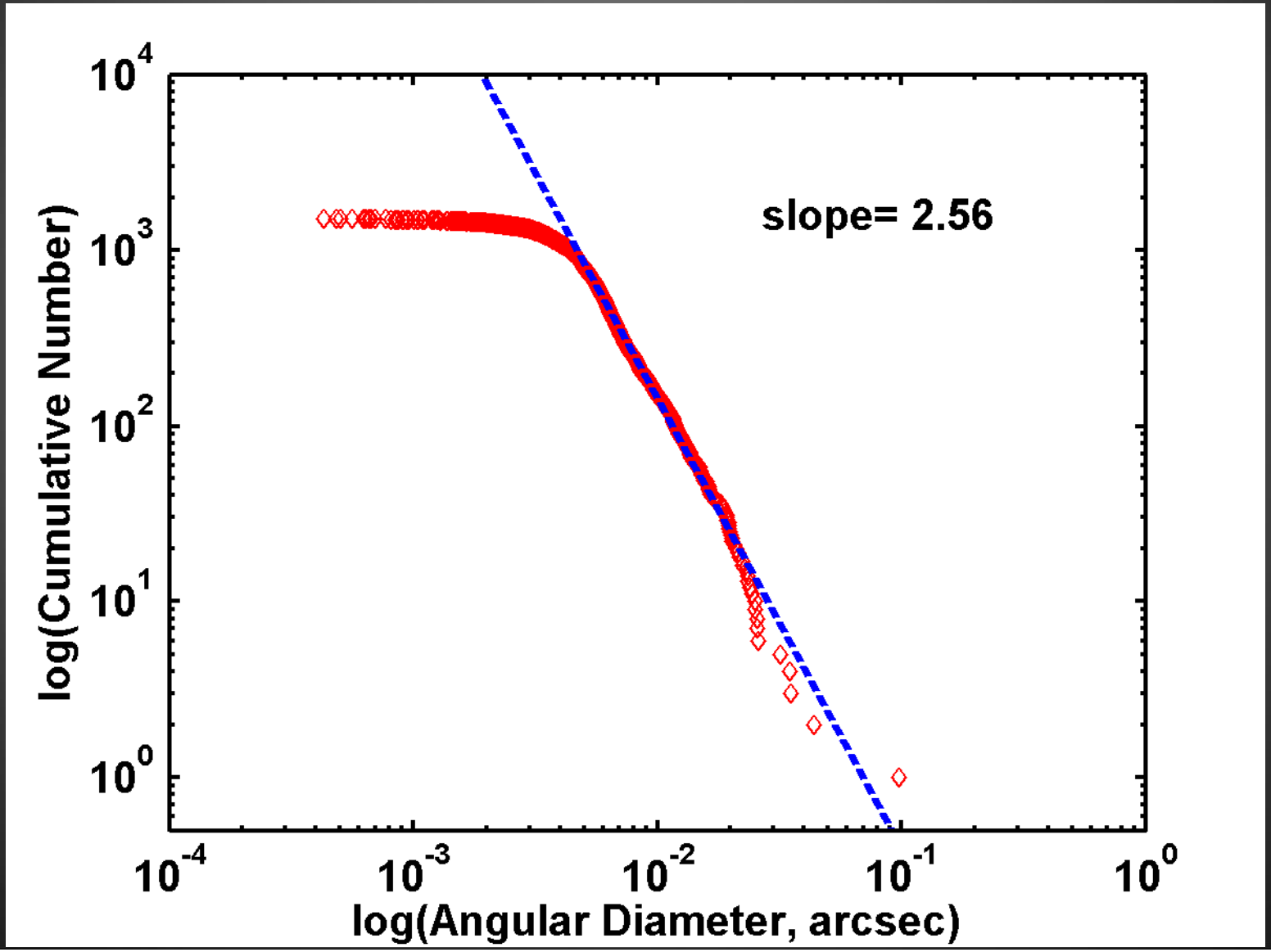
Cumulative Size Distribution (sizes computed with same albedo p=0.1)



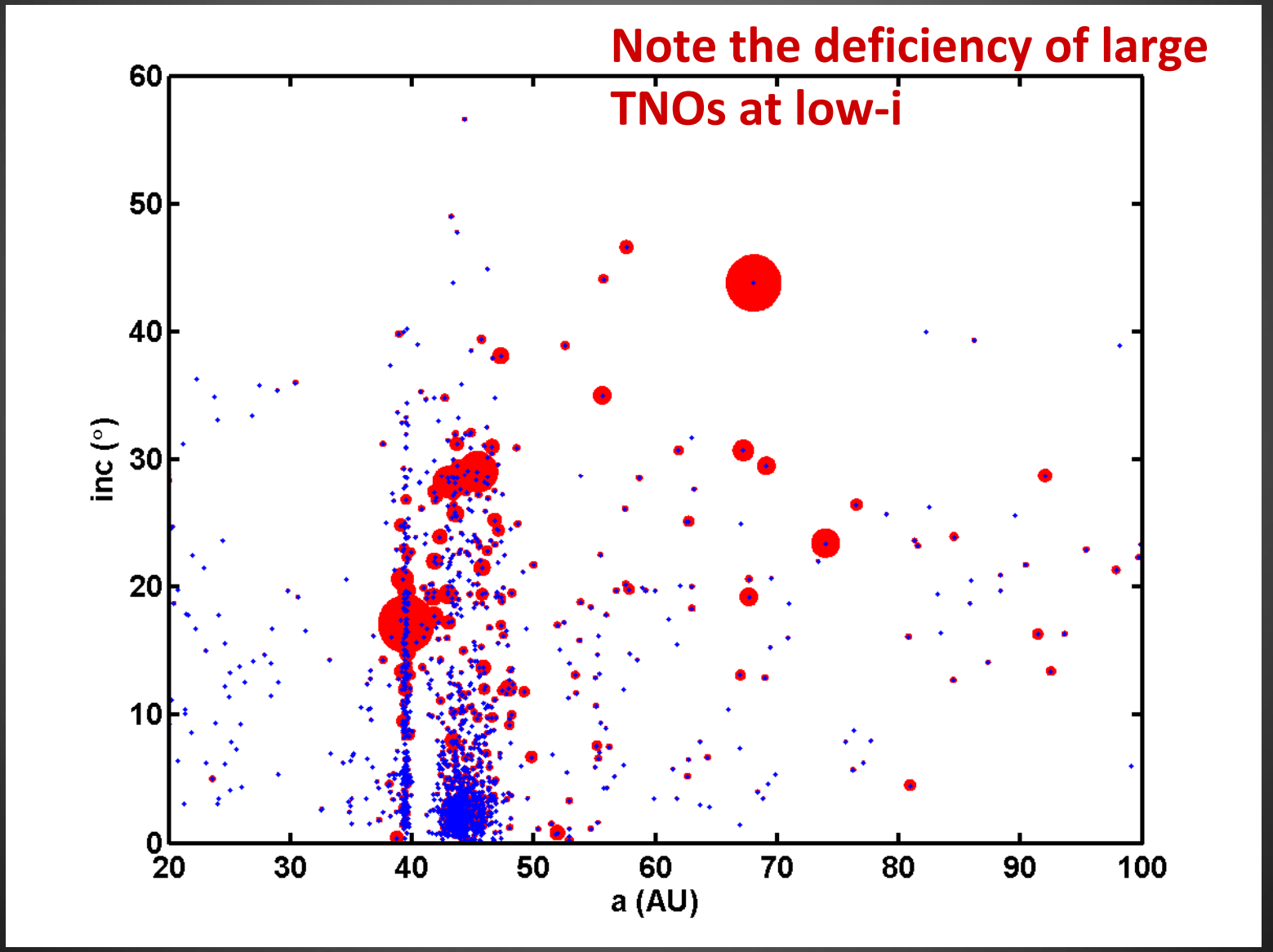
Cumulative Size Distribution (known + assumed albedo)



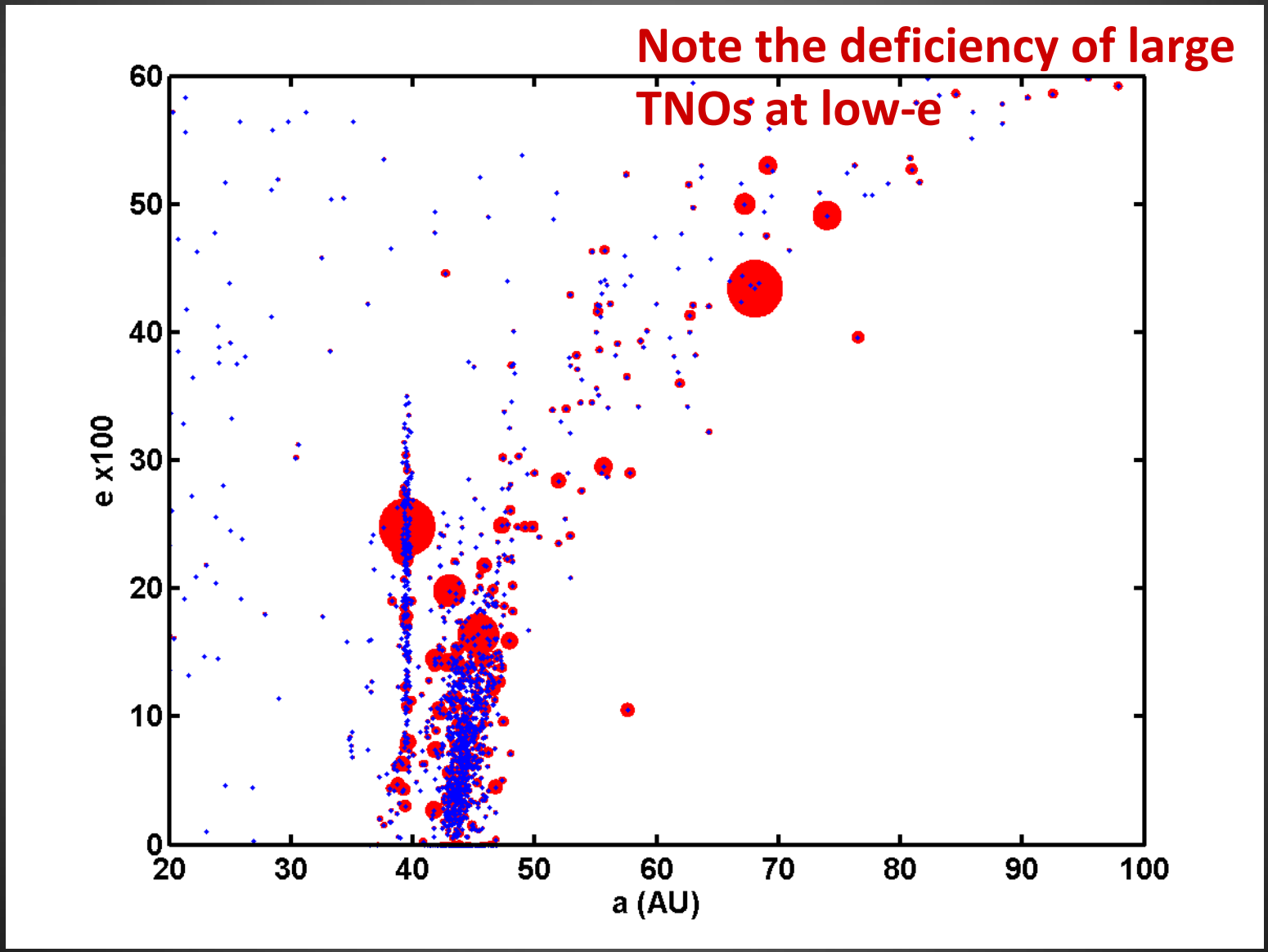
Cumulative distribution Angular Diameter



a vs i


Note the deficiency of large
TNOs at low-i
inc (°)
a (AU)
0
10
20
30
40
50
60
20
30
40
50
60
70
80
90
100

a vs e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0
10
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30
40
50
60
20
30
40
50
60
70
80
90
100

Coverage of the Palomar Survey down to R~20.5

Brown (2009)

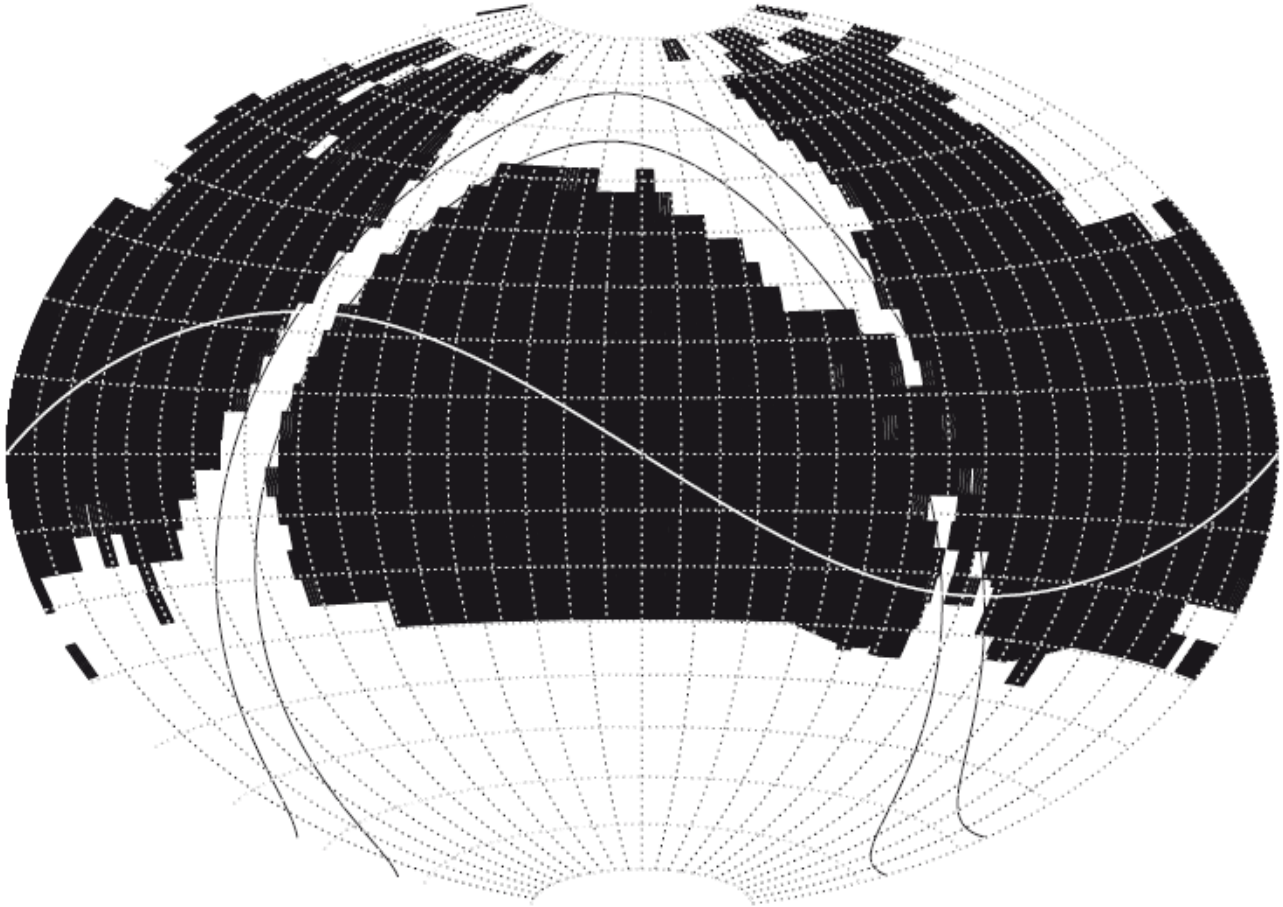
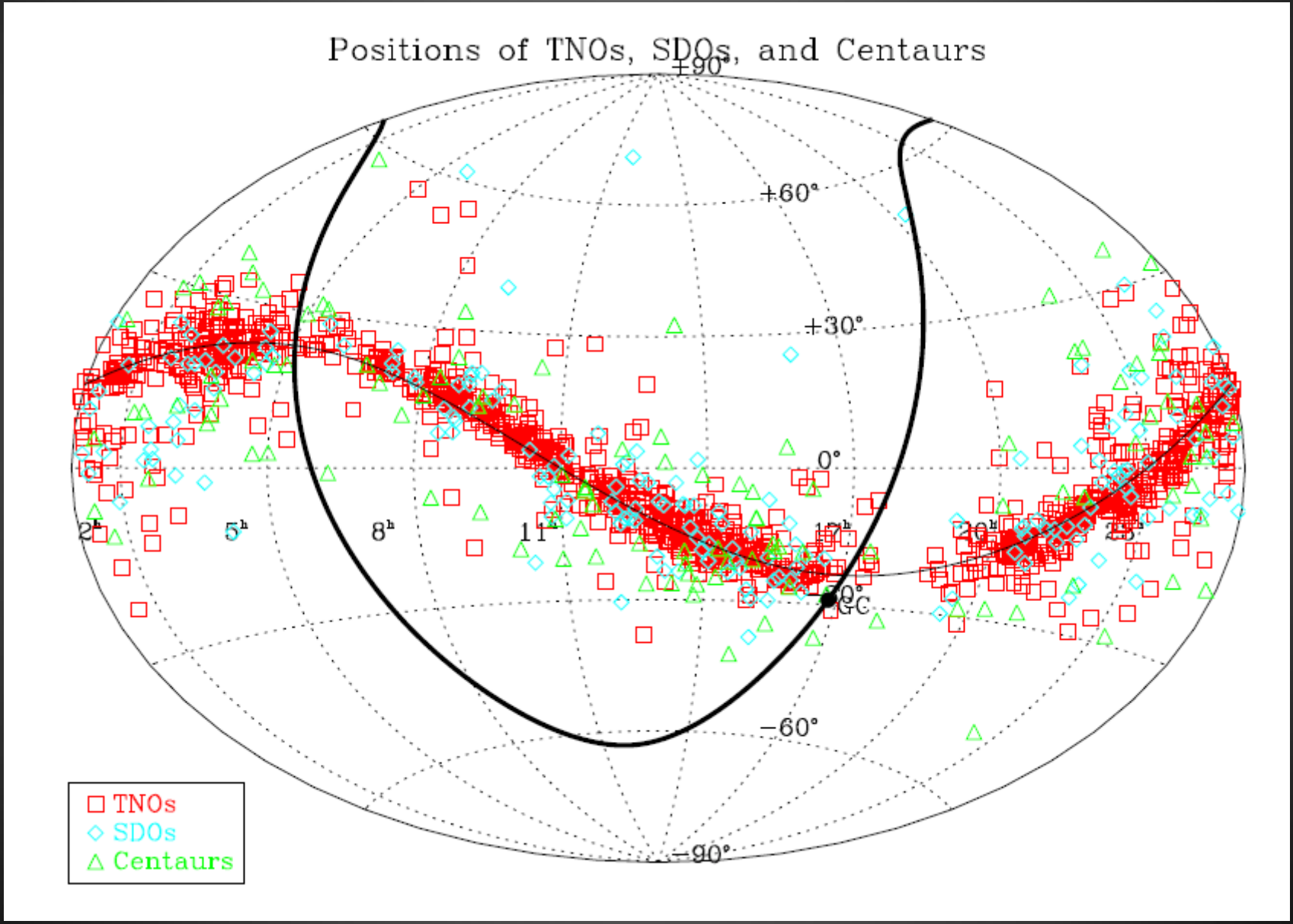


Fig. 1. Coverage of the Palomar survey for large Kuiper belt objects. The map is centered at RA and declination of 0°. The white line shows the ecliptic. Approximately 20,000 deg² north of −30° declination, mostly avoiding the galactic plane, have been covered to a limiting magnitude of R ~ 20.5. Seventy-one large KBOs have been found in the survey, including most of the large KBOs discussed here.

What was the efficiency?

Do we expect some missing large TNOs in the searched area?

Present positions



How many plutoids?

- Palomar survey of large TNOs covered 20.000 deg^2 down to R-mag. ~ 20.5
- It corresponds to H<0.5 for a object at 100 AU
- 20.000 deg^2 ~ half of the sky

- They detected 4 objects with H<1 (including Pluto)
- One would expect to find 3-4 more large TNOs like the 4 official "plutoids“ (assuming 100% efficiency)

- Where?
  - Close to the galactic plane ~ 1
  - With Dec<-30 ~ 2-3

- >40 more with H<4.8 to be discovered

(Tancredi, 2010)

On going southern surveys

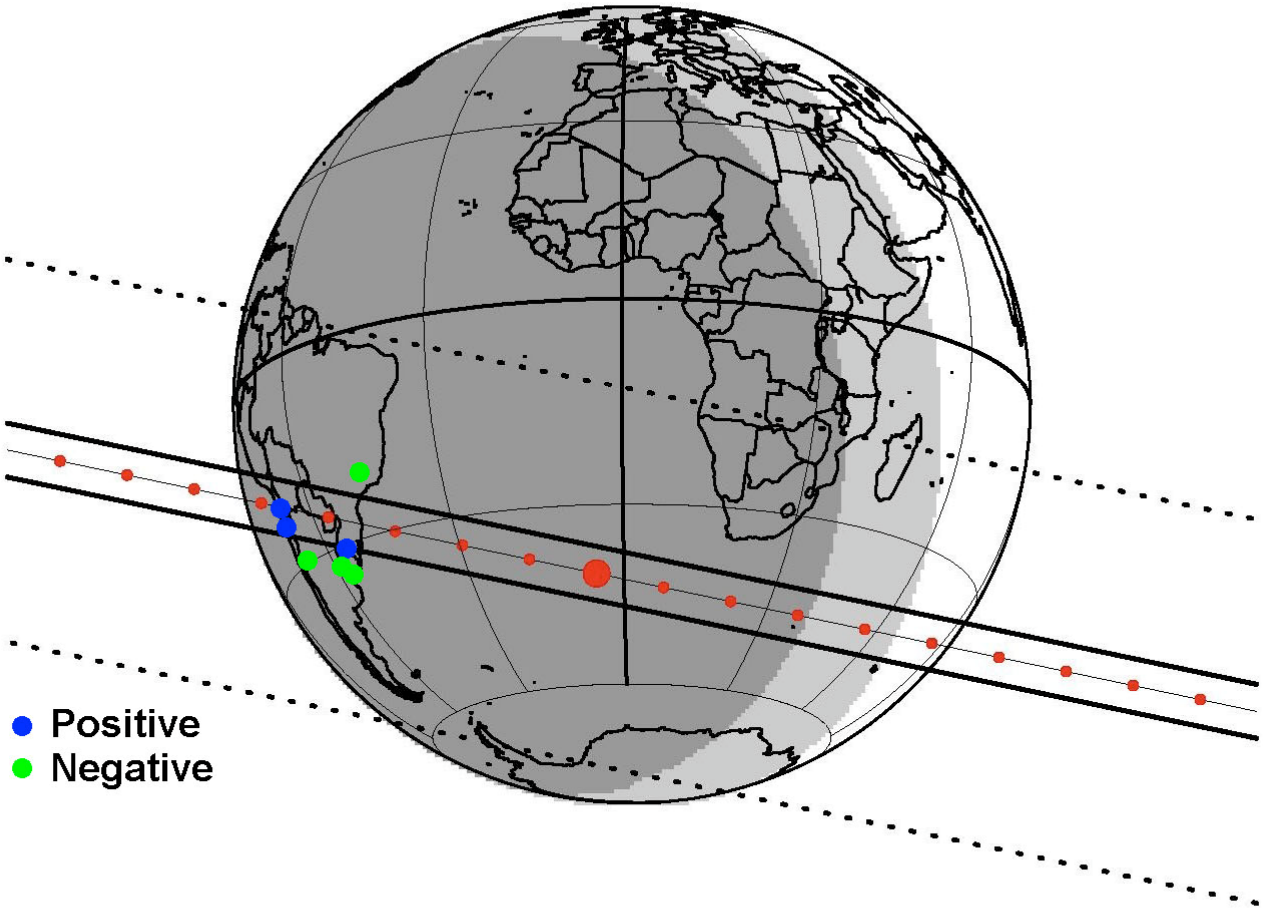
- La Silla-QUEST (LSQ), Chile – Rabinowitz et al.
- Las Campanas , Chile - Sheppard, Udalski, Trujillo and OGLE TEAM
- San Pedro de Atacama, Chile & San Juan (Argentina) – Ortiz et al.

- 7 discoveries with H<4.8 in the last year
- Not known the limiting magnitude, the area already covered or the efficiency.

Prospects for Gaia

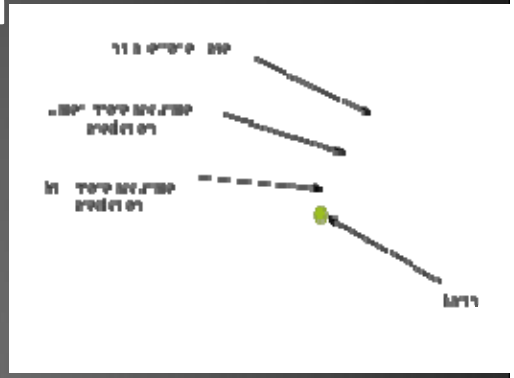
- Very few discoveries of bright TNOs
  - May be a few close to the galactic plane
- There will be ~60-80 objects with V<20 to follow-up
- Astrometric measurements of these 60-80 objects
  - Improvements in the orbits
  - Very accurate predictions of occultations
- Reanalysis of previous astrometric measurements of faint TNOs with a better catalogue

Occultation of Quaoar (4/5/2011)



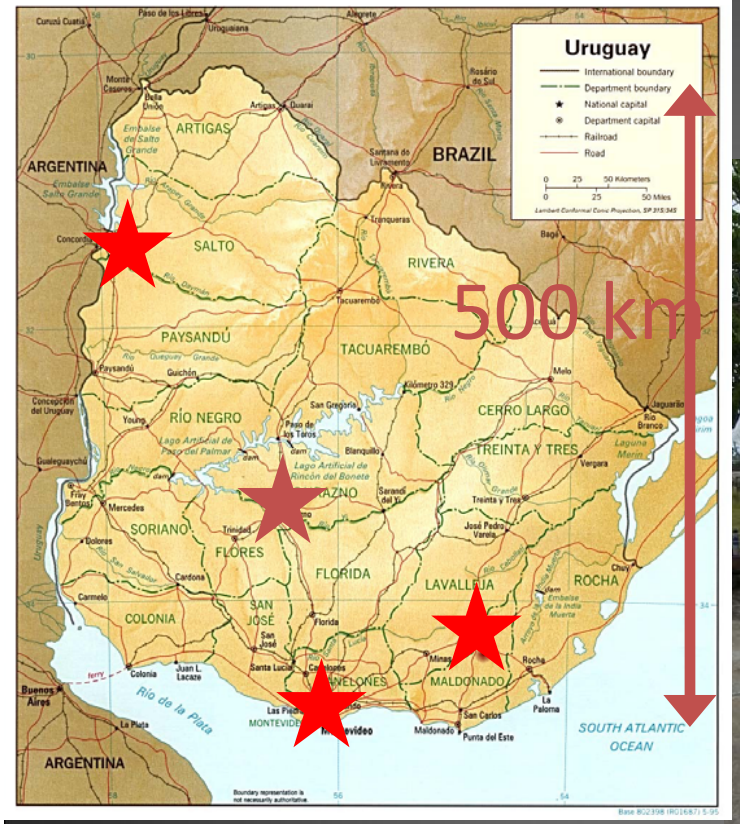
Deterministic vs Probabilistic predictions

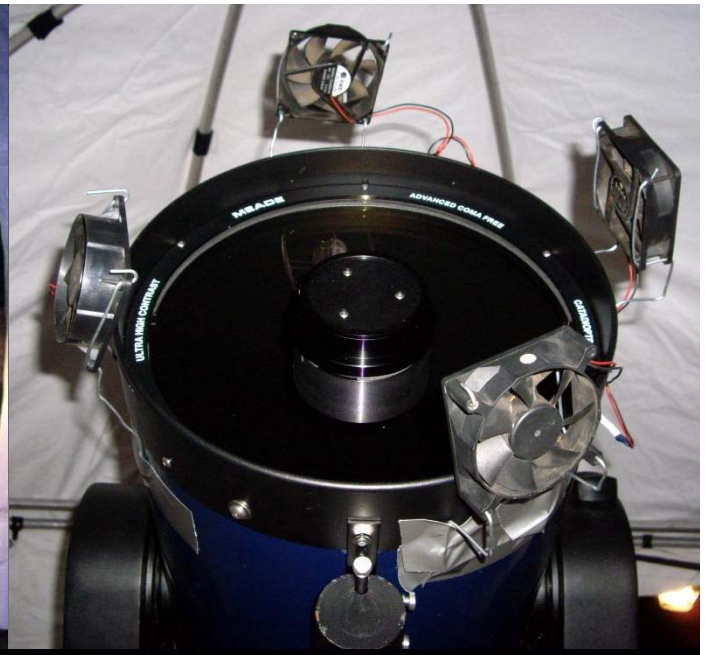
- Occultation predictions are in a situation similar to the one of impact prediction 15 yrs. ago.
- (Virtanen et al. 2003, Granvik et al. 2009)

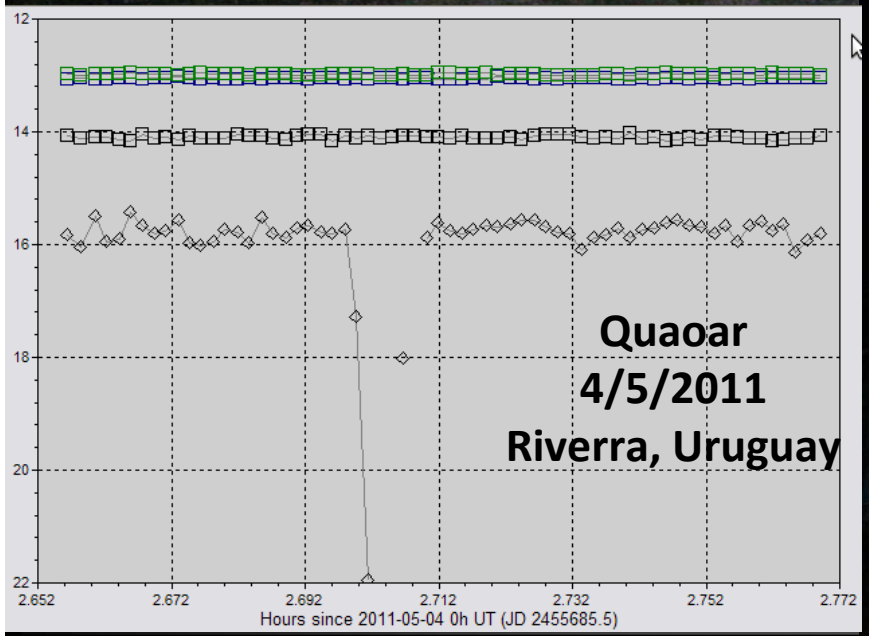


- Impact: yes or no? But, it should be a %
- Sources of uncertainties:
  - Proper motion and position of star - GAIA
  - Ephemeris of TNO
    - Large ones — GAIA
    - Small ones — GAIA

An Enthusiastic Group of Occultation Observers




MEADE
ADVANCED COMA FREE
ULTRA HIGH CONTRAST
CARBON


12
14
16
18
20
22
2.652
2.672
2.692
2.712
2.732
2.752
2.772
Hours since 2011-05-04 0h UT (JD 2455685.5)
Quaoar
4/5/2011
Riverra, Uruguay