350 μm Observations of Asteroids, Secondary Calibrators, and Stellar Standard(s)

C. Darren Dowell

Jet Propulsion Laboratory,

California Institute of Technology,USA

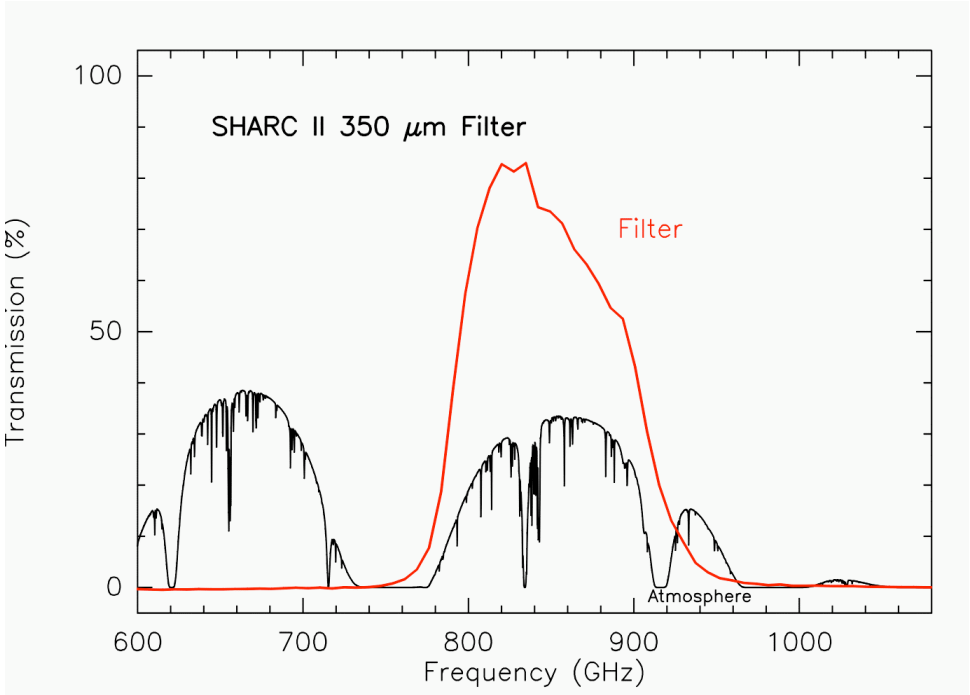
2008 Feb 7

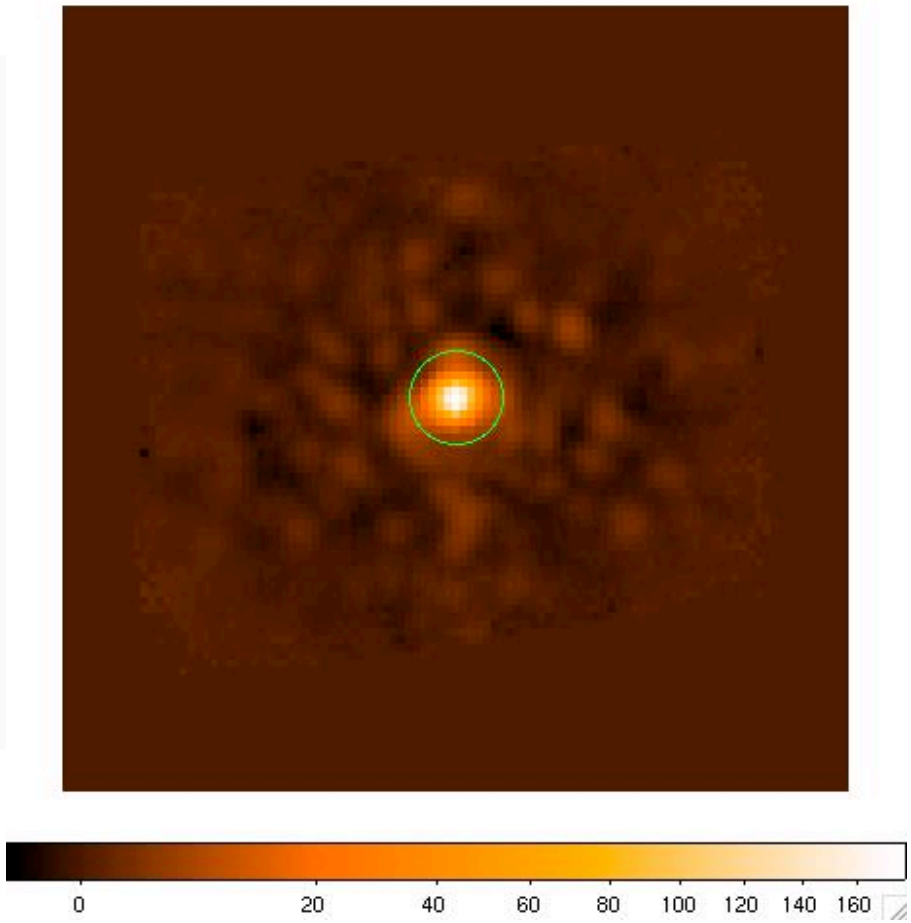
Government sponsorship acknowledged.

Scope of this Project

- CSO/SHARC II 350 μm archive (2003-date):
  - bright (>2 Jy), compact calibrators for ground-based use; 10% accuracy goal
  - limited observations of fainter calibrators for Herschel
- Calibration relative to Mars, Uranus, Neptune
  - Starlink FLUXES program from JCMT:
    - Mars: $T_B \approx 210$ K (Wright 1976; Wright 1995, priv. commun.)
    - Uranus: $T_B = 64.0$ K (Griffin & Orton 1993)
    - Neptune: $T_B = 60.9$ K (1% below Griffin & Orton 1993)
- Paper (Dowell, Sandell, et al.) to be produced this year.
  - Analysis shown today is preliminary.
  - 10% uncertainty unless stated otherwise.

SHARC II/CSO



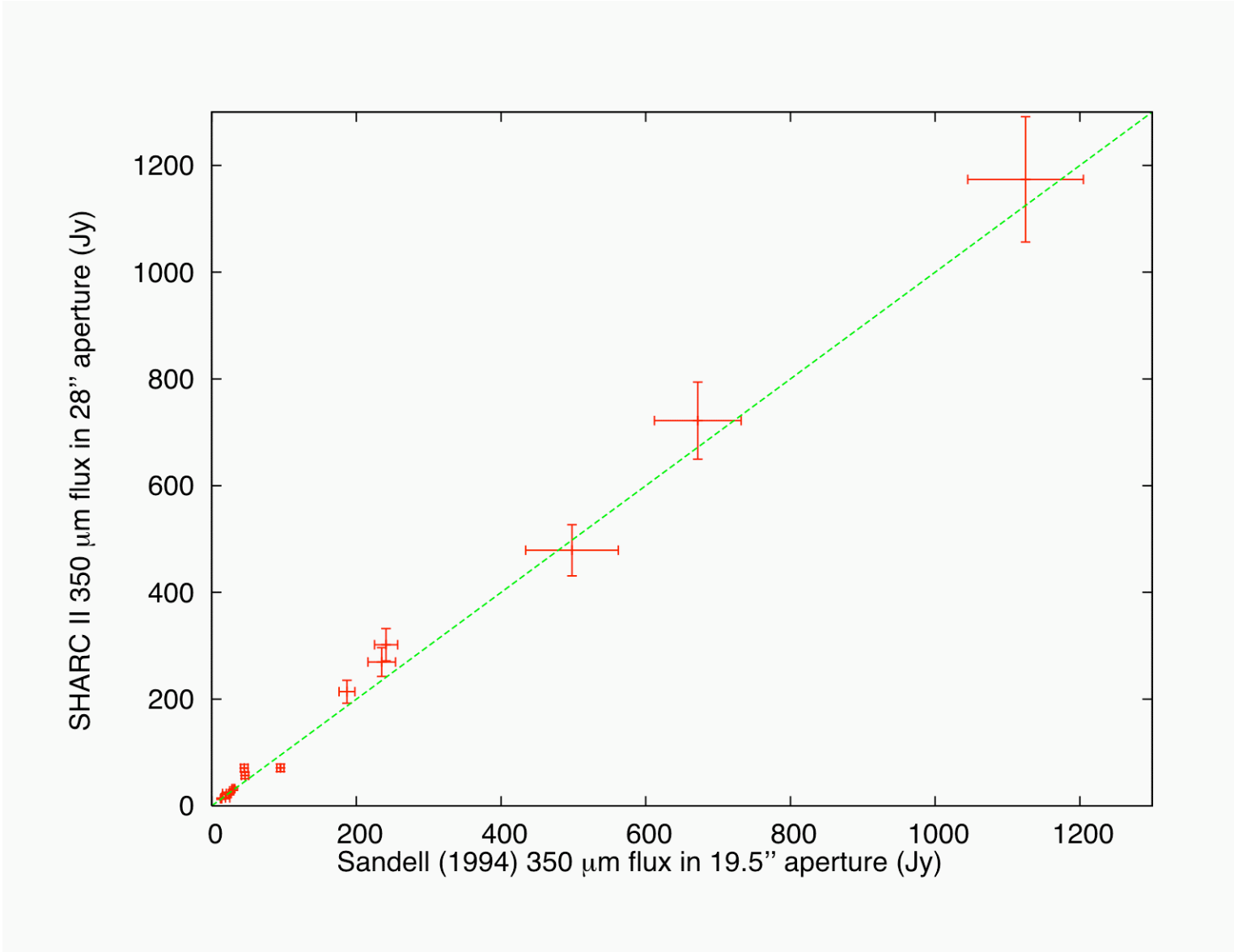


- λ_{eff} = 350 μm
- main beam: 8.5″ FWHM

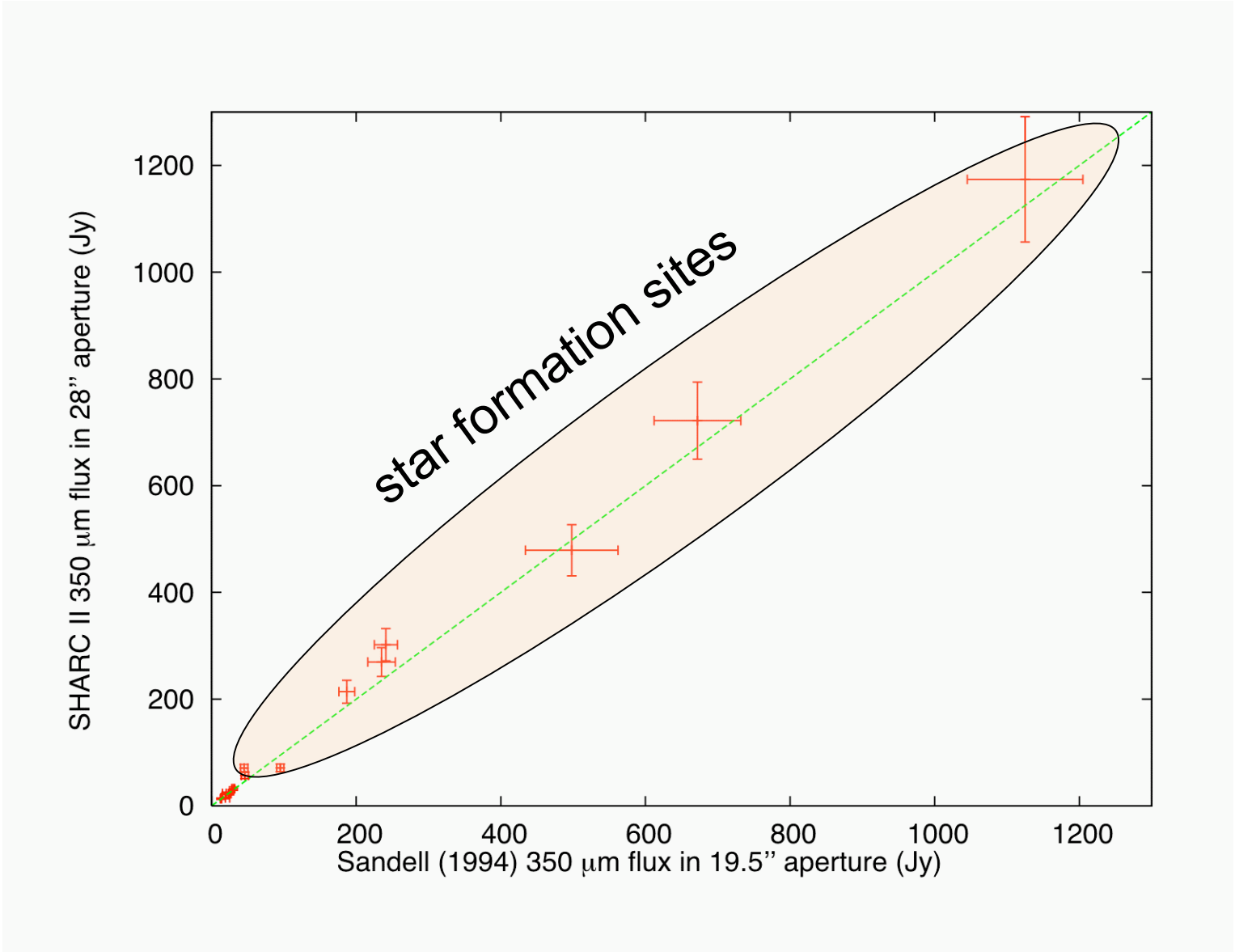
Data Analysis

- Nonlinearity correction (≤ 25%)
- Calibration of atmospheric absorption based on total power on bolometer array
- 28’’ aperture for photometry
- simultaneous fit over all sources, using Mars, Uranus, Neptune as fixed references

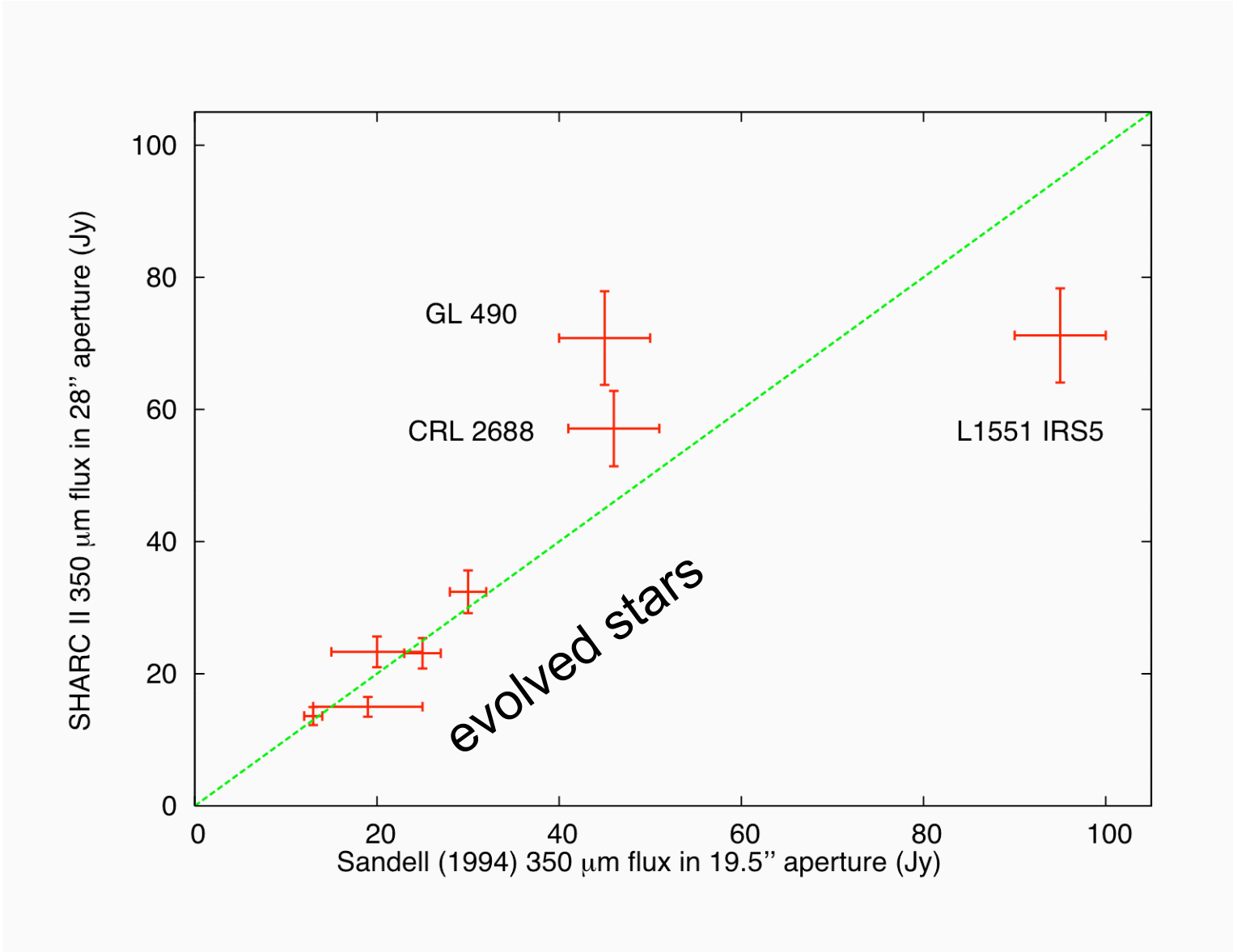
Bright Secondary Standards



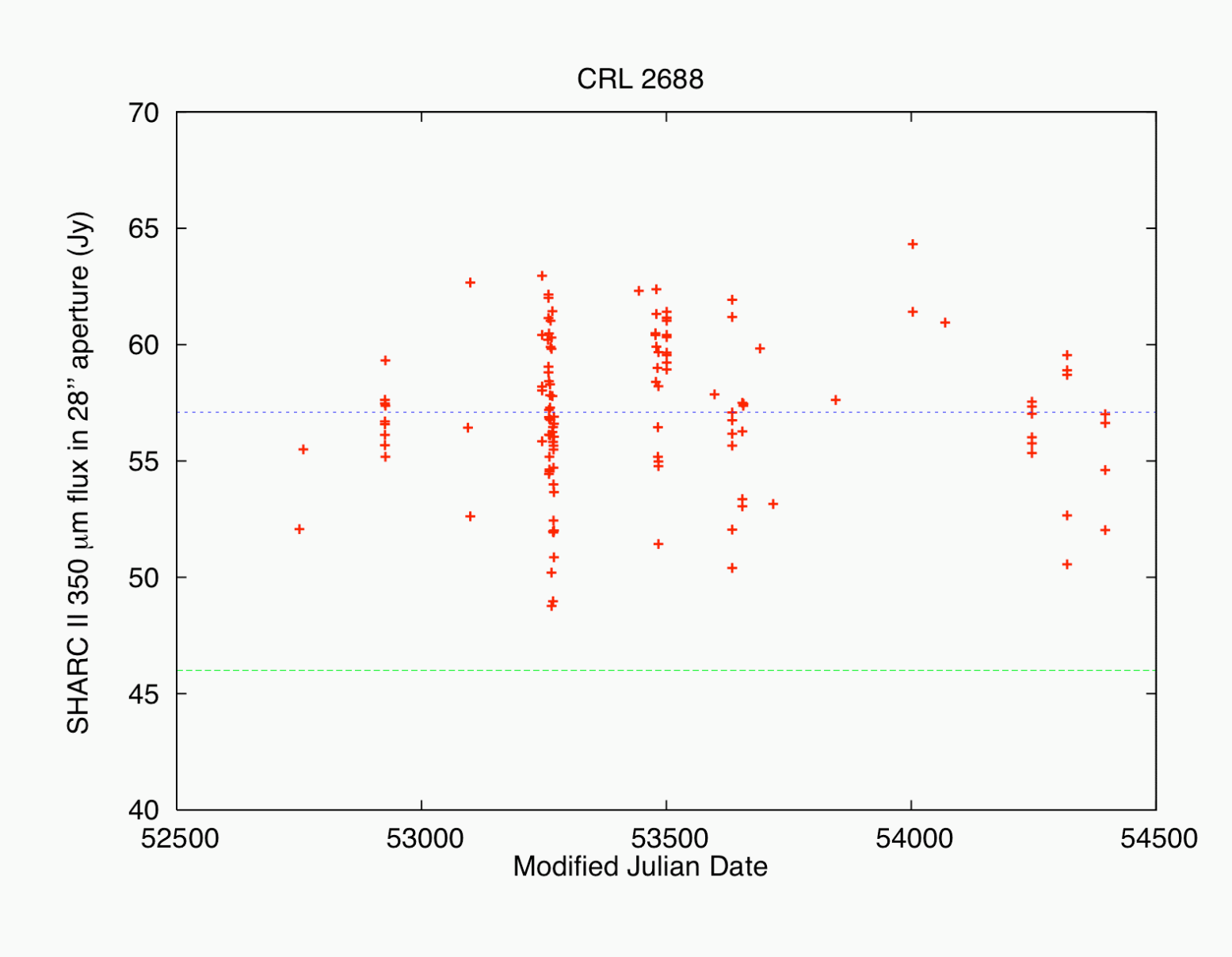
Bright Secondary Standards



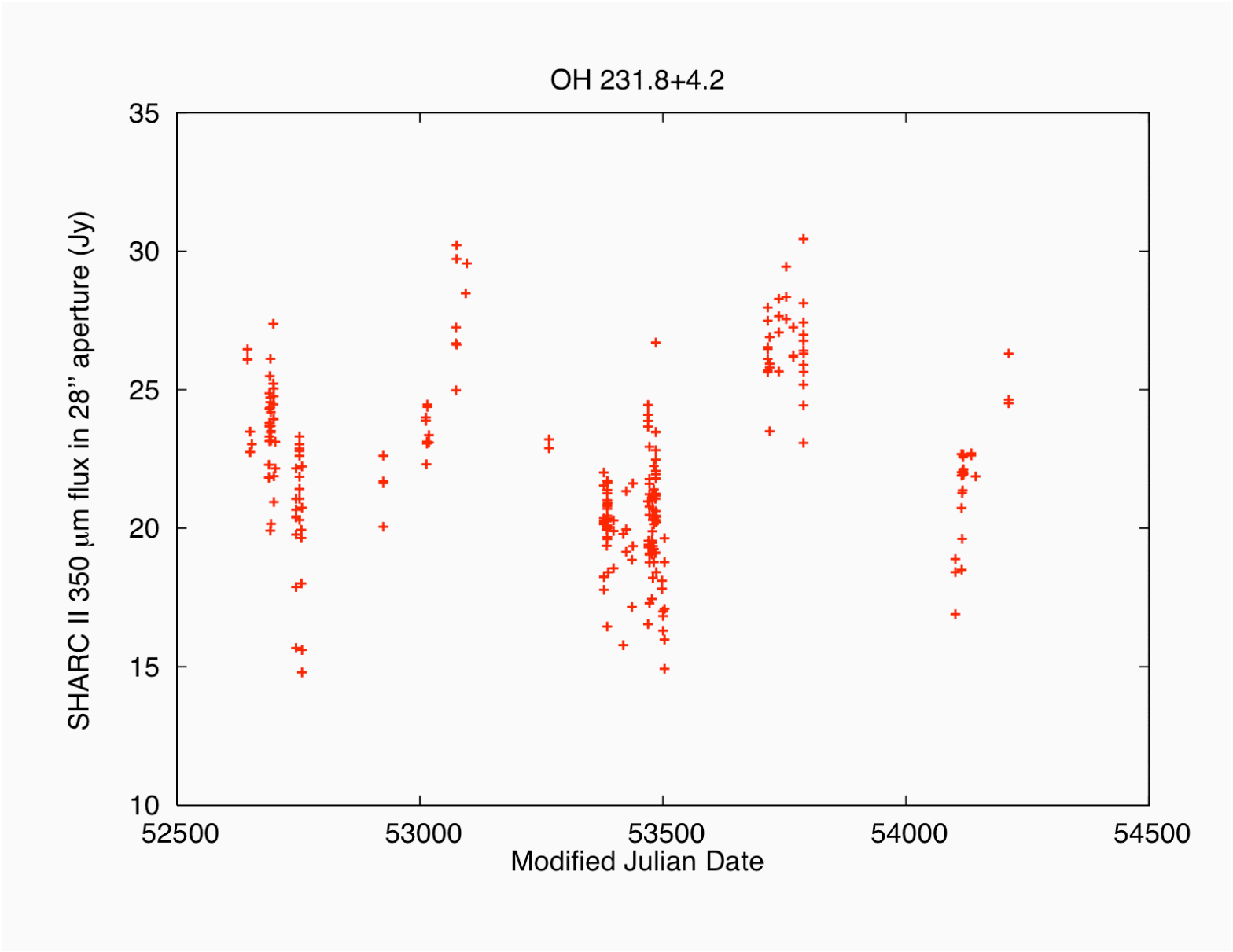
Bright Secondary Standards



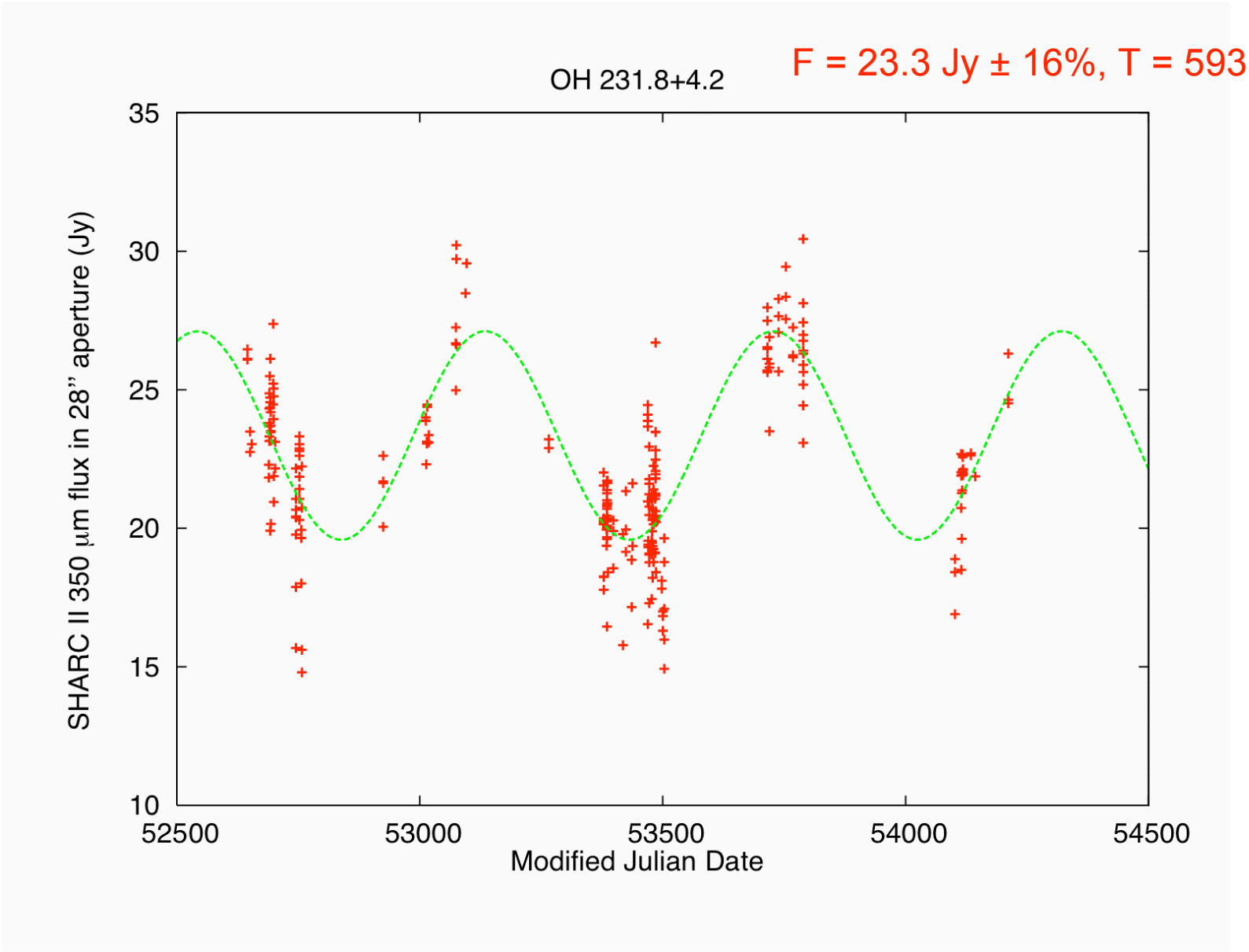
Evolved Stars



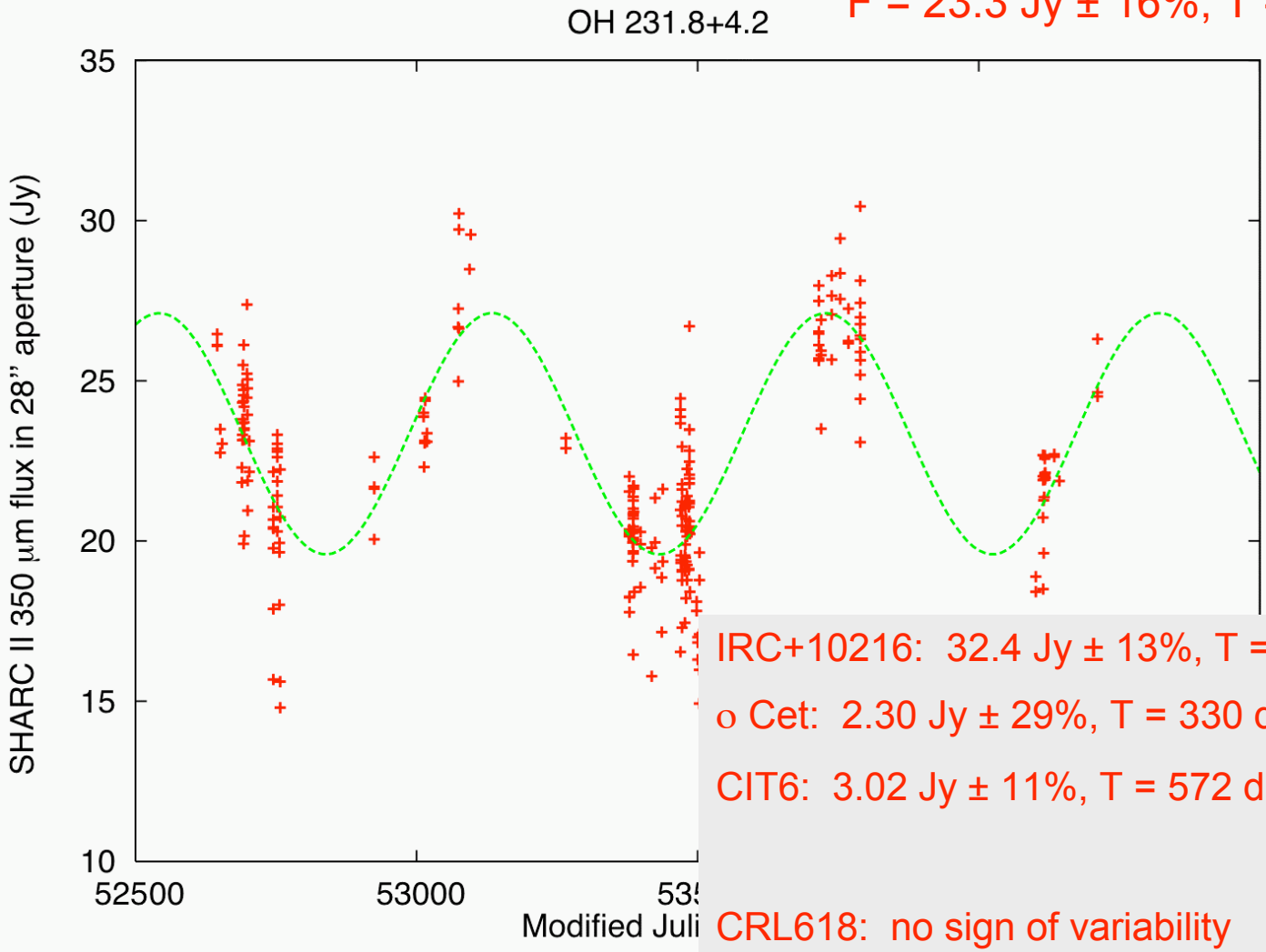
Evolved Stars



Evolved Stars



Evolved Stars



IRC+10216: 32.4 Jy ± 13%, T = 671 d

o Cet: 2.30 Jy ± 29%, T = 330 d

CIT6: 3.02 Jy ± 11%, T = 572 d

CRL618: no sign of variability

CRL2688: no sign of variability

Miscellaneous 350 μm Point Sources

- Galilean Satellites:
  - Callisto: T_B = 128 K (within 5% of de Pater et al. 1989)
  - Ganymede: T_B = 117 K (within 3% of de Pater et al. 1989)
- Stellar Disks:
  - HL Tau: 17.0 Jy
  - TW Hya: 6.48 Jy
  - ρ Oph SR 21A: 3.79 Jy
  - limited data on numerous ~1 Jy disks
- Extragalactic:
  - Arp 220: 11.4 Jy
  - Mrk 231: 1.92 Jy ± 15%
  - limited data on numerous ~1 Jy IR galaxies

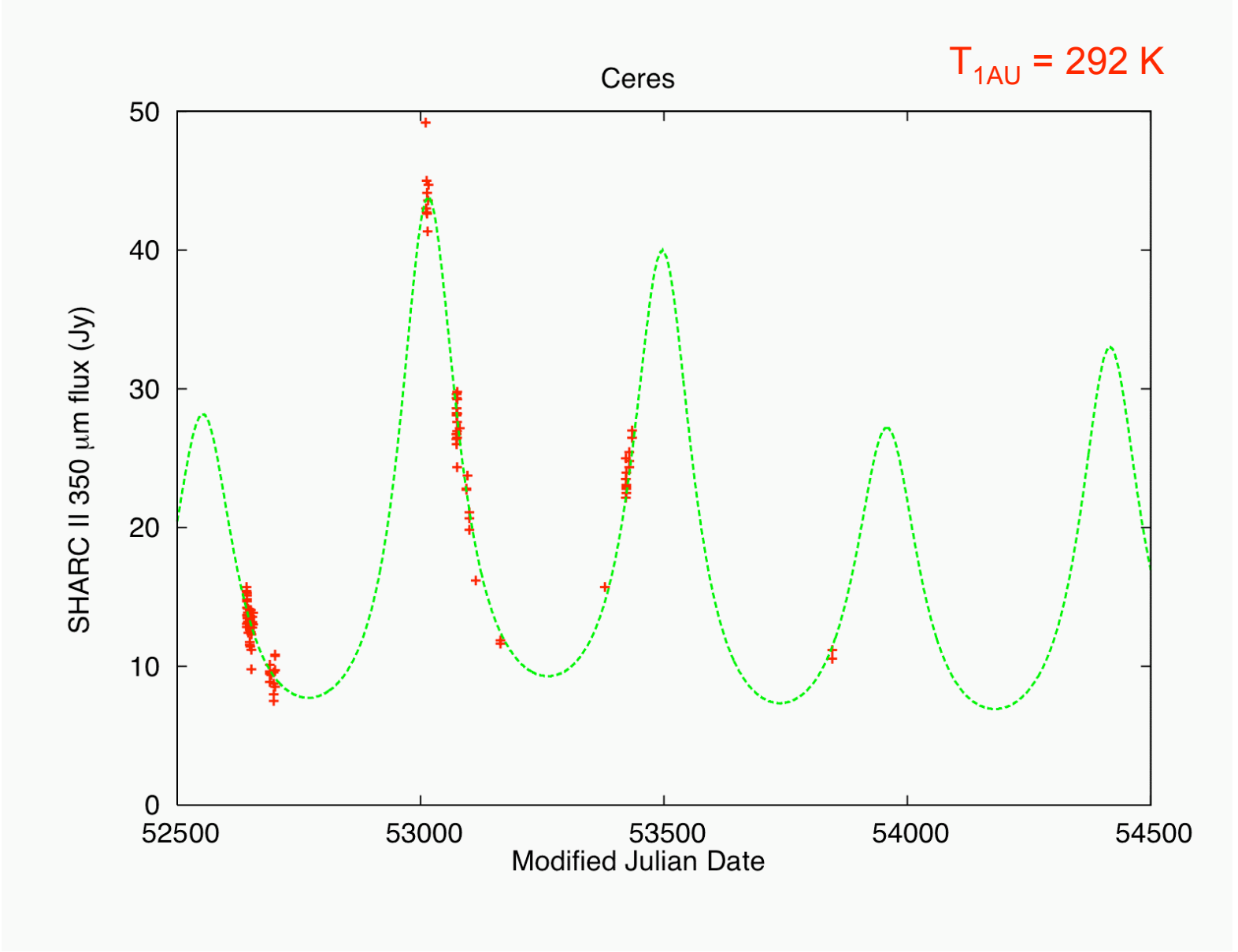
Mars, Uranus, Neptune

- Mars vs. Uranus:
  - 2005 May 13, 15.2-16.5 UT, stable conditions
    - observed Mars/Uranus = 18.5, 7±2% lower than FLUXES prediction
  - However, for full archive, observed Mars/Uranus is low by only 3%.
- Mars vs. Neptune:
  - Over full archive, Mars/Neptune is low by 7%.

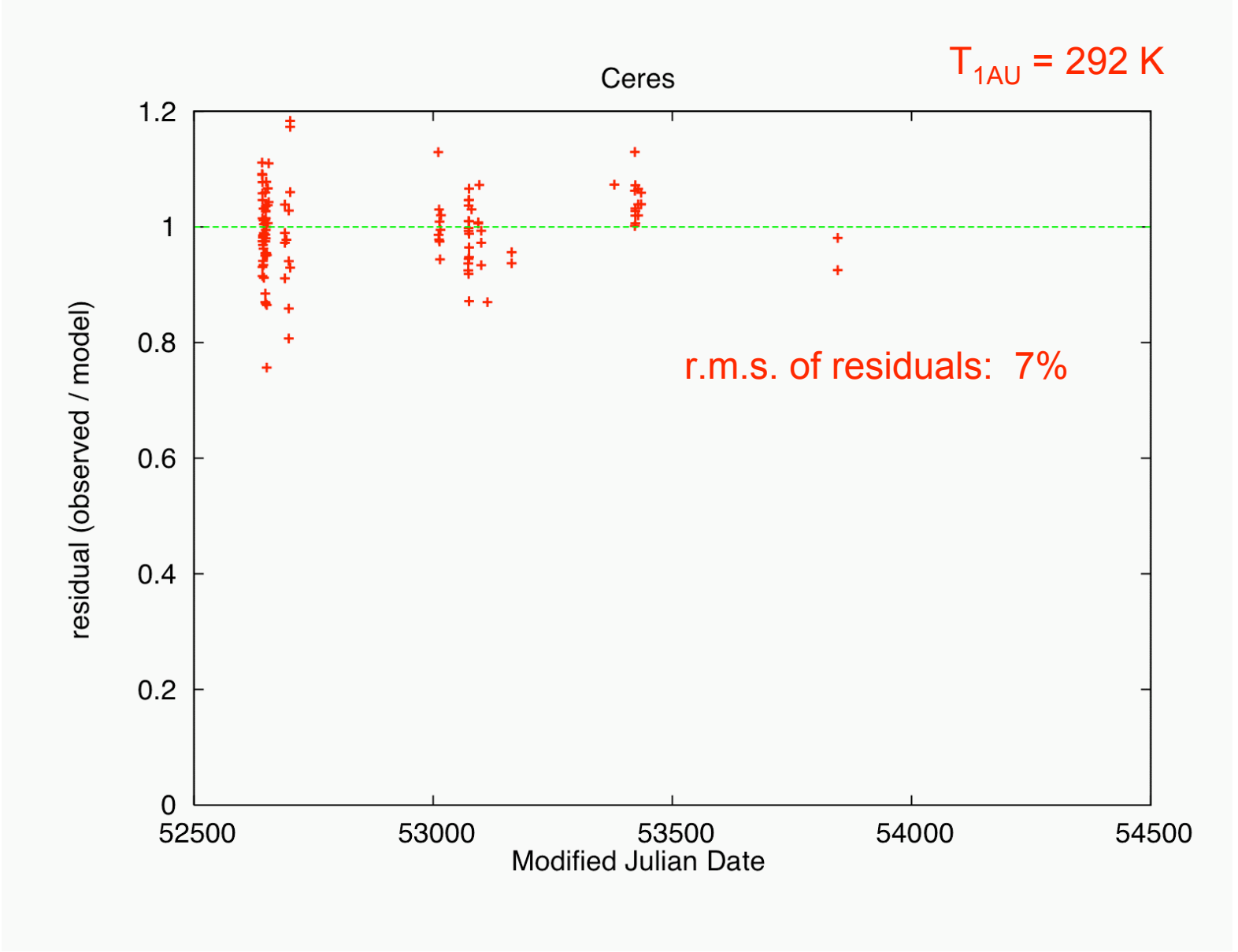
Asteroids

- Simple model:
  - $T_B = T_{1AU} (r / 1\ AU)^{-1/2}$
    - r = heliocentric distance
  - $F_\nu = B_\nu(T_B)\ \Omega$

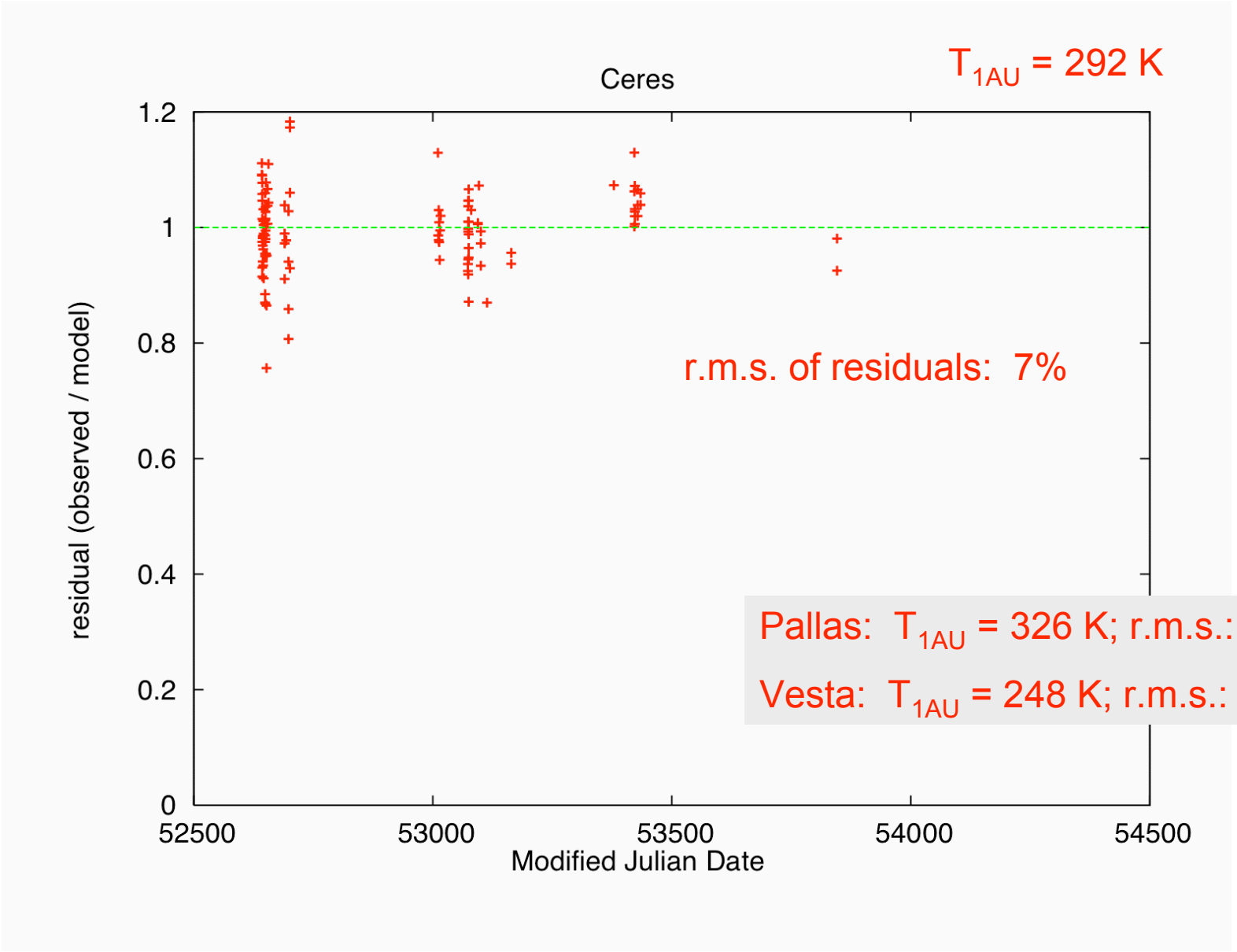
Bright, Well-Observed Asteroids



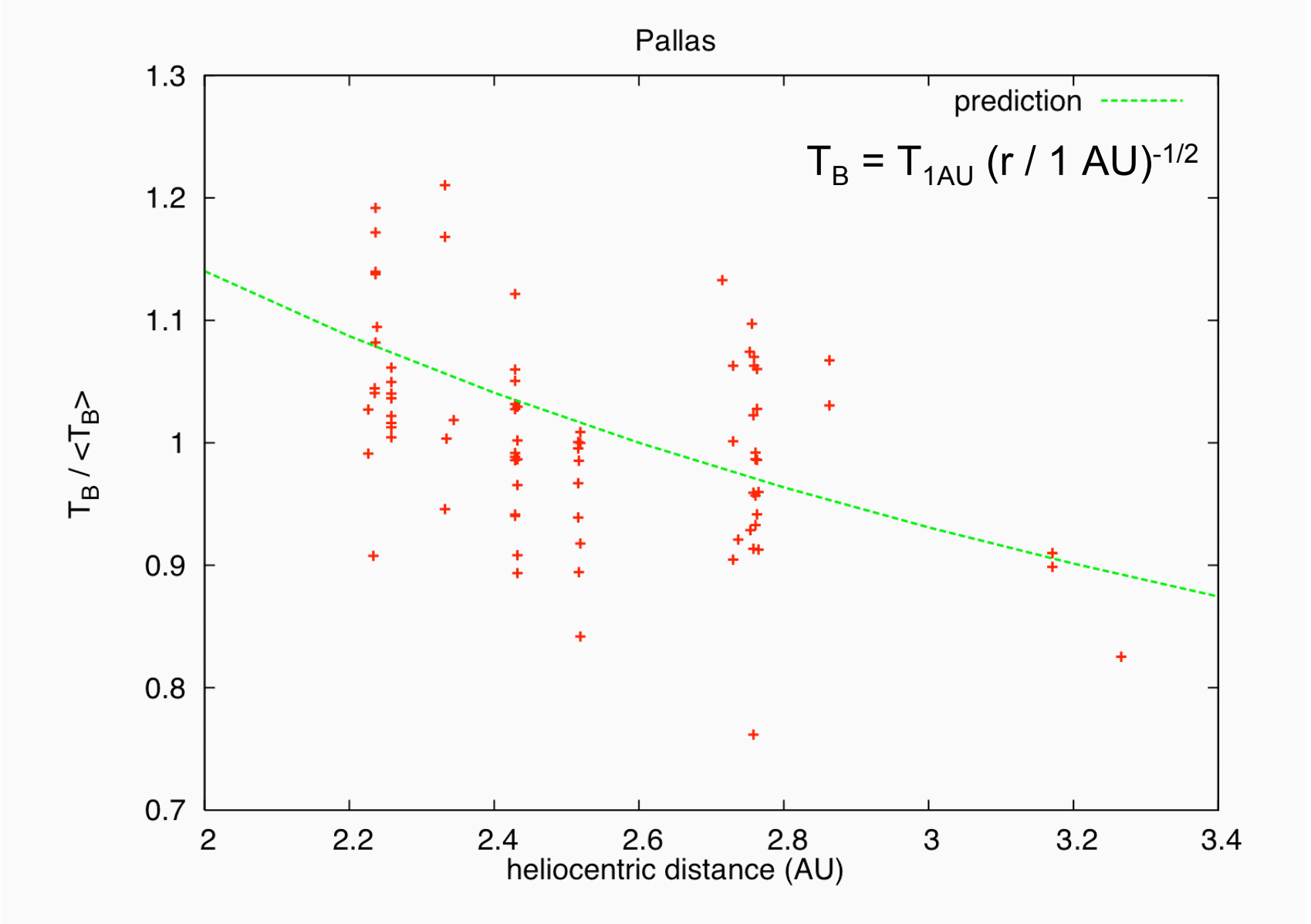
Bright, Well-Observed Asteroids



Bright, Well-Observed Asteroids



Pallas: T_B vs. heliocentric distance

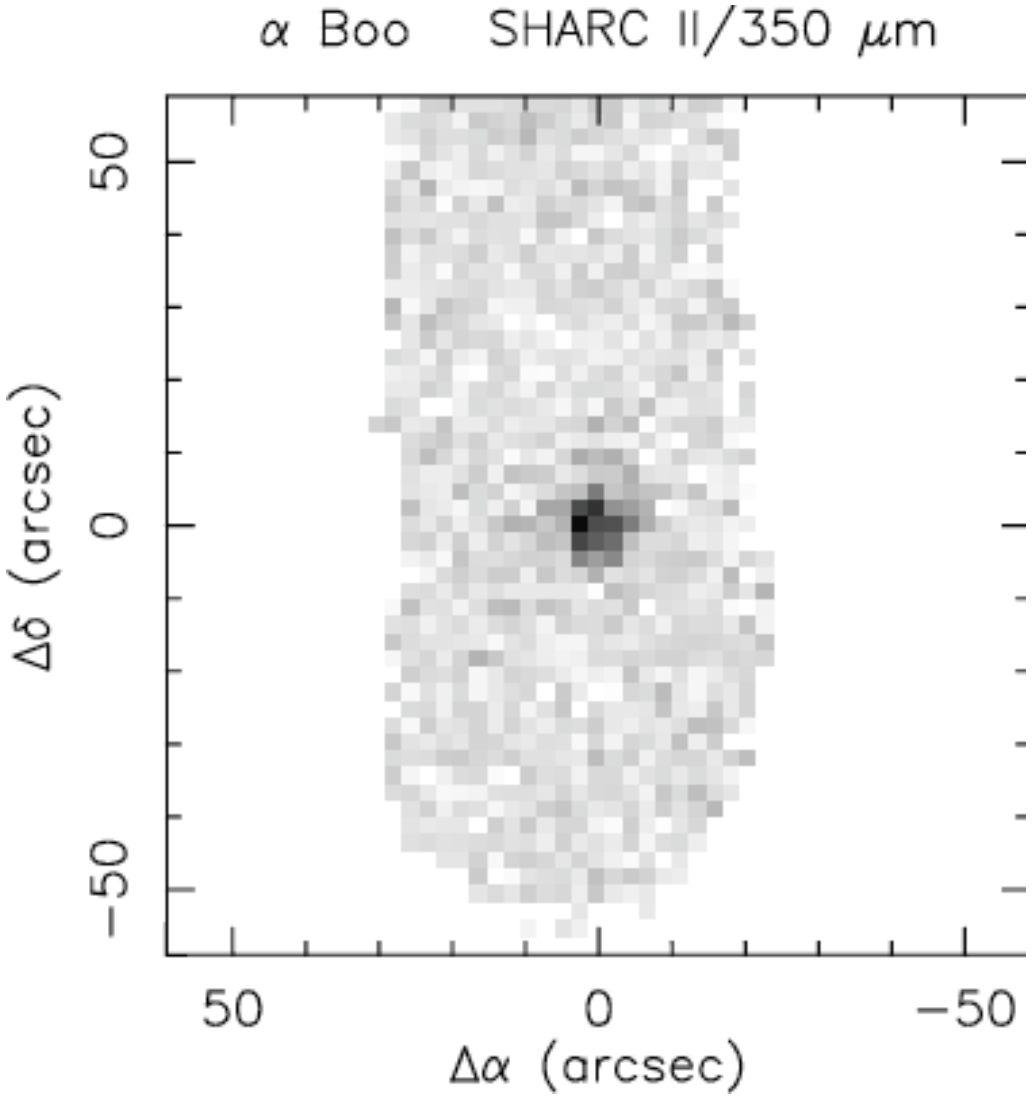


Asteroids at 350 μm (10-25% unc.)

- Hygiea (C): T_{1AU} = 412 K
- Metis (S): 339 K
- Juno (S): 334 K
- Pallas (B): 326 K
- Davida (C): 292 K
- Ceres (C): 292 K
- Egeria (G): 289 K
- Vesta (V): 248 K
- Psyche (M): 200 K

- also observations of: Amphitrite (S), Cybele (C), Diotima (C), Europa (C), Io (C)

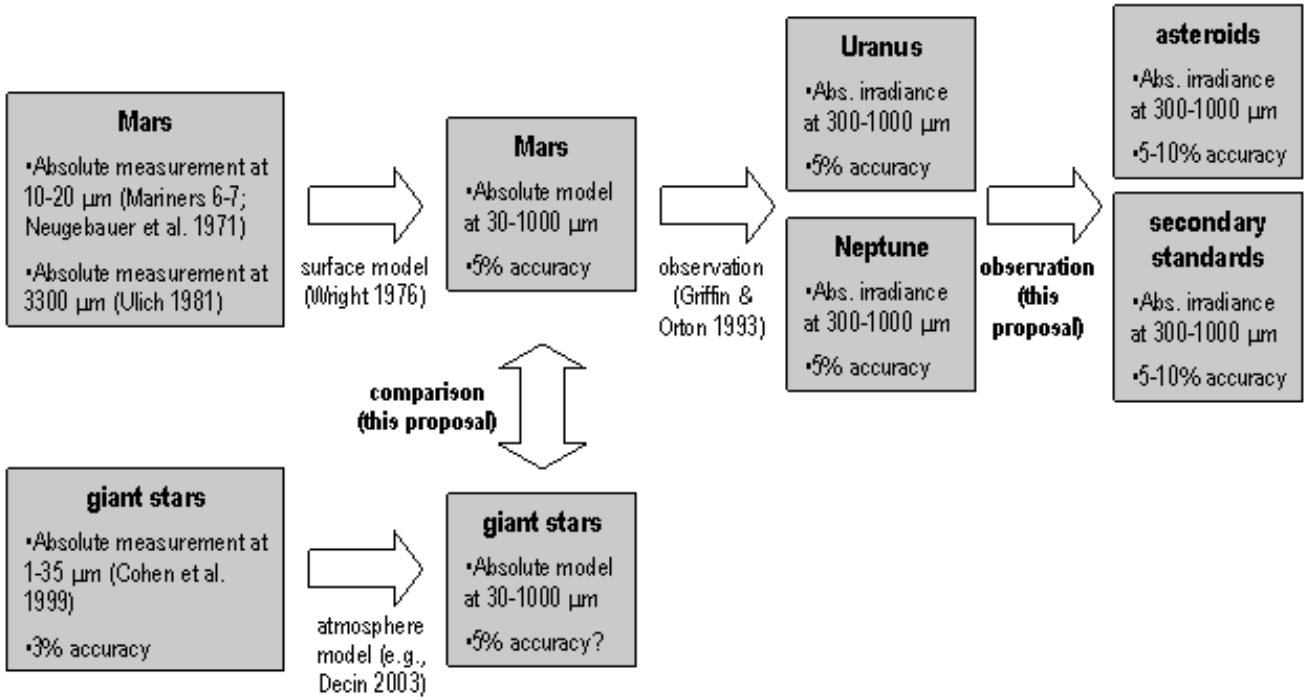
Stellar Standard α Boo



- F_ν = 0.54 Jy
- within 20% of model prediction (W. Vacca, priv. commun.)
- only IR stellar standard detected so far at 350 μm

What is needed now for ground-based observations in support of Herschel?

- CSO will continue observations of bright calibrators.
- Difficult to get observing time for faint Herschel calibrators.
  - If important, consider buying CSO time?



- This work was performed at the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration (NASA).