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The Dust Sublimation Region in Nearby AGN

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Lag-Luminosity Relationship

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- From Stefan-Boltzmann: $L \propto R^2 T^4$
- $\tau \propto R$
- $\tau \propto \sqrt{L}$

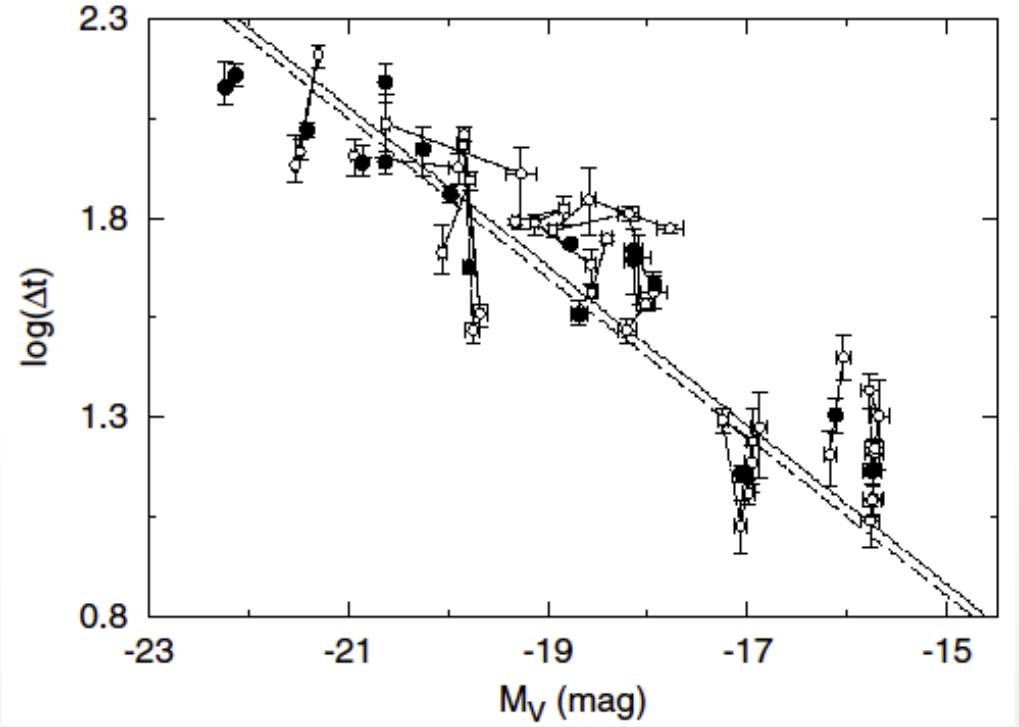

Figure: A plot showing the lag-luminosity relationship from Koshida et al. 2014

- Use τ as a proxy for luminosity to create a Hubble Diagram.

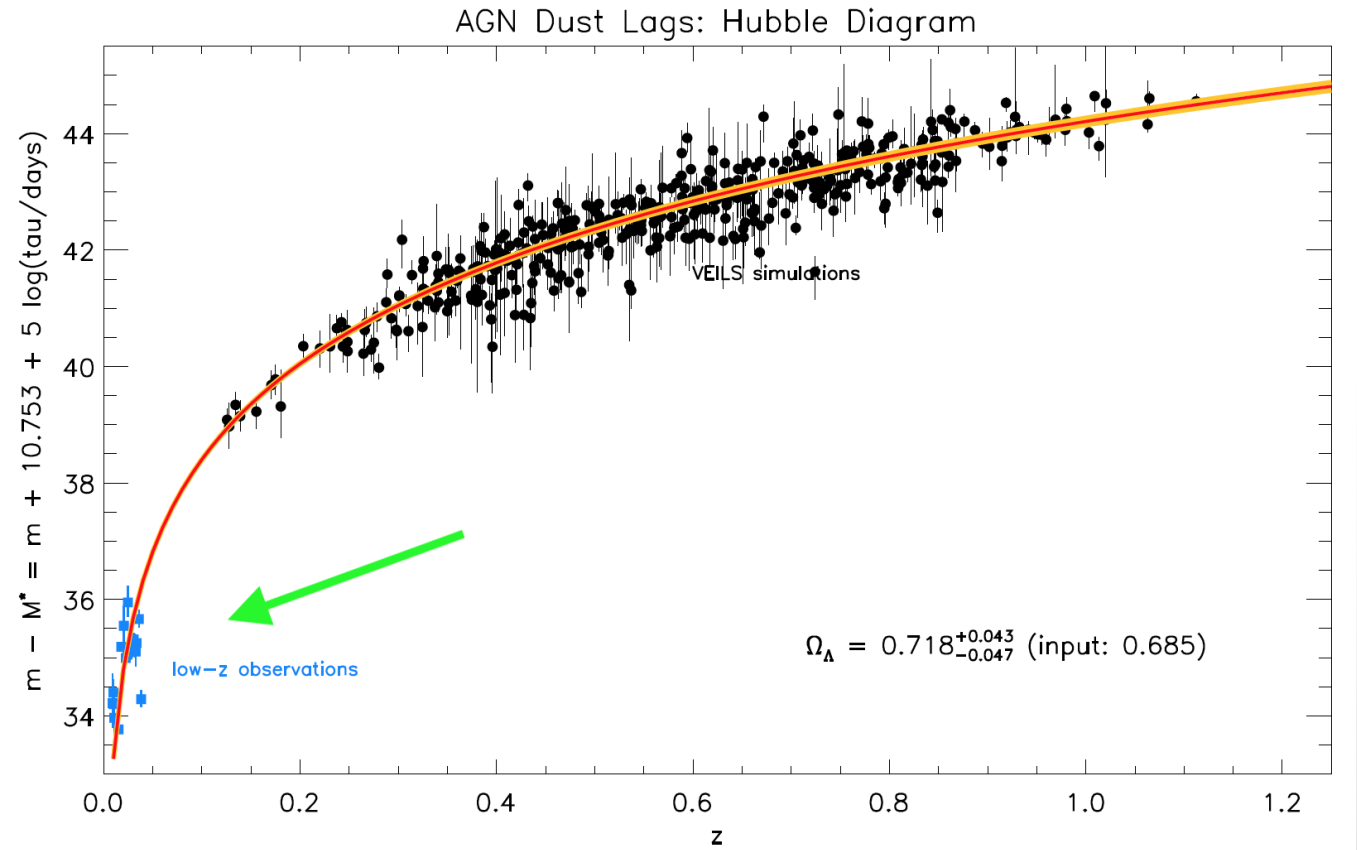

Figure: A simulated AGN Hubble Diagram. Image credit: Hönig et al. 2017.

VEILS

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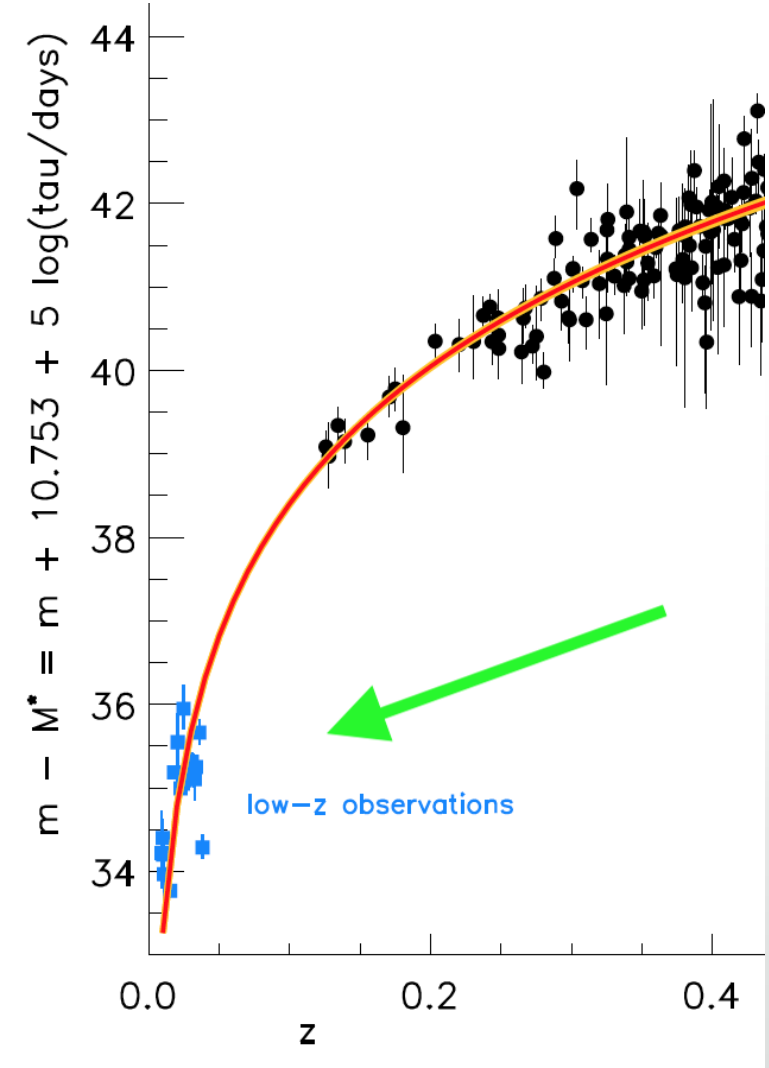
- Use τ as a proxy for luminosity to create a Hubble Diagram.
- Need Low Intrinsic Scatter



Dust Reverberation Mapping

Continuum Reverberation Mapping

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- Accretion disc emits in UV through V bands
- Torus absorbs $\&$ re-emits
  - Hottest dust emits in K band, corresponds to sublimation temperature, $T_{\text{sub}} \sim 1,500\text{K}$.
- Monitor AGN in V and K band. Find Delay in emission - τ.

$$\Downarrow$$

- From $\tau = R_{\text{sub}}/c$, find Sublimation Radius - R_{sub}.

$$\Downarrow$$

- Use τ as a proxy for Luminosity from $L \propto T^4 R^2$

The Sample

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- Low Redshift Type 1s, $z \sim 0.015$
- 15 AGN, 3 NLSy1s, 4 previously reverberation mapped
- Monitoring:
  - V ($\sim 0.5\mu$m) and K ($\sim 2\mu$m) band
  - SMARTS 1.3m telescope

Figure: CTIO - Cerro Tololo Inter-American Observatory

Light Curves

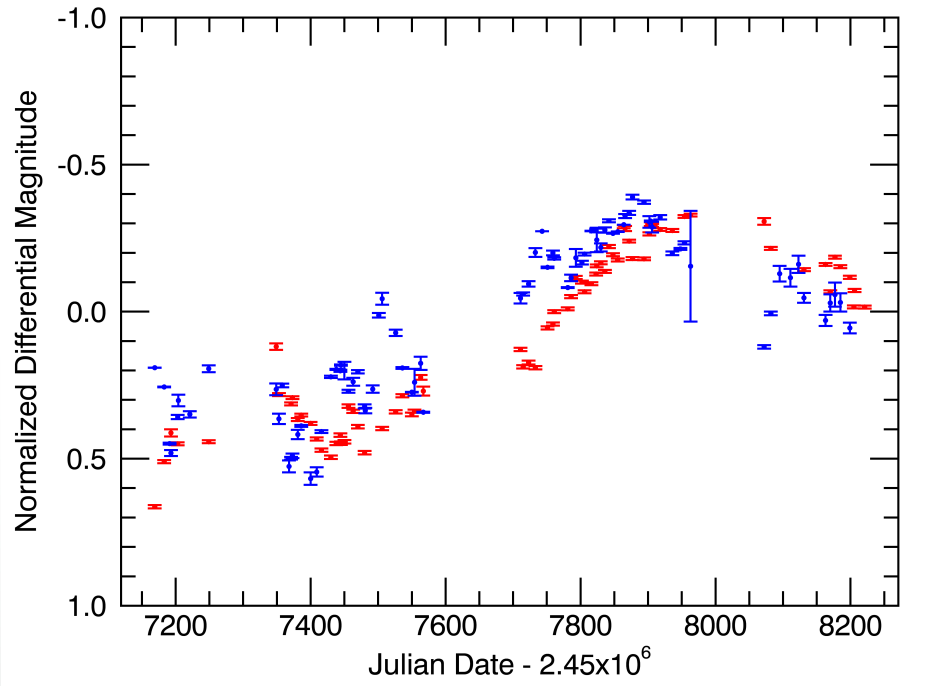


Figure: Light curve for NGC3783, V band in blue, K band in red.

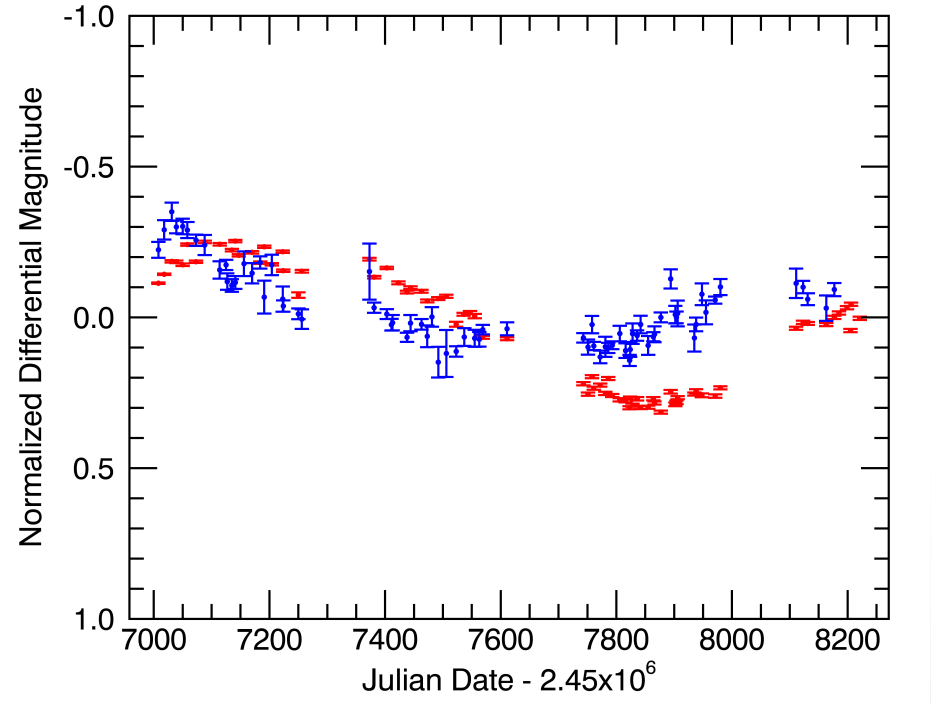
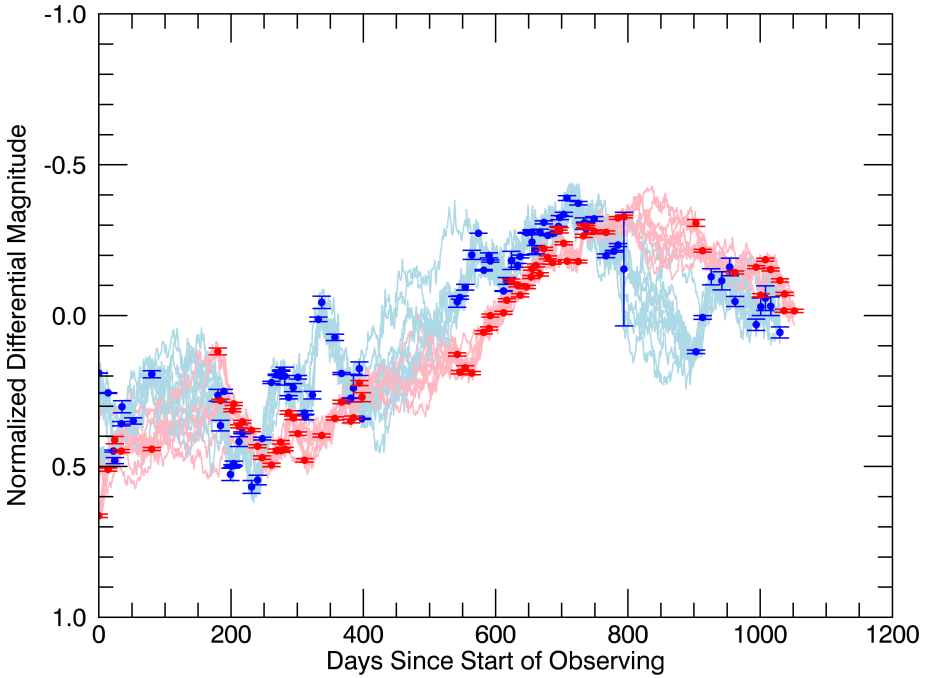


Figure: ESO323-G77, both figures from Boulderstone et al. [in prep].

Light Curves

Interpolations



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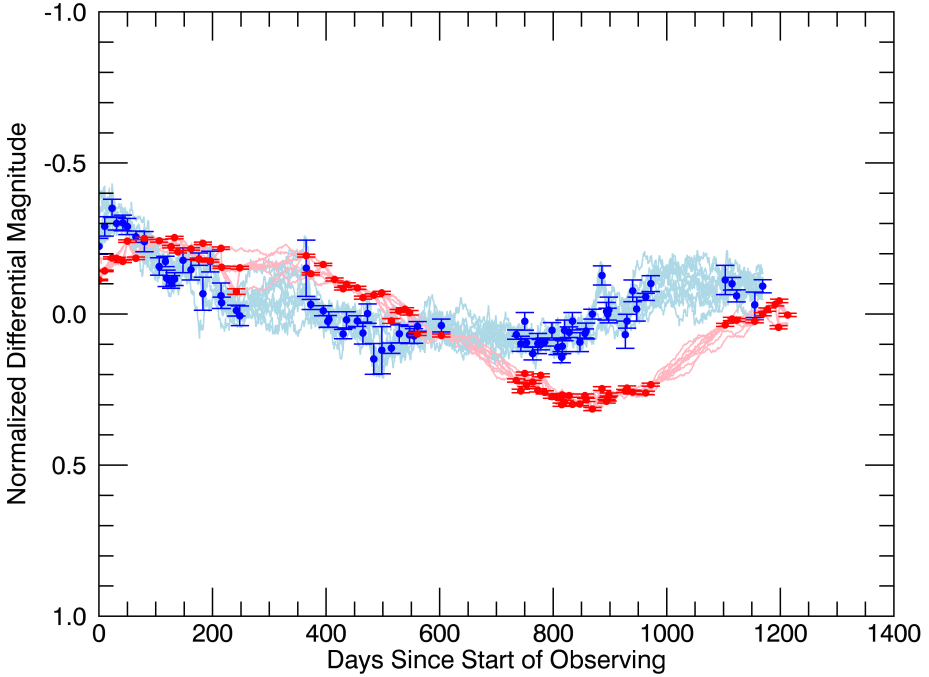

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Results

Cross Correlation

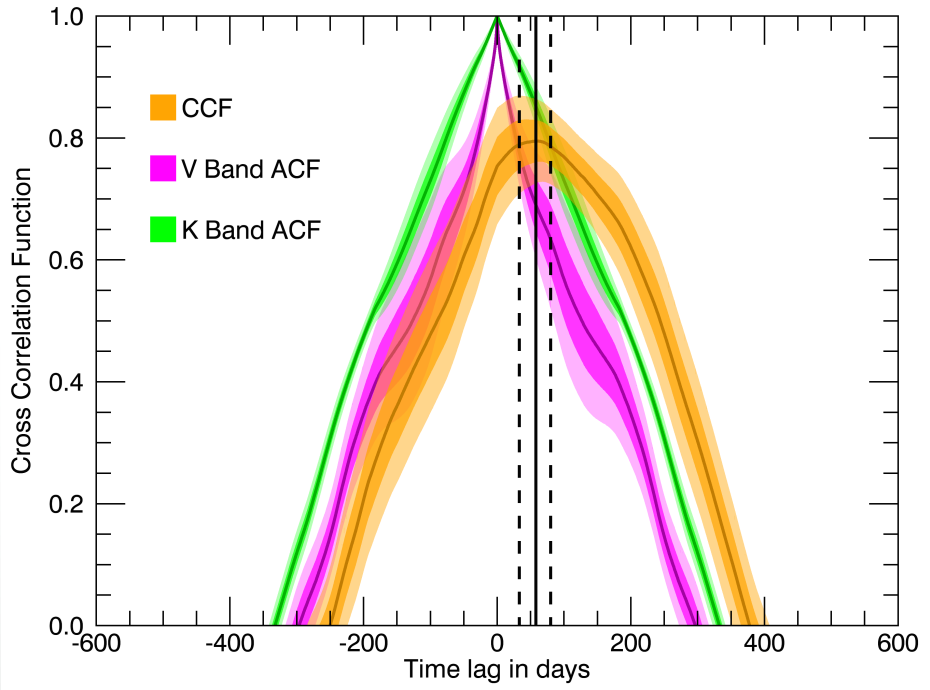


Figure: Cross correlation function for NGC3783. The vertical lines on each plot show the result and the 1σ confidence boundaries.

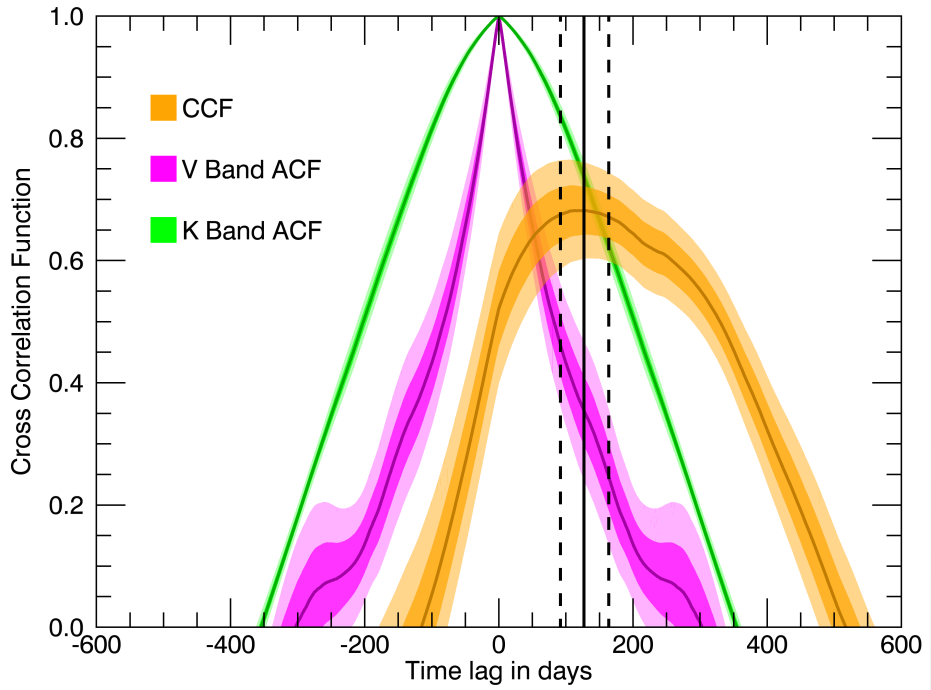


Figure: CCF for ESO323-G77. The shaded regions on each plot show the 1σ and 2σ confidence regions.

Results

Histograms

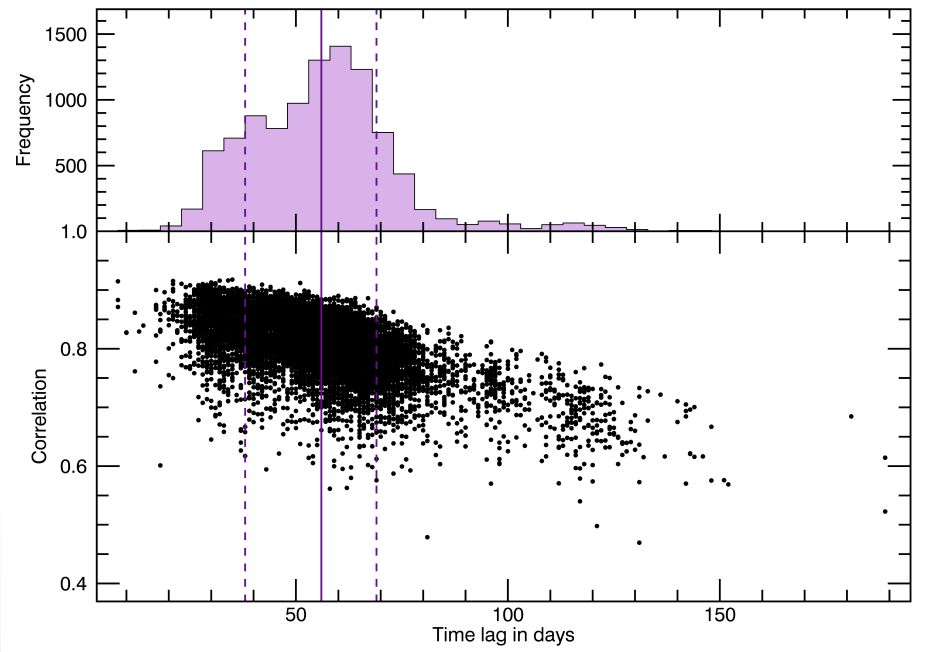


Figure: Histogram showing the frequency distribution for the peaks CCFs NGC3783, $\tau = 56^{+13}_{-18}$ days

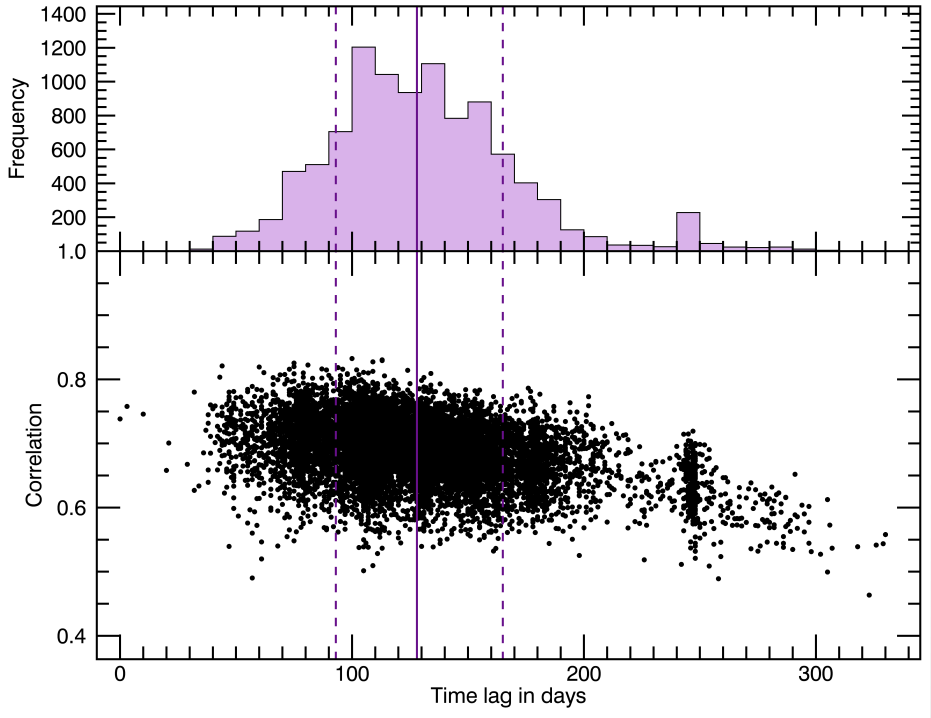


Figure: The same but for ESO323-G77, $\tau = 128^{+37}_{-35}$ days.

Discussion

Lag Luminosity Relationship

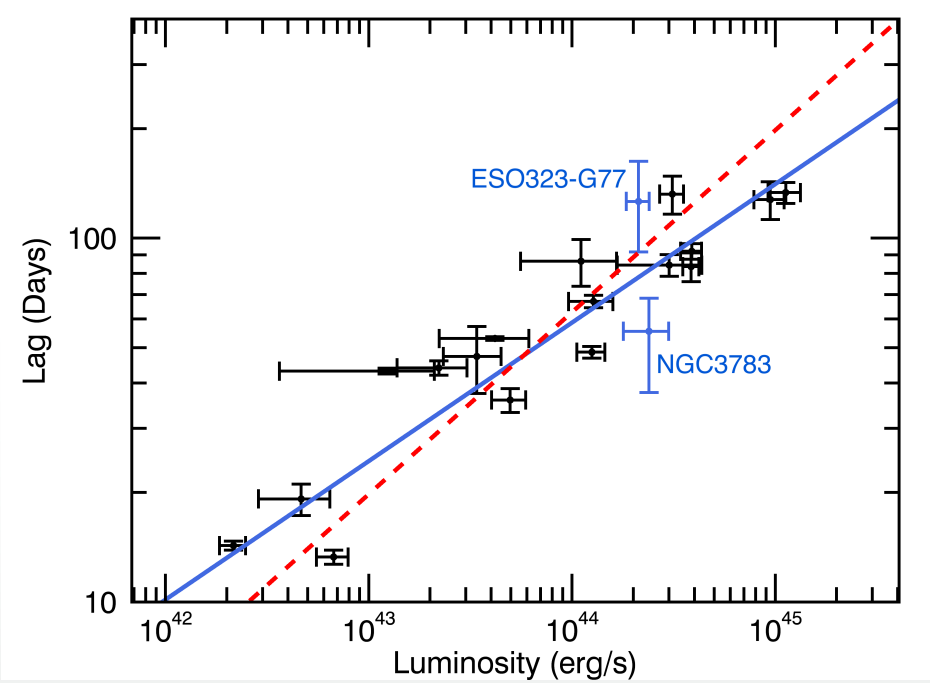


Figure: Our results with those from Koshida et al. 2014. The red line dashed line has a gradient of 0.5.

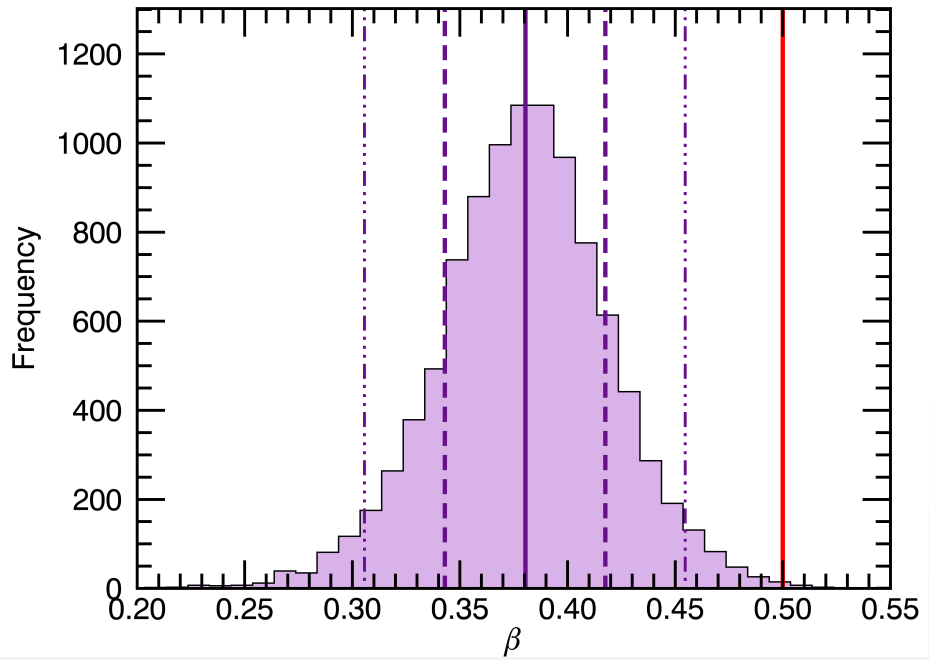
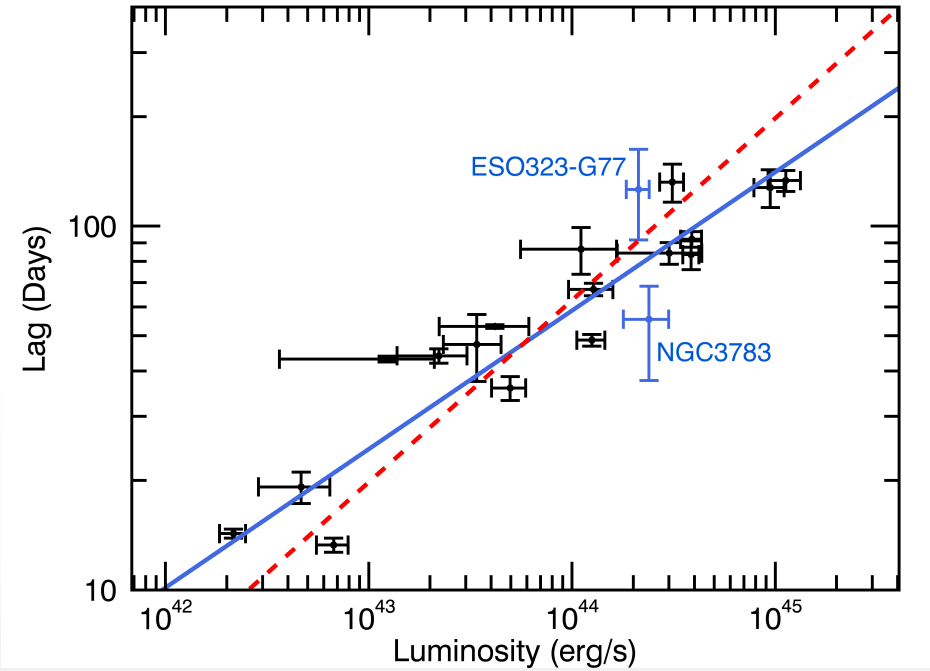


Figure: Our results for the gradient of the slope, $\beta = 0.38 \pm 0.037$ from Bayesian Analysis.

Discussion

Lag Luminosity Relationship



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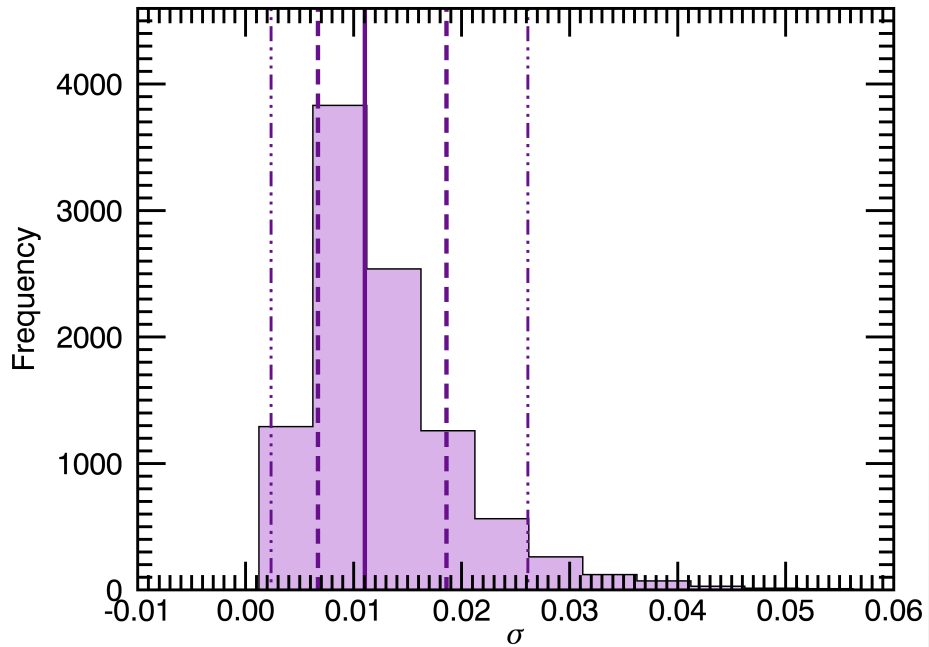

Figure: Our results for the value of the intrinsic scatter: $\sigma = 0.011^{+0.007}_{-0.004}$

Summary & Future Work

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- Result for NGC3783 of $\tau = 56^{+13}_{-18}$ days, $R_{\text{sub}} \sim 0.047$ pc
- Result for ESO323-G77 of $\tau = 128^{+37}_{-35}$ days or $R_{\text{sub}} \sim 0.11$ pc
- Result is consistent with other Seyfert 1 Galaxies.
- Low intrinsic scatter - $0.011^{+0.007}_{-0.004}$

- Bootstrapping of our points.
- Removal of accretion disc component and host galaxy from CCF
- Repeat with other AGN in our sample

$\Downarrow$

Continue laying groundwork for VEILS.