

AGN Reverberation Mapping with the Australian Dark Energy Survey

Janie K. Hoormann

University of Queensland

29 June 2018

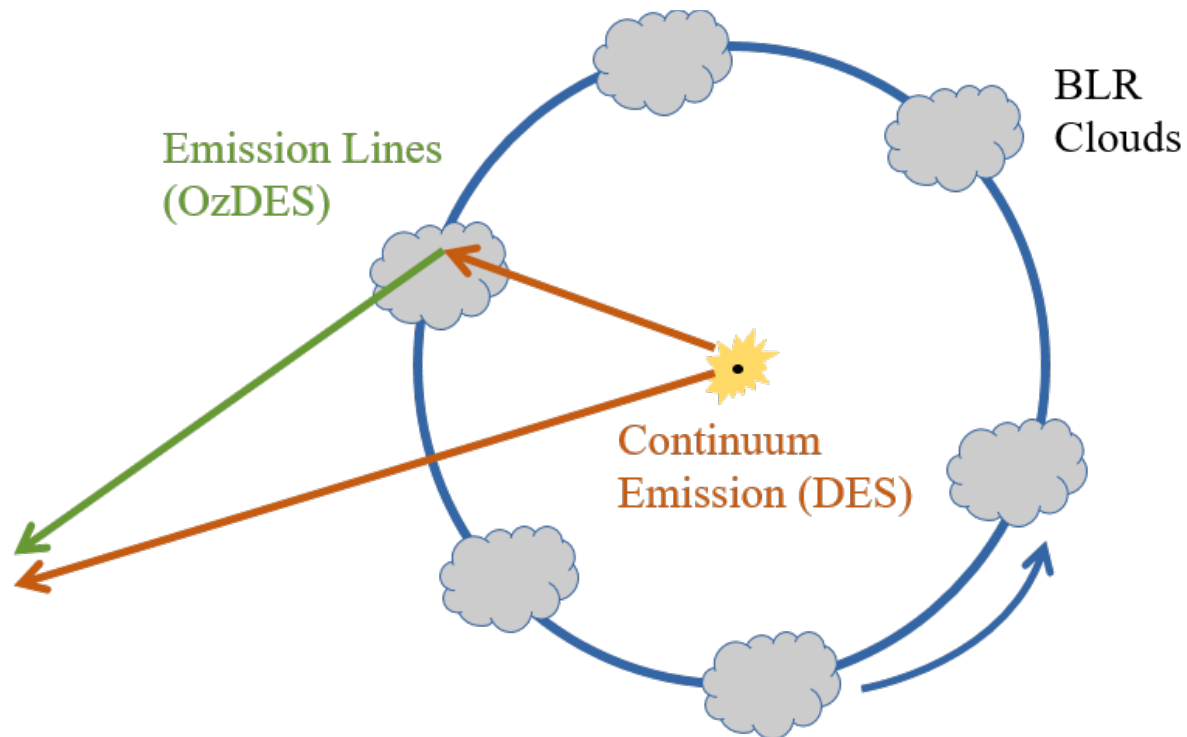
Reverberation Mapping

- RM uses time delays to measure sizes of AGN features
 - Radius of the Broad Line Region (BLR) clouds
- Assuming black hole and clouds are in virial equilibrium

$$M = \frac{f c \tau \Delta V^2}{G}$$

Observer

- Allows you to obtain geometrical information about regions too small to image directly



The Big RM Questions

- A relationship between the BLR radius and AGN luminosity has been observed at low redshifts
 - Does this hold out to high redshifts?
- Can AGN be used as a high redshift standard candle?
- If we have black hole mass measurements out to high redshifts what can this tell us about black hole and galaxy evolution?

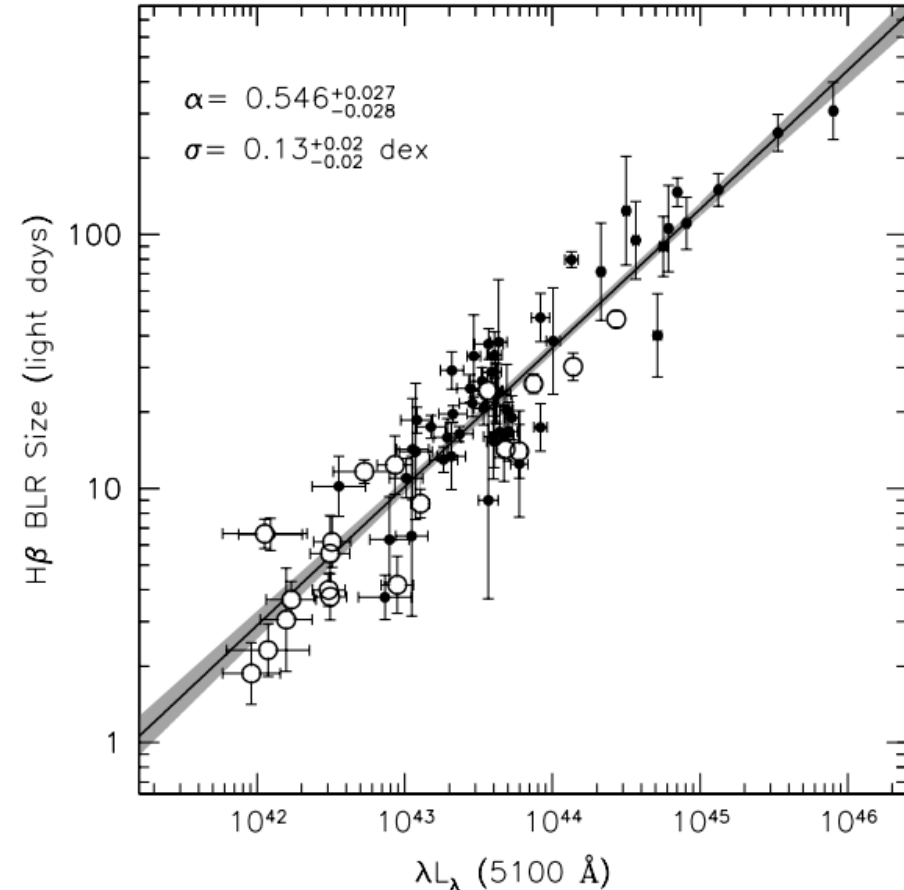
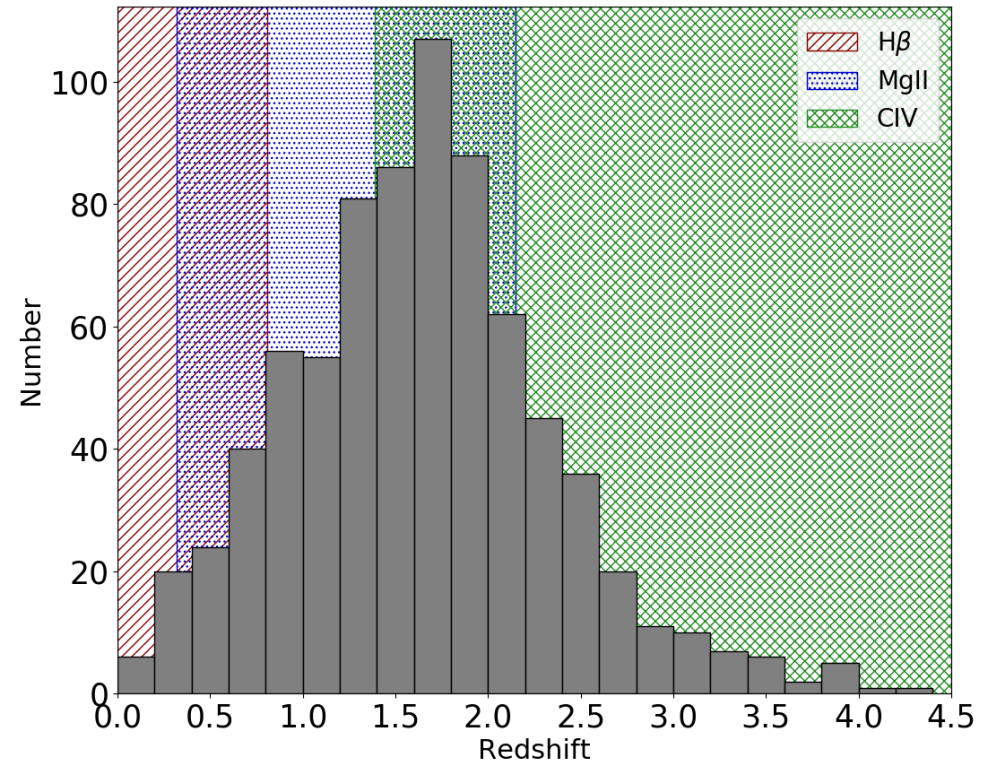


Fig 11: Bentz et. al. 2013 ApJ 767:149

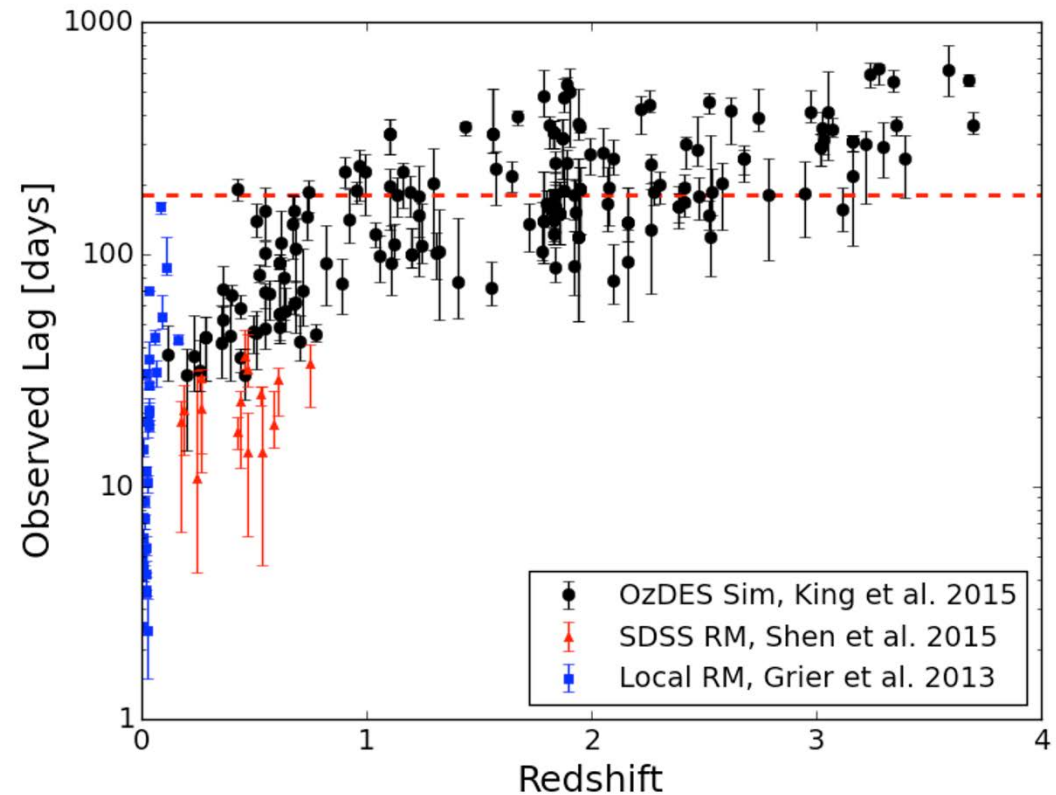
Reverberation Mapping with OzDES

- Targeting 771 AGN
 - $0 < z < 4.5$
- Weekly observations with Dark Energy Survey (DES)
 - 525 nights over 6 years on the Blanco Telescope with DECam
 - Model the continuum emission from the disk
- Monthly observations with OzDES
 - 100 nights over 6 years on the AAT with 2dF AAOmega
 - Model the response of the BLR
 - H β , MgII, CIV emission lines
- Expect lags for 30-40% of our AGN
 - Around 140 time lags measured from all previous surveys (most at $z < 1$)



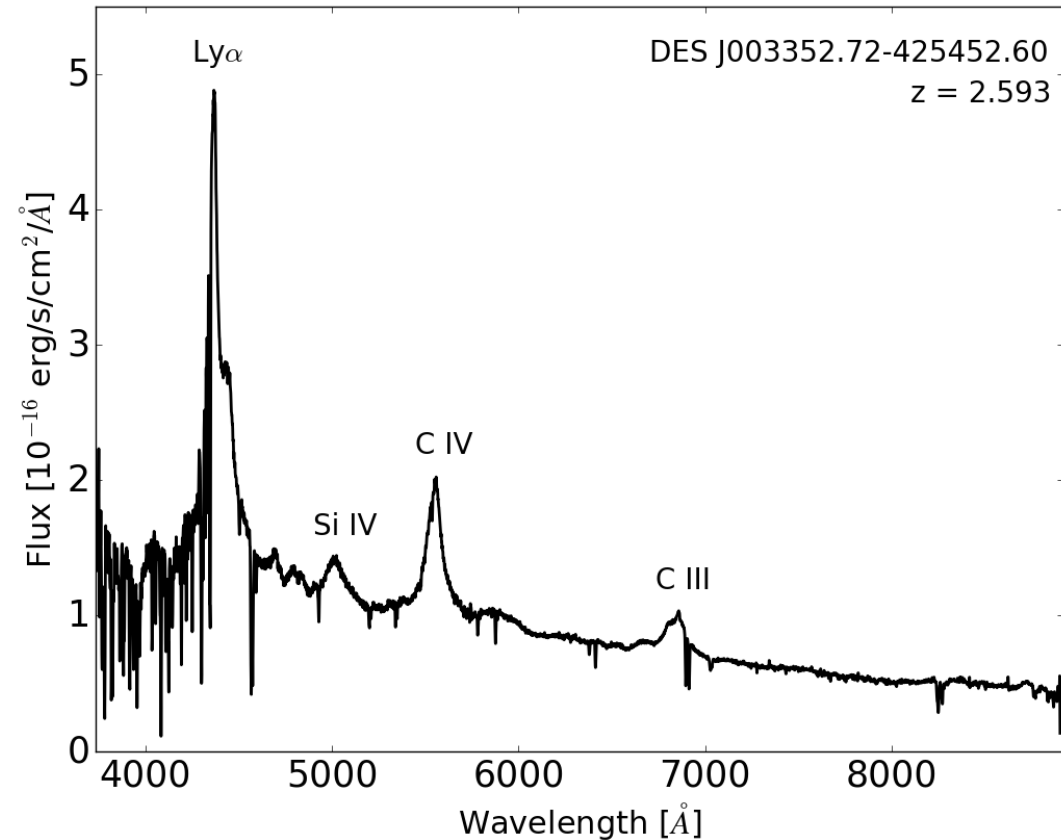
Reverberation Mapping with OzDES

- Targeting 771 AGN
 - $0 < z < 4.5$
- Weekly observations with Dark Energy Survey (DES)
 - 525 nights over 6 years on the Blanco Telescope with DECam
 - Model the continuum emission from the disk
- Monthly observations with OzDES
 - 100 nights over 6 years on the AAT with 2dF AAOmega
 - Model the response of the BLR
 - H β , MgII, CIV emission lines
- Expect lags for 30-40% of our AGN
 - Around 140 time lags measured from all previous surveys (most at $z < 1$)



Lag Calculations

- Perform spectrophotometric calibration of OzDES data
 - Mean scatter in sensitivity $\sim 5\%$
- Perform local continuum subtraction and iron subtraction (MgII, H β)
- Line flux found by integrating over the emission lines
- Lag found by performing interpolated cross correlation of the light curves

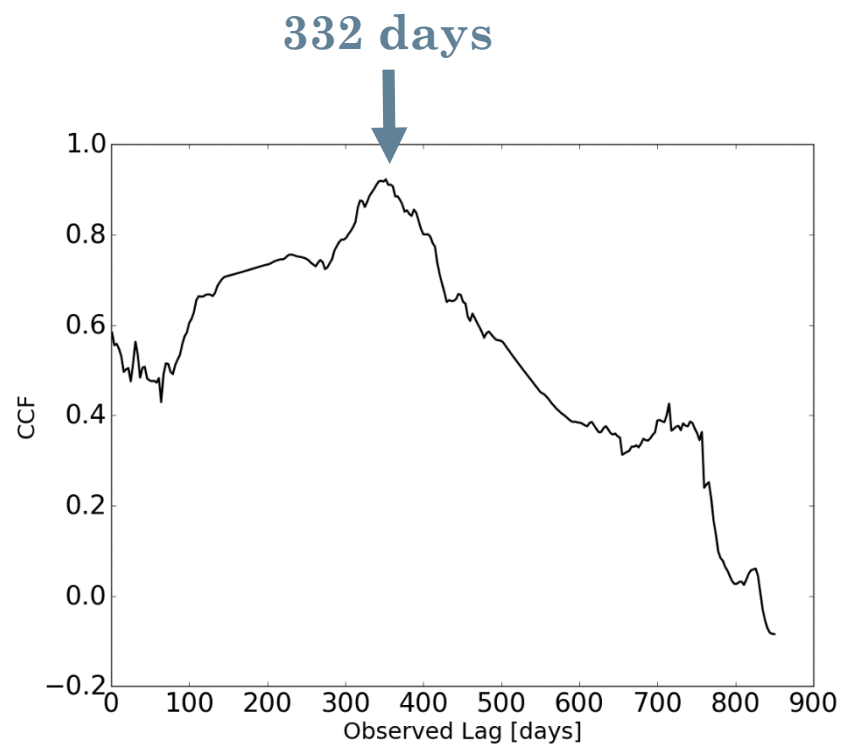
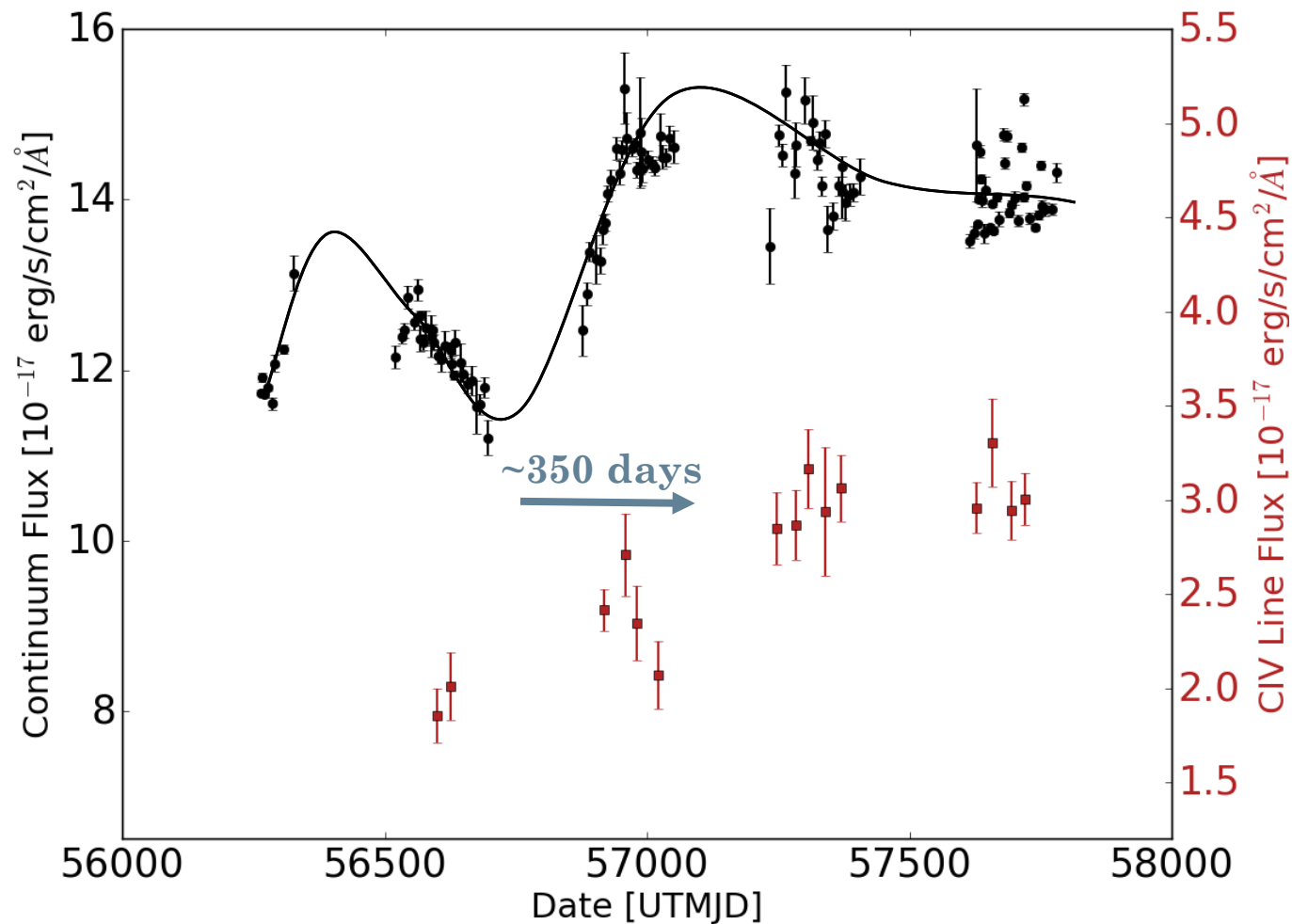


DES J003352.72-425452.60

Observed Lag = 332_{-80}^{+44} days

$z = 2.593$

Rest Frame Lag = 92_{-22}^{+12} days

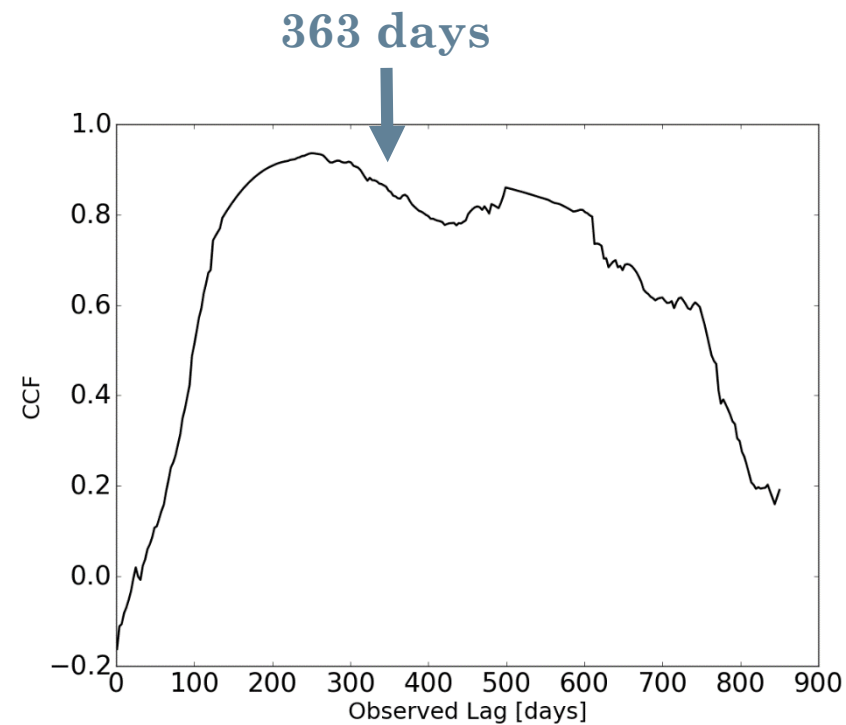
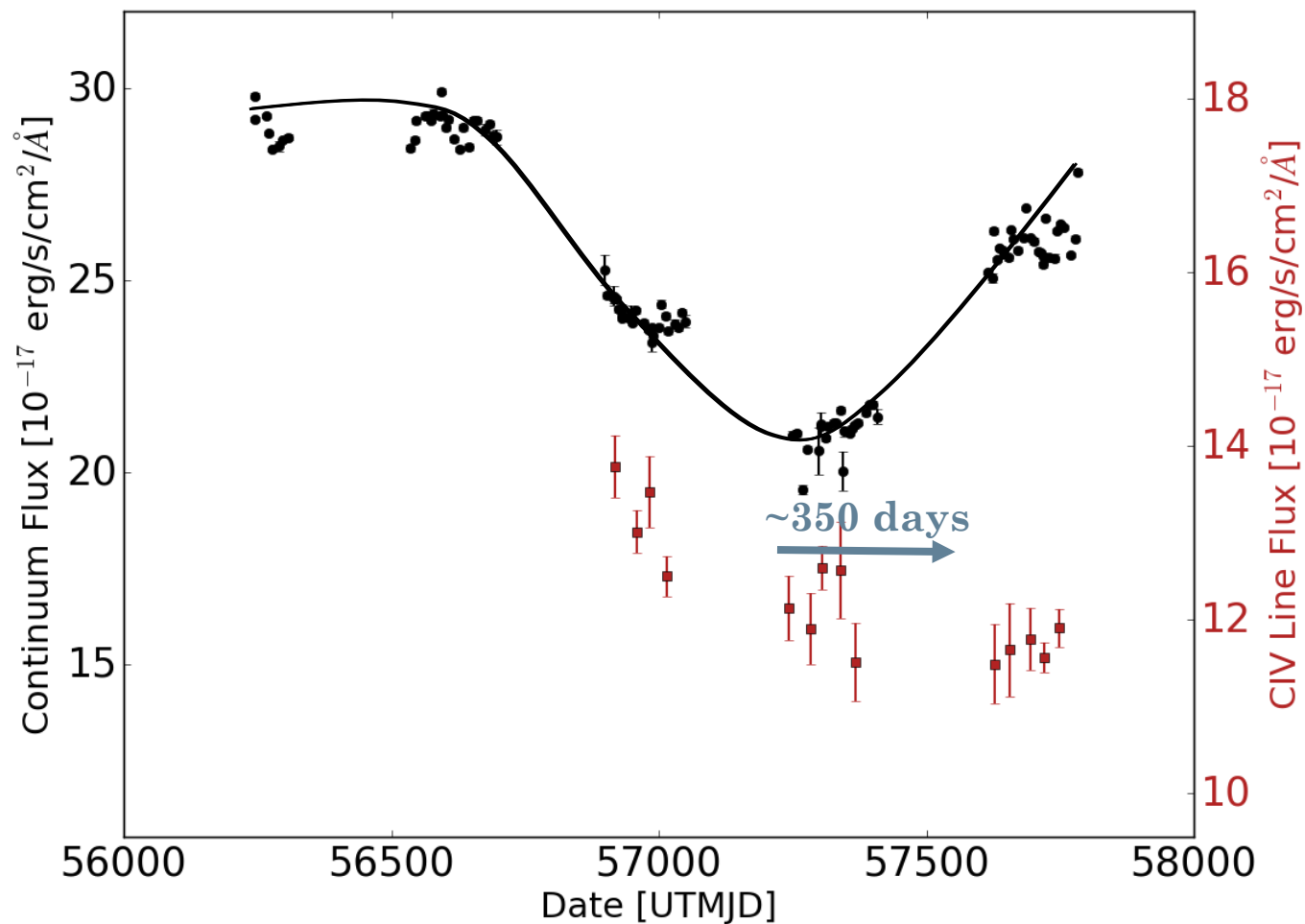


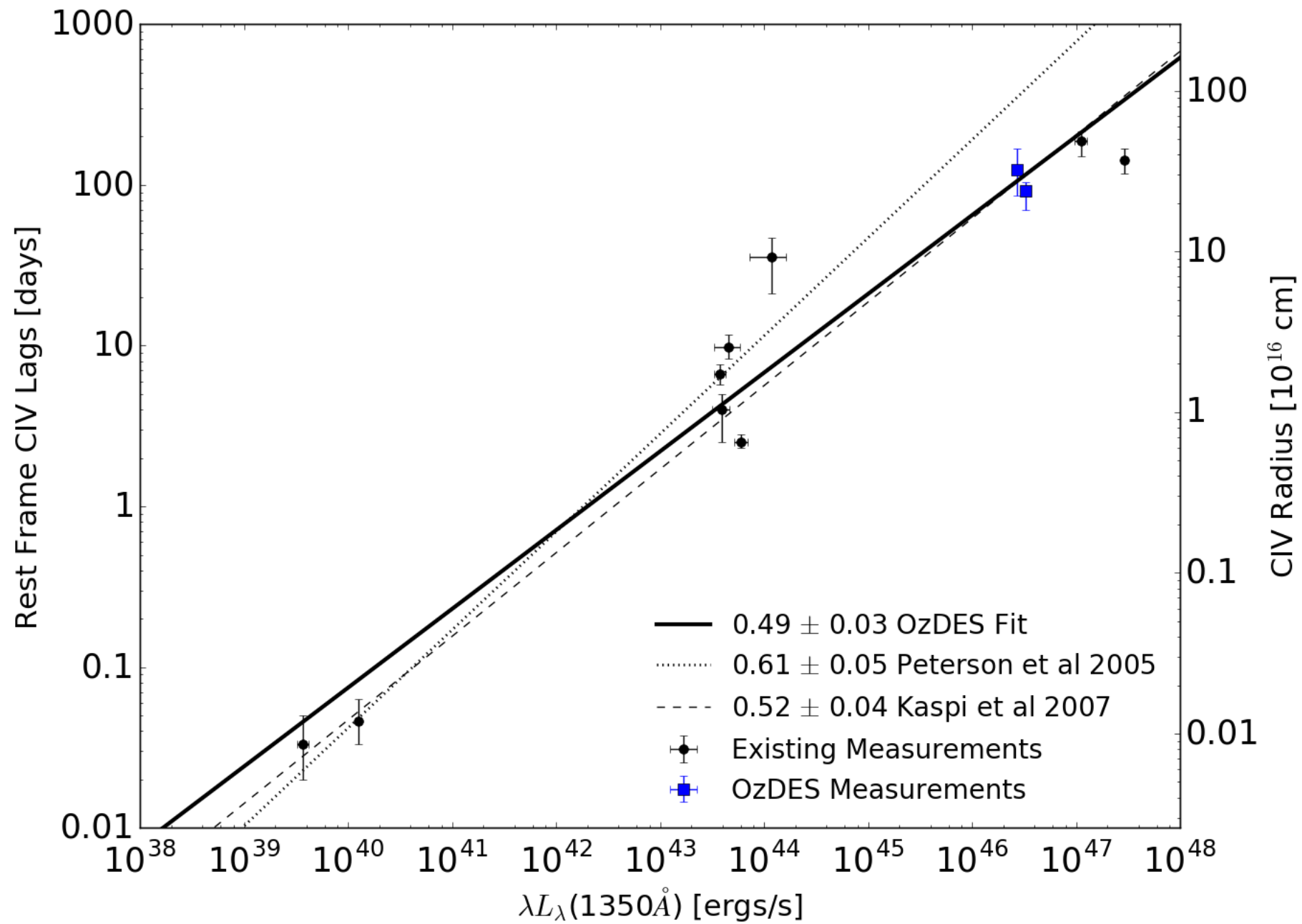
DES J023828.19-040044.30

Observed Lag = 363_{-113}^{+126} days

$z = 1.905$

Rest Frame Lag = 125_{-39}^{+43} days





Summary

- OzDES is targeting 771 AGN out to $z=4$
- Recovered first 2 lags using the CIV line
- Expect to recover 100's more with full data set
- Will allow us to directly measure the Radius-Luminosity Relationship out to high redshifts

