The Dust Sublimation Region in Nearby AGN

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Lag-Luminosity Relationship

- 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 $\tau$ as a proxy for luminosity to create a Hubble Diagram.

Figure: A simulated AGN Hubble Diagram. Image credit: Höning et al. 2017.
Use $\tau$ as a proxy for luminosity to create a **Hubble Diagram**.

Need **Low Intrinsic Scatter**
Dust Reverberation Mapping

Continuum Reverberation Mapping

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

$\downarrow$

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

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

- 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].
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Results

Cross Correlation

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

Figure: CCF for ESO323-G77. The shaded regions on each plot show the $1\sigma$ and $2\sigma$ 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

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

\[
\sigma = 0.011^{+0.007}_{-0.004}
\]
Summary & Future Work

- 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

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Continue laying groundwork for VEILS.