PTF/iPTF for Solar System Observations

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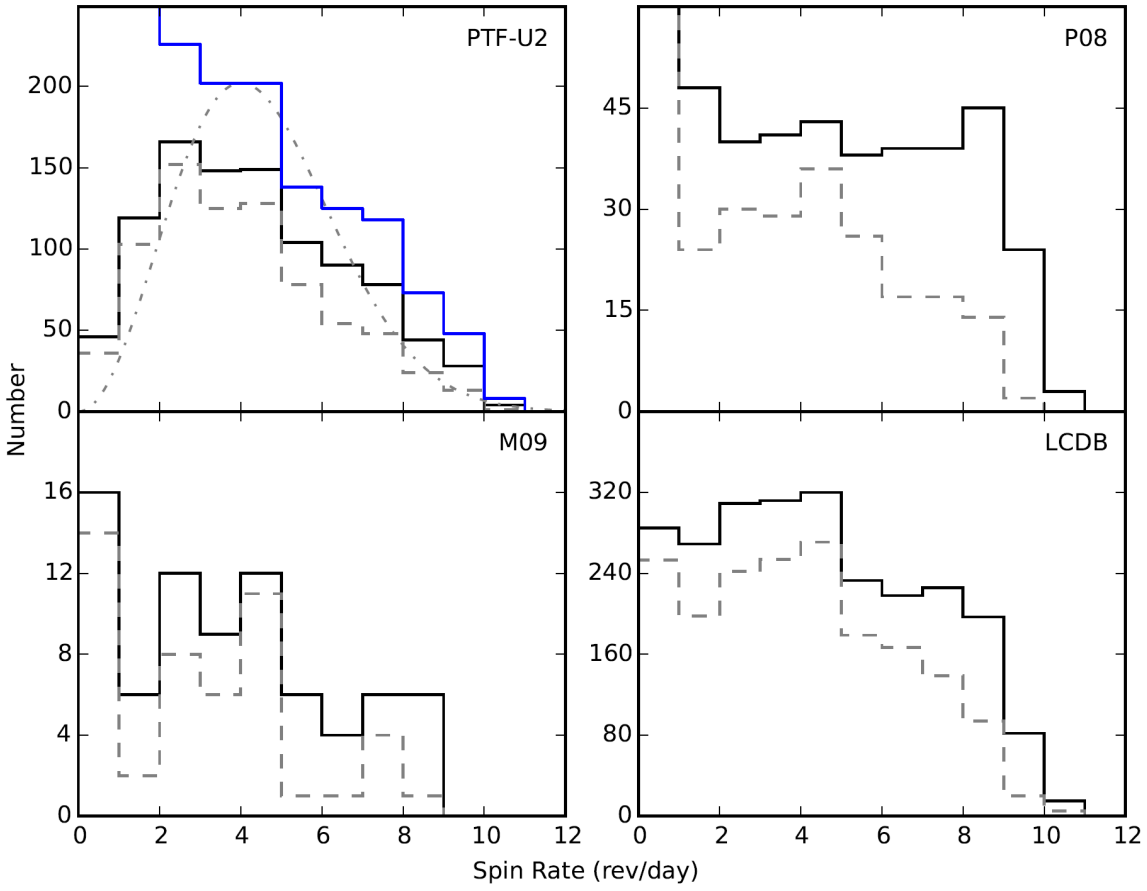
TANGO Project
National Central University

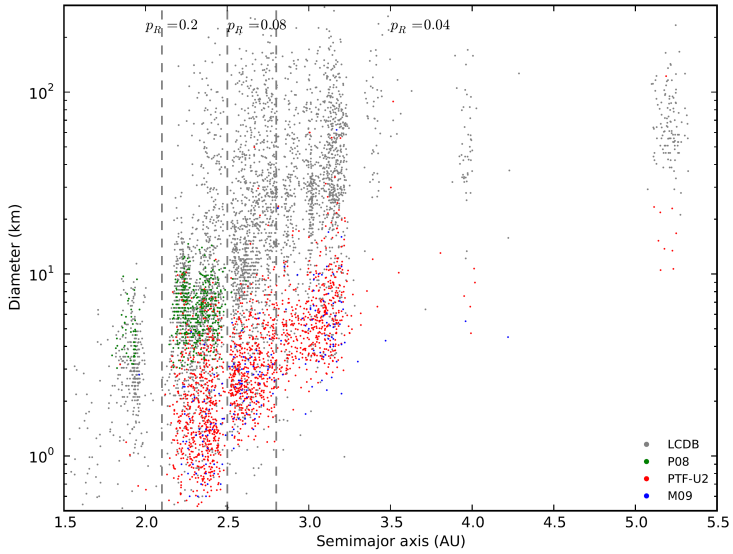
Outline

- Basic results
- On-going studies
- Future work (ZTF, SED Machine, Robo-AO)

The Spin-Rate Distribution Comparison

D of 3-15 km





P08: ~400 samples
Project of collecting single target (Pravec et al 2008)

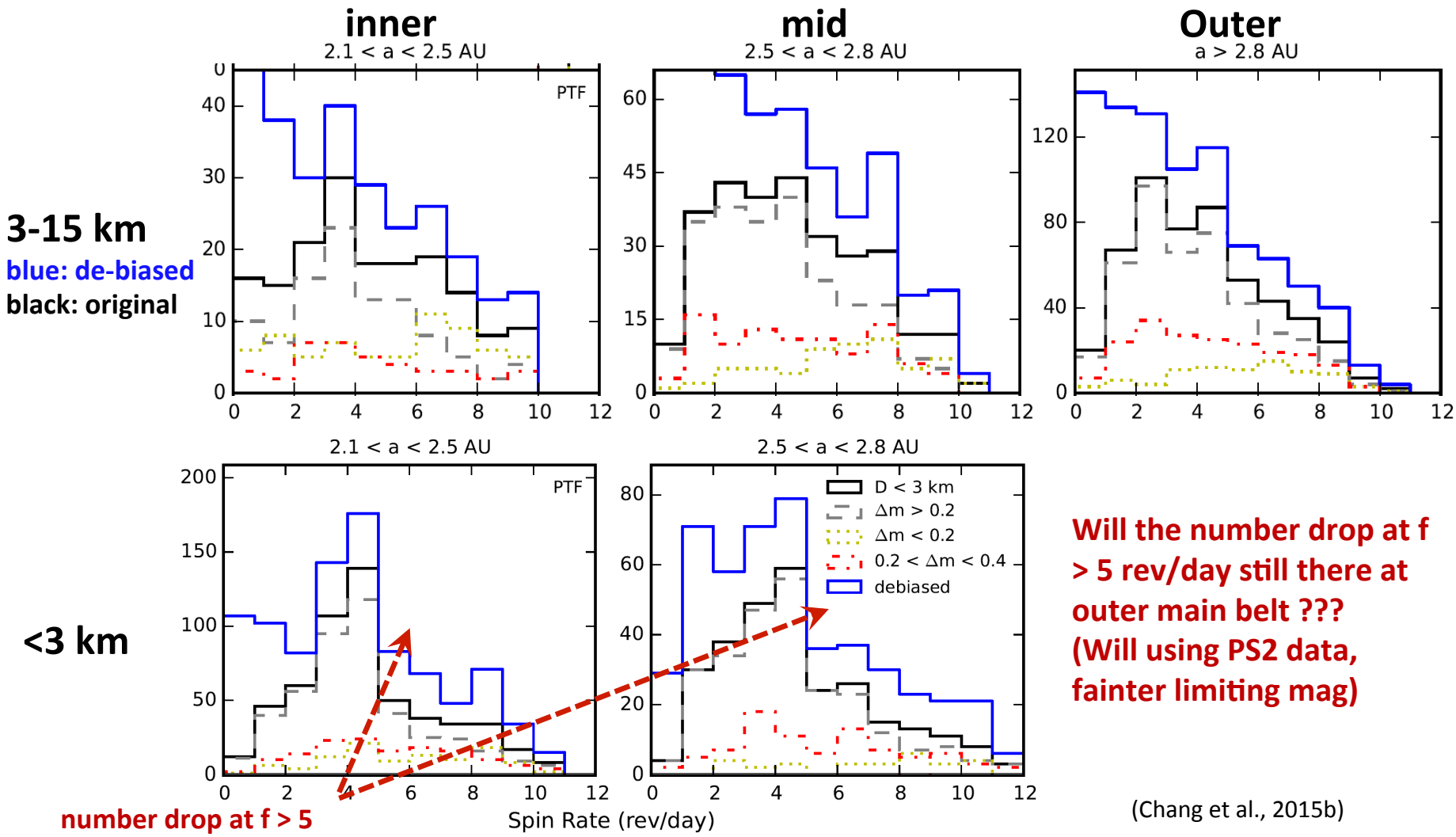
LCDB: ~4000 samples
Minor planet center, reported from world-wide

PTF: ~1800 (dedicated), ~9000 (archived)

Only Pravec et al, 2008 is flat, others show non-flat (number decrease at f > 5 rev/day). YORP effect might not work as fast as what we thought. (Chang et al., 2015b)

The PTF Spin Rate Distribution

(3-15 km and <3 km for different locations; 10 min cadence)

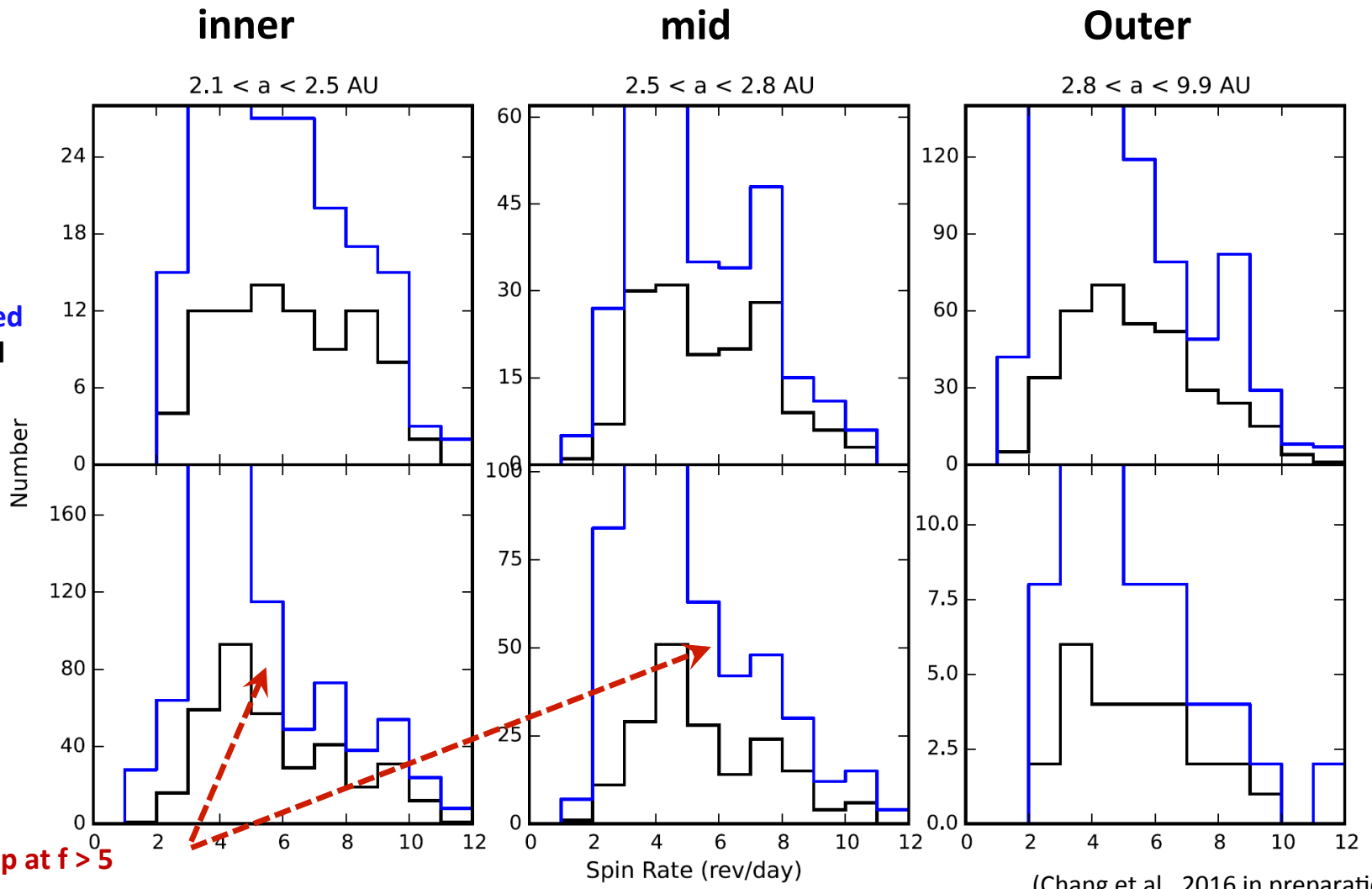


Will the number drop at f > 5 rev/day still there at outer main belt ??? (Will using PS2 data, fainter limiting mag)

(Chang et al., 2015b)

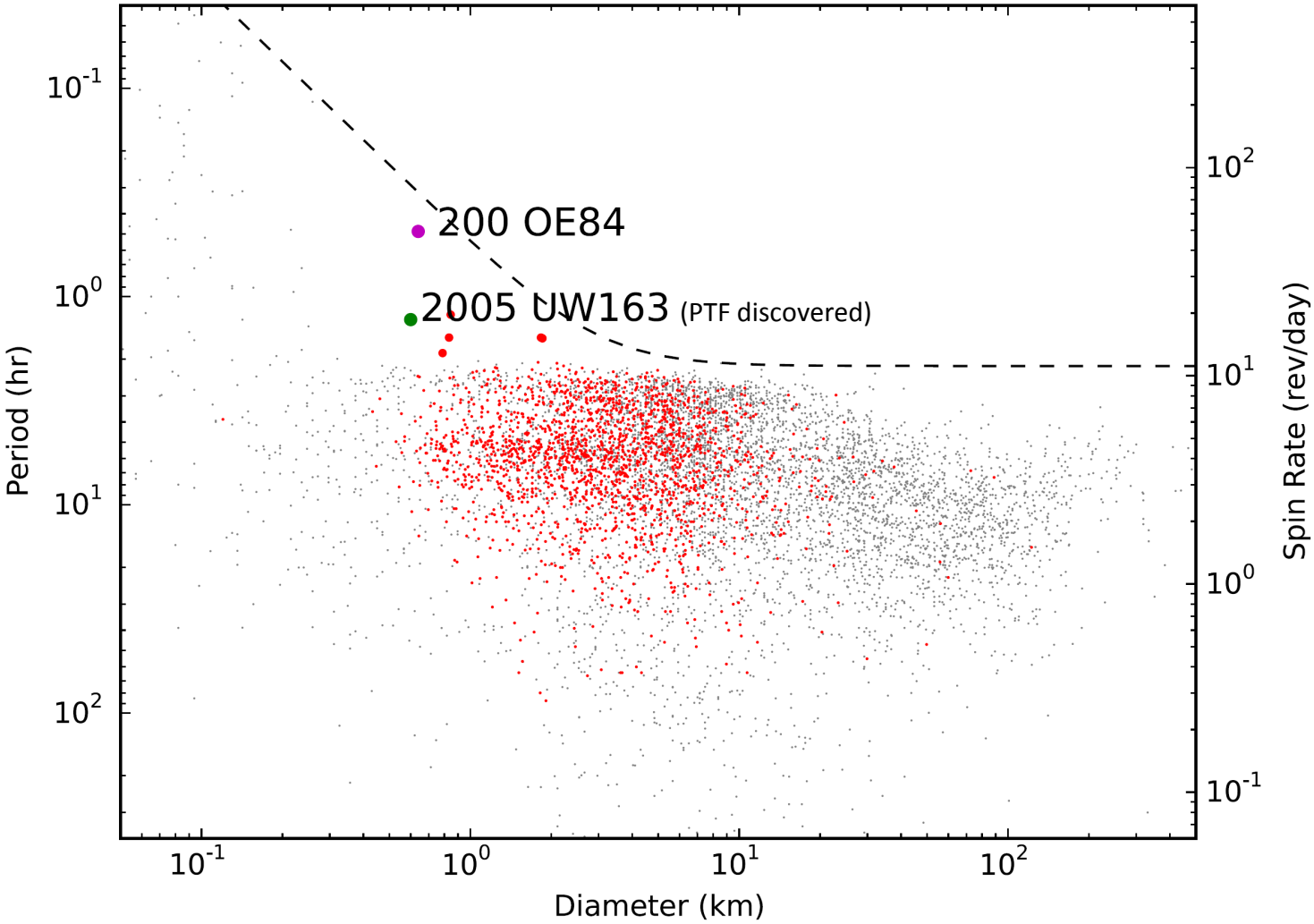
The PTF Spin Rate Distribution

(3-15 km and <3 km for different locations; 5 min candence)

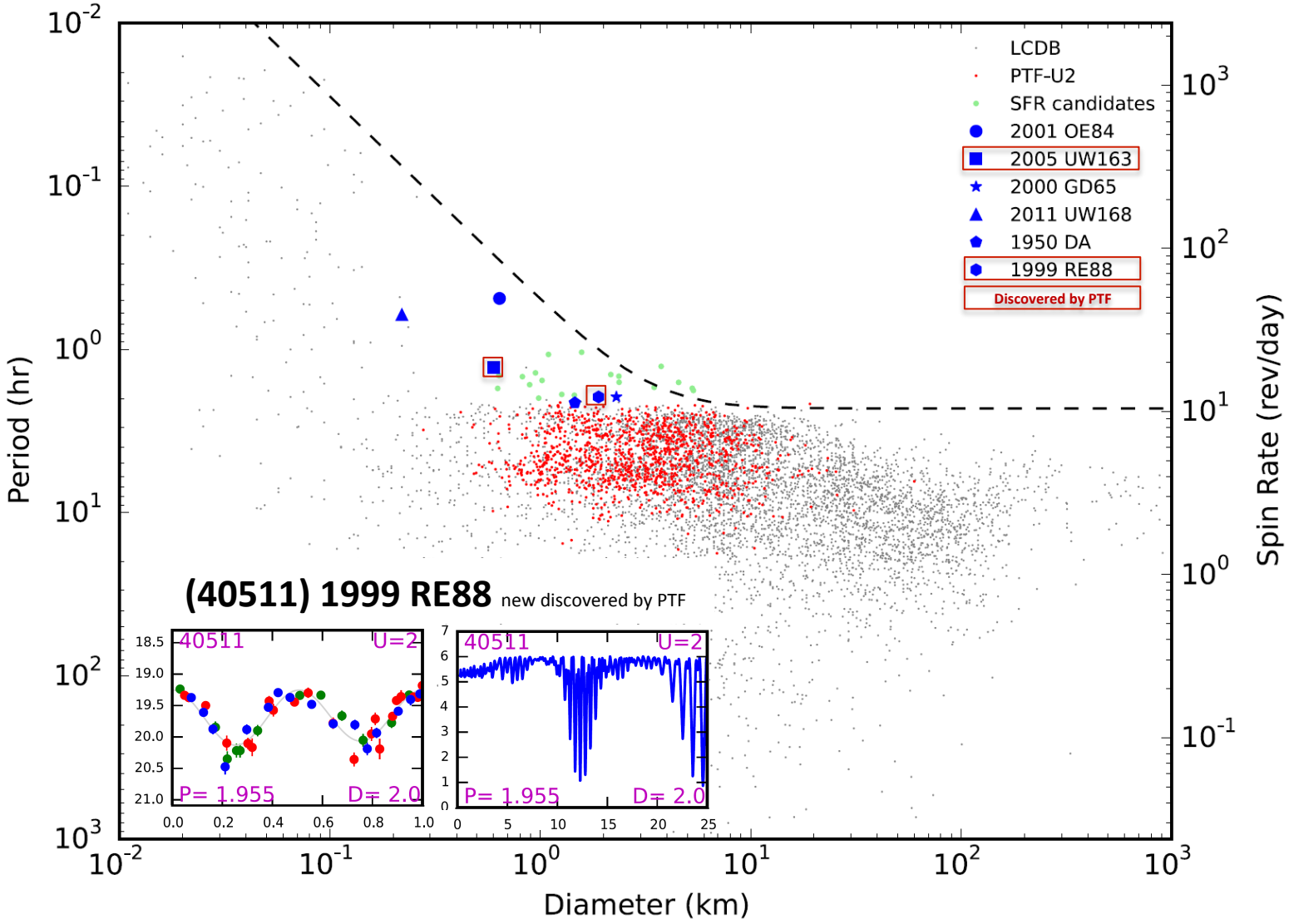


(Chang et al., 2016 in preparation)

Super fast rotators (before 2015)

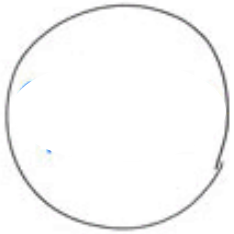


Super fast rotators (up-to-date)

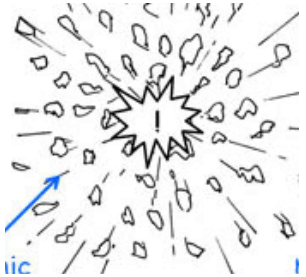


(Chang et al., 2016 in preparation)

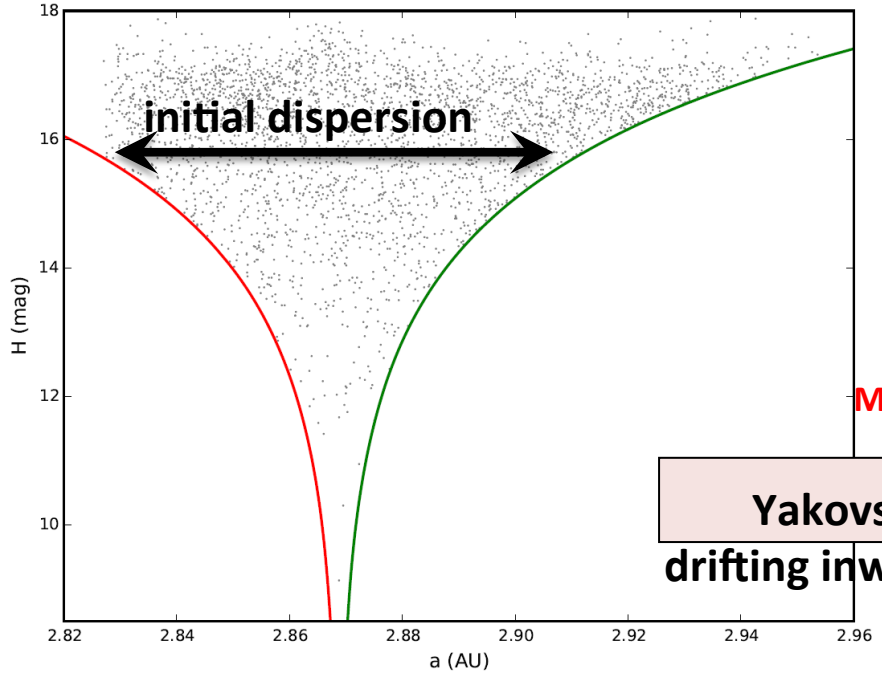
Asteroid Family Formation

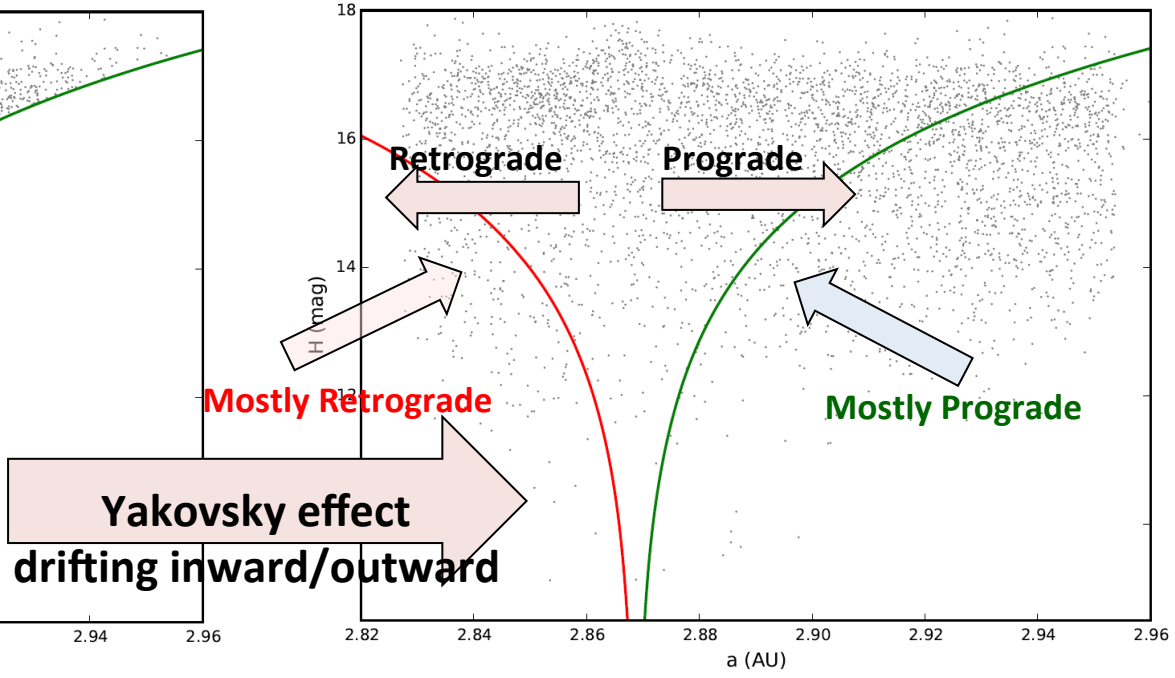


Catastrophic collision

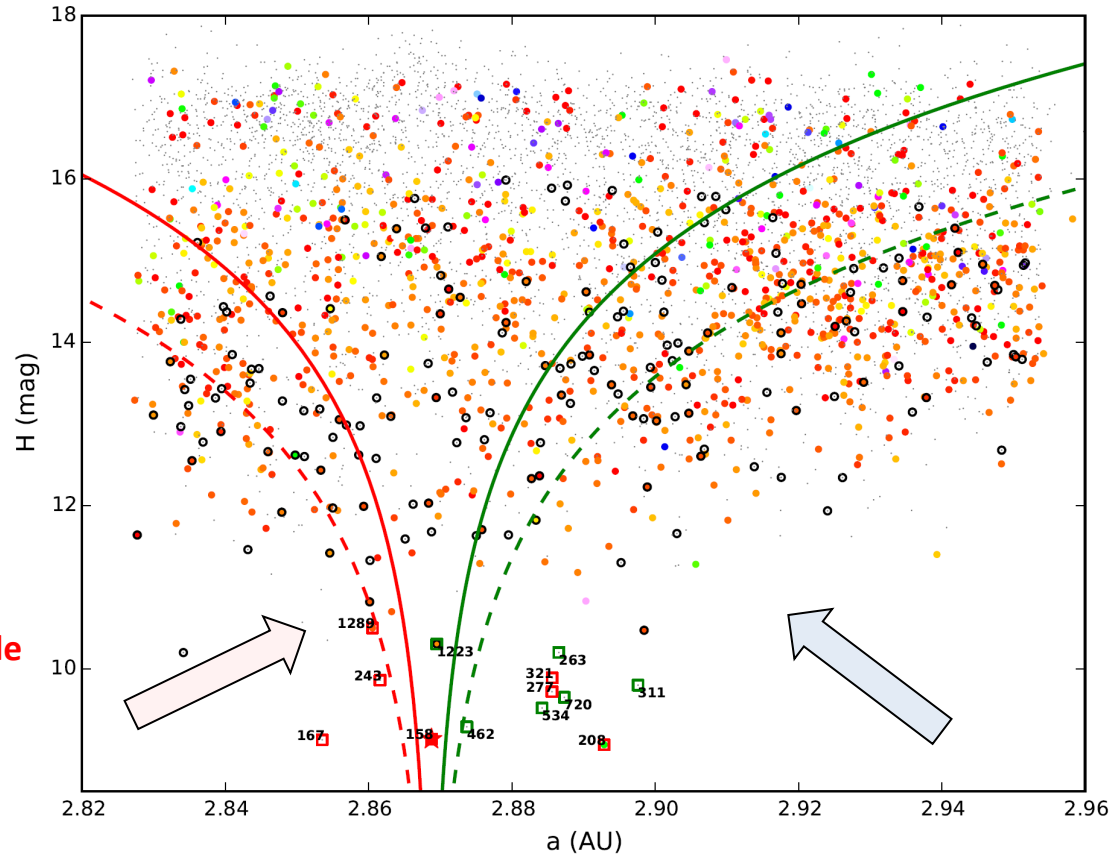


- **Catastrophic collision ➔ initial dispersion**
  - **The smaller asteroids, the more dispersed**
- **Yakovsky effect ➔ members drift to both ends**
  - **Prograde: to larger semi-major axis**
  - **Retrograde: to smaller semi-major axis**





Slavin state of the Koronis family



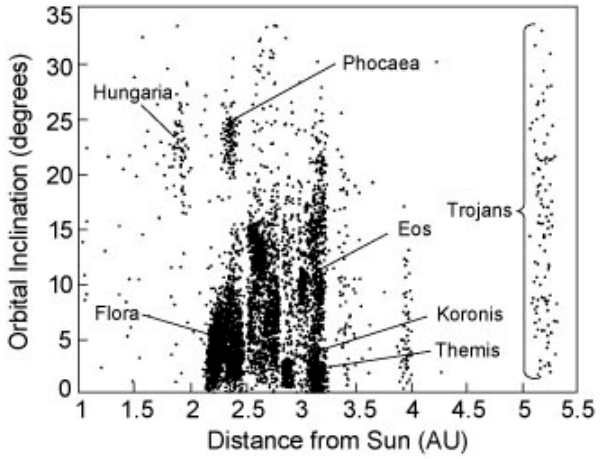
Mostly Retrograde (<5 h or >13 h)

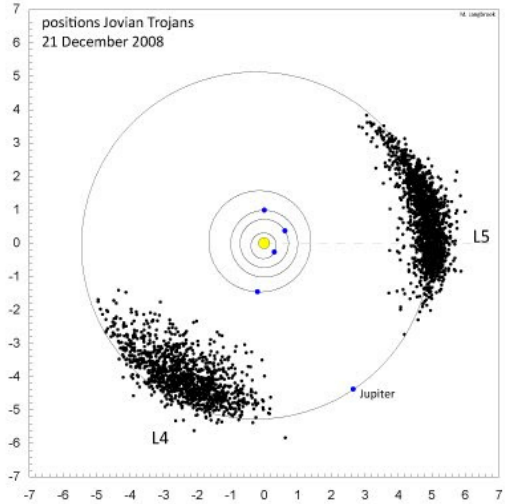
Mostly Prograde (7.5 – 9.5 hr)

(Chang et al., 2016)

On-going work

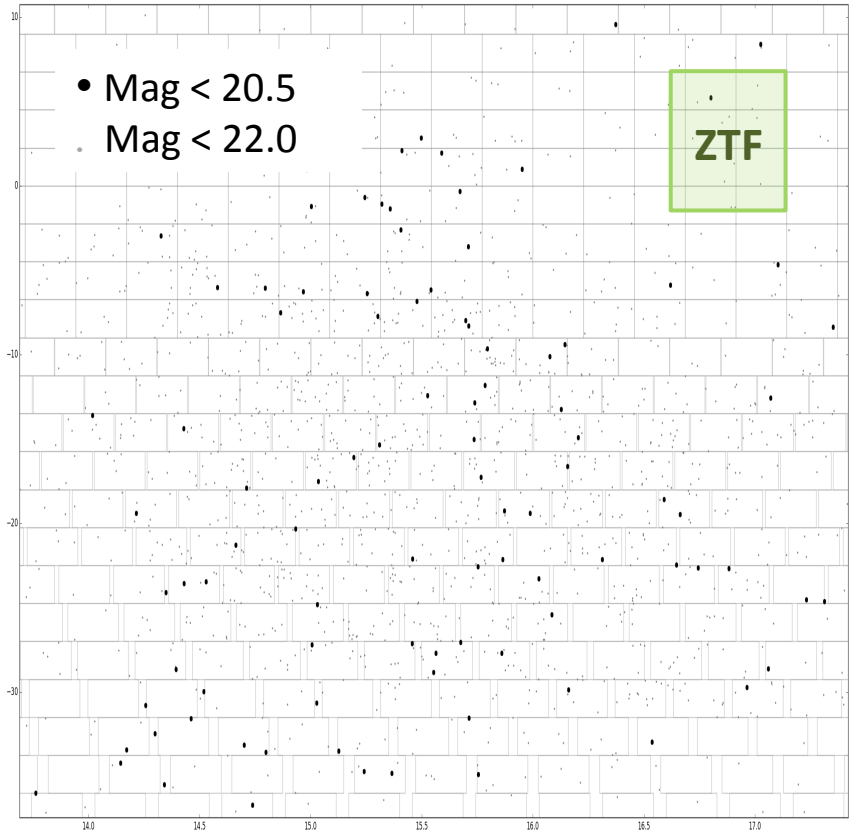
- Rotation period distribution of M-type asteroids (PTF archive) Sharon Chu
- Rotation period distribution of the Karin asteroid family (PTF archive) Sherry Pan
- Rotation period distribution of the Jovian Trojans (P48 project proposal) Rex Chang



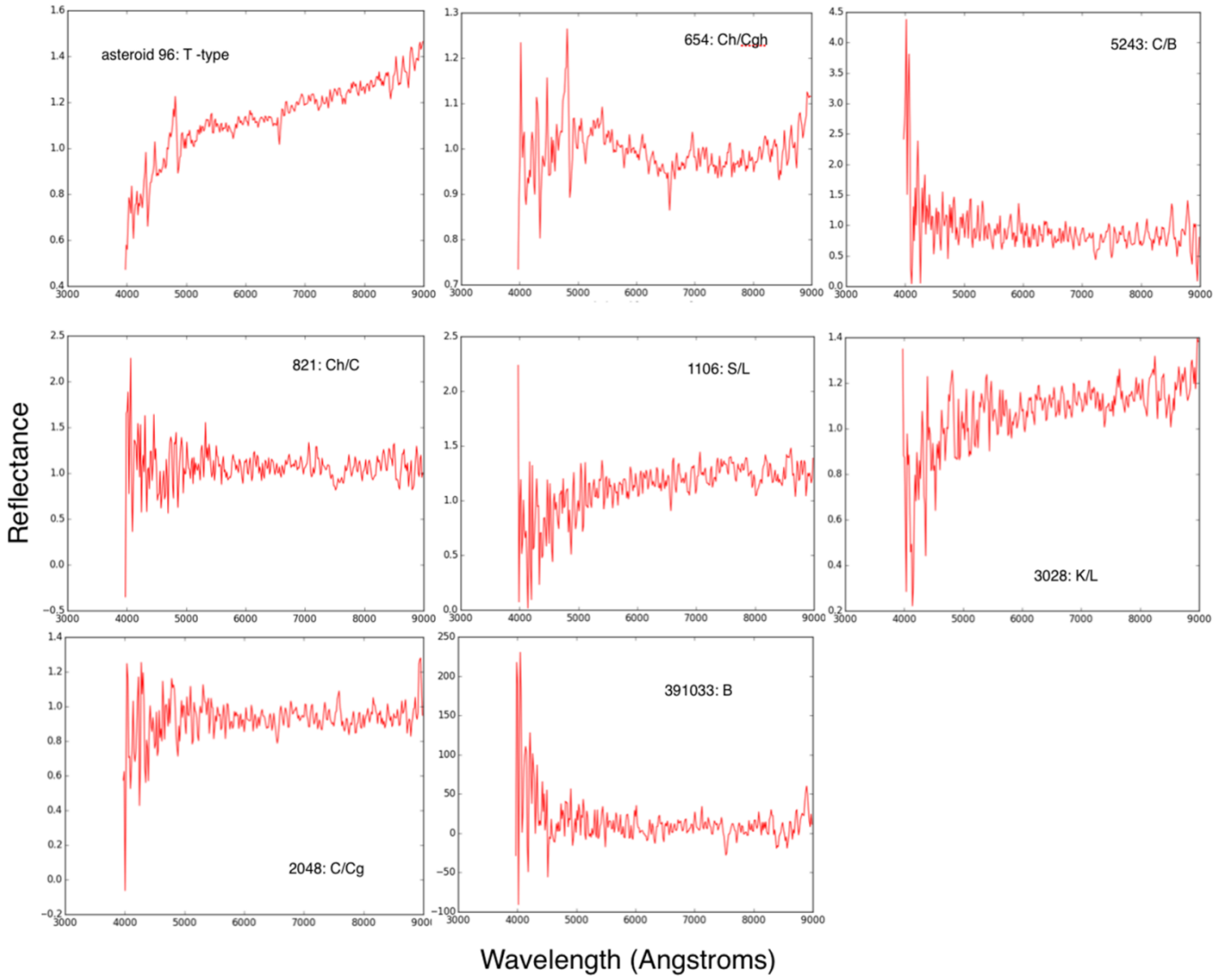


Jovian Trojans with iPTF

- How many JTs accessible to P48?
  ➔ ~200 JTs of mag < 20.5 in total
- A iPTF Field
  ➔ ~1 JTs
- a 12-field + 20 min cadence
  ➔ ~20 JTs



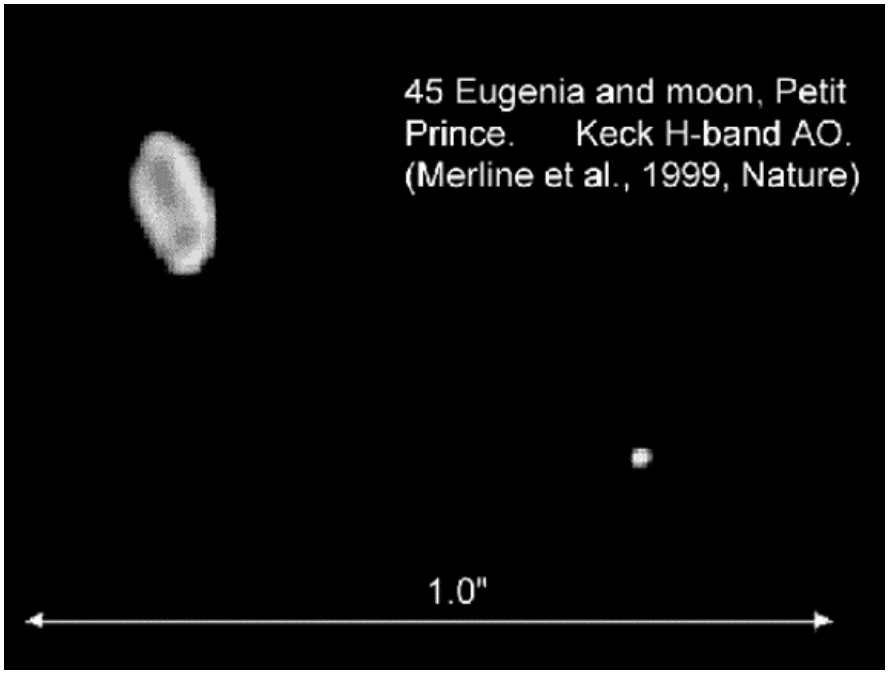
SED Machine/ P60



SED Machine/P60

- About 10 NEAs brighter than 16 mag per month.
- About 25 NEAs brighter than 17 mag per month
- For 30 min exposure time, SEDM is able to observe around 10 NEAs per night.
- We can also do rotationally resolved spectra of NEAs with 30-min cadence.

Robo-AO observations of binary asteroids



http://athene.as.arizona.edu/~lclose/talks/ins/ESO_SDI_TALK_2.html

(90 Antiope (0.1”binary) 2x85 km

Robo-AO (N ~ 300/m<16)

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Number of objects found: 281
*****************  SBFIND v2.7-linF95  2016-Jan-11 18:17:51  *****************

 Observation Date = 2016-Jan-29 06:59:59 (2457416.791667 UT)
         Location = Kitt Peak
Center R.A., Dec. = 07:37:22, +22 56'26" (J2000)
    Offsets (+/-) = 02:00:00, +30 00'00"
  Magnitude Limit = 16.0
  Magnitude Req. =  true
 Requested Group =  all asteroids and comets
                                J2000                          Dist. from Center
                                    R.A.          Dec.          R.A.   Dec.   Norm  Vmag
  IAU# Object Name              hh:mm:ss.ss +dd mm'ss.s"        (s)    (")    (")
------ ---------------------  ----------------------  ----------------  -----
12 Victoria                  07:16:15.93 +11 17'30.2"  -1.E3 -4.E4 4.6E4  11.4
27 Euterpe                   05:47:21.38 +23 59'00.4"  -7.E3  4.E3 9.9E4  9.65
30 Urania                    07:25:22.31 +22 37'13.3"  -720. -1.E3 1.1E4  10.6
33 Polyhymnia                08:08:14.81 +22 39'04.8"   2.E3 -1.E3 2.8E4  13.3
36 Atalante                  08:32:15.65 +45 36'45.6"   3.E3  8.E4 9.5E4  11.7
40 Harmonia                  09:26:27.89 +19 59'10.1"   7.E3 -1.E4 9.9E4  9.89
47 Aglaja                    09:16:55.57 +21 32'19.9"   6.E3 -5.E3 9.0E4  12.5
70 Panopaea                  06:19:11.11 +36 54'47.9"  -5.E3  5.E4 8.6E4  13.0
80 Sappho                    09:22:30.47 +01 05'26.2"   6.E3 -8.E4 1.2E5  11.7
83 Beatrix                   06:29:27.38 +31 03'31.2"  -4.E3  3.E4 6.8E4  12.2
88 Thisbe                    07:21:44.82 +19 44'36.0"  -937. -1.E4 1.8E4  11.8
93 Minerva                   09:16:09.32 +26 19'22.1"   6.E3  1.E4 9.0E4  12.3
97 Klotho                    09:36:21.59 +06 05'35.7"   7.E3 -6.E4 1.2E5  10.6
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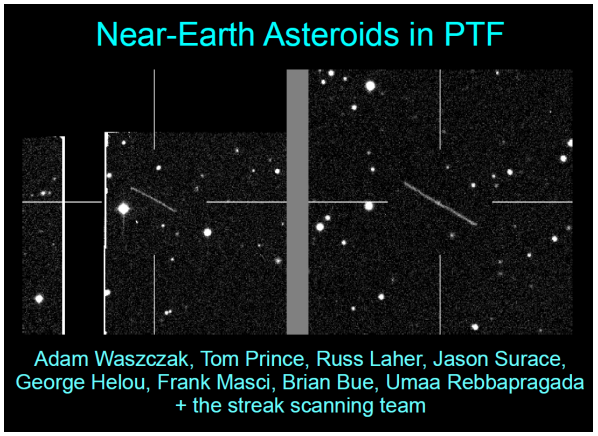
Streaking asteroids

I think the survey of the orbital distribution of small objects(< 50 m) is a nice project since the result can be compared with the lunar crater distribution. But some description is needed to explain the procedure (and technical difficulties).



Orbital determination

- There is not much information in a single streak. It is impossible to have good orbital determination for a single streak.
- Therefore, we can not derive the orbital distribution of small NEAs from a collection of streaks.

Alternative approach

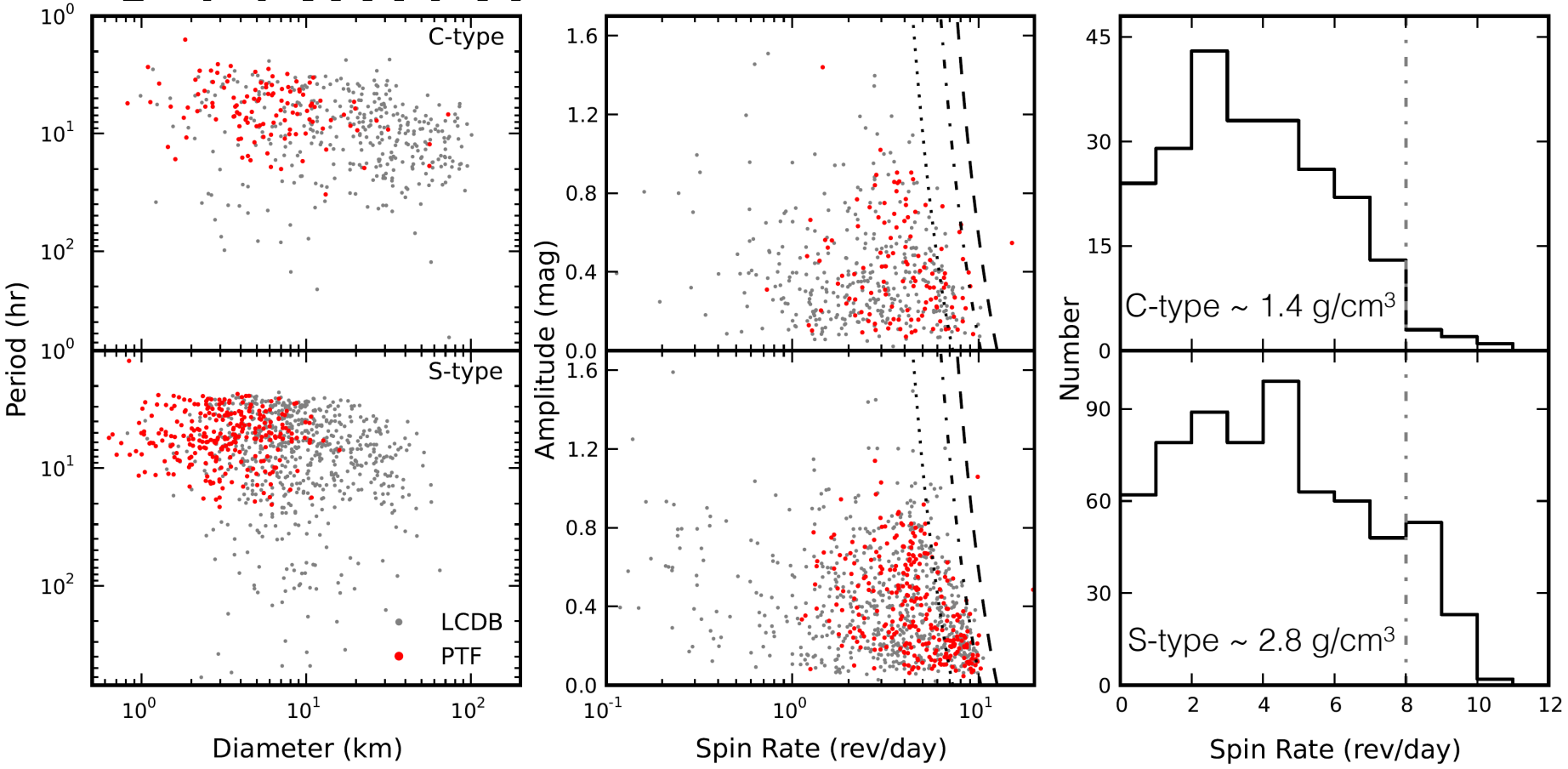
- We can create several different synthetic NEA models, based on the knowledge of pervious theoretical and observational studies, i.e. NEOWISE observation.
- Put the models into survey simulator to simulate ZTF observations.
- Survey simulator will generate a set of asteroid streaks, with location, brightness, length and orientation.
- Compare the simulation results with real observation, and identify the acceptable models.
- Adjust the synthetic NEA models to have the better fit.

Thanks.

Spin Rate vs Taxonomy

the evidence of P ~ 3.3 √

$1 + \Delta m / \rho$



(Chang et al., 2015b)