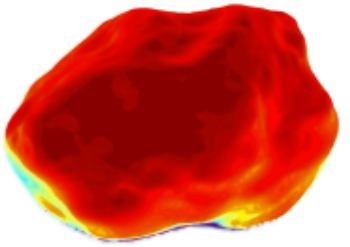
THERMOPS - III



NEOWISE data – Straightforward Cases

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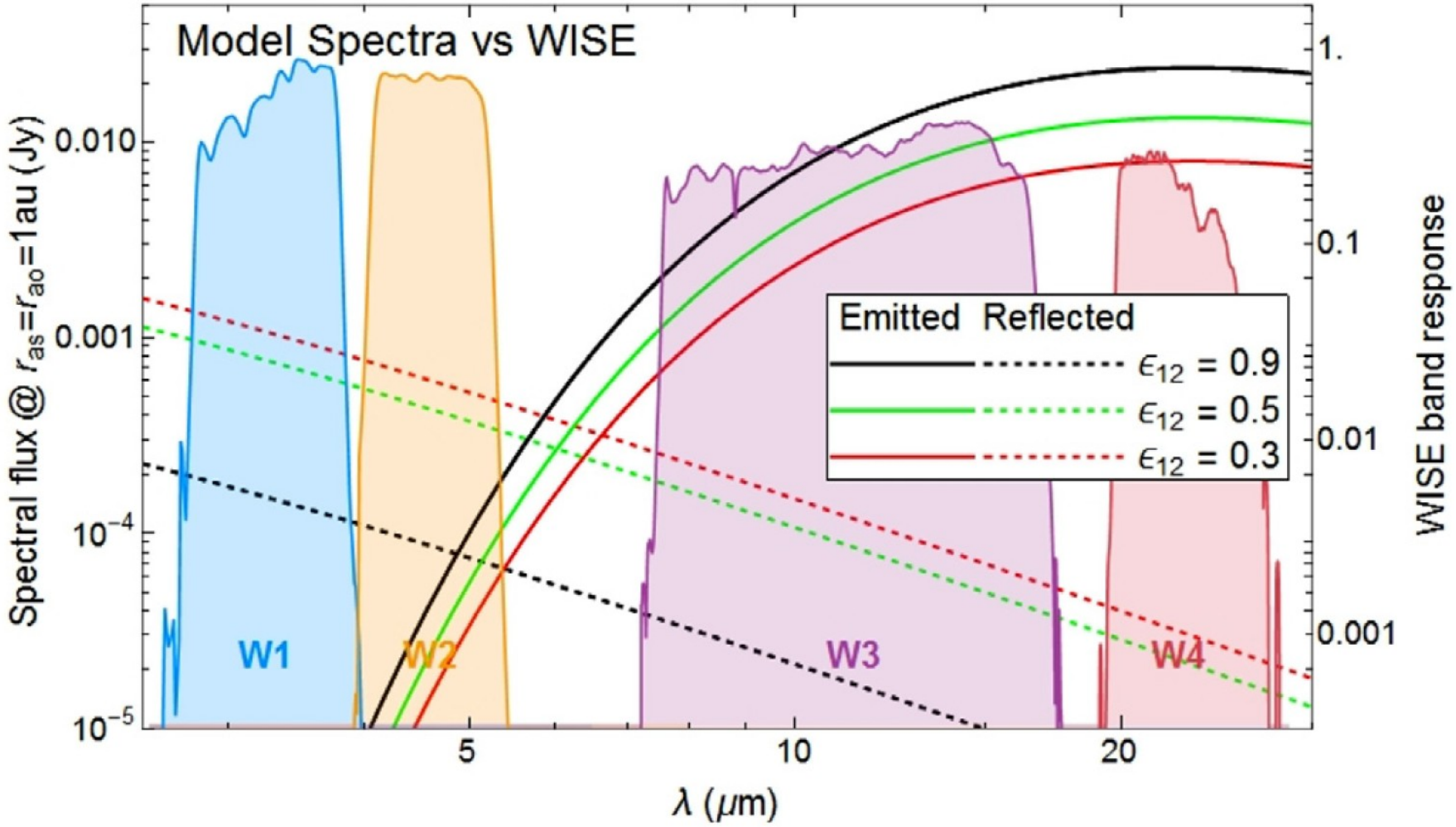
WISE/NEOWISE



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Data Filters

- Photometric quality flag = A, B, or C
- Artifact flag = 0; No saturated pixels
- Signal to Noise Ratio > 4
- PSF fit reduced χ^2 <= 2
- JPL Horizons position within 95% CI adjusted sigma on RA, DEC
- Remove background object confusion cases
- Remove asteroid conjunctions
- A minimum of 3 datapoints per band in all four bands

Photometric

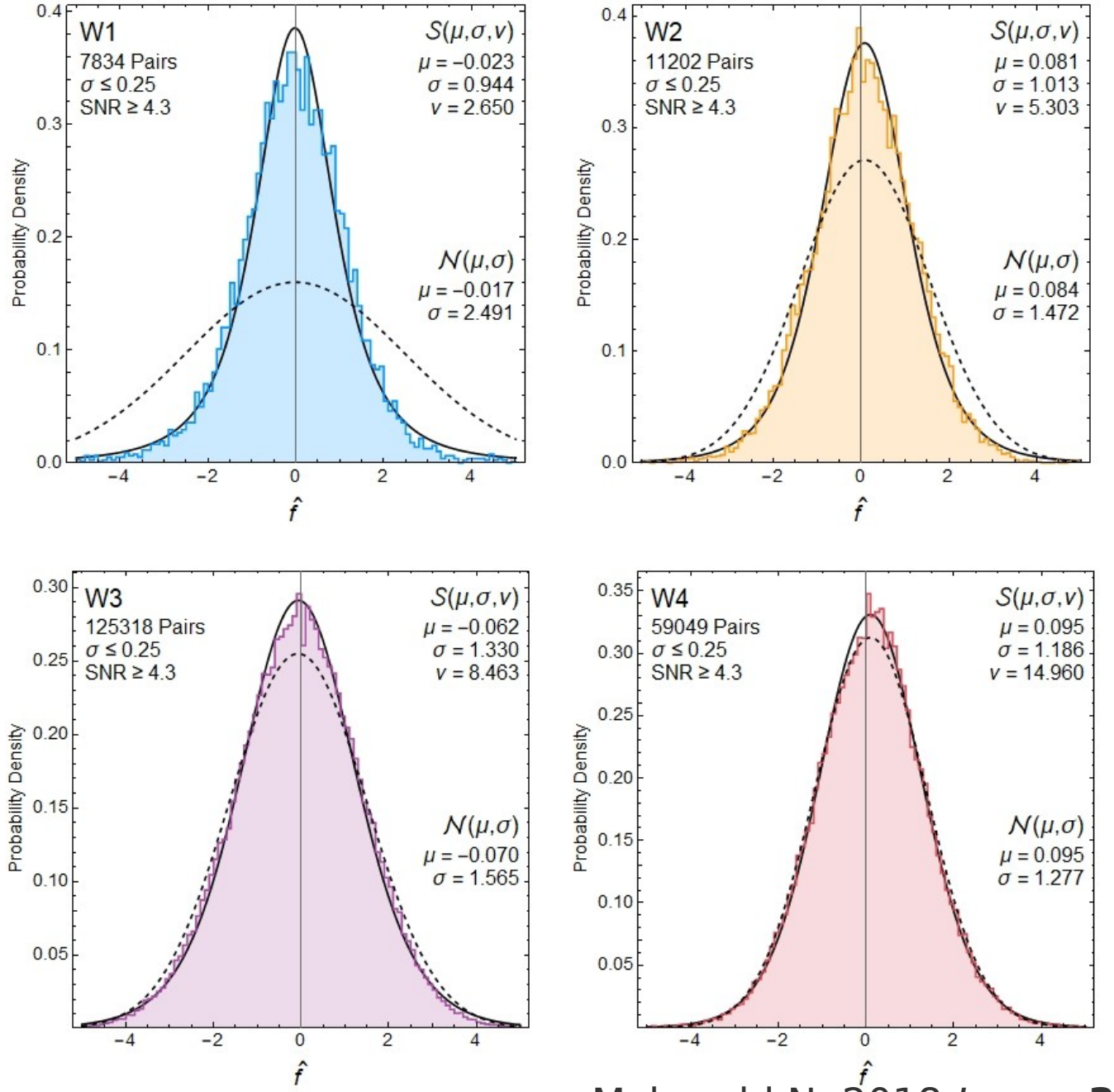
Location and confusion

Data reliability

Total Asteroids Remaining = 4688

Error Scaling

$$\hat{f} = \frac{f_1 - f_2}{\sqrt{\sigma_1^2 + \sigma_2^2}}$$



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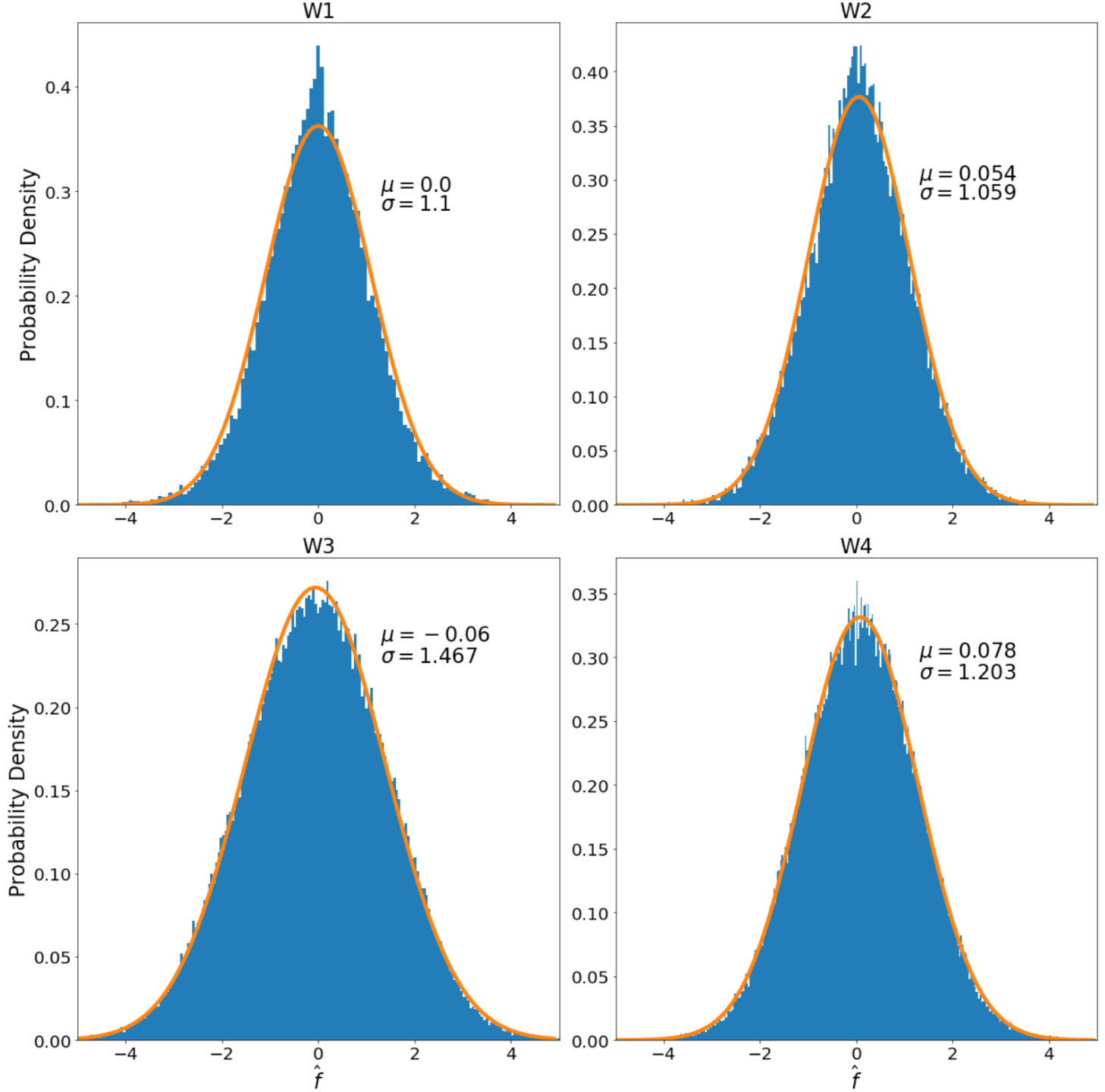

Thermal Models

$$F_{\mathrm{obs}}(\lambda, \alpha, r_{\mathrm{as}}, \ r_{ao}) = \frac{D^2}{4 \ \mathrm{AU}^2 \ {r_{\mathrm{ao}}}^2}$$
$$\times \left(\epsilon(\lambda) F_{\mathrm{model}}(\alpha, \lambda) + p(\lambda) \frac{\psi_{\mathrm{HG}}(\alpha, G)}{{r_{\mathrm{as}}}^2} F_{\mathrm{Sun}}(\lambda) \right)$$

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Thermal Models

$$F_{\mathrm{NEATM}}(\alpha,\lambda) = \int_{\alpha-\pi/2}^{\alpha+\pi/2}\int_{0}^{\pi} B_\nu\left(T_{\mathrm{ss}}(r_{\mathrm{as}})\max(0,\sin\theta\cos\phi)^{0.25},\frac{c}{\lambda}\right) \times\sin^2\theta\ \cos(\alpha-\varphi)\ d\theta d\varphi.$$

$$F_{\mathrm{Sun}}(\lambda) = \frac{\pi {R_{\mathrm{sun}}}^2}{\mathrm{AU}^2} B_\nu\left(5778\ \mathrm{K},\frac{c}{\lambda}\right)$$

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Thermal Models

- Myhrvold reparameterization

$$T_{ss}(r_{as}) = \frac{1}{\sqrt{r_{as}}} \left(\frac{S(1 - p_v q)}{\epsilon_B \ \sigma \ \eta} \right)^{0.25} = \frac{393.598}{\sqrt{r_{as}}} \left(\frac{1 - p_v q}{\epsilon_B \ \eta} \right)^{0.25} = \frac{T_1}{\sqrt{r_{as}}}$$

- For all models--fit by minimizing χ^2 using scaled uncertainties

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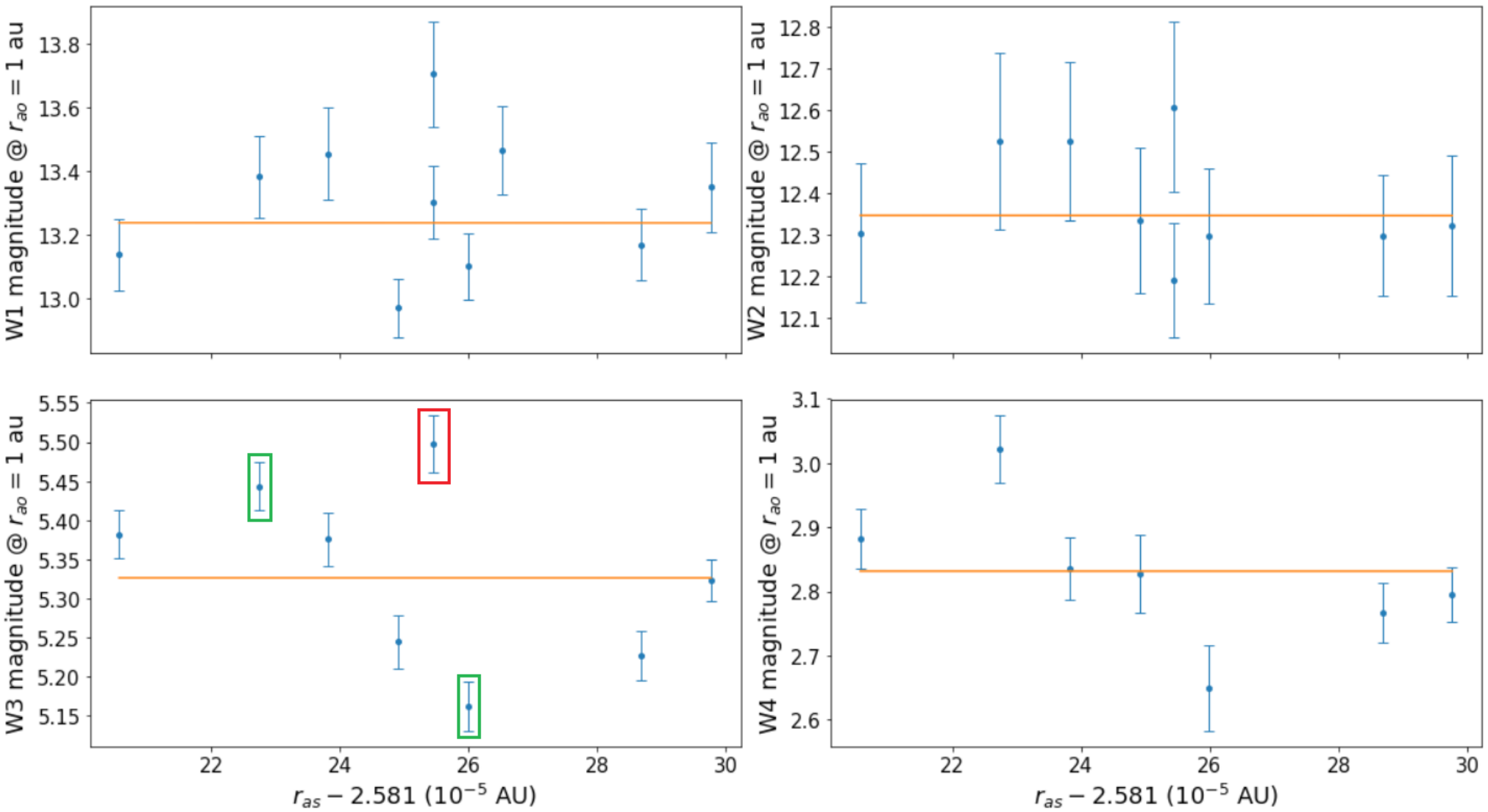
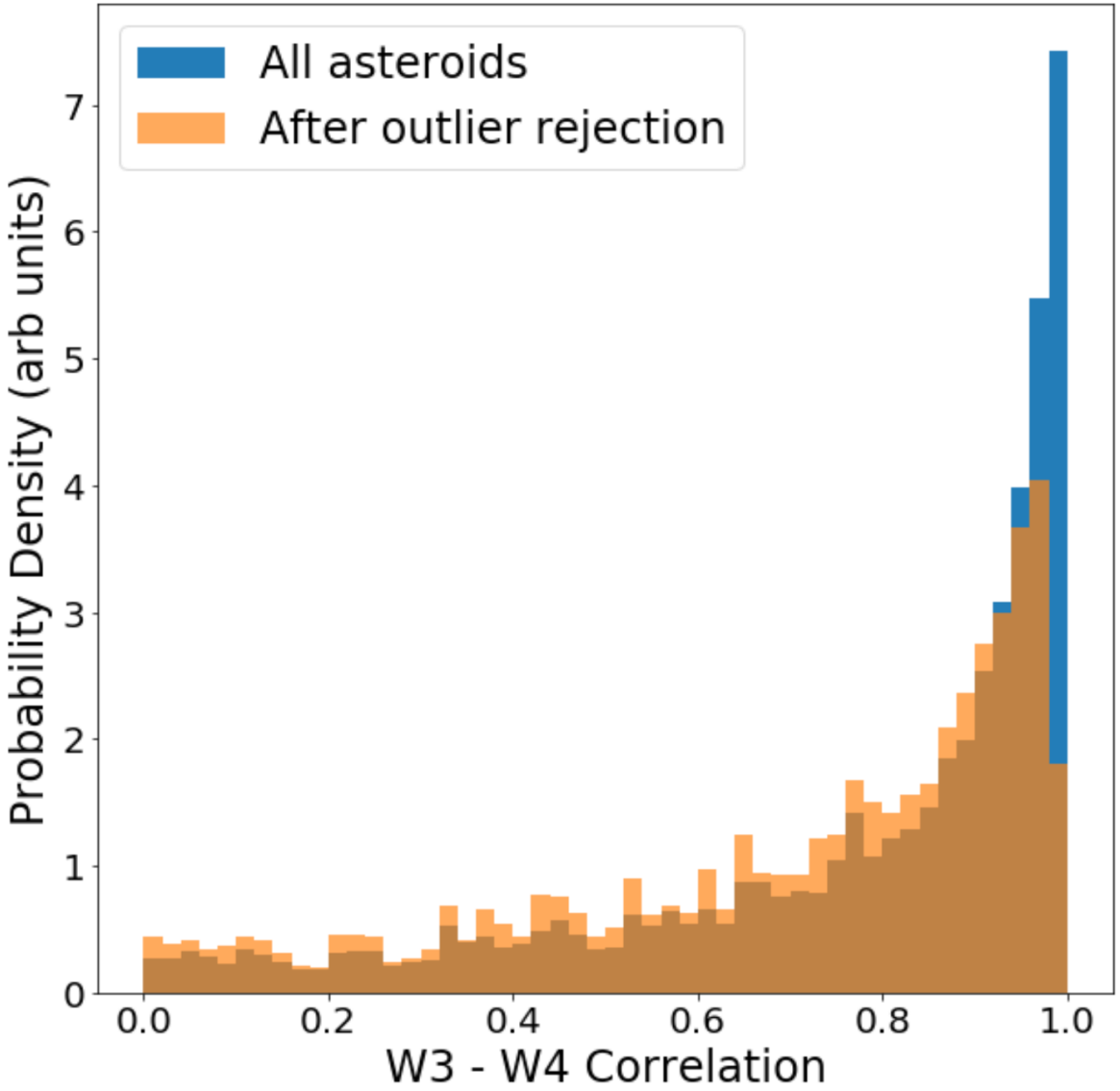
Outlier Rejection

- Iterative procedure
  - Perform model fit with all data
  - Data points with residuals greater than 3σ are discarded
  - Repeat procedure with remaining data points until convergence
- Eliminates additional asteroids
- Future: addition of light curve fitting

Outlier Rejection

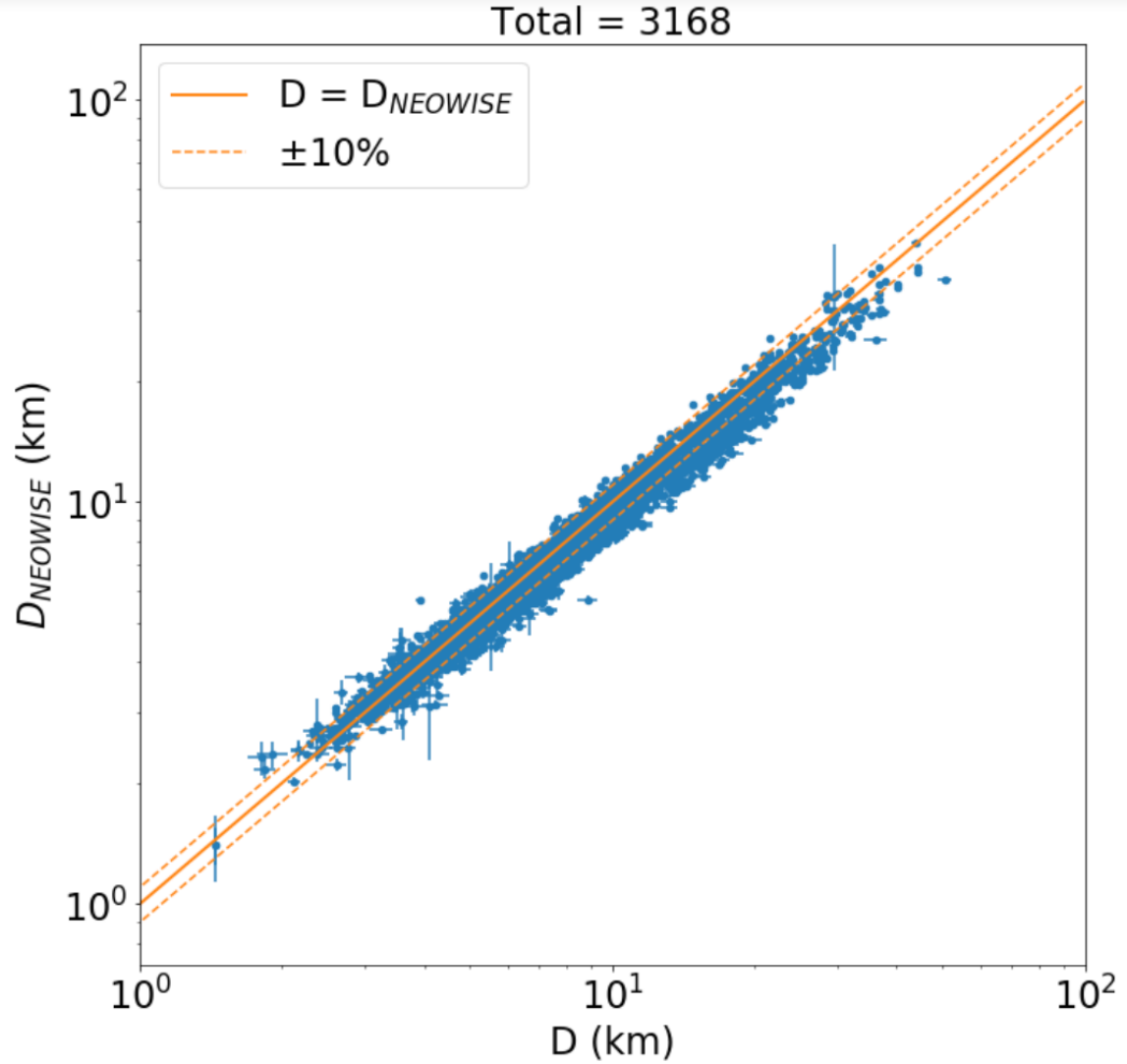


W3-W4 Correlation



Comparison with NEOWISE (2011)

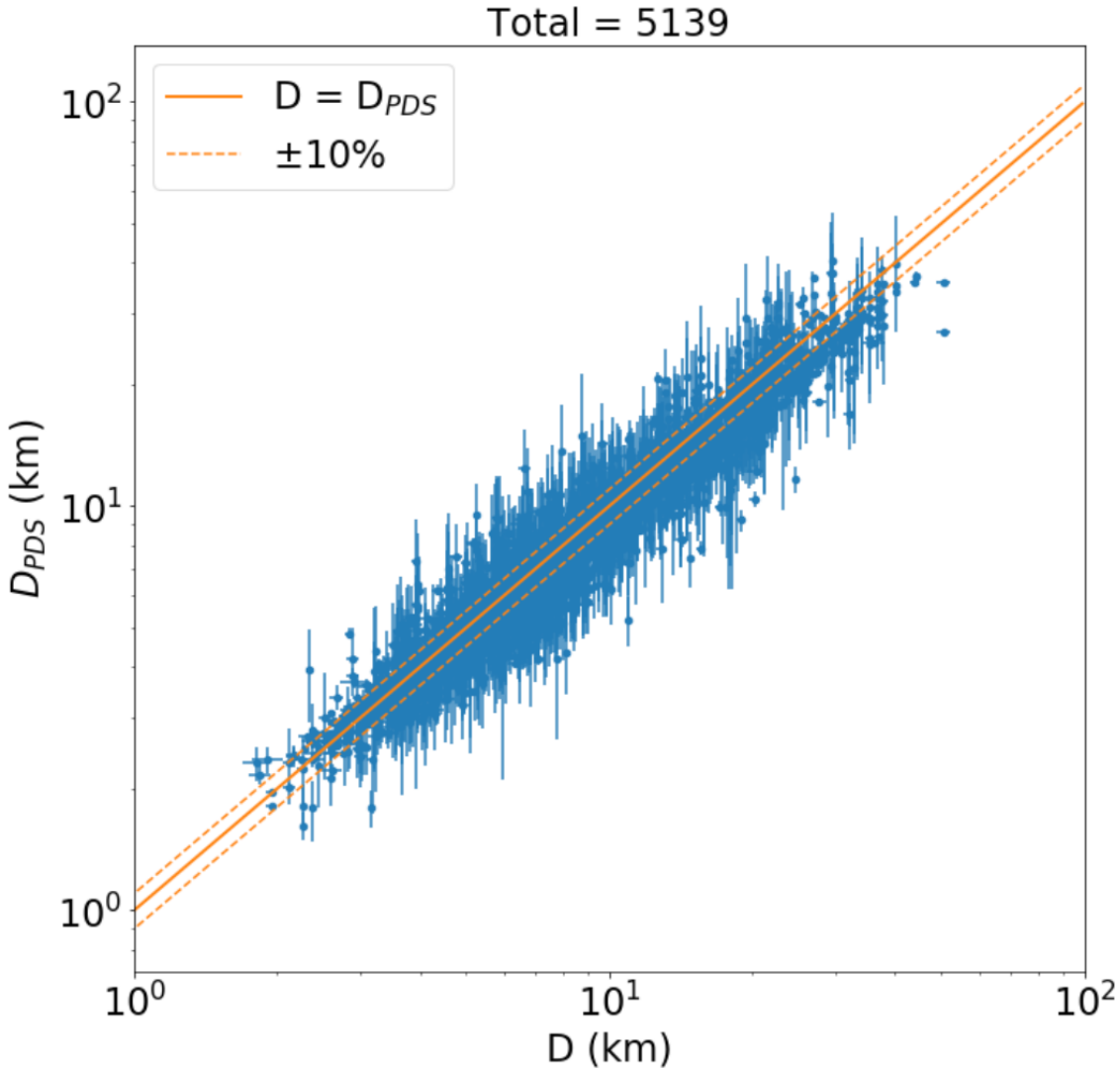
- Main belt asteroids
- Systematic offset:
  - Mean of $D/D_{NEOWISE}$: 1.04
  - STD of $D/D_{NEOWISE}$: 0.098



Masiero, J., et al., 2011. *Astrophys. J.* **741**

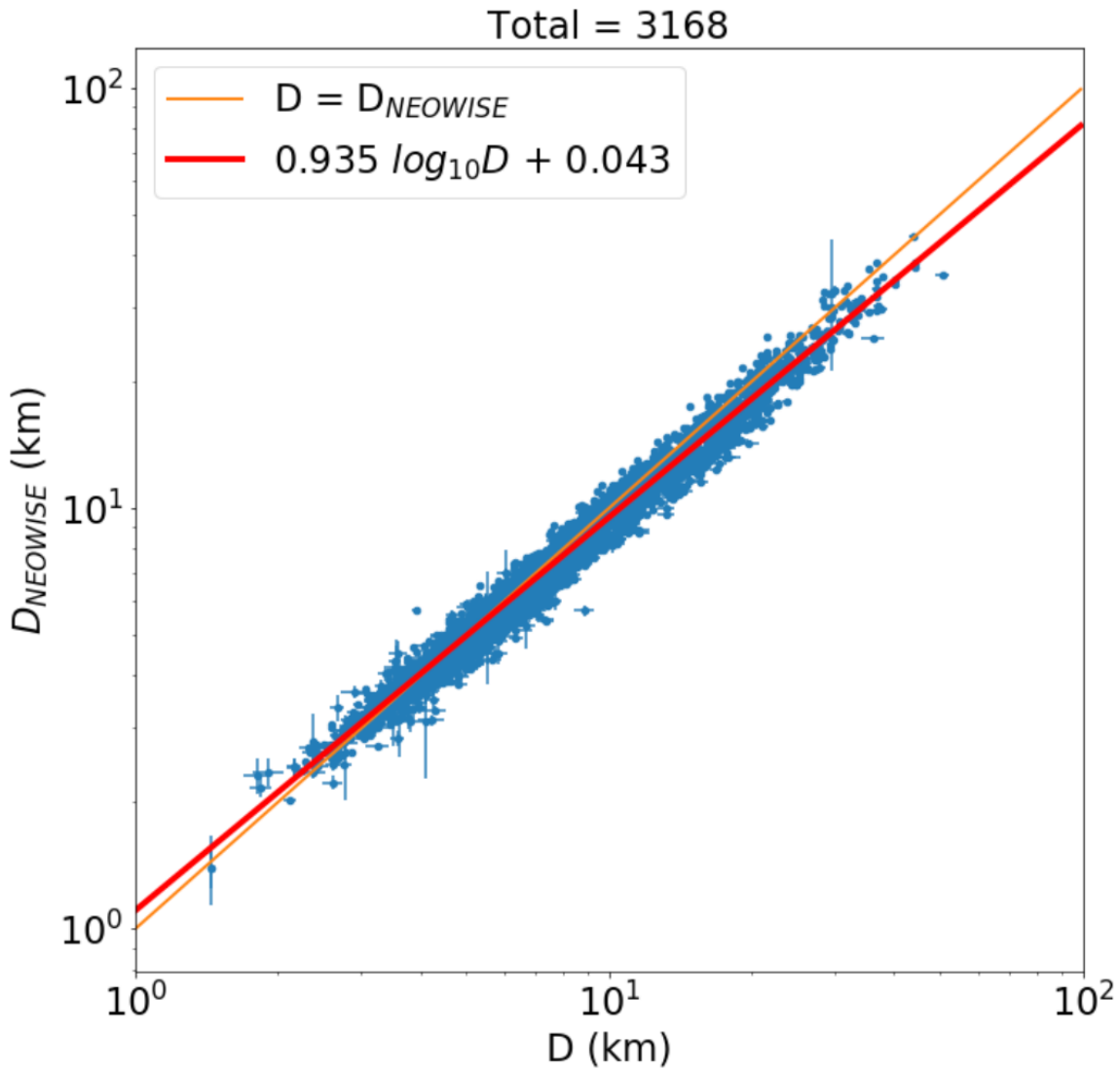
Comparison with NEOWISE (PDS)

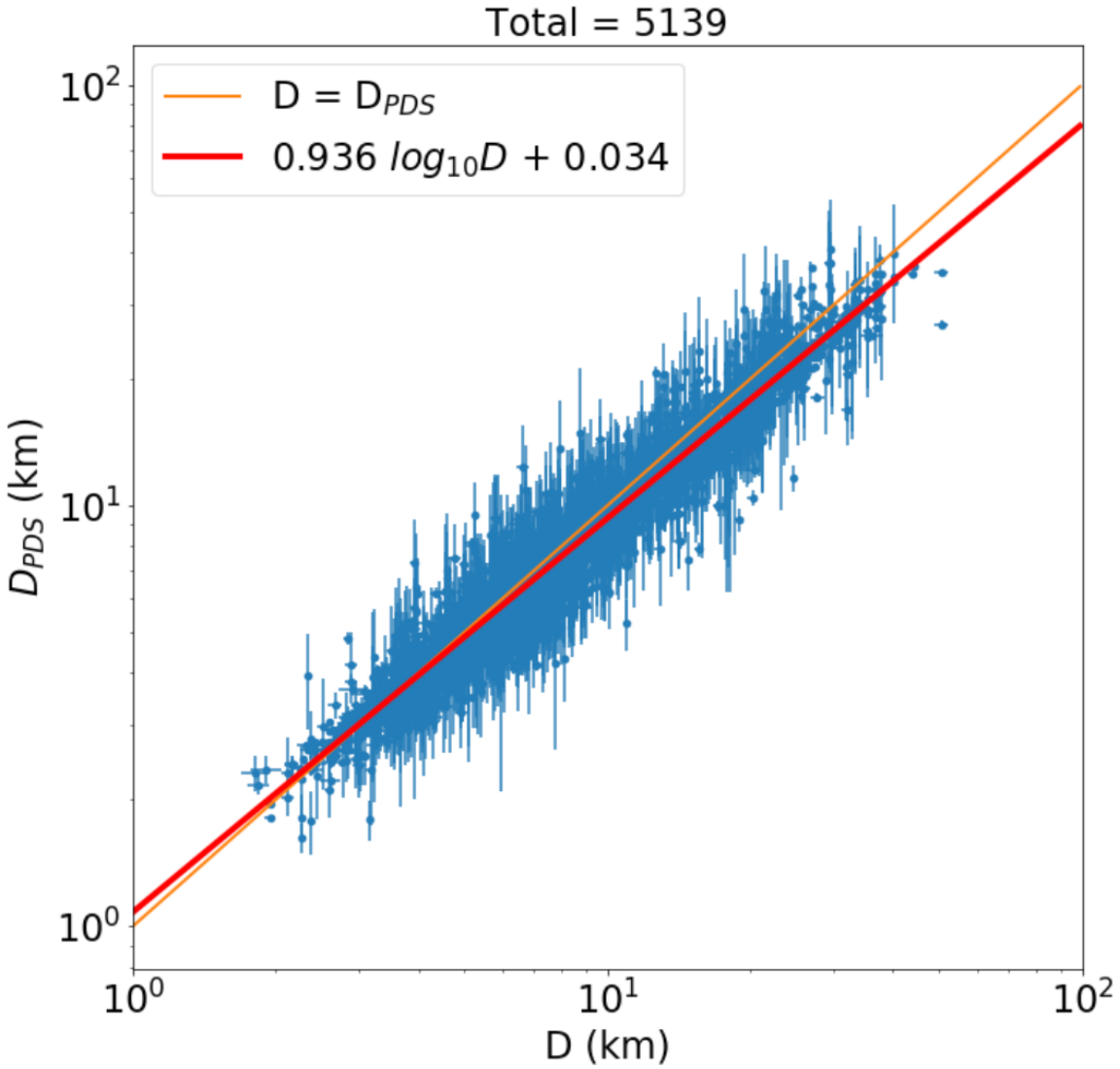
- Systematic offset:
  - Mean of D/D_{PDS} : 1.065
  - STD of D/D_{PDS} : 0.142



EAR-A-COMPIL-5-NEOWISEDIAM-V1.0 NASA Planetary Data System

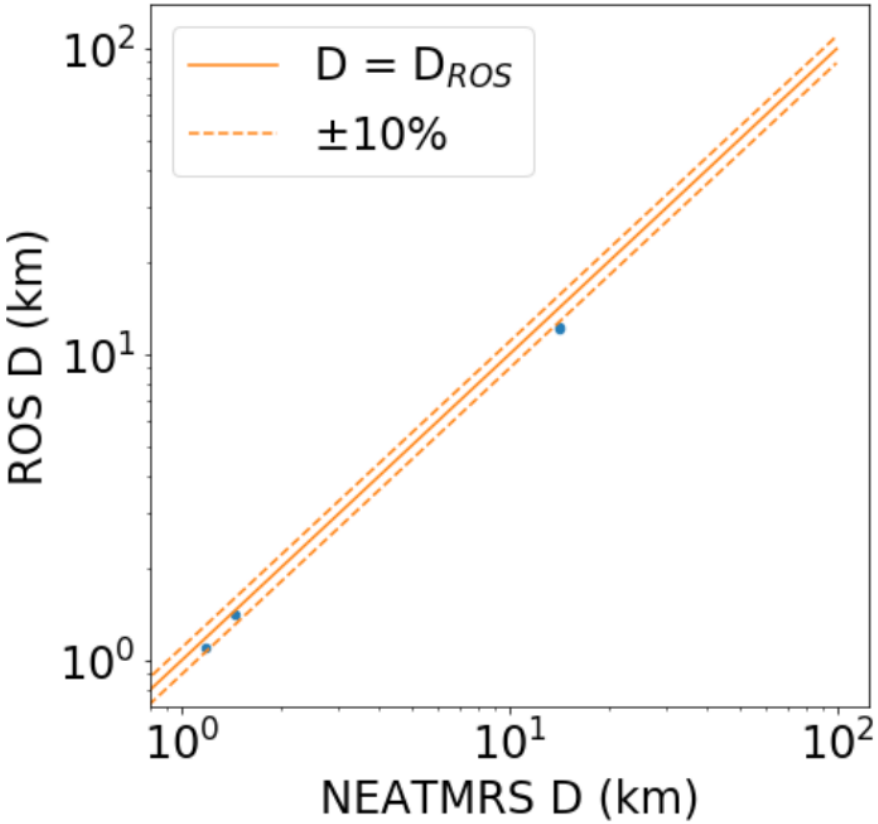
Linear Regression Fit



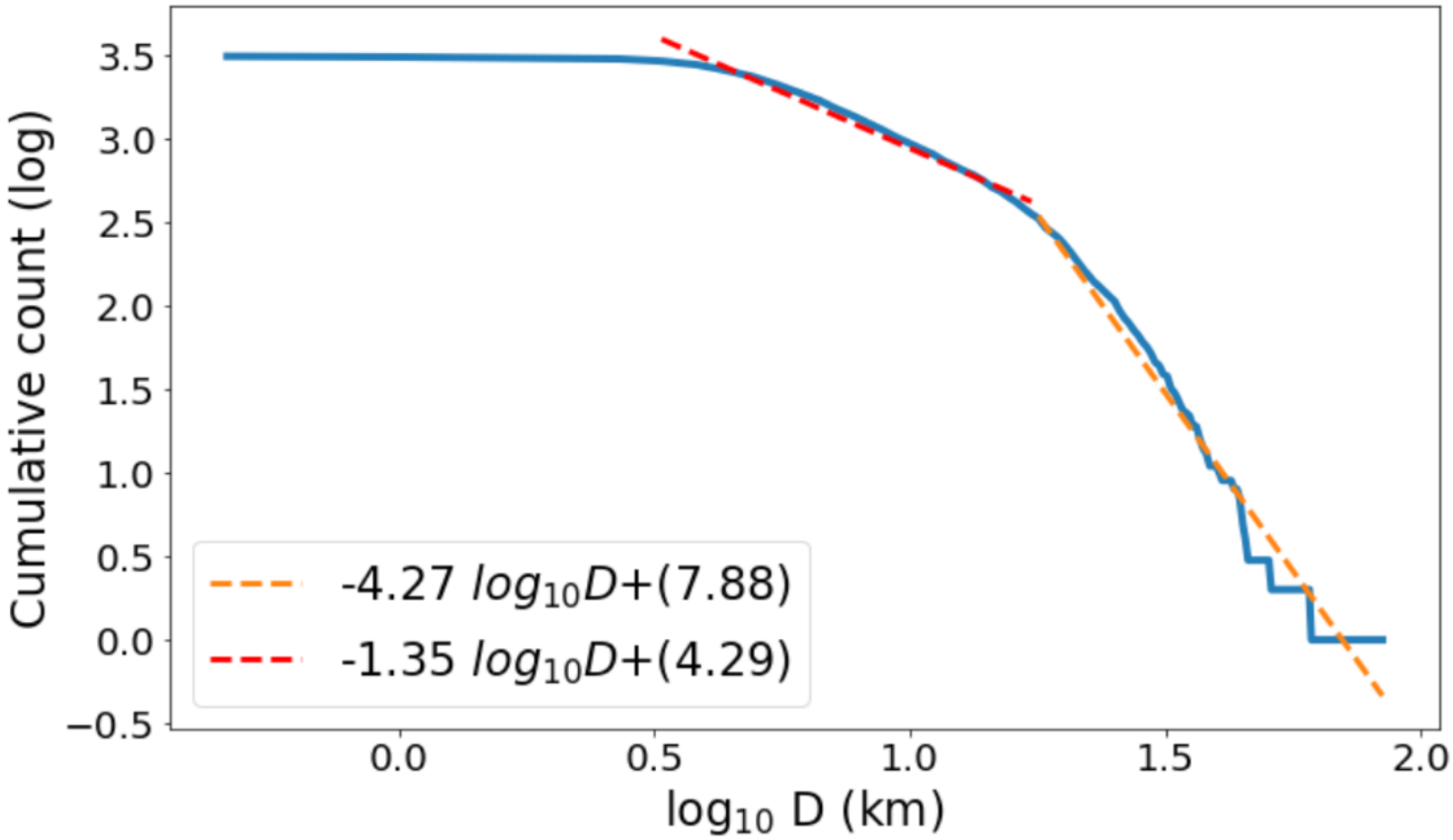


Comparison with Independent Estimates

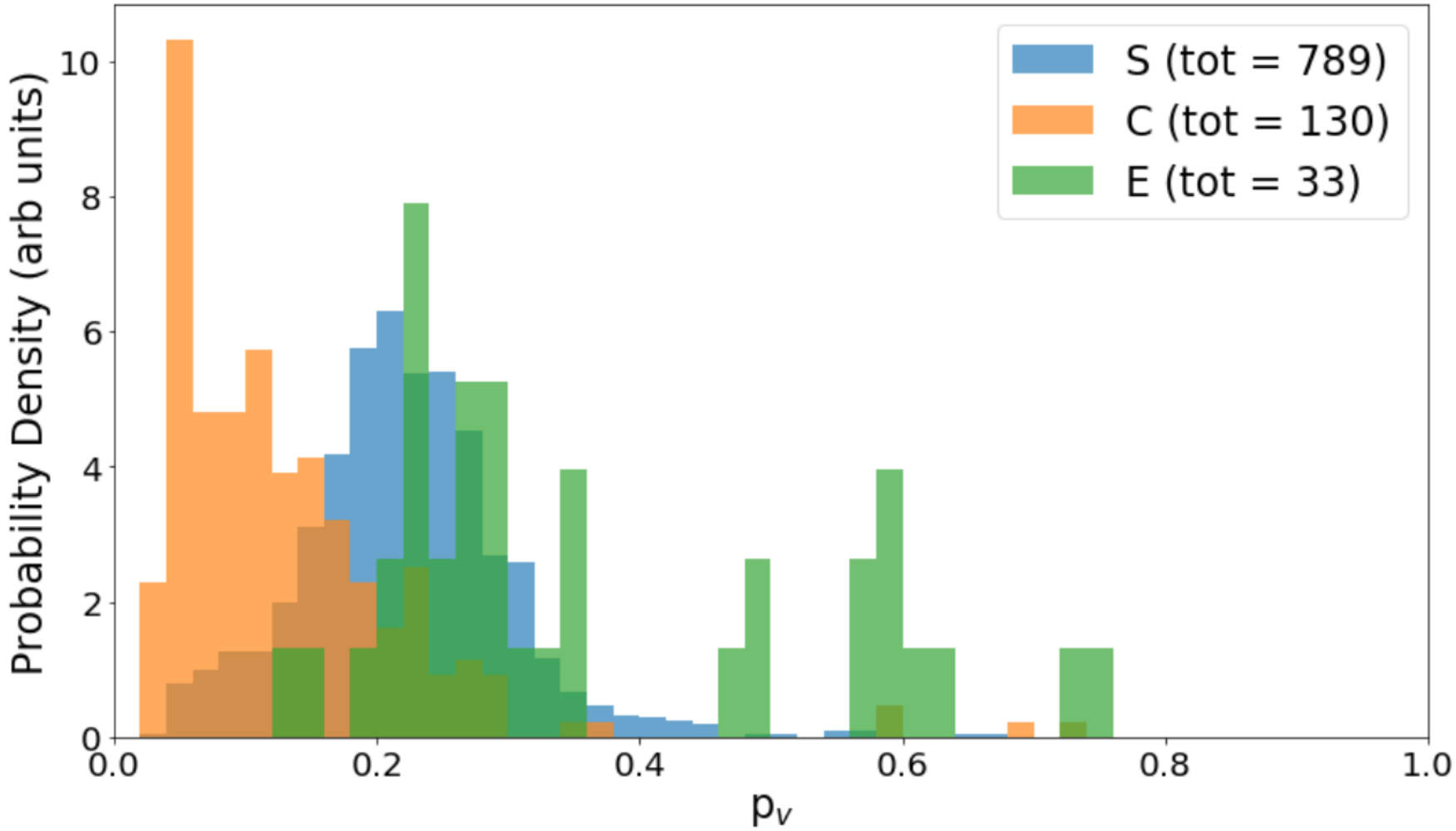
Asteroid	D_{ROS} (km)	$\sigma_{D_{ROS}}$ (km)	D_{here} (km)	$\sigma_{D_{here}}$ (km)
951	12.0	N/A	14.062	0.147
951	12.2	N/A	14.062	0.147
164121	1.1	N/A	1.175	0.013
68216	1.4	N/A	1.441	0.021



Size Distribution



Taxonomy Distribution



Future Directions

- Light Curves
- How to handle less well-behaved cases
  - Wavelength-dependent beaming parameter?
  - Wavelength-dependent emissivity? (See next talk)