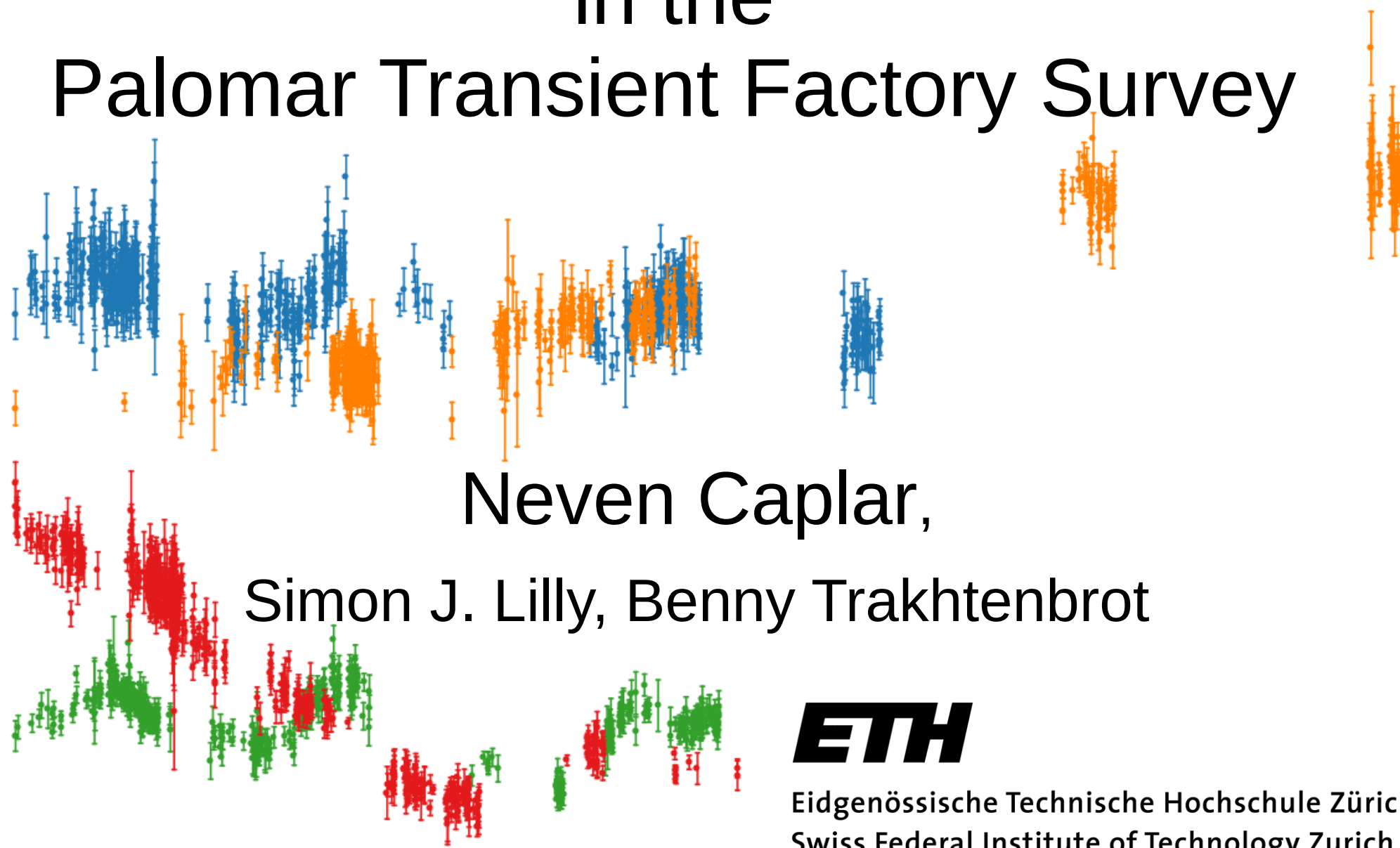


Quasar Variability in the Palomar Transient Factory Survey



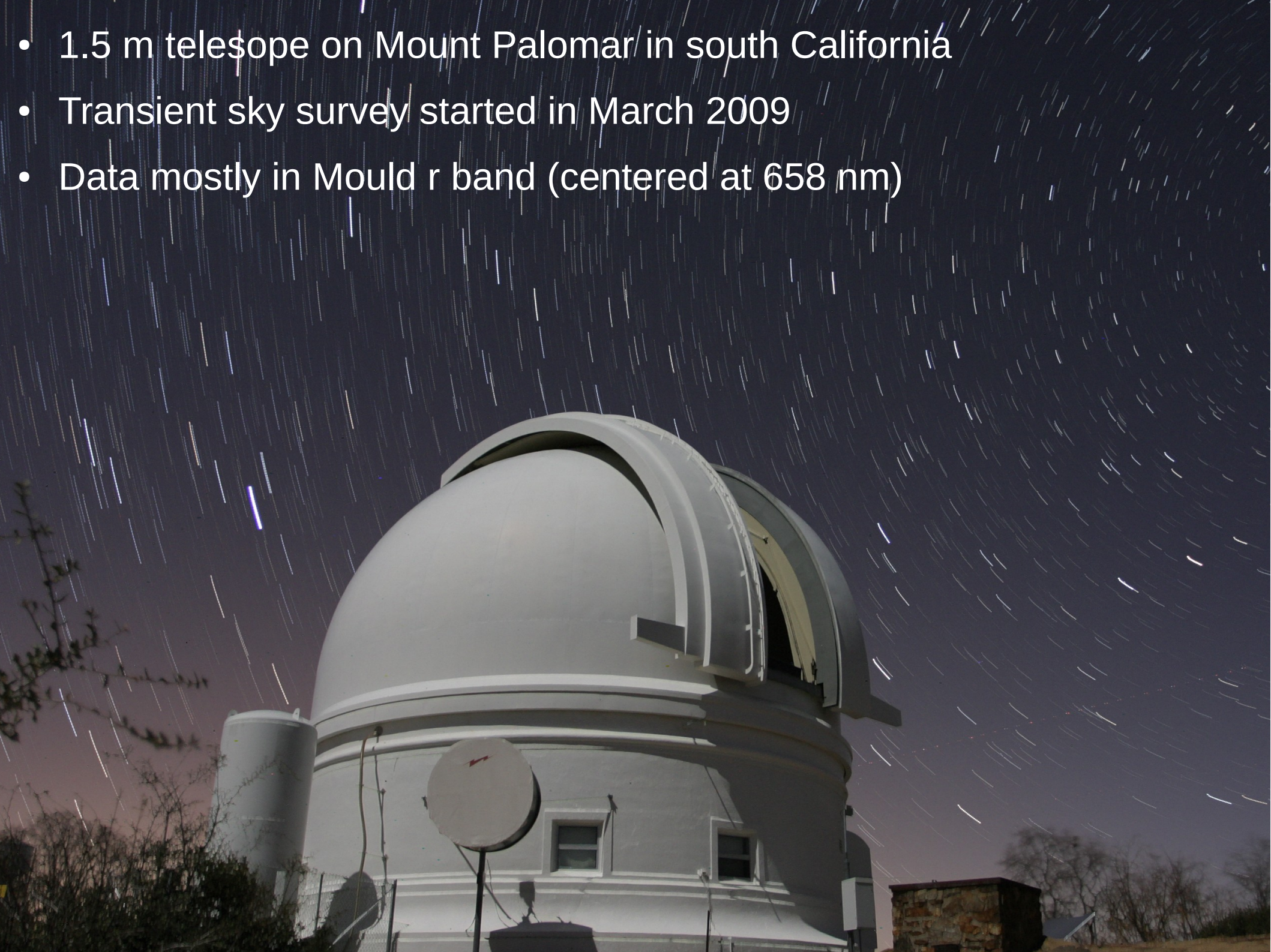
Neven Caplar,

Simon J. Lilly, Benny Trakhtenbrot

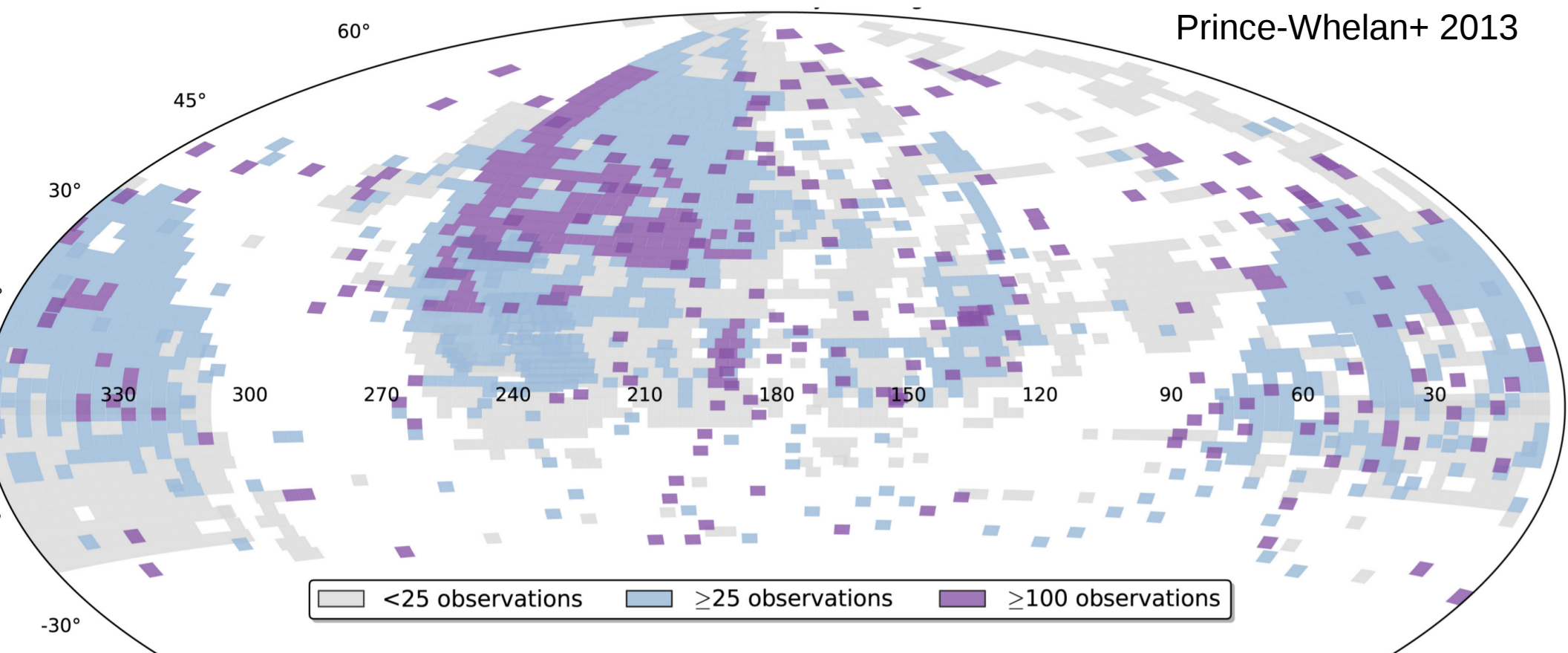


Eidgenössische Technische Hochschule Zürich
Swiss Federal Institute of Technology Zurich

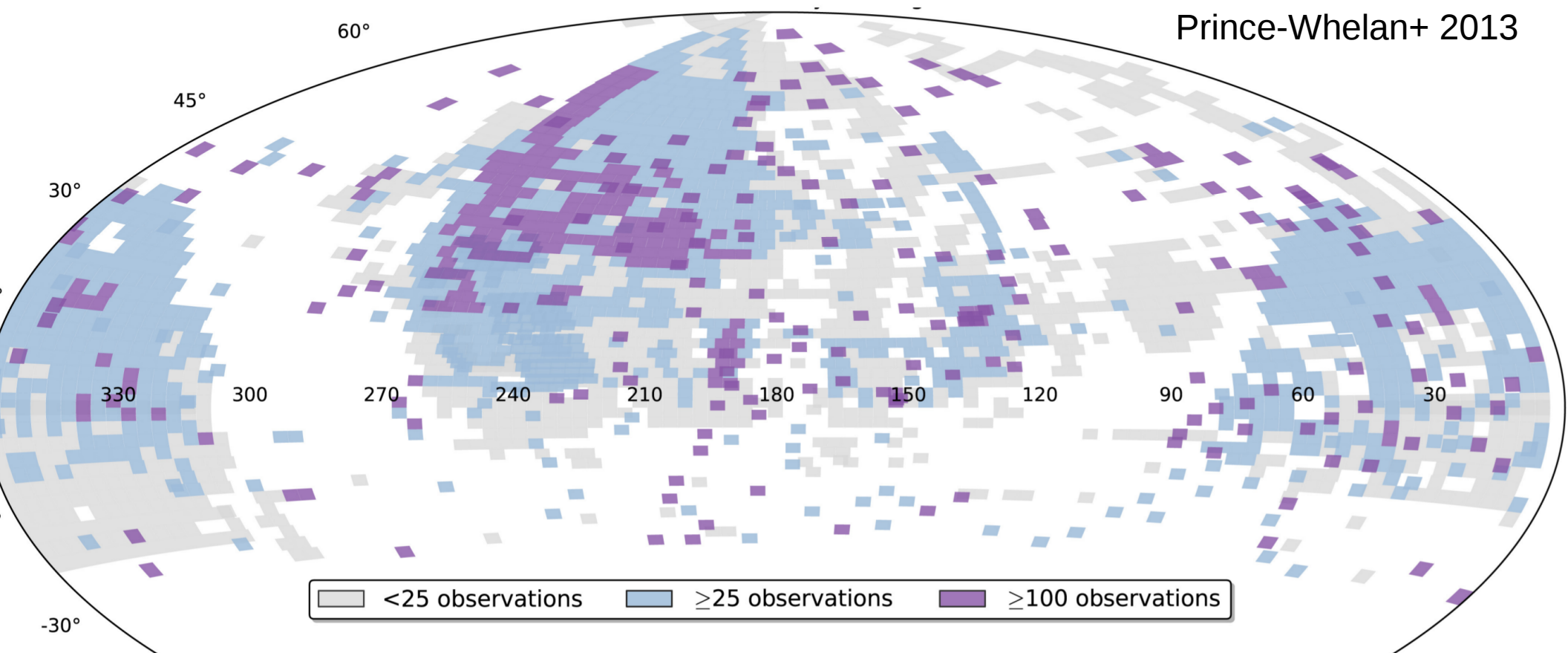
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- Data mostly in Mould r band (centered at 658 nm)



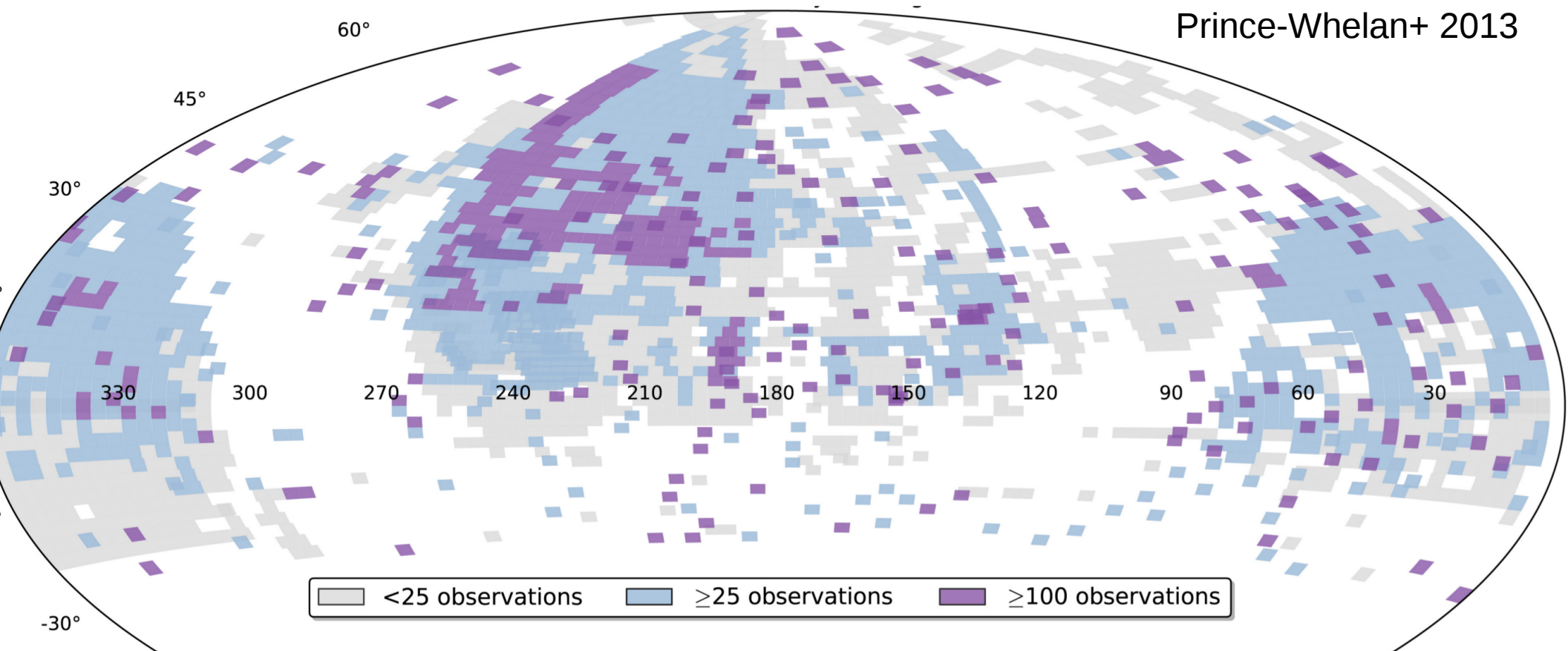
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- 25500 AGNs brighter than $r=19.1$
- 2.2 million data points = largest calibrated single band dataset!



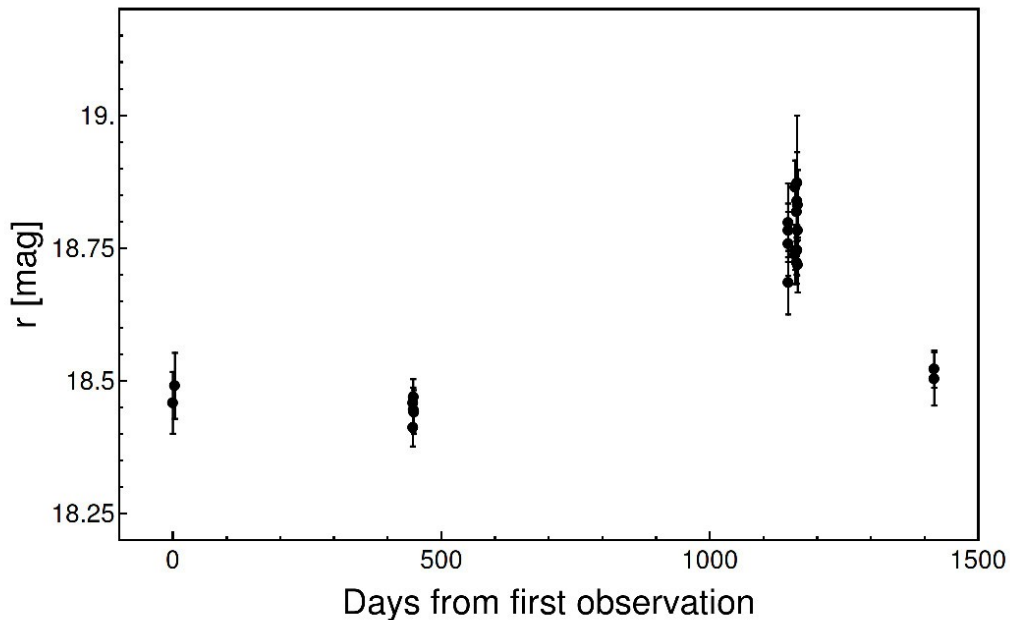
Re-calibration of survey

- AGN light-curves were re-calibrated
- We search for zeropoints which minimize the scatter of reference objects (stars)
- We achieve excellent performance; excess variance is consistent with zero for vast majority of AGNs
- Data public during this year <http://people.phys.ethz.ch/~caplarn/PTF/>

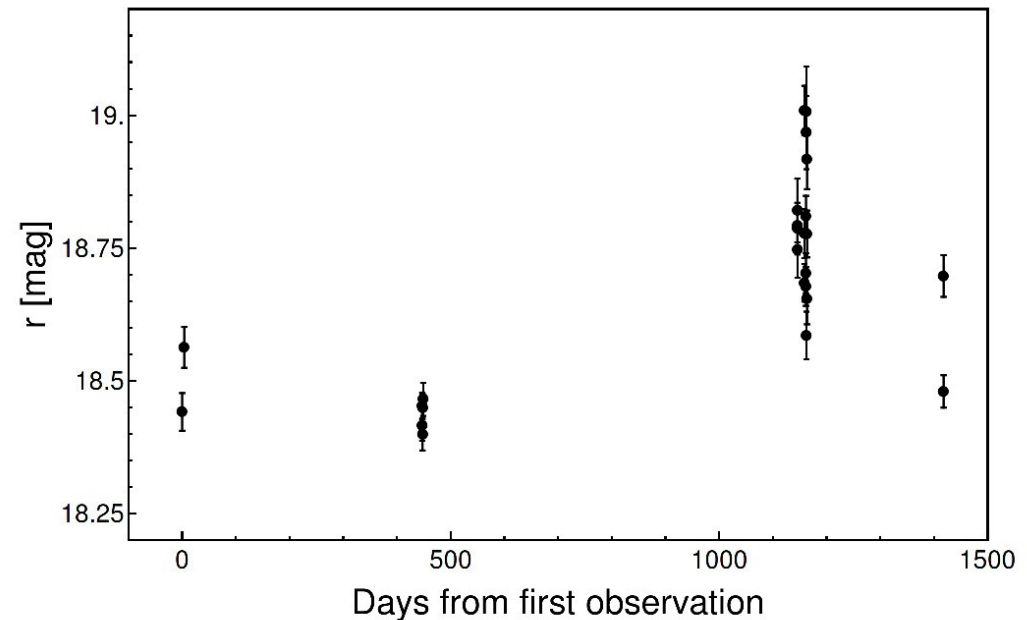
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Calibration from this work



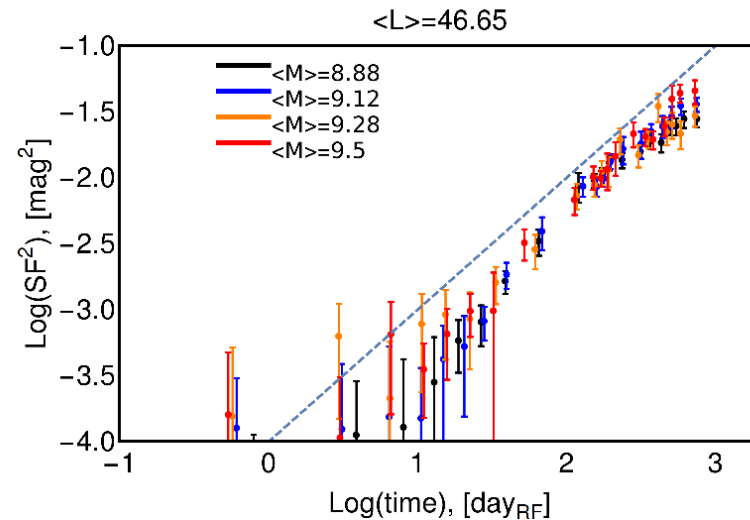
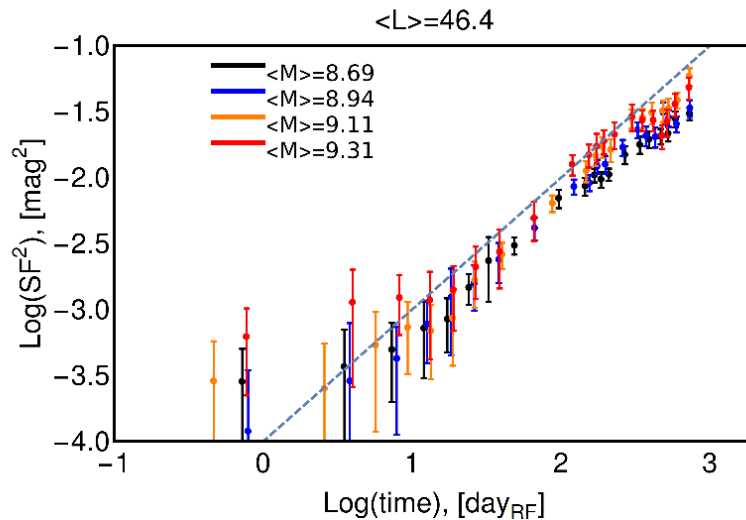
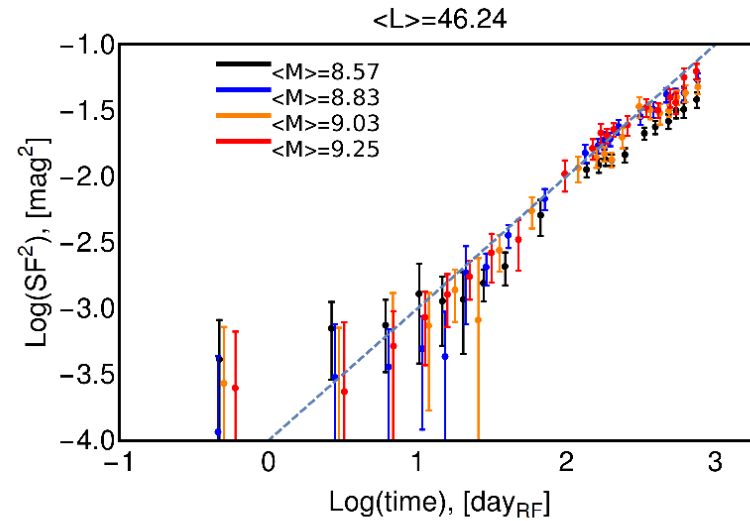
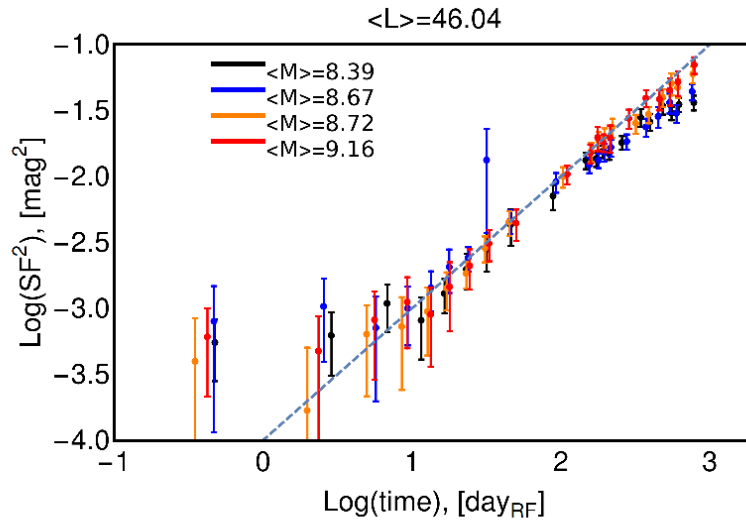
Calibration from Ofek et al. 2012



- SF² (structure function)² analysis
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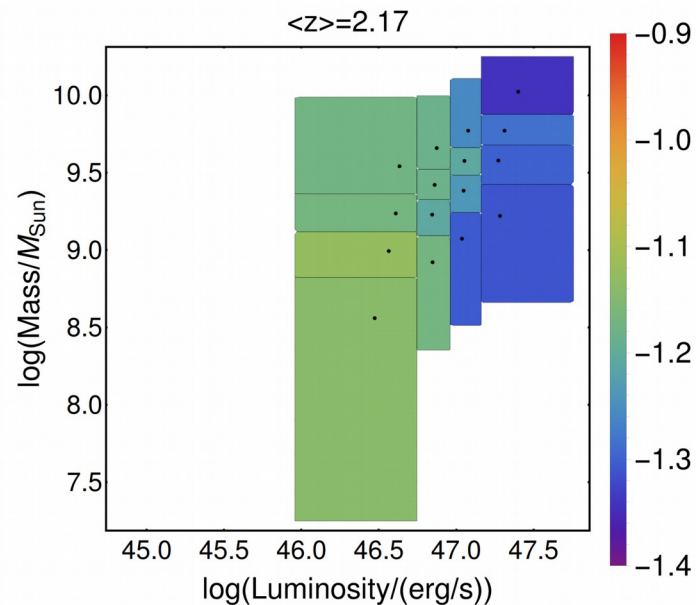
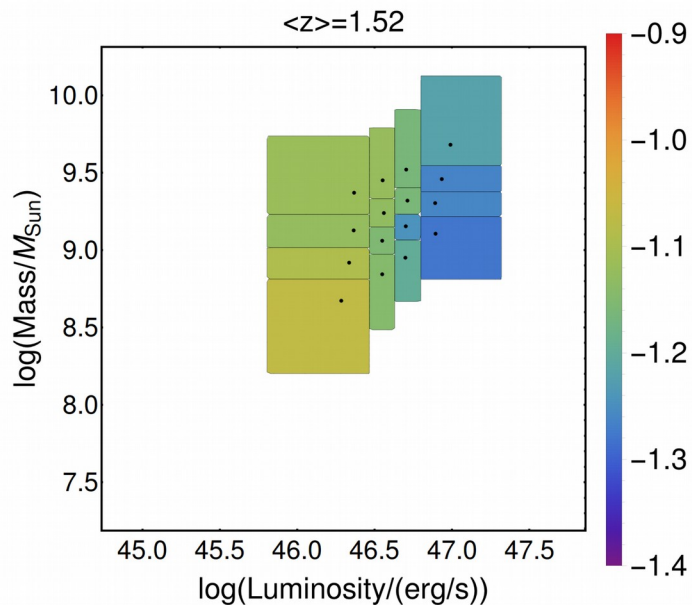
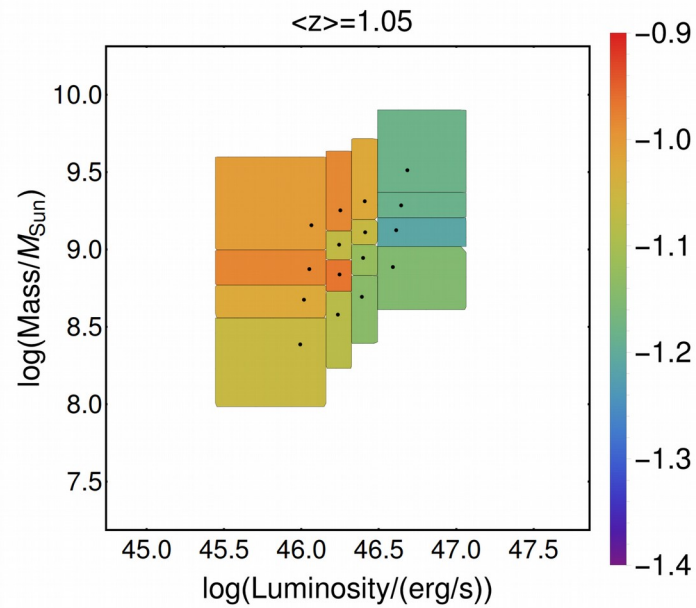
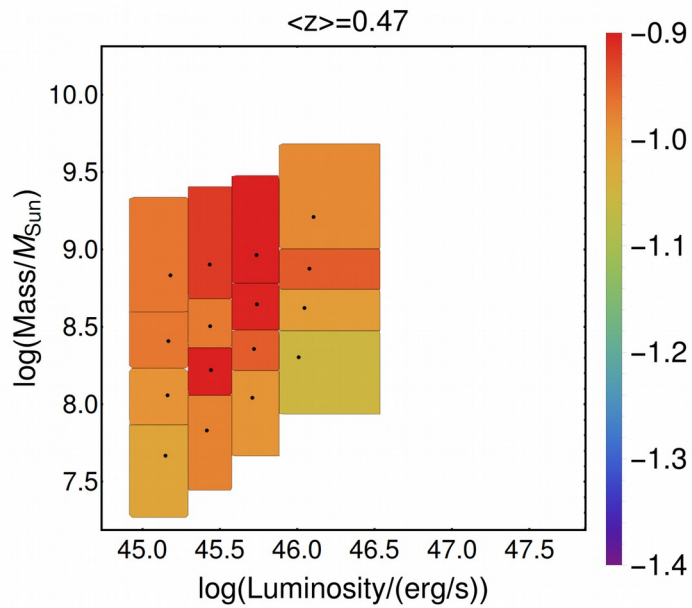
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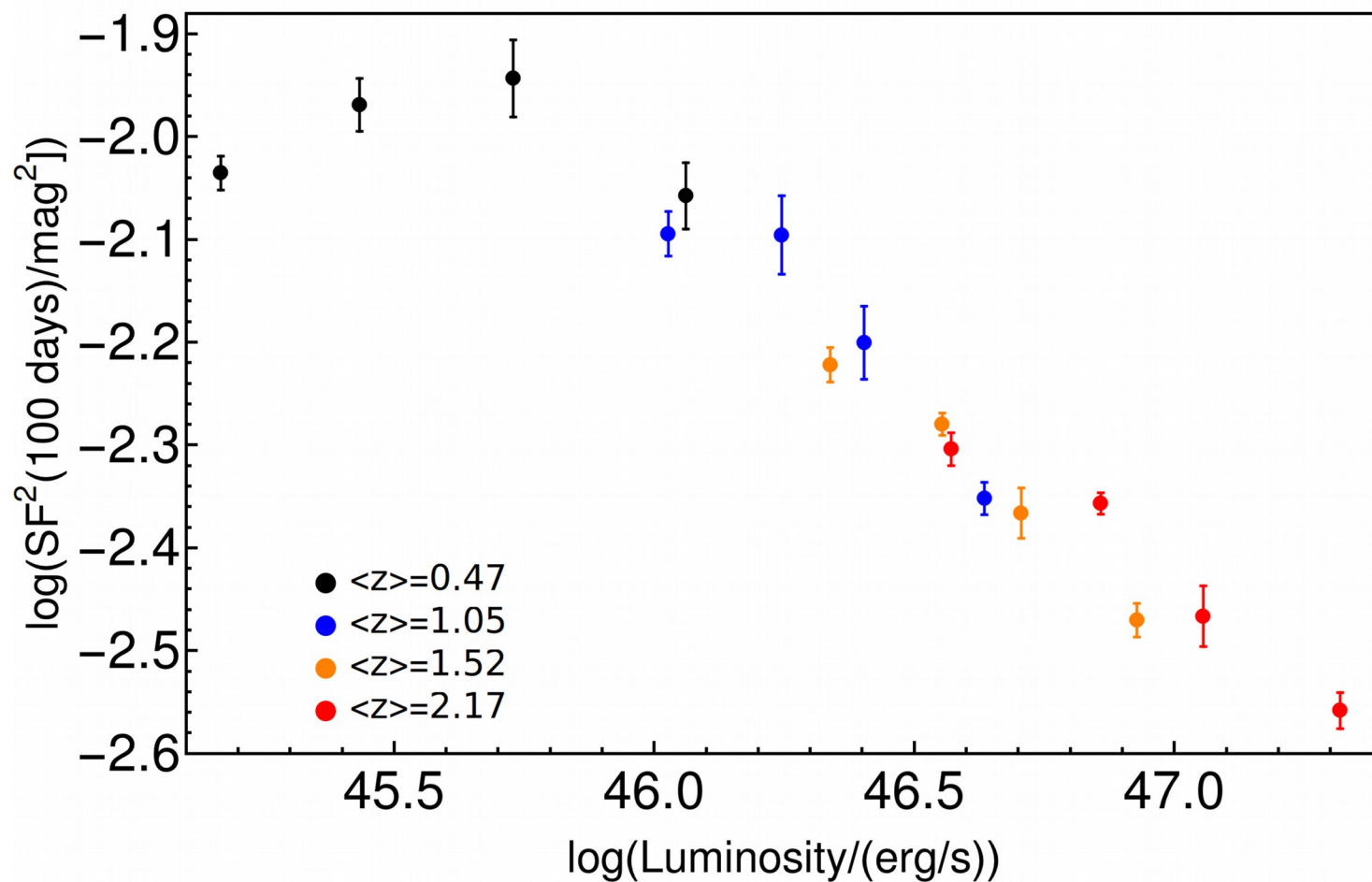


$z=1$

$\log(\text{SF}(100 \text{ days}_{\text{RF}})/\text{mag})$

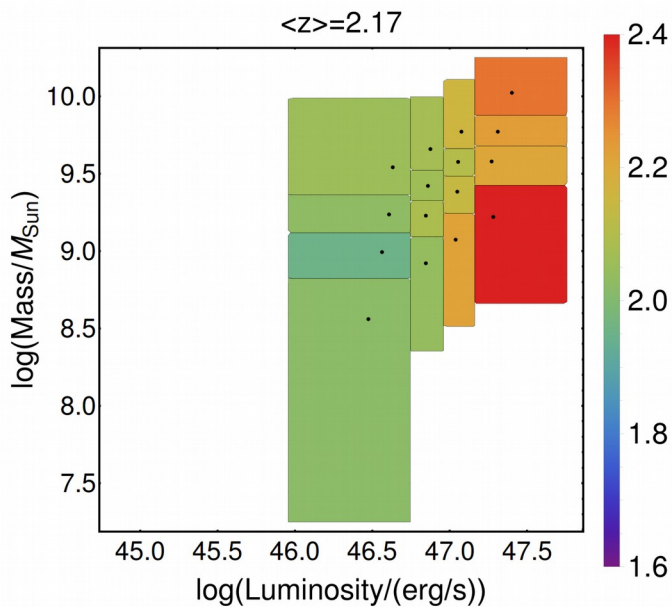
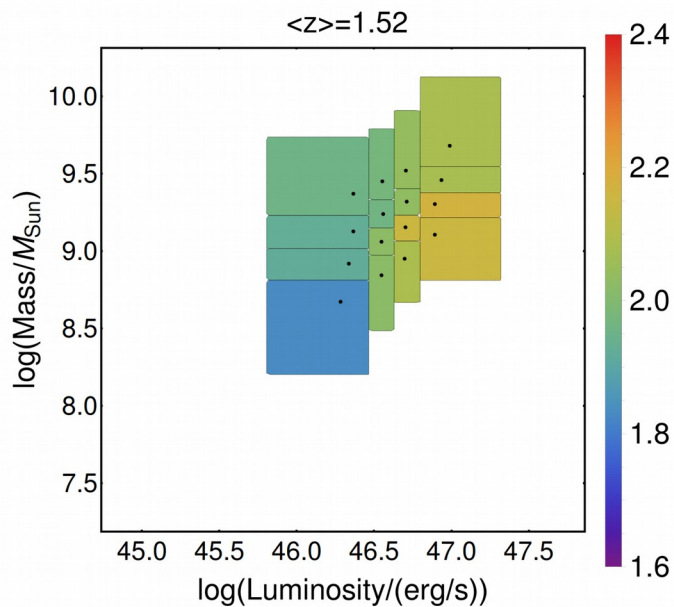
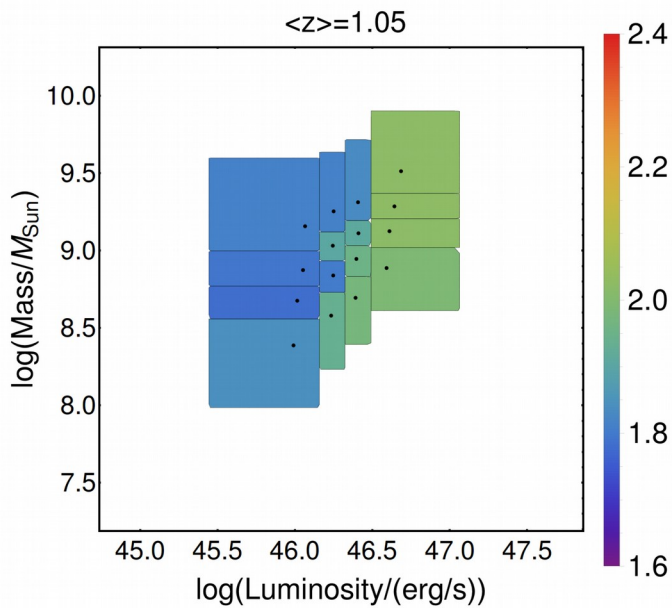
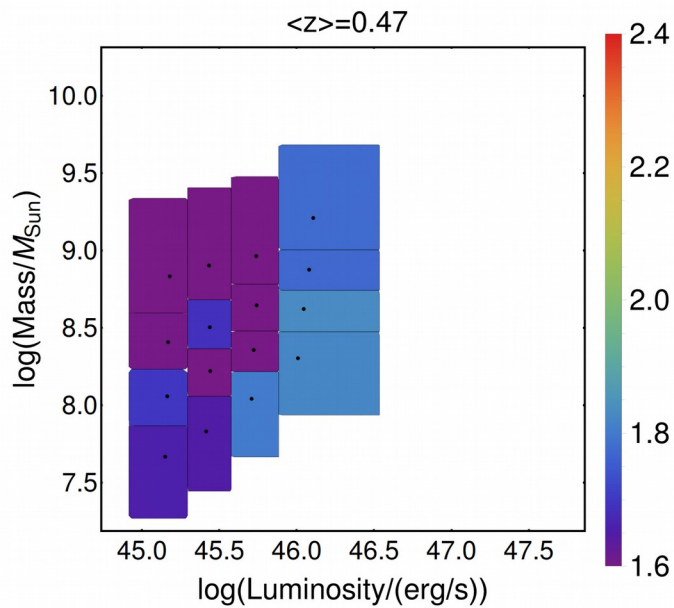


- Wavelength correction estimated from SDSS dataset to normalize to 4000 A
- No correlation with redshift
- Little to no correlation with mass
- Clear dependence with luminosity



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$\log[\text{time}_{\text{RF}}/\text{days}_{\text{RF}}]$ for SF to reach 0.071 mag



- Alternative way to interpret the data – τ , time to reach certain variability

- From data $\tau \propto L^{0.4}$

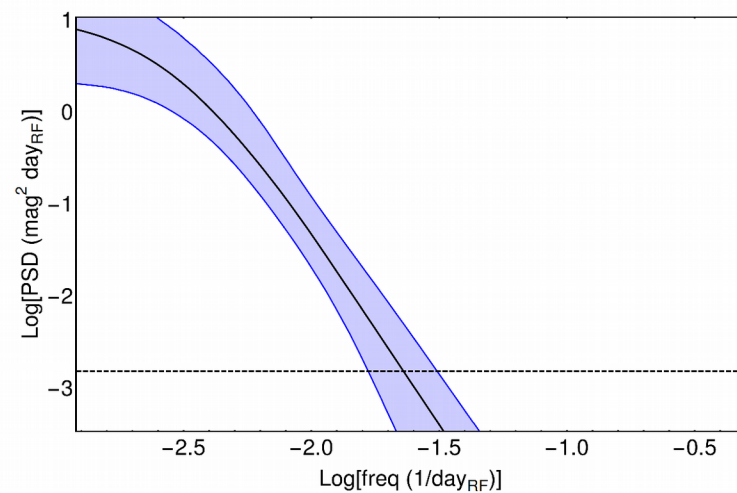
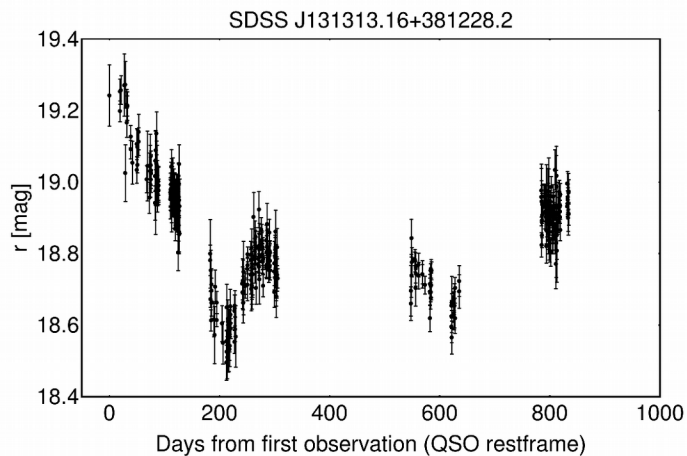
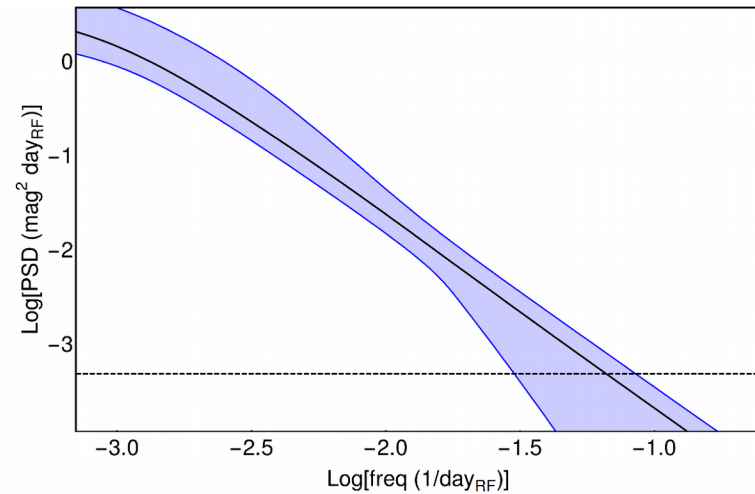
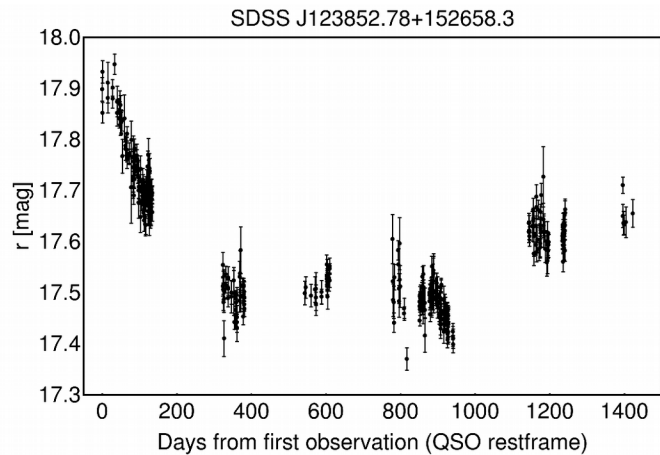
- Simplest model with thin disc and Kelperian orbits $\tau \propto L^{0.5}$

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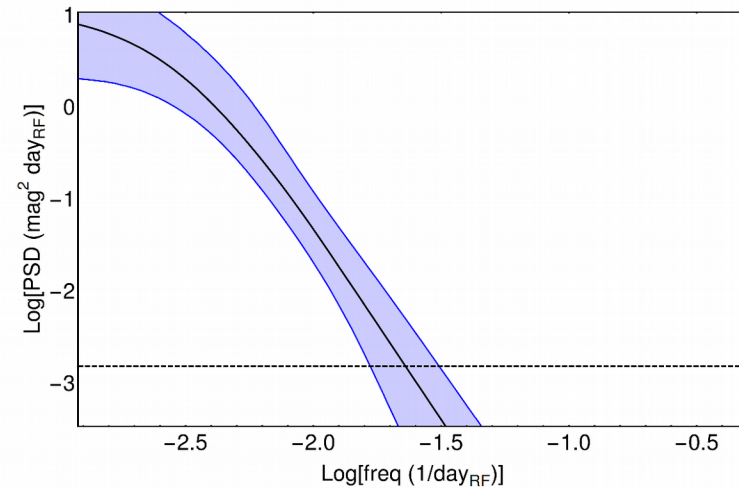
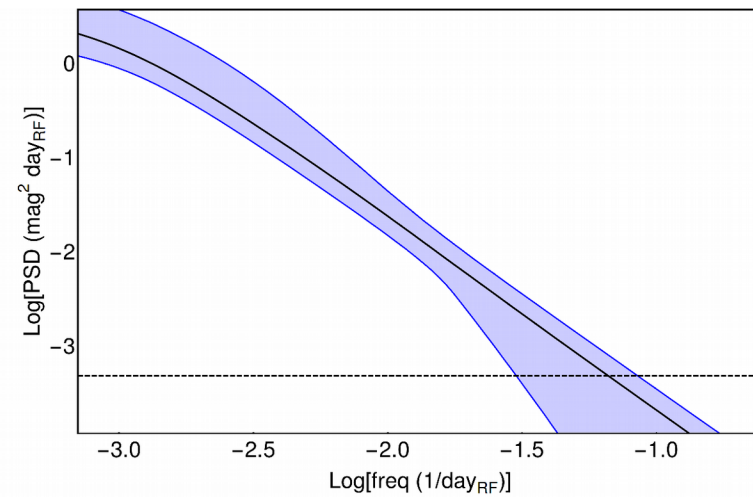
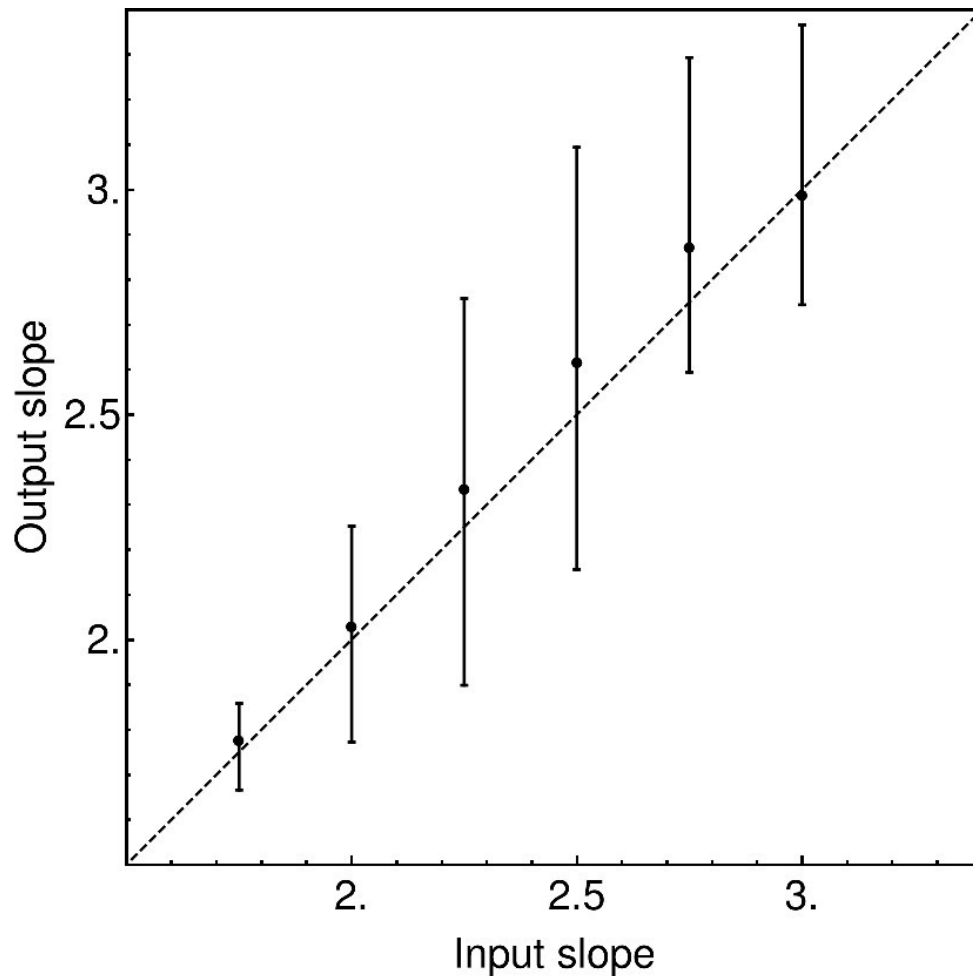
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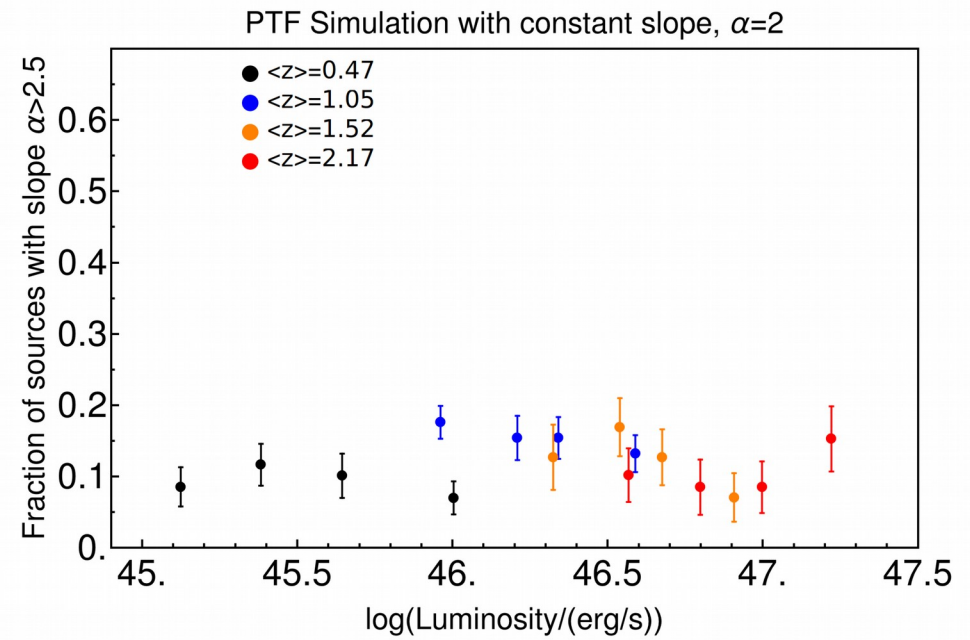
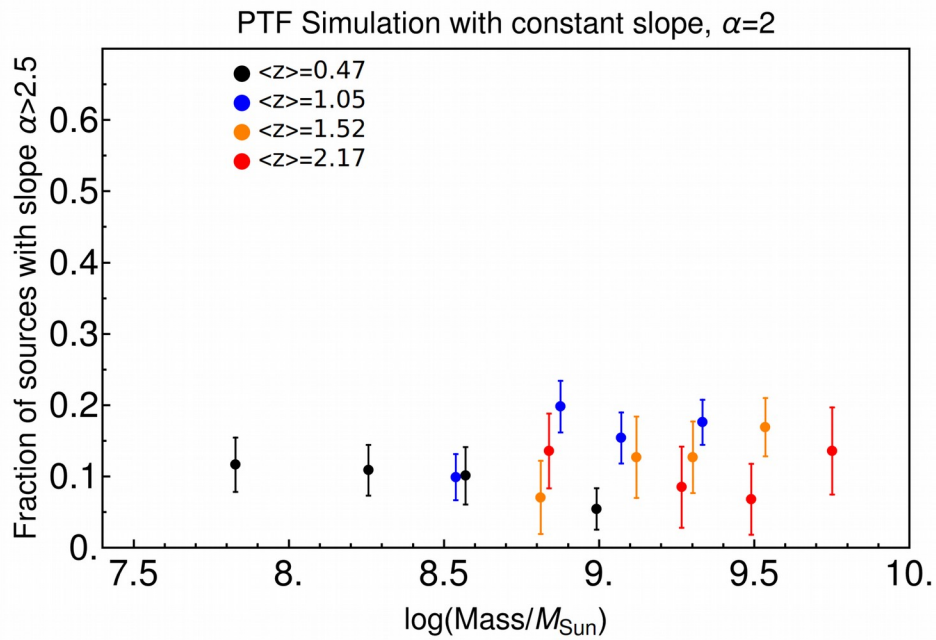
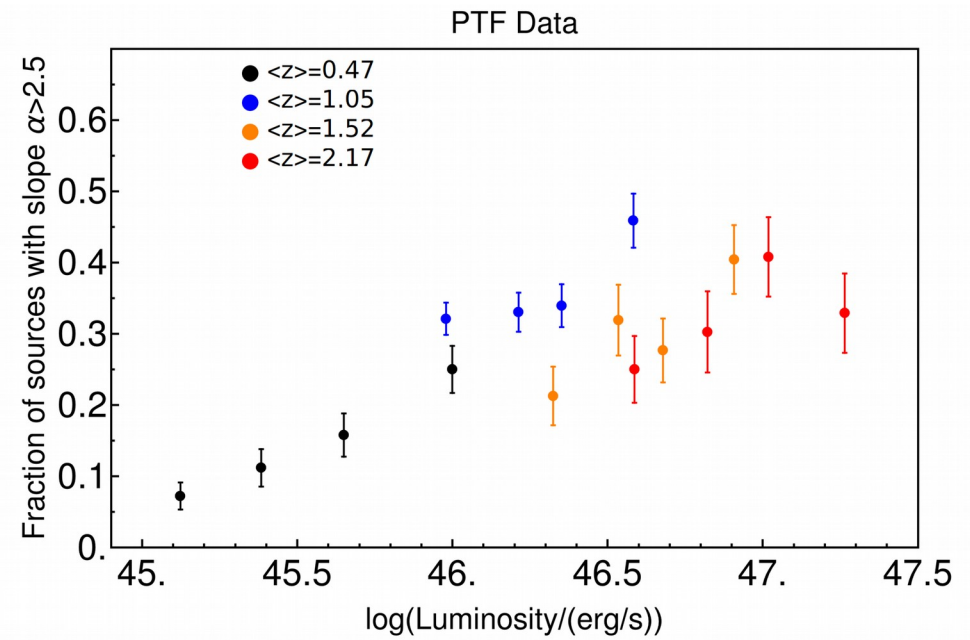
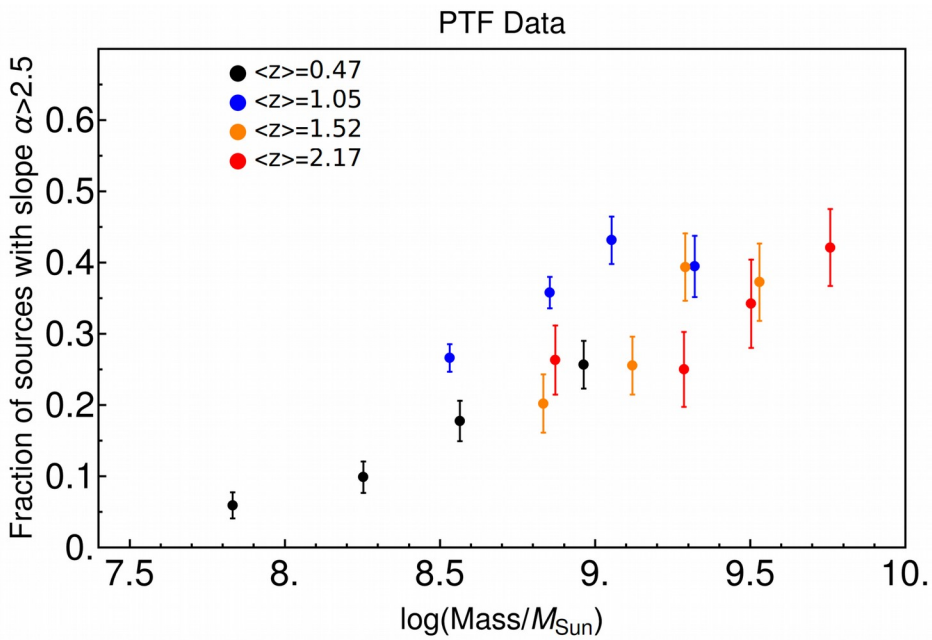
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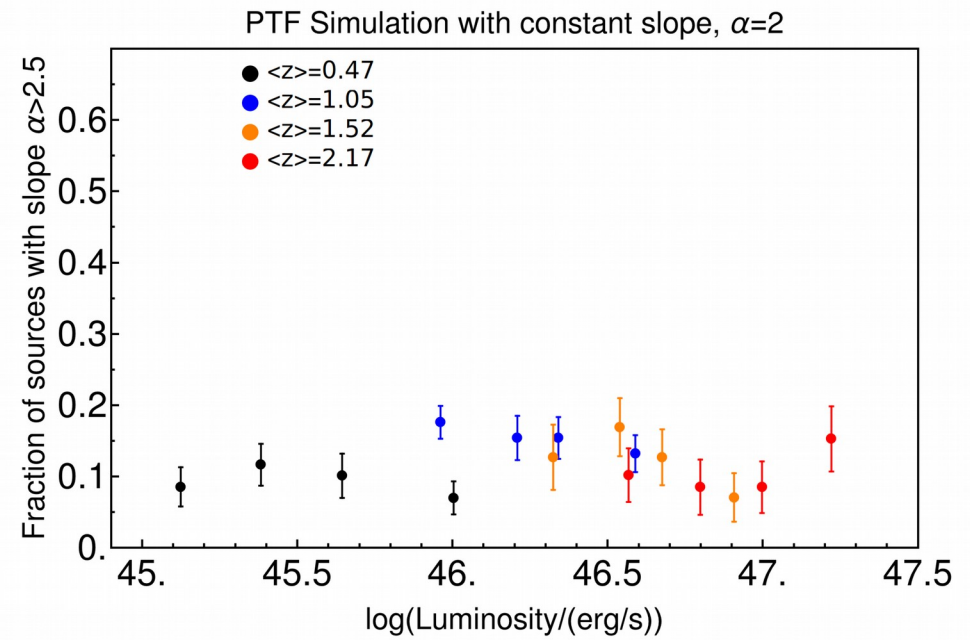
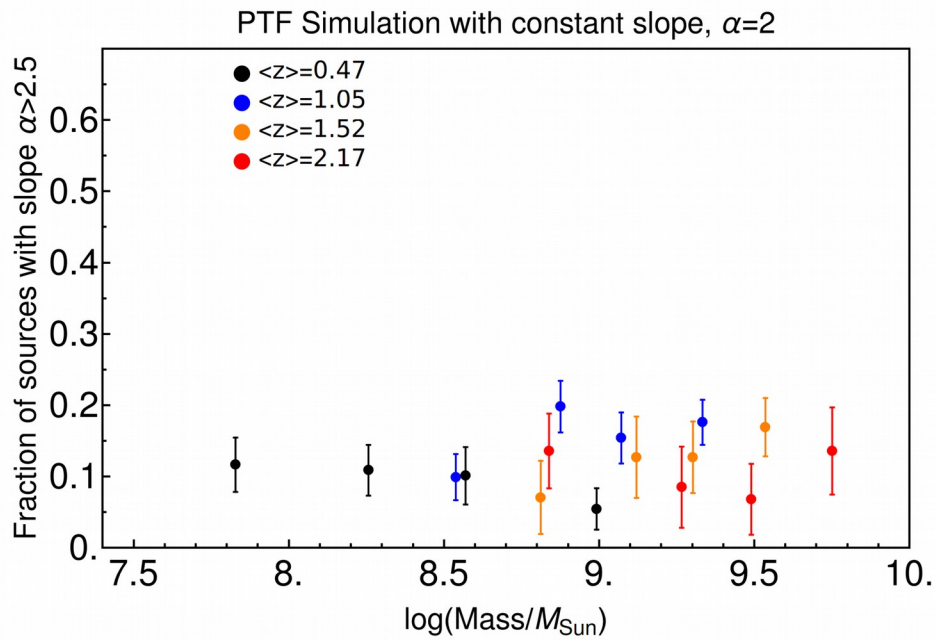
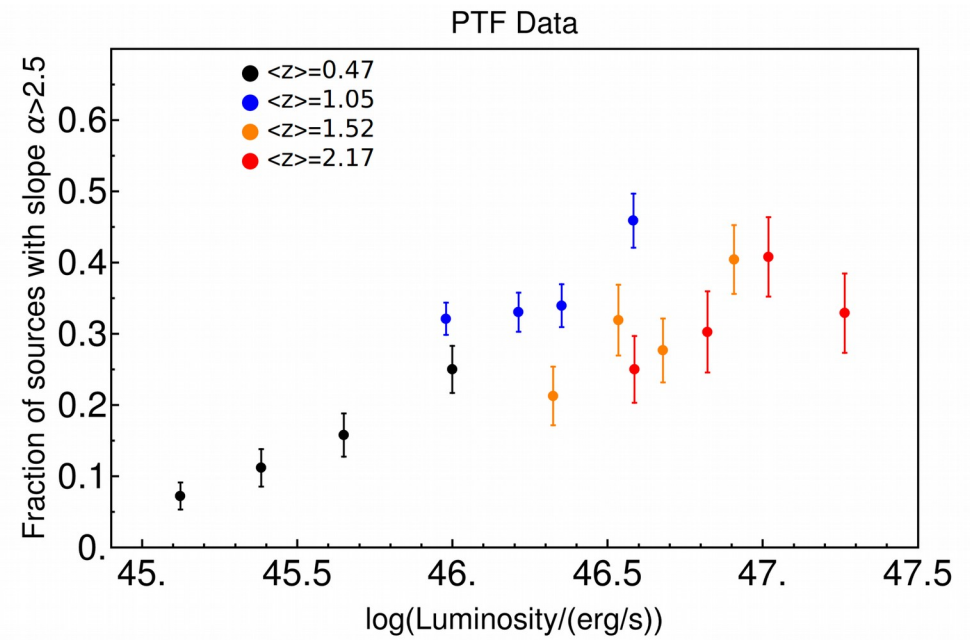
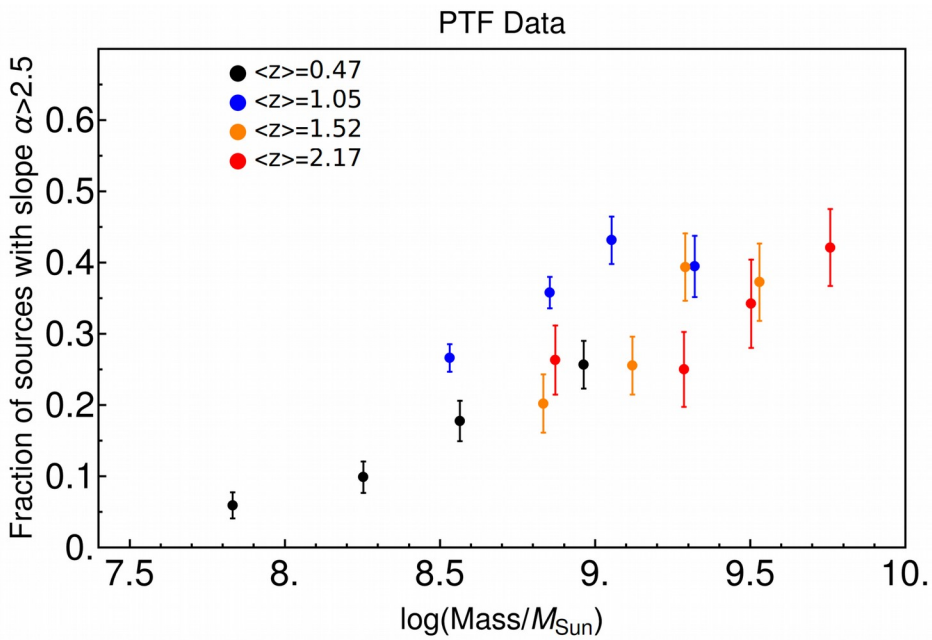
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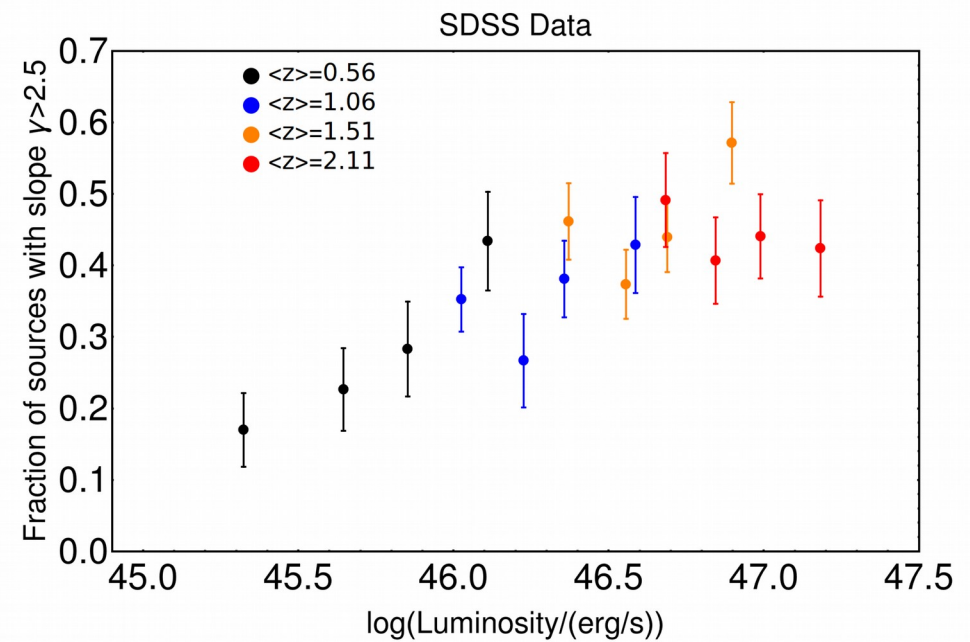
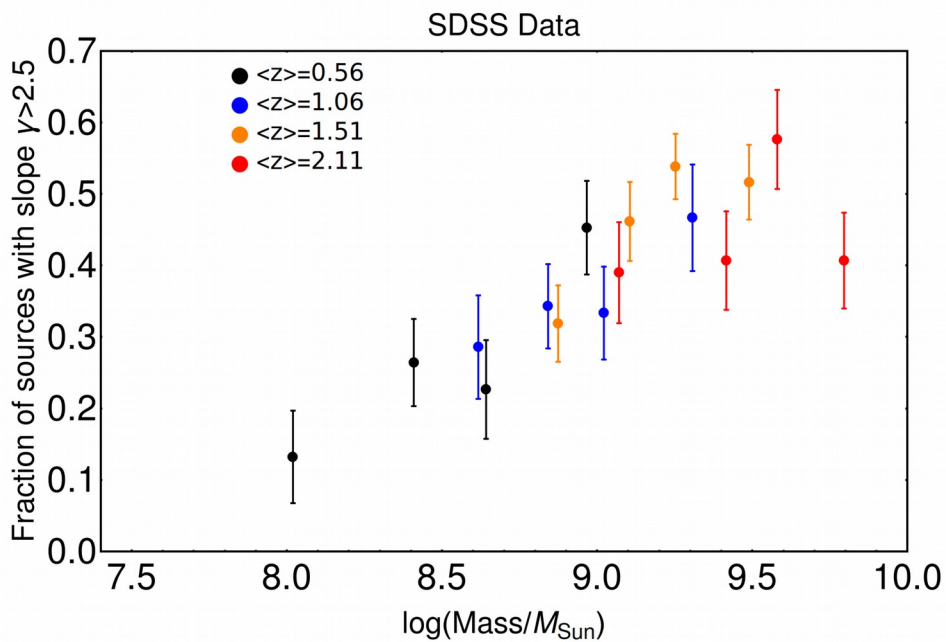
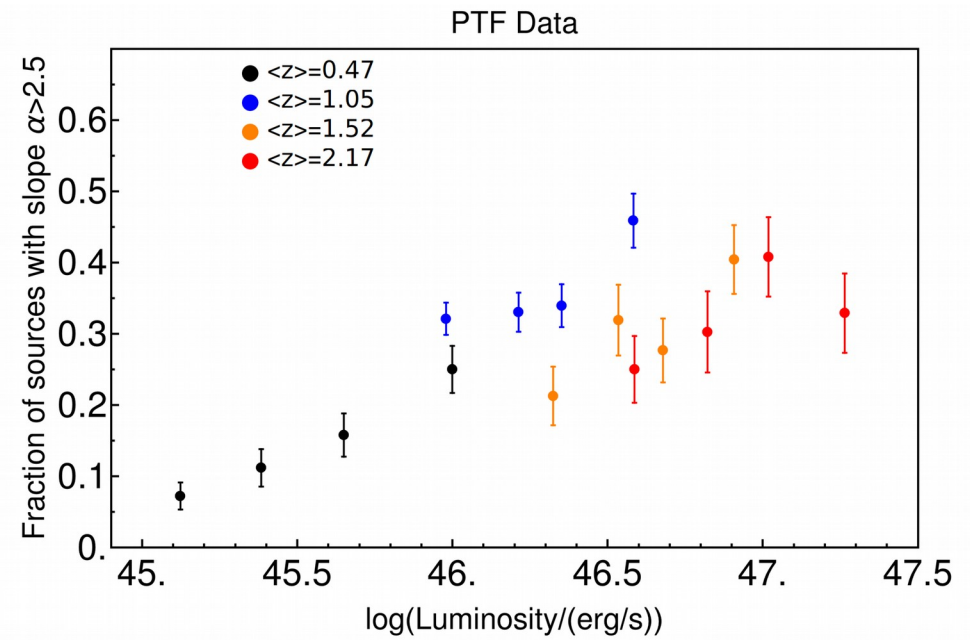
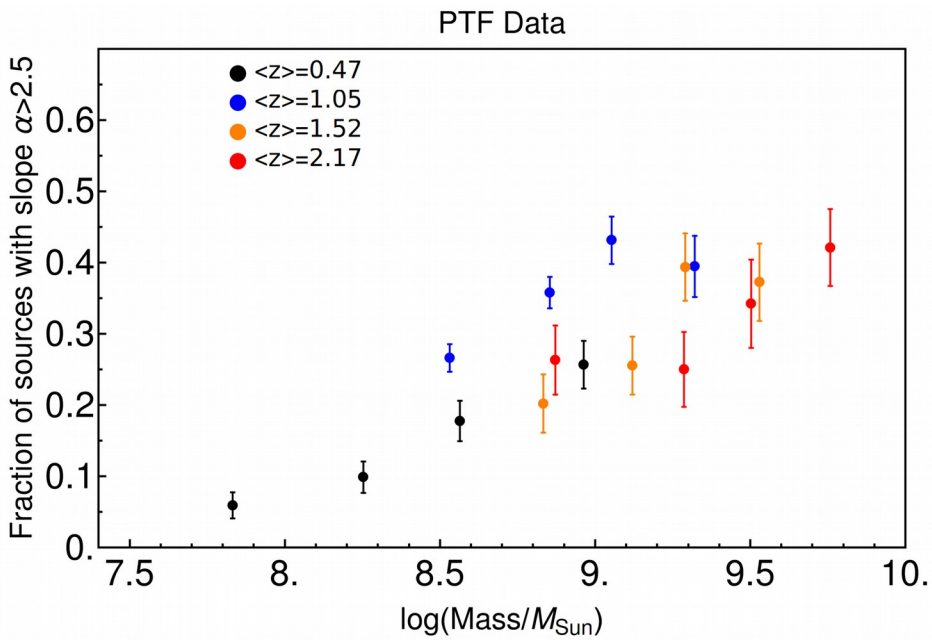




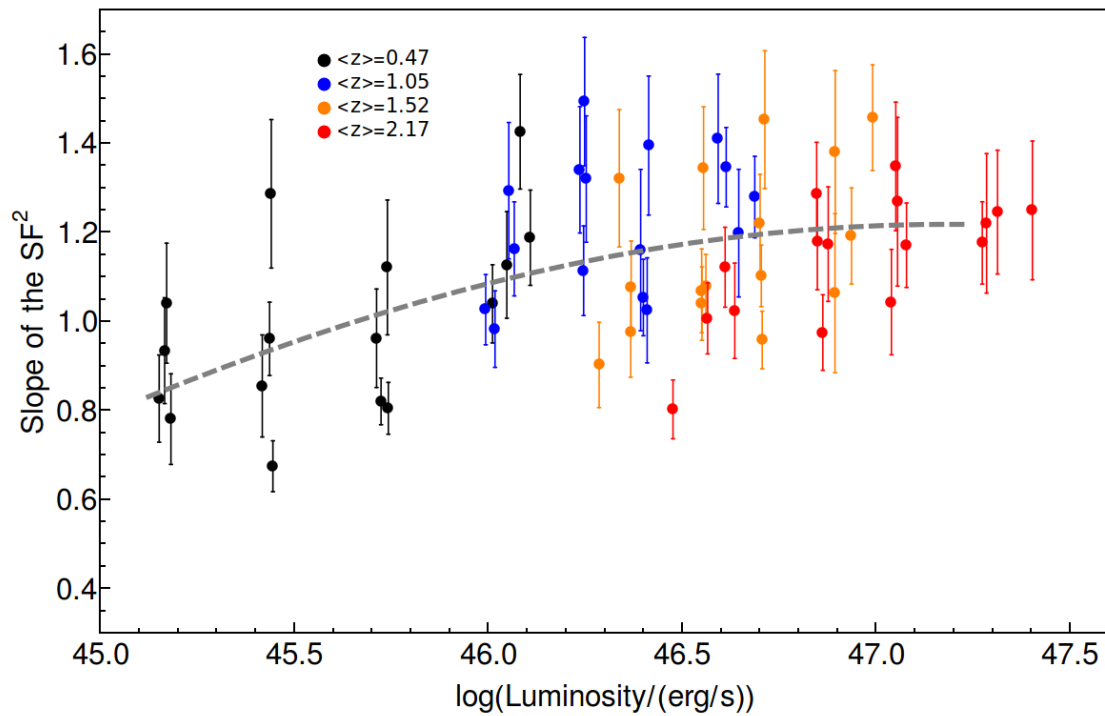
- Steepening of the slope with mass/luminosity



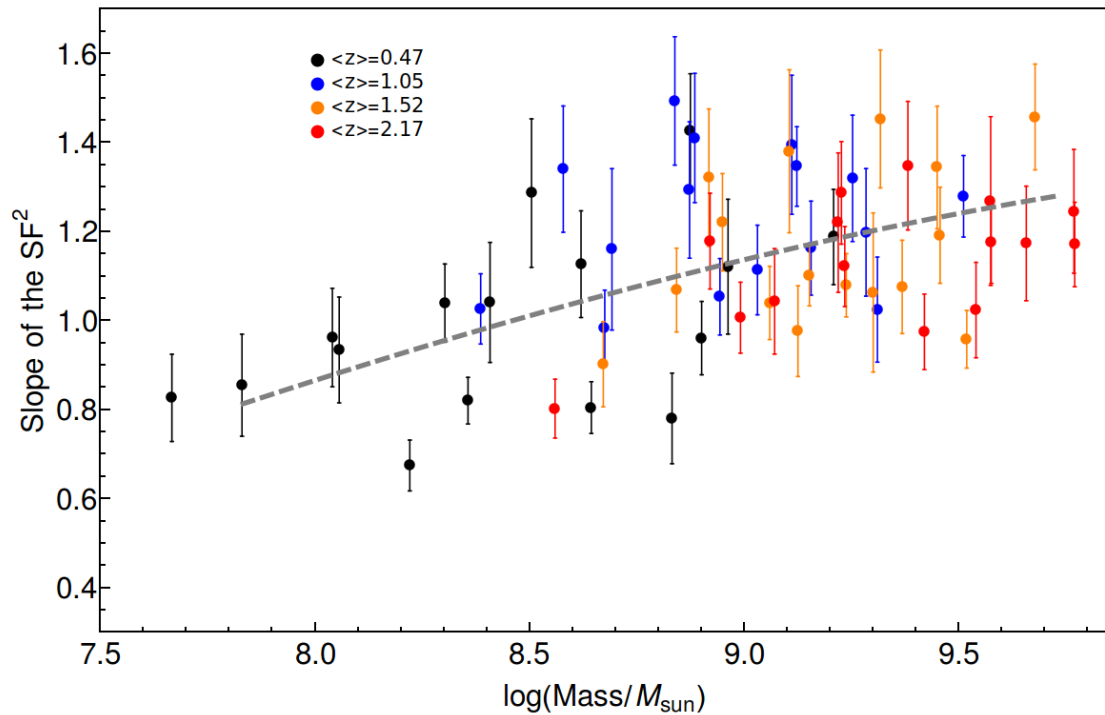
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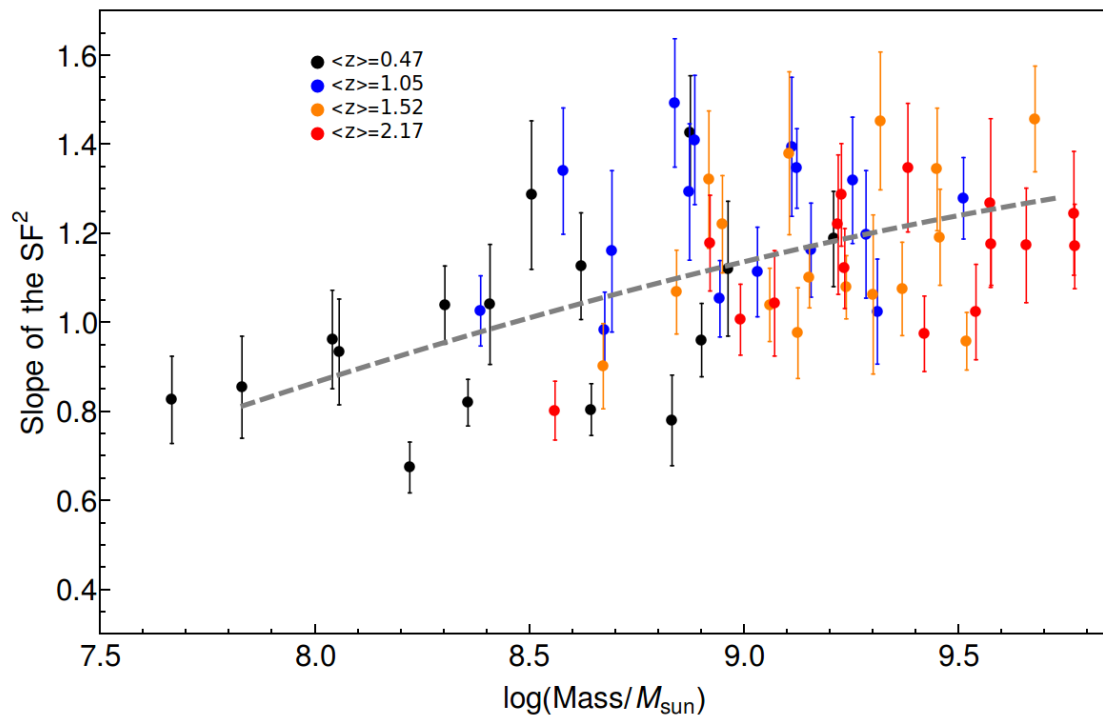
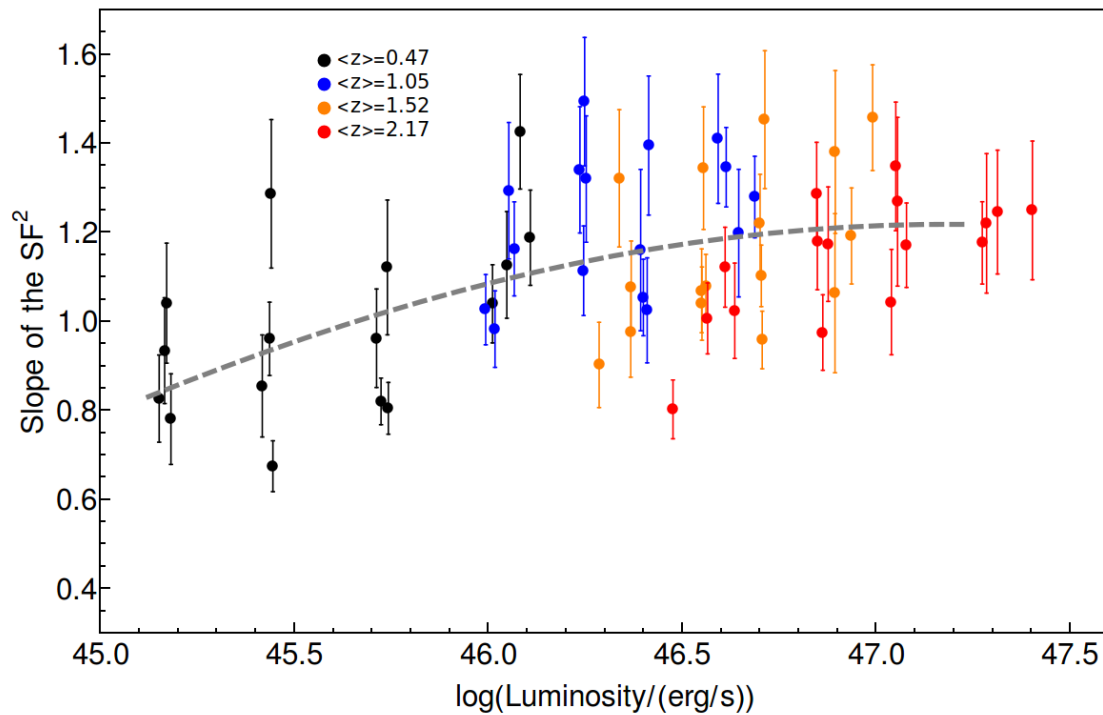


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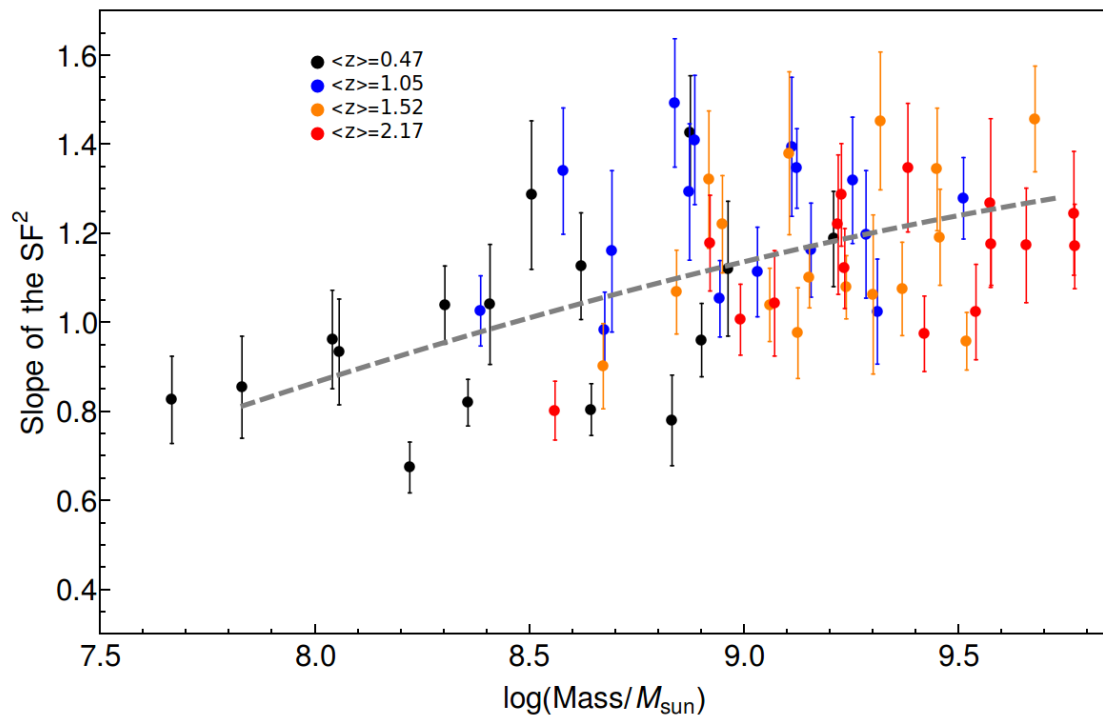
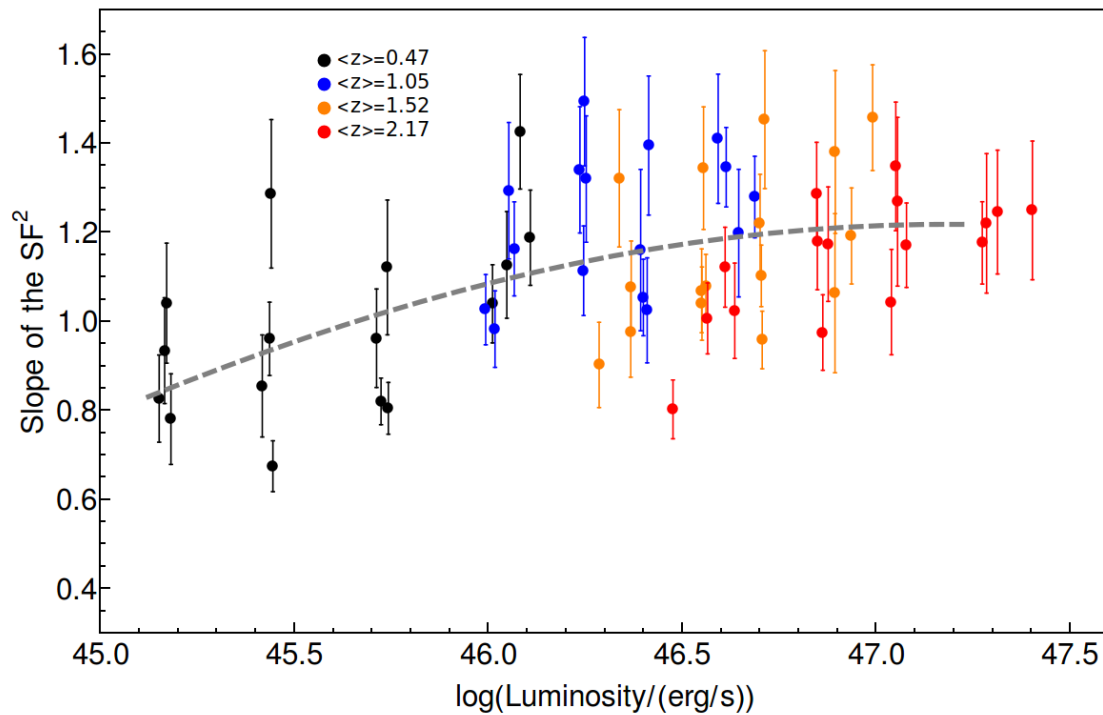


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- Fits in the mass-luminosity plane show preference for the effect to be connected with mass.
- Effect now seen with the SF analysis in PTF & SDSS (Kozłowski 16, and this work)
- Effect also seen with the PSD analysis in PTF, SDSS & Pan-STARRS1 (Simm+ 16, and this work)

Summary

- Largest fully calibrated single-band dataset for studying AGN variability
 - Data available in 2016
- Anti-correlation of variability with luminosity
 - If time to reach certain variability interpreted as time-scale τ , $\tau \propto L^{0.4}$ this is similar to the prediction of simplest model $\tau \propto L^{0.5}$
- Strong evidence towards steepening of the PSD slope with mass

