Changing-look AGNs in DESI

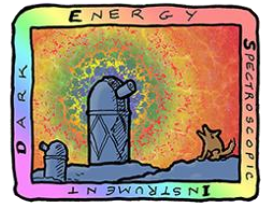
A Recurring CL-AGN with Asymmetric BEL and multiple flares

Wei-Jian Guo NAOC

2024/10/15

Special Astrophysical Observatory, Russian Academy of Sciences

Contents of Talk



Dark Energy Spectroscopic Instrument

U.S. Department of Energy Office of Science

- DESI Survey and First Data Release
- CL-AGNs Research
- The CL-AGNs work in DESI
- A Recurring CL-AGN with Asymmetric BEL
- Summary

Dark Energy Spectroscopic Instrument (DESI)

Dark Energy Spectroscopic Instrument

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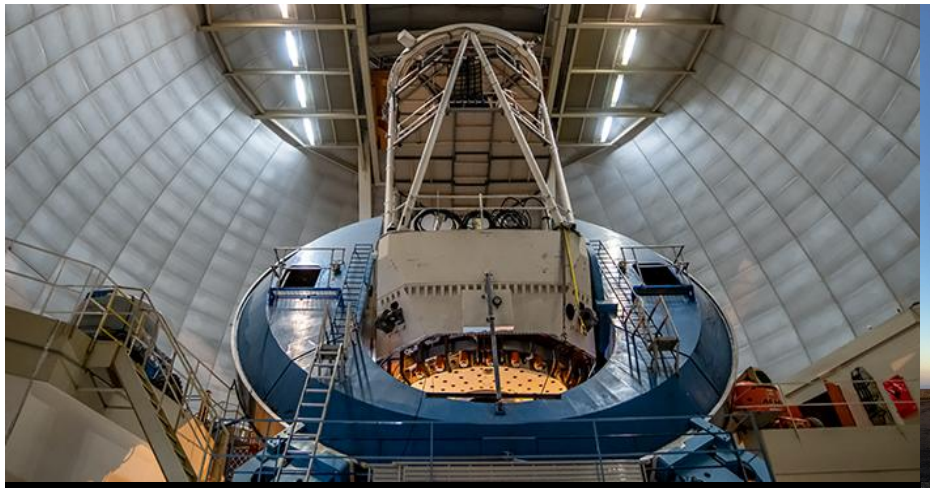

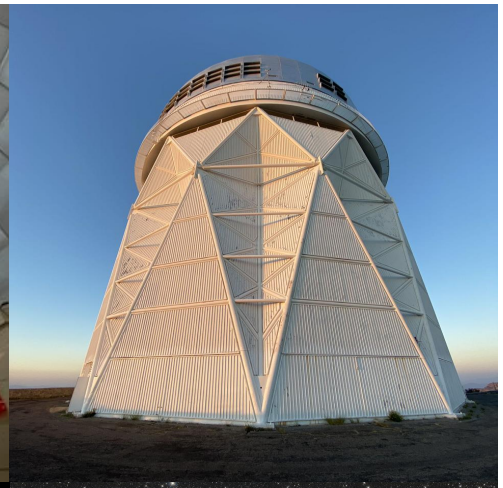

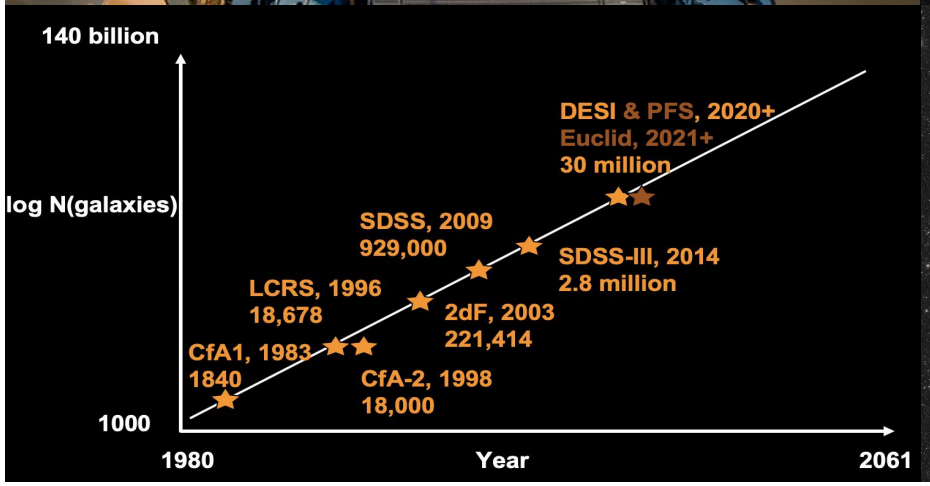

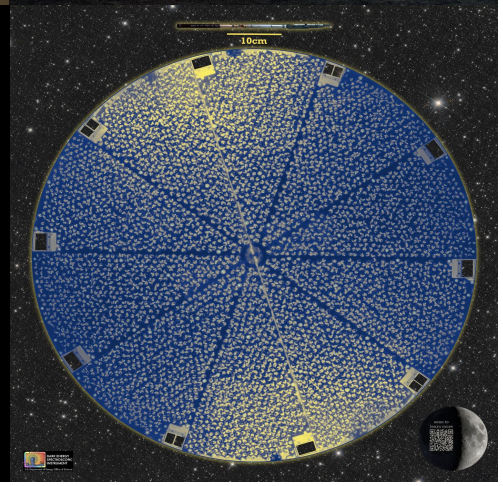

Stage IV dark energy measurement

Supported by the Department of Energy Office of Science

Mayall 4-meter telescope at Kitt Peak National Observatory

5000 Eyes: Mapping the Universe

Tens of millions optical spectra of galaxies and quasars

Wavelength:	Blue	$360 < \lambda \leq 555$ nm	Red	$555 < \lambda \leq 656$ nm	Infrared	$656 < \lambda \leq 980$ nm
Resolution :	Blue	$R = 2{,}000 \sim 3{,}200$	Red	$R = 3{,}200 \sim 4{,}100$	Infrared	$R = 4{,}100 \sim 5{,}000$

DESI Year 1 Data

Dark Energy Spectroscopic Instrument

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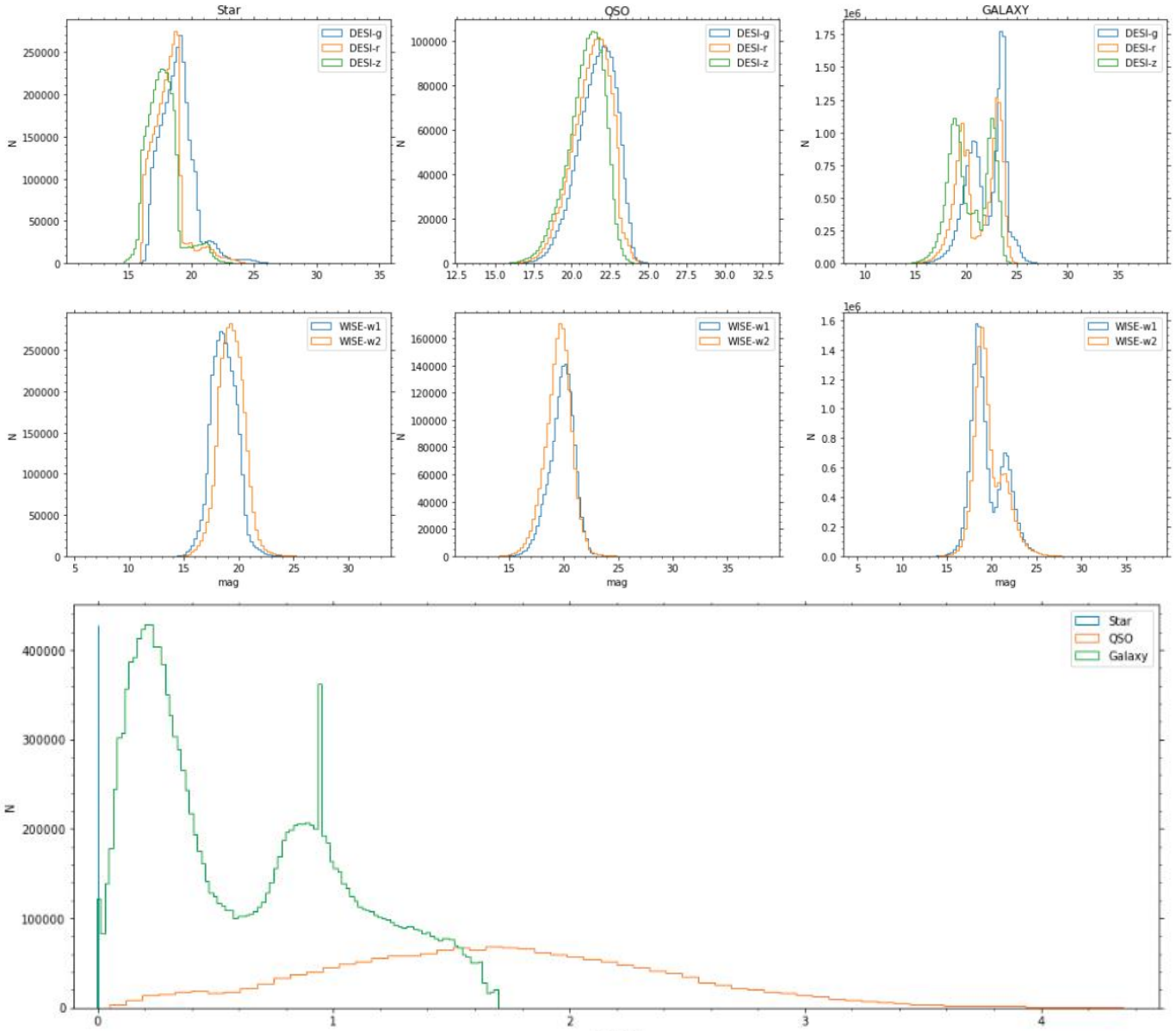


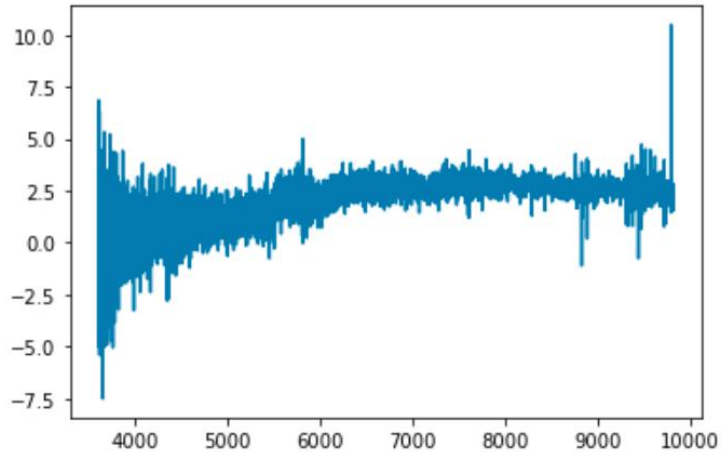
Redrock for "Iron"

Total: 23,060,727 coadded spectra

Star: 4,827,137 coadded spectra

QSO: 1,772,694 coadded spectra

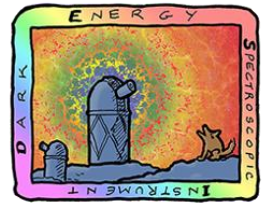
Galaxy: 16,460,896 coadded spectra



AGN catalog: still working

Afterburn+quasarnet: 2,847,435

Contents of Talk



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Active Galactic Nuclei

Dark Energy Spectroscopic Instrument

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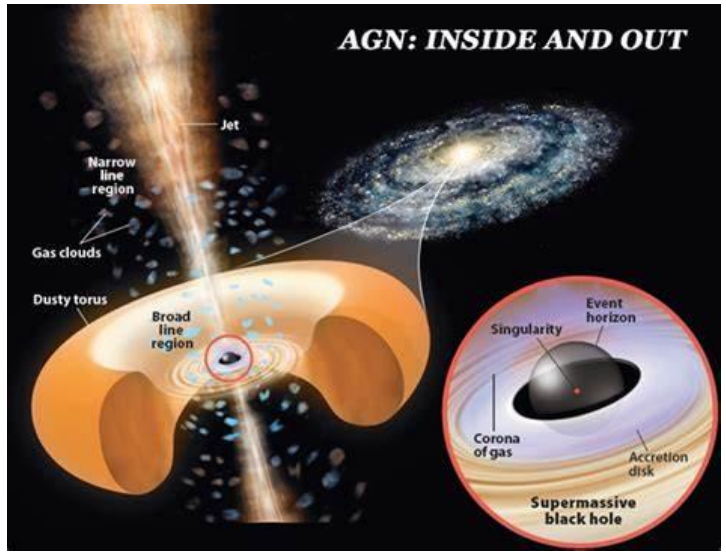
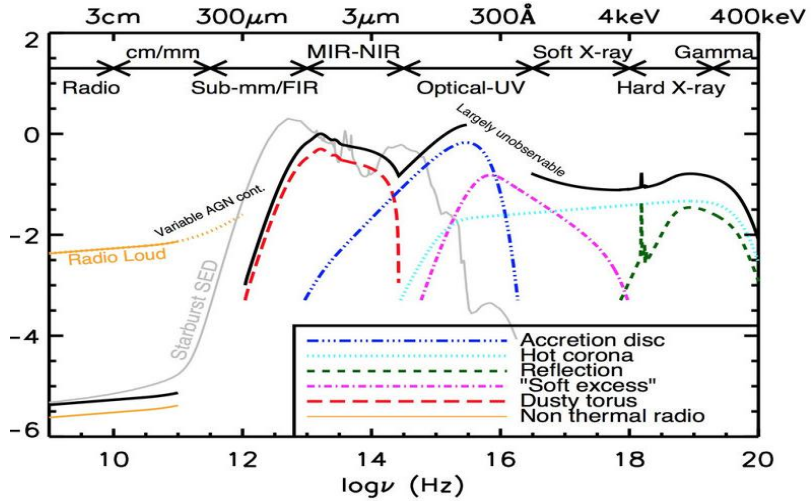
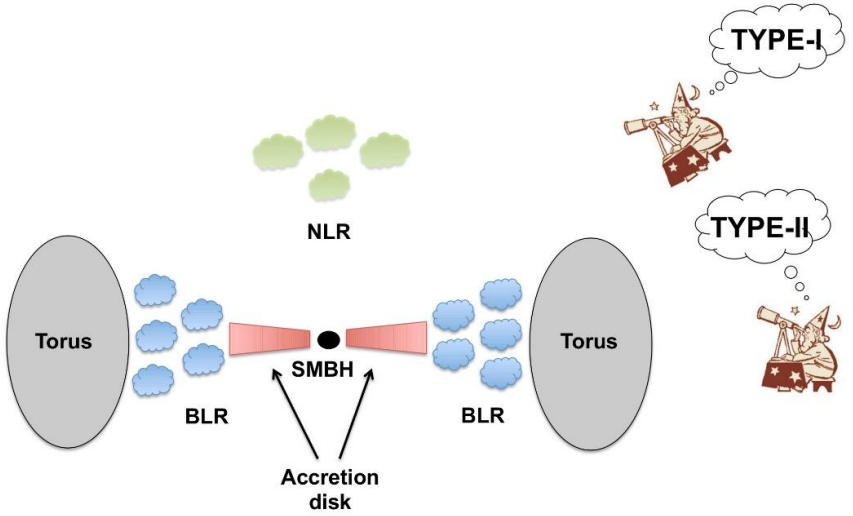
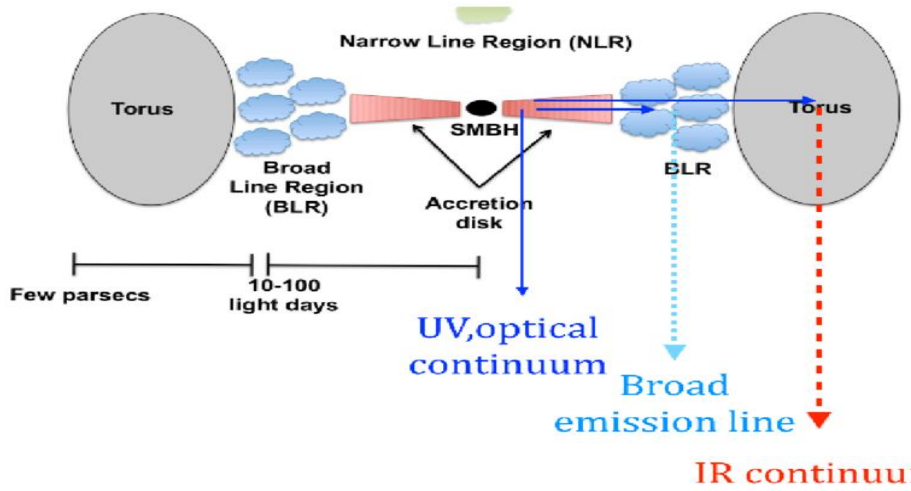
Observation





Unification Paradigm





AGN Evolution

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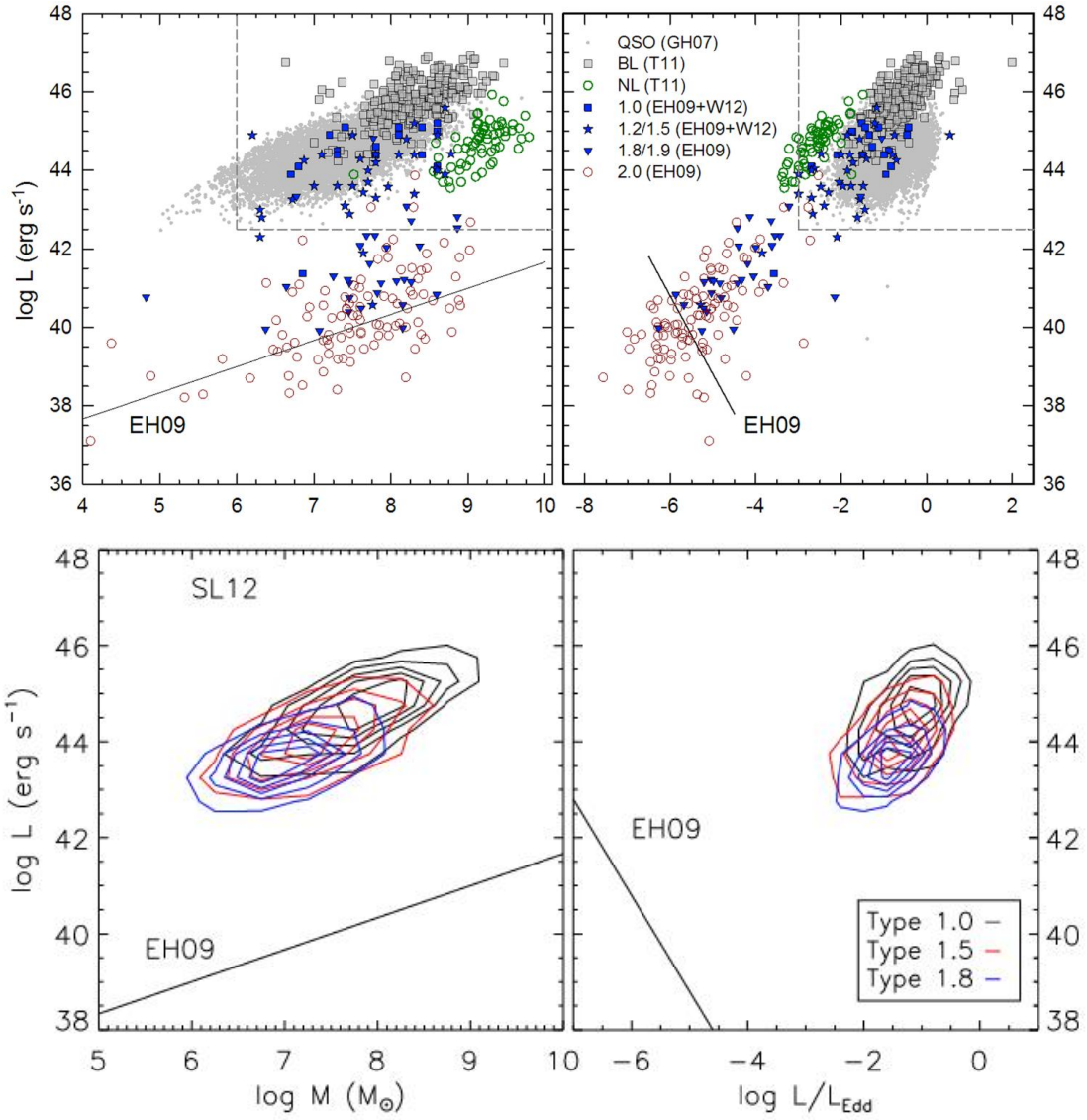
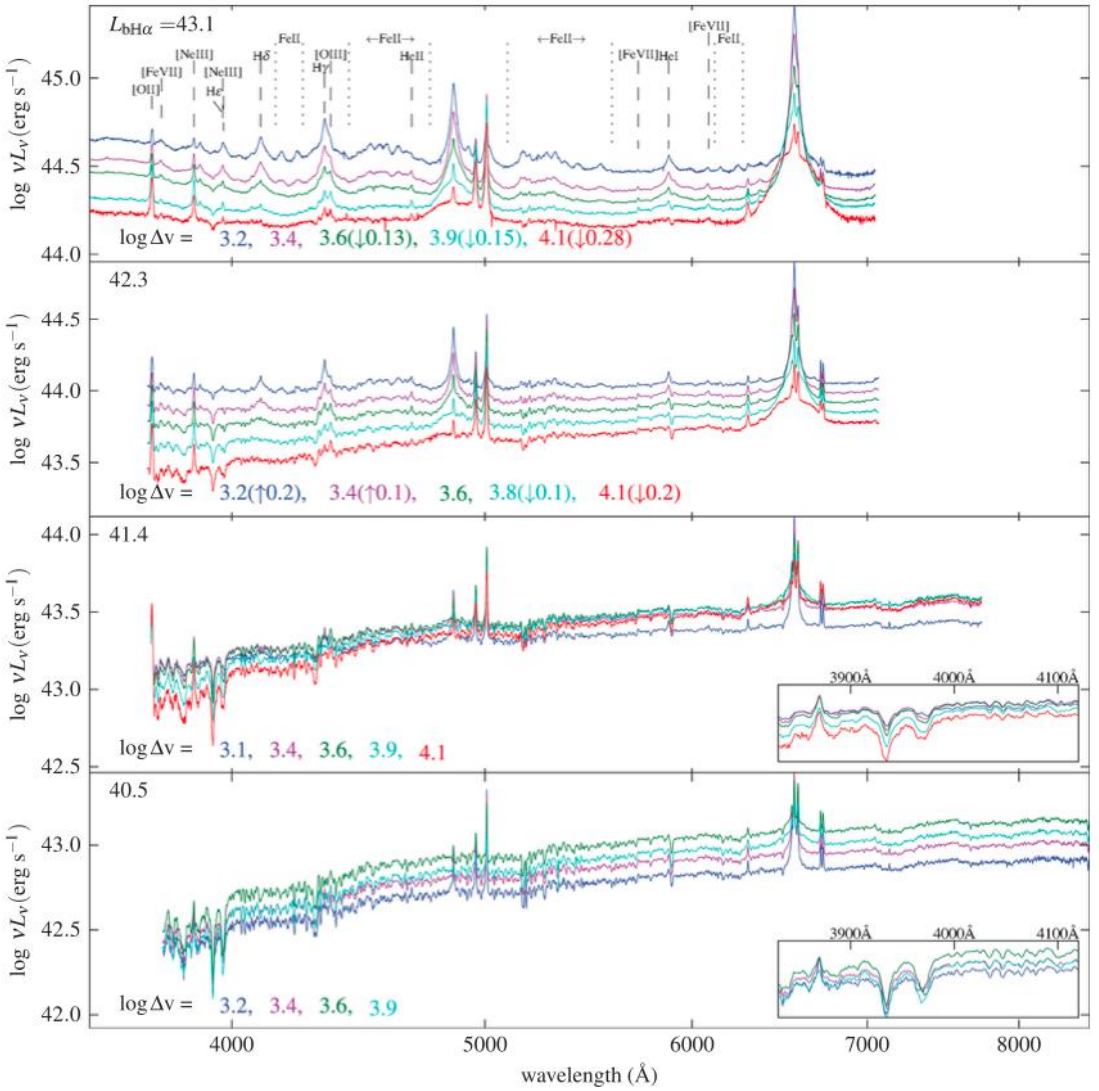
Elitzur et al. 2014



Stern & Laor 2012



Discover of the Changing-look AGN

Dark Energy Spectroscopic Instrument

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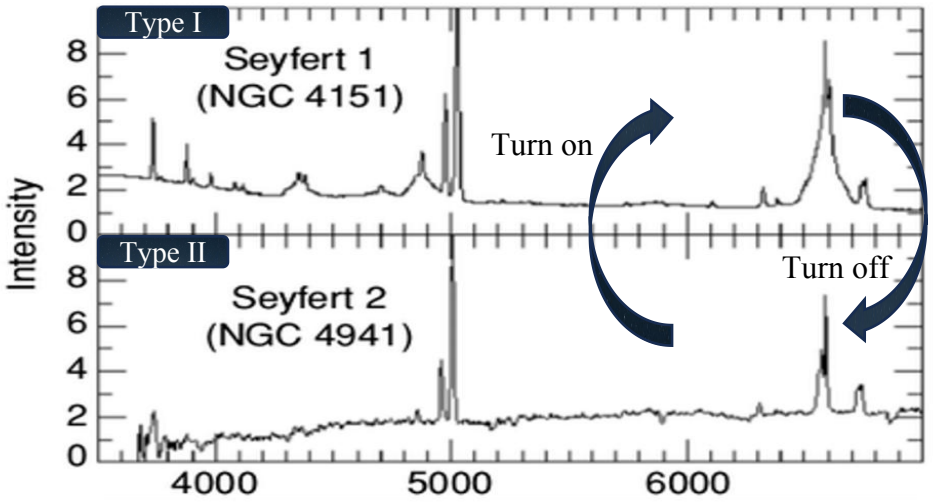
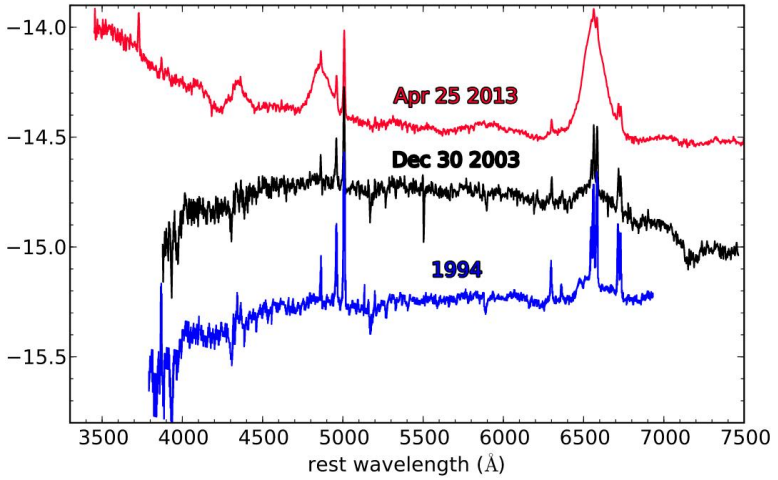
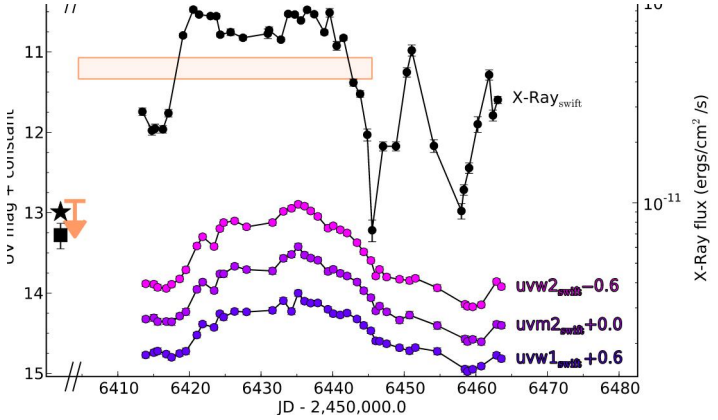
View Angle

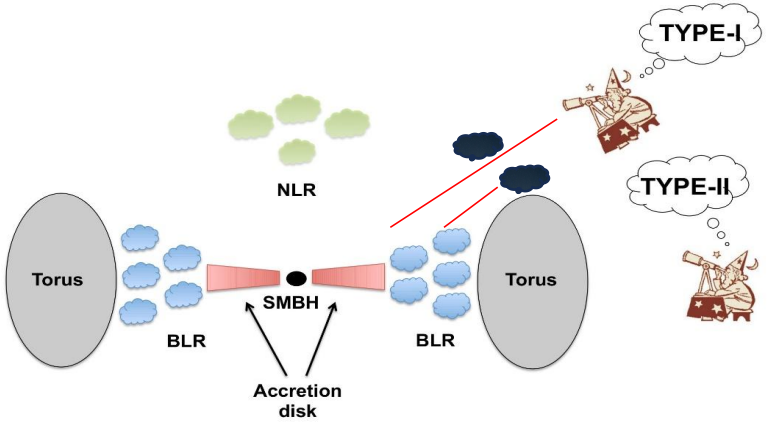


NGC 2617

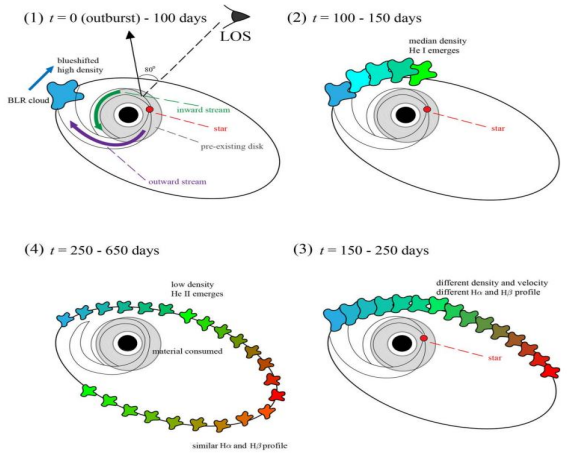




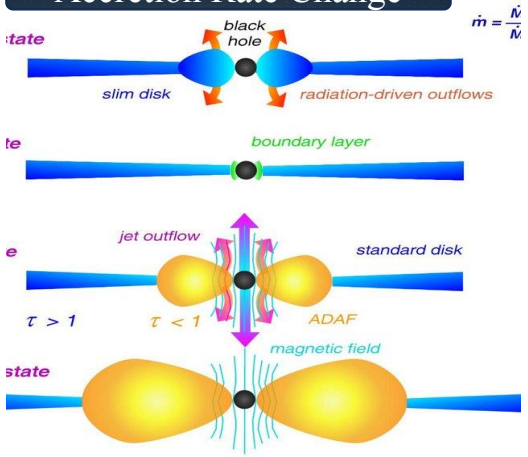
Obscured by Clouds



Tidal Disruption Event



Accretion Rate Change



DESI CL-AGN project (PI: Wei-Jian Guo)

Dark Energy Spectroscopic Instrument

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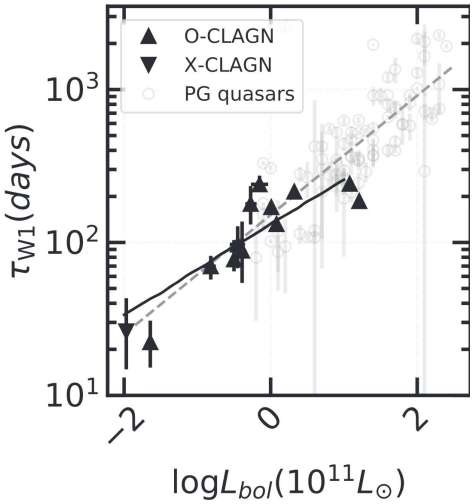
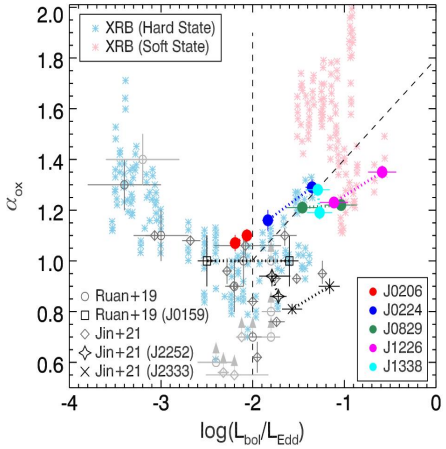
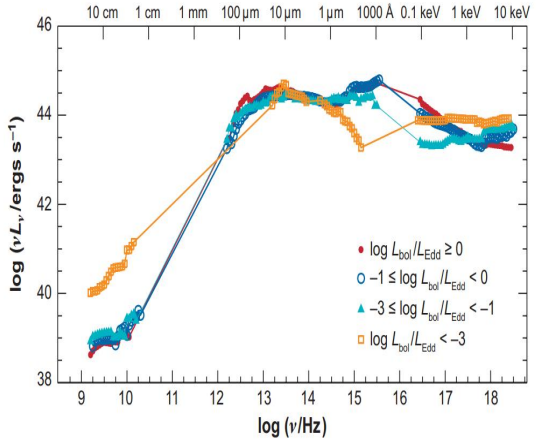
Mid-Infrared characteristic and torus properties
Data:WISE
Leader: GREENWELL, CLAIRE L. (Durham)

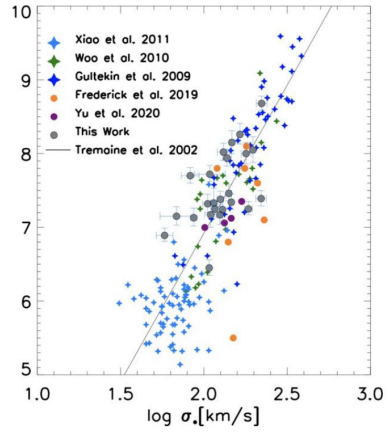




Search for the CL-AGN, statistical analysis, SED for CL-AGN
DESI collabration:
Wei-Jian Guo,David Alexander, Rahma Alfarsy, Rebecca Canning, Tamara Davis, Vicky Fawcett, Linhua Jiang, claire greenwell, Stephanie Juneau, John Moustakas, Zhiwei Pan, Ragadeepika Pucha, Małgorzata Siudek, Hu Zo

Radio characteristic
Data: FIRST and VLASS
Leader: Victoria Fawcett (Newcastle)
Zhi-qiang Cheng(NNU)

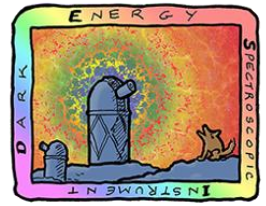




X-Ray characteristic
Data: eROSTA and Einstein Probe
Leader: Huaqing Cheng (EP) Stephanie Juneau (Noirlab) Wei-Jian

Host galaxy characteristic
Data: DESI SDSS WISE
Leader: Junjie Jin (NAOC) Shengxiu Sun (PKU) Malgorzata Siudek (IFAS)

Contents of Talk



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CL-AGN Selection

Dark Energy Spectroscopic Instrument

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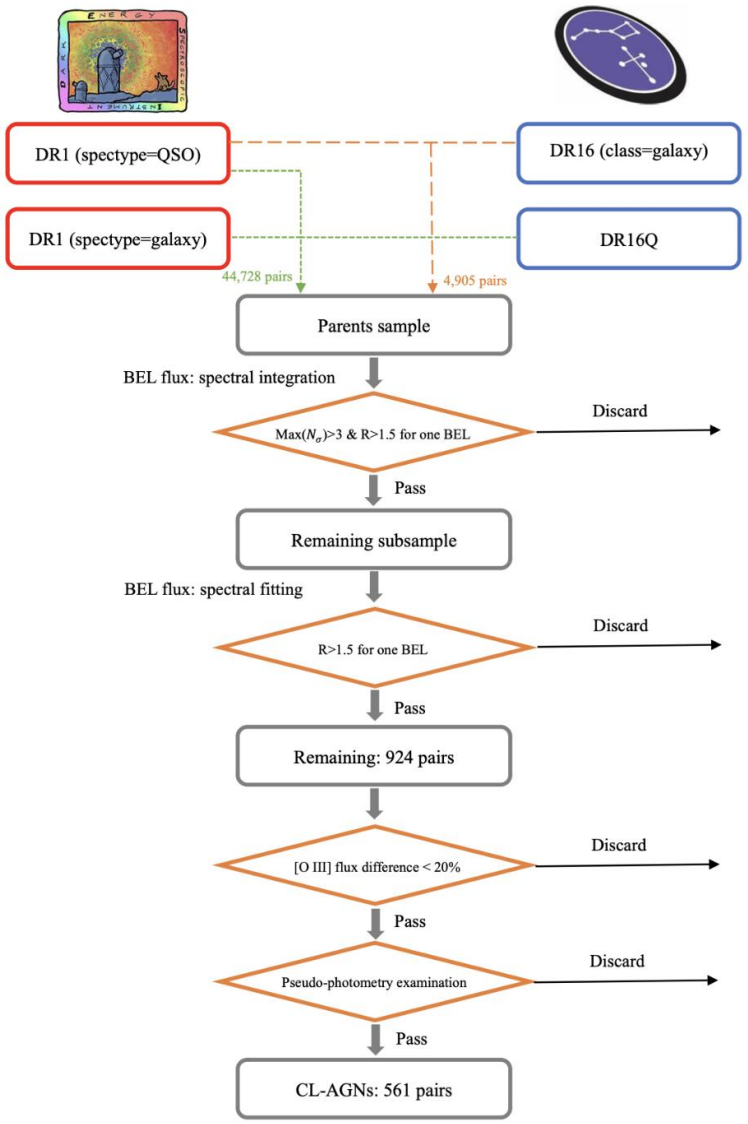

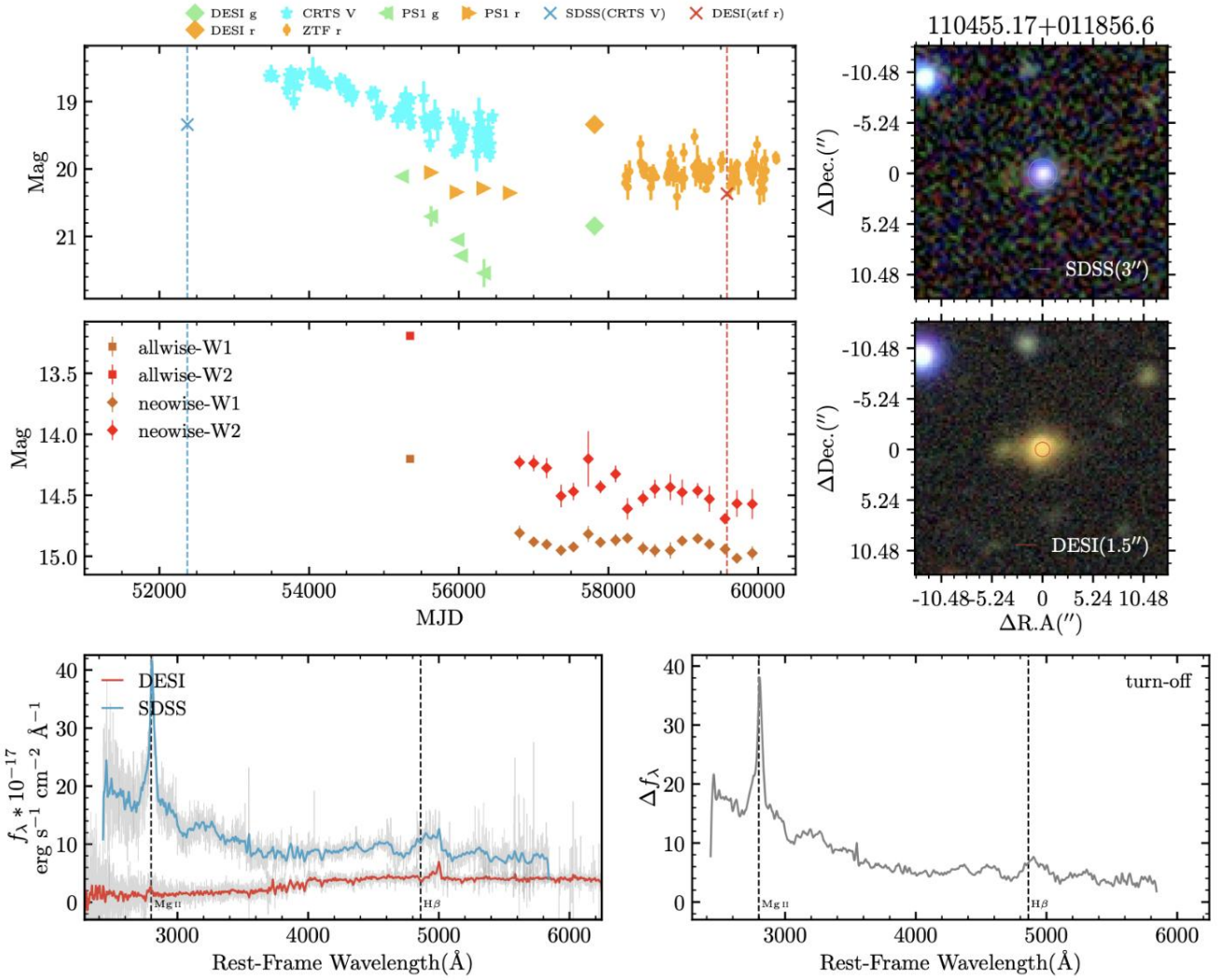

Example of CL-AGN

Dark Energy Spectroscopic Instrument

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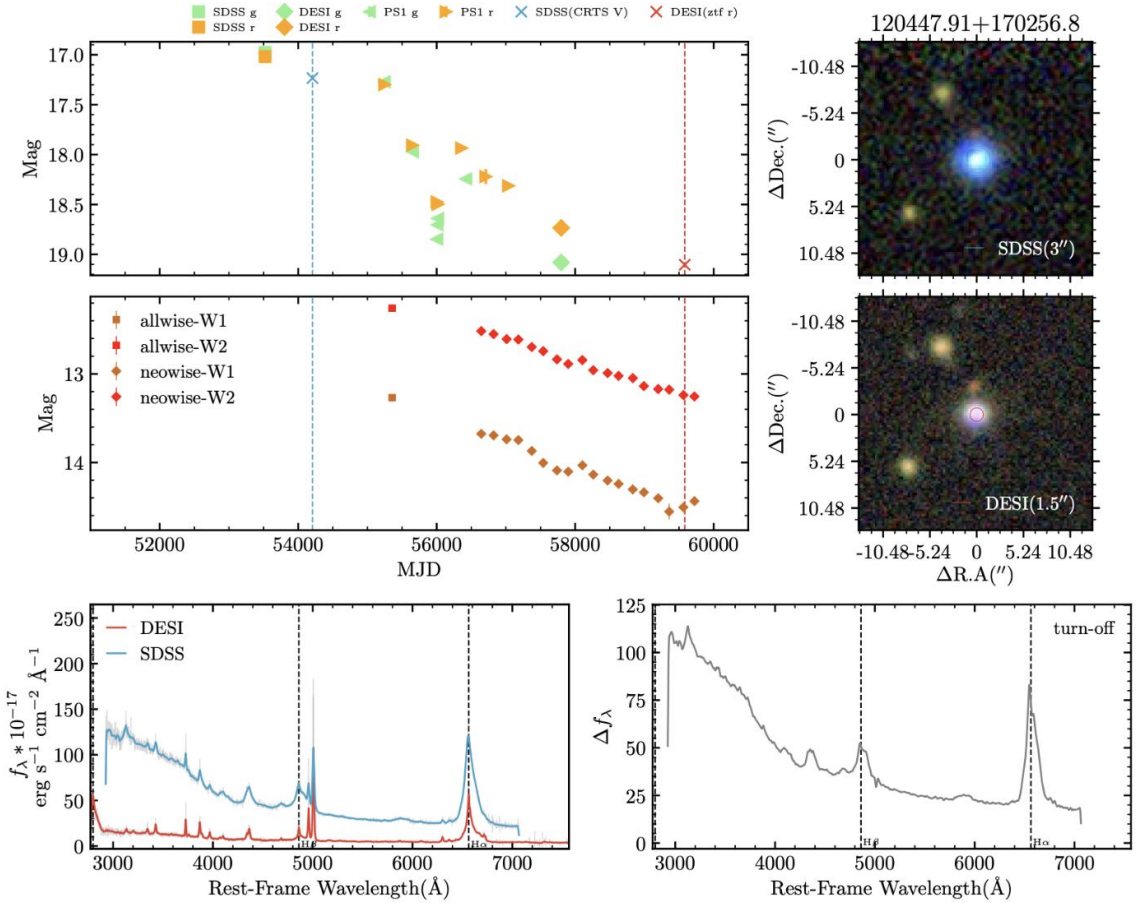

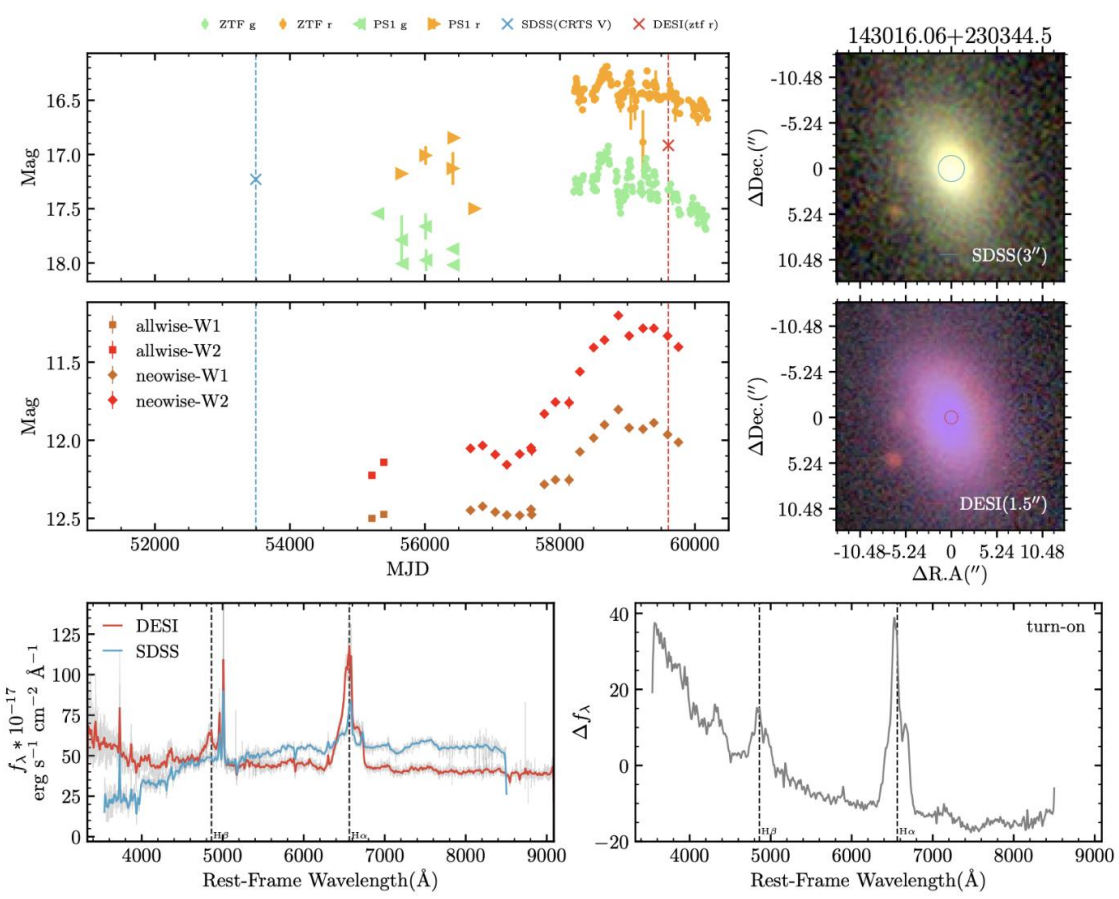

SDSS Fiber Drop!

Dark Energy Spectroscopic Instrument

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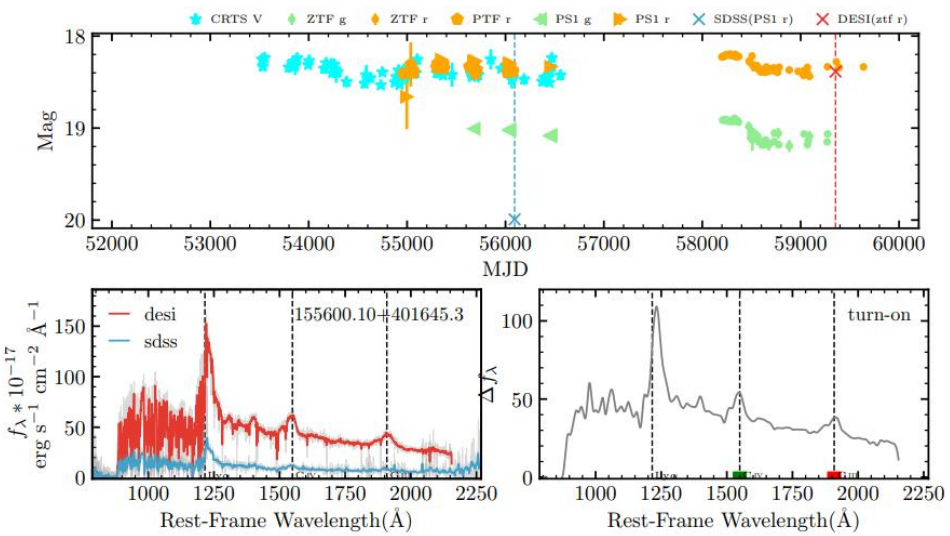

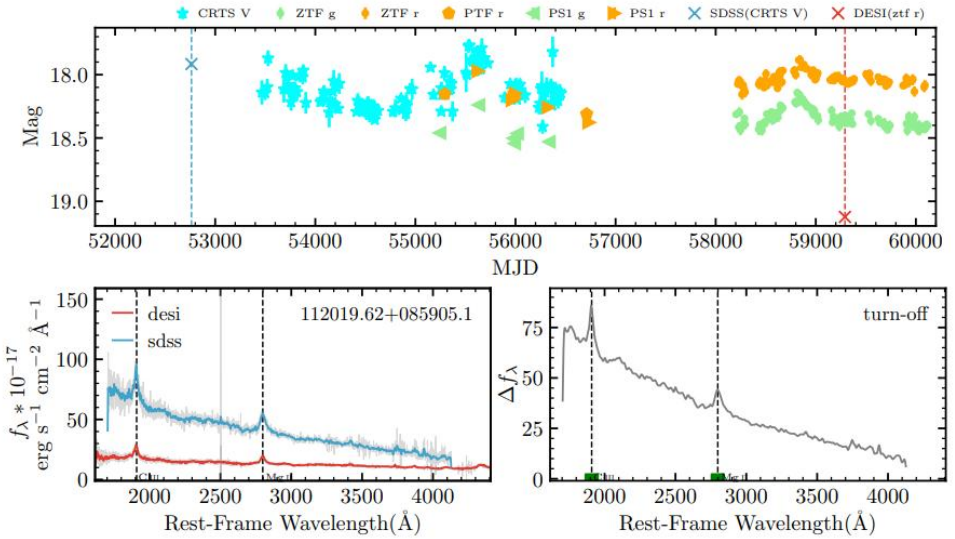

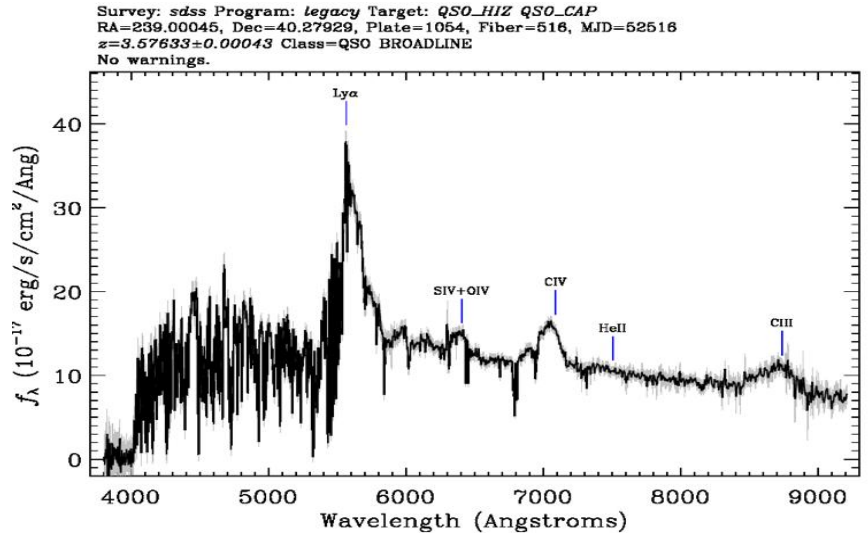

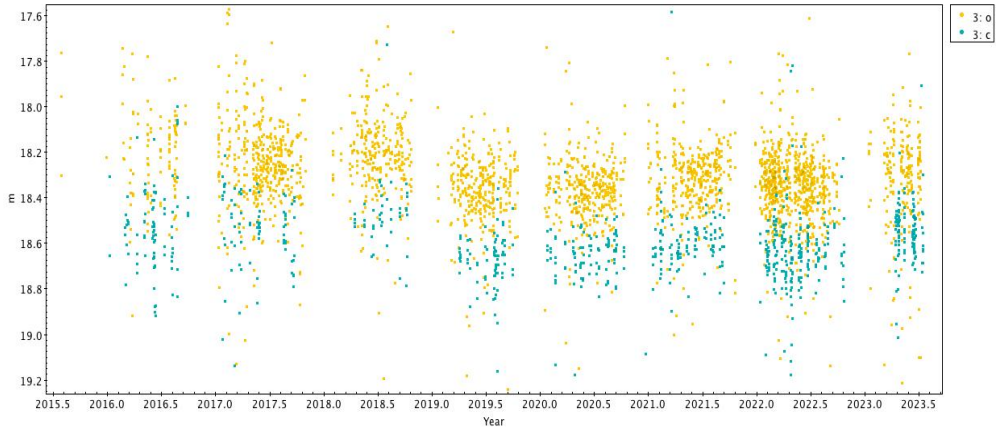

Statistical Results: Broad Emission lines

Dark Energy Spectroscopic Instrument

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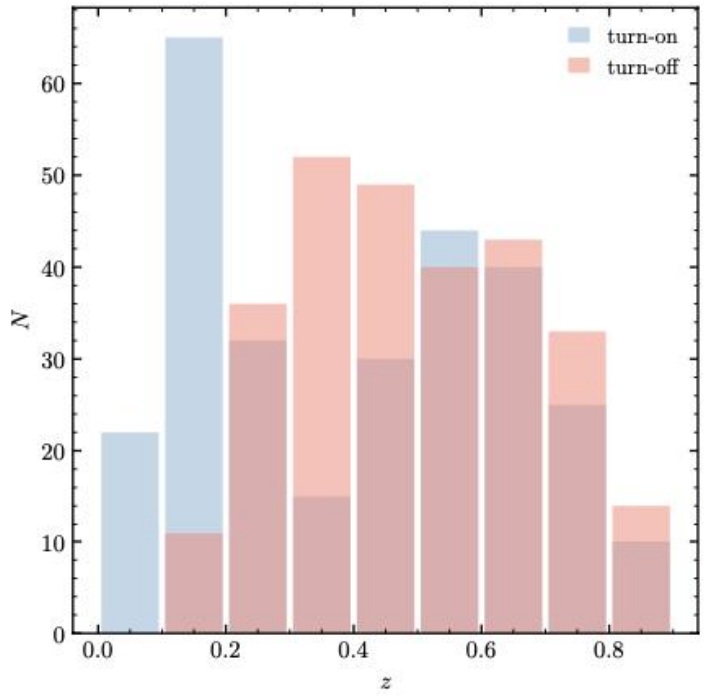

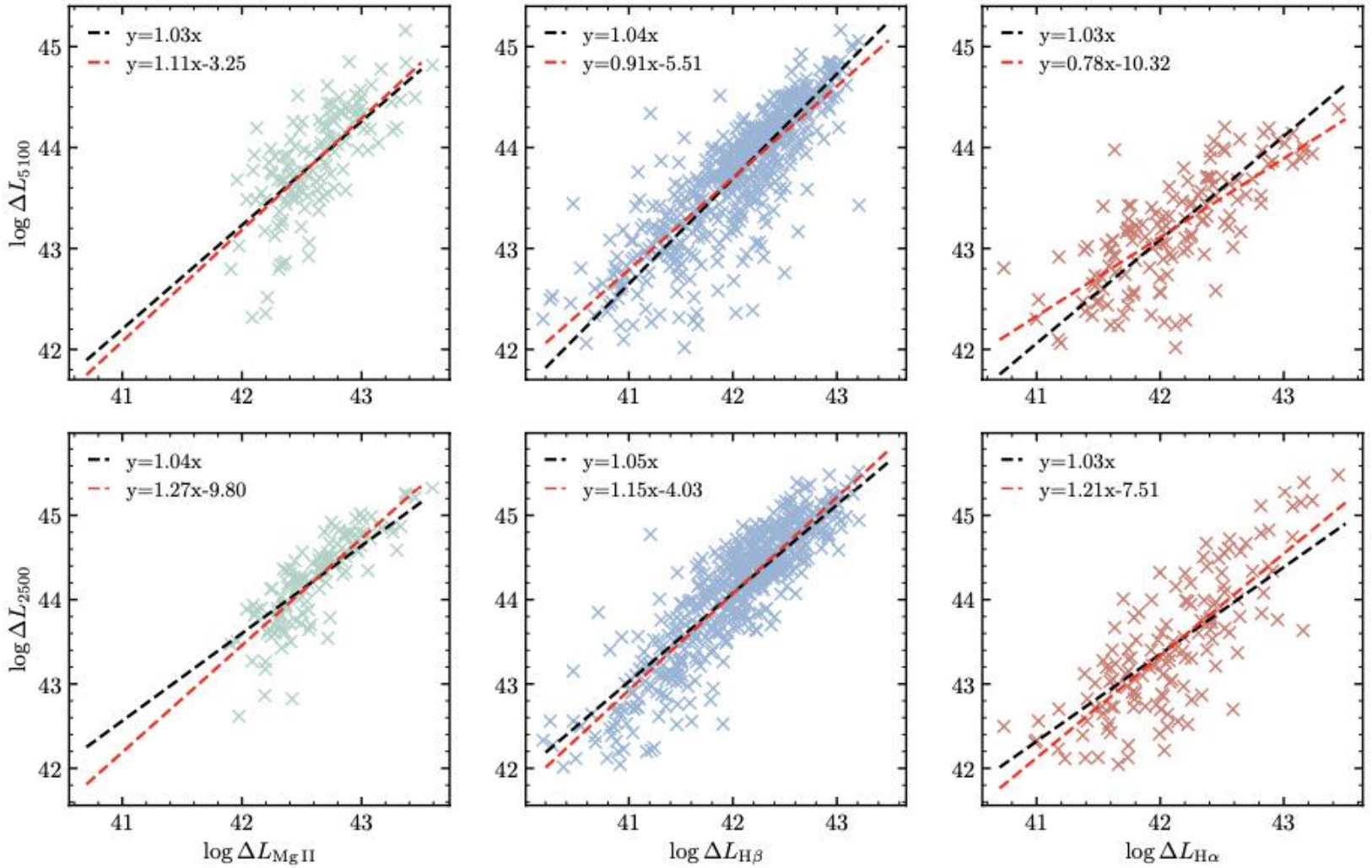

Statistical Results: Broad Emission lines

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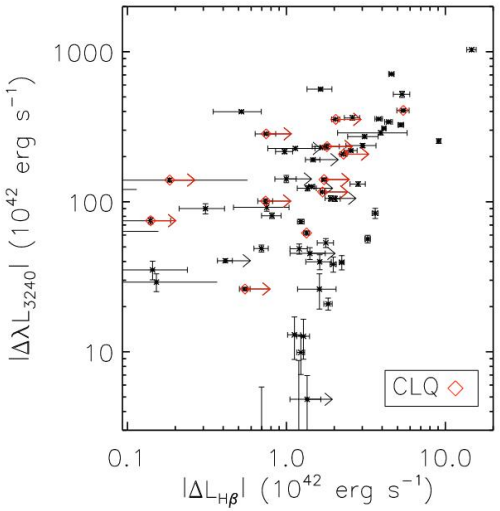
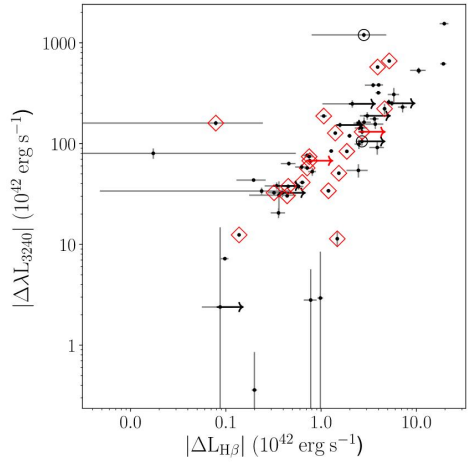
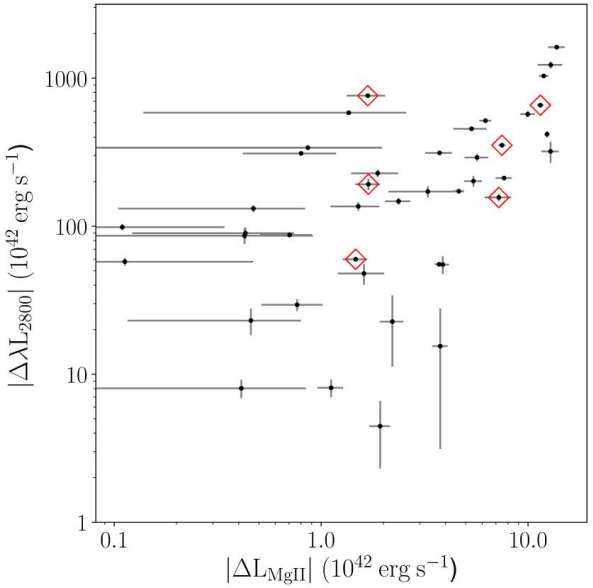
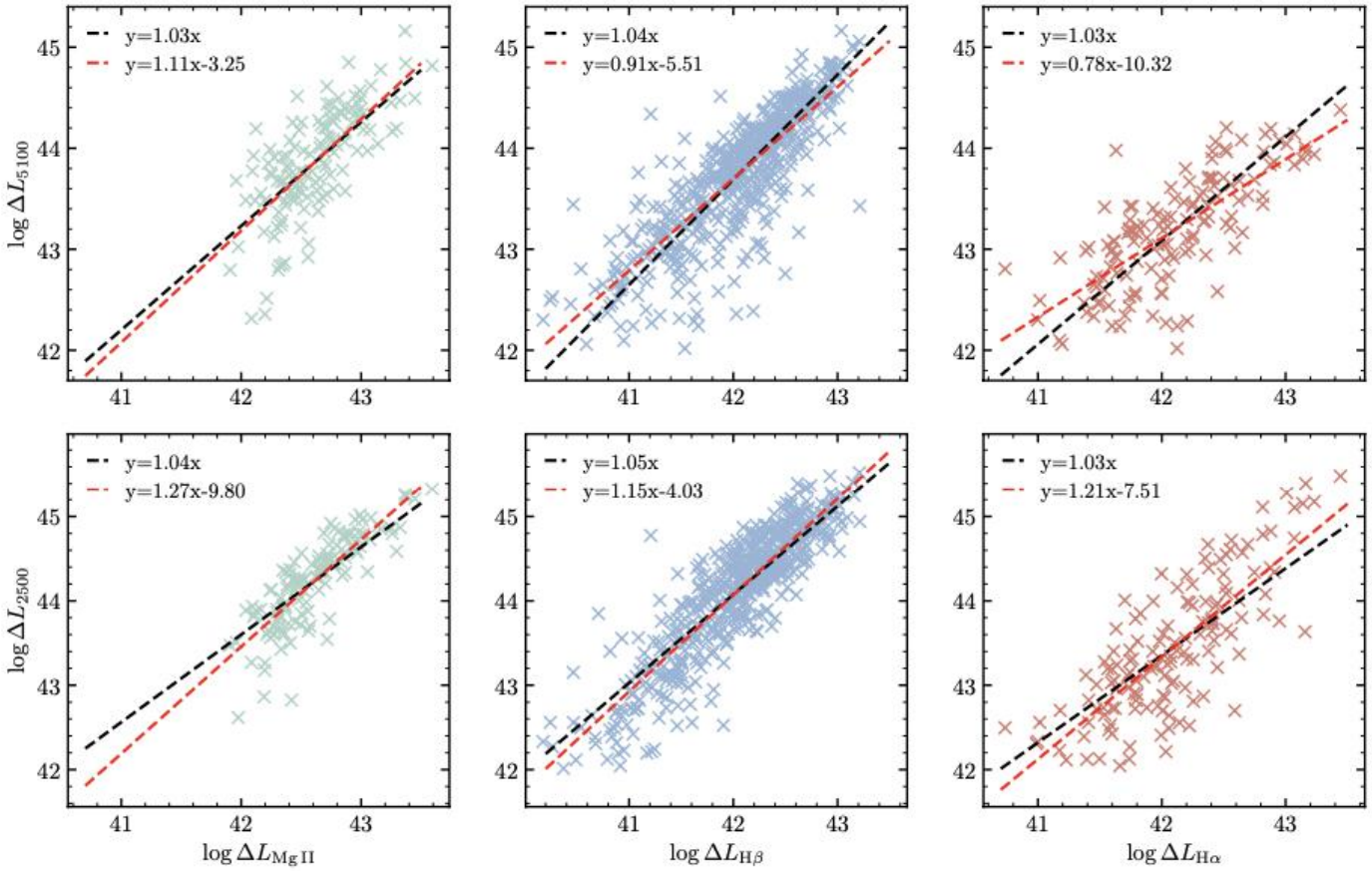
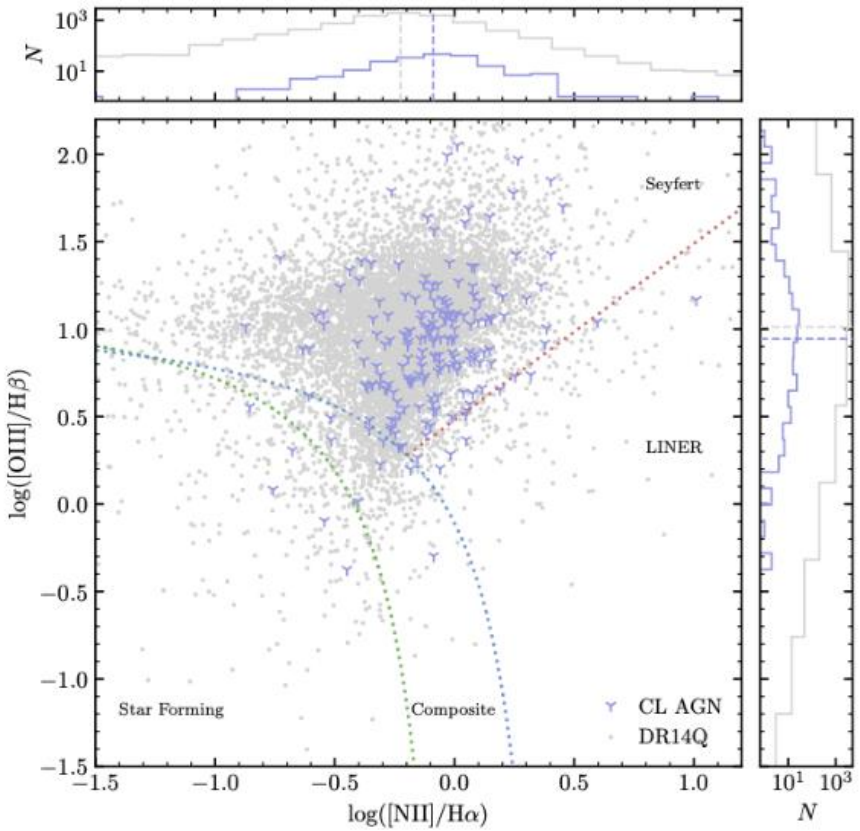


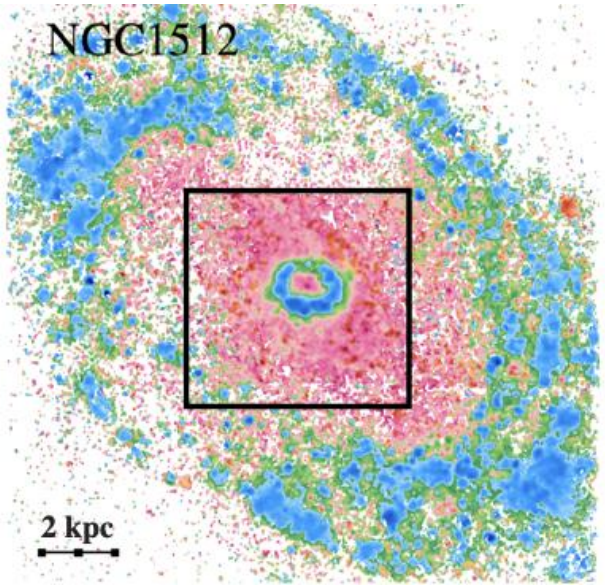


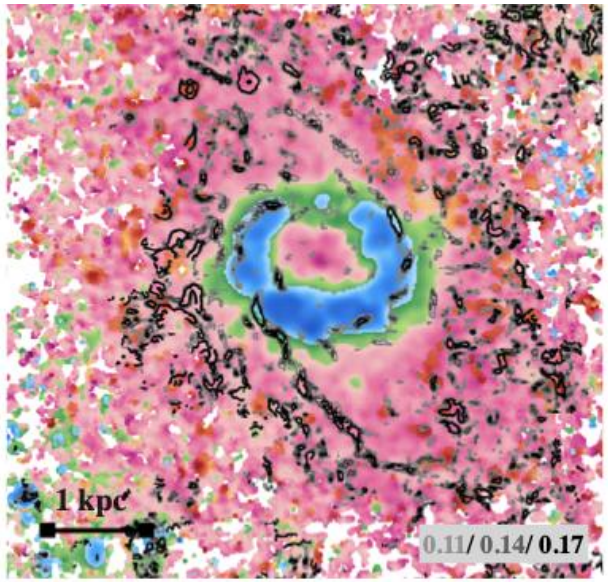


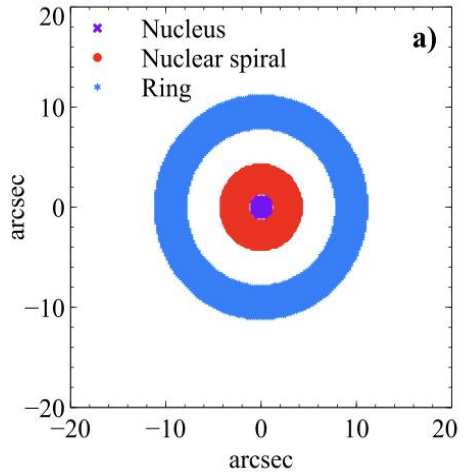


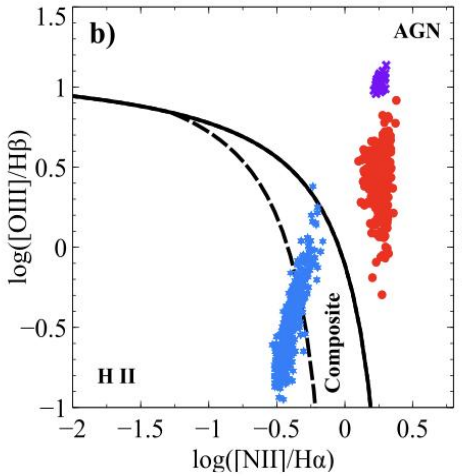
Statistical Results: BPT

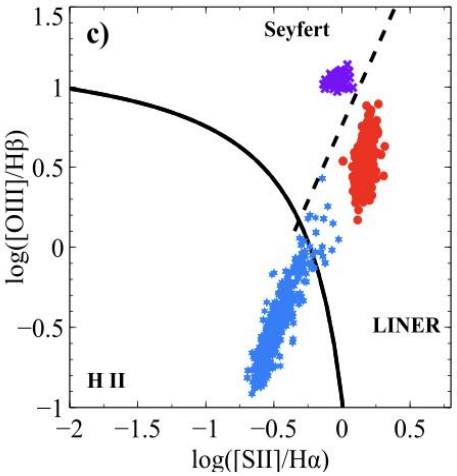












Dark Energy Spectroscopic Instrument

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Statistical Results: Physical Properties

Dark Energy Spectroscopic Instrument

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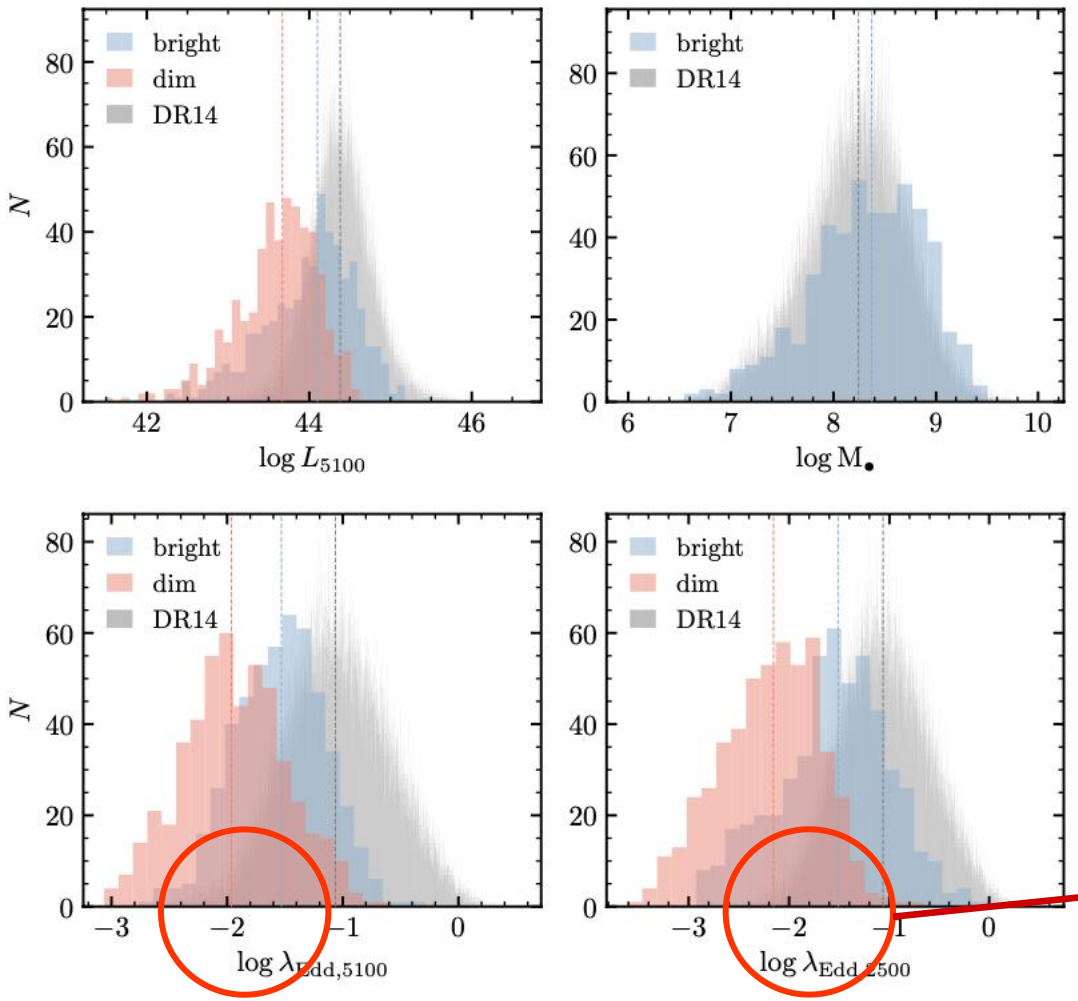
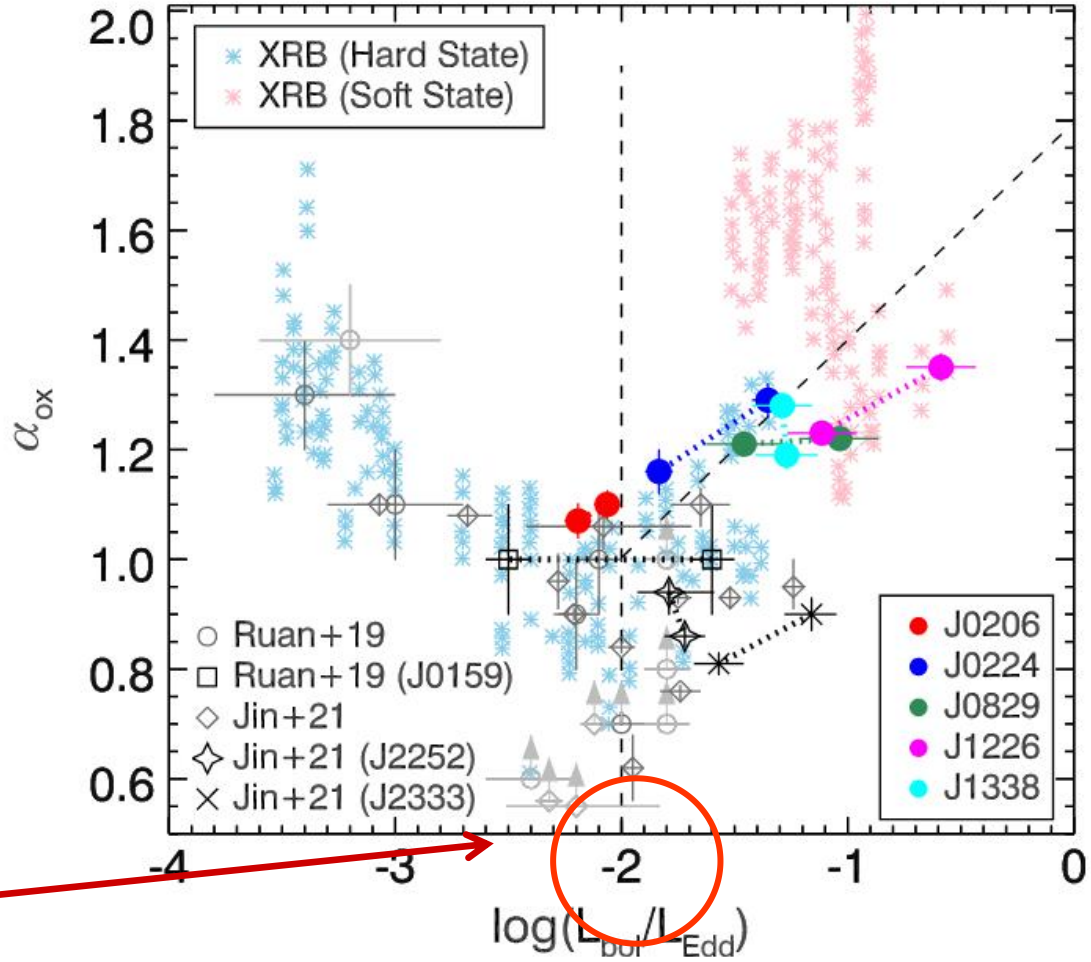
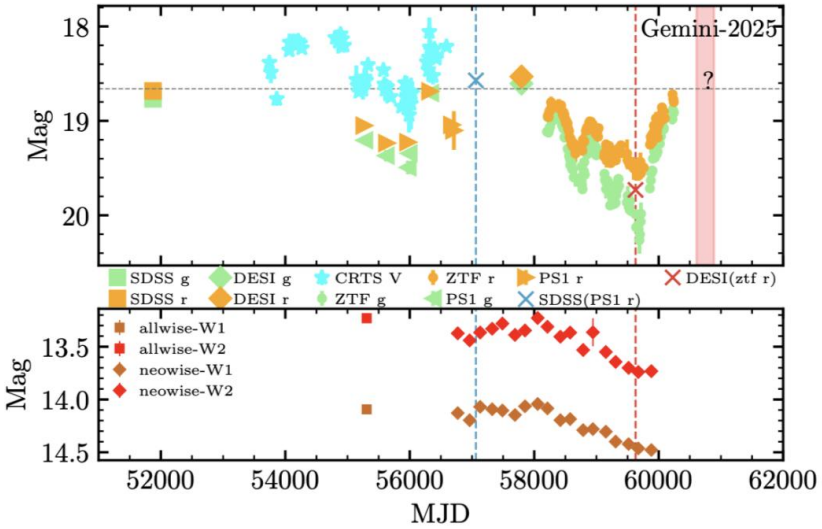
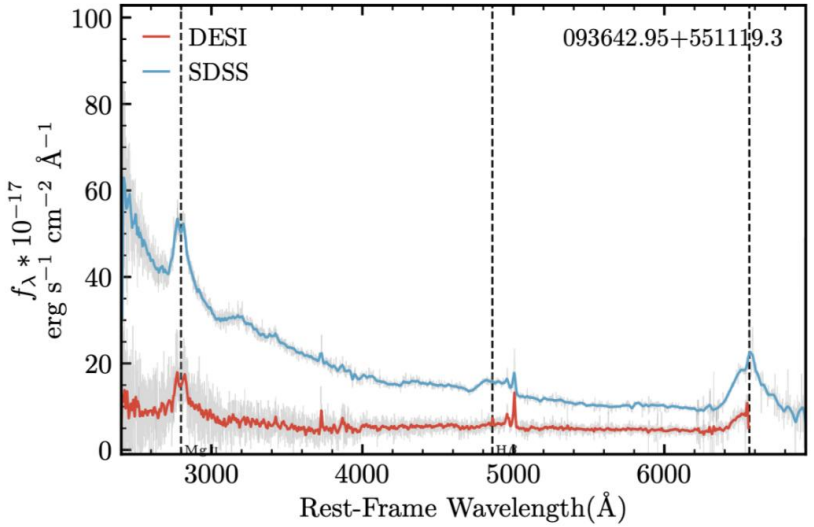
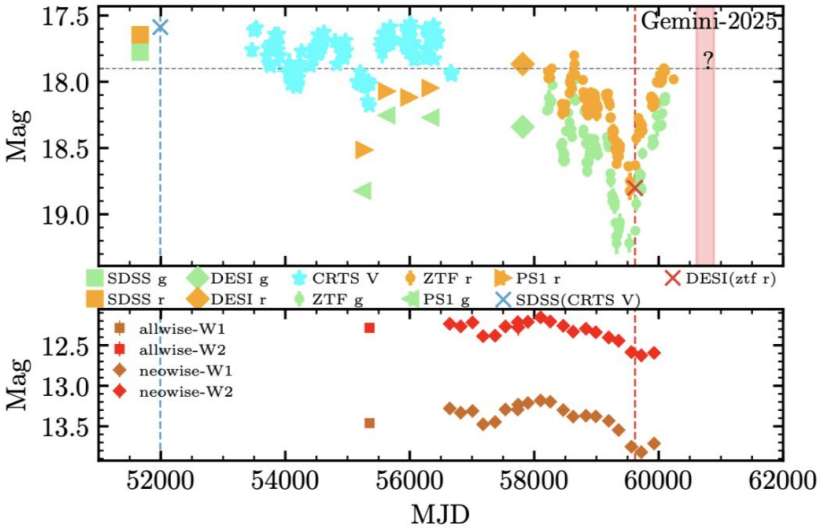


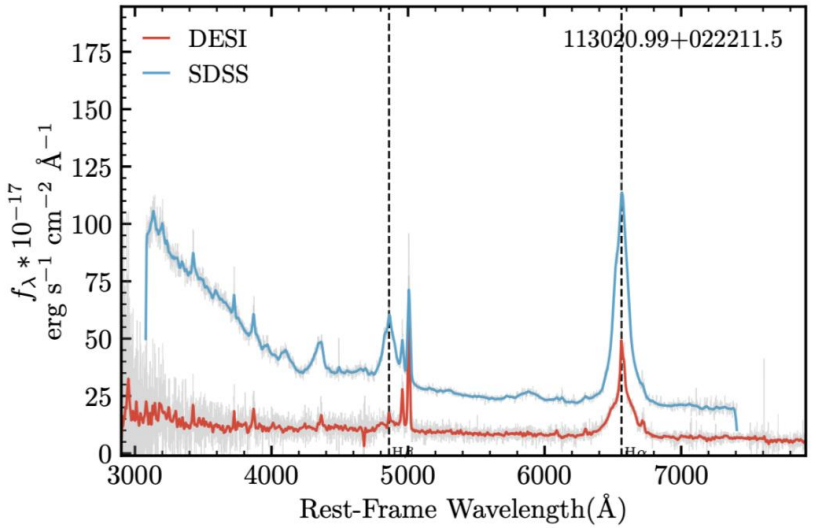


Recurring CL









Dark Energy Spectroscopic Instrument

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TDE-like flare

Dark Energy Spectroscopic Instrument

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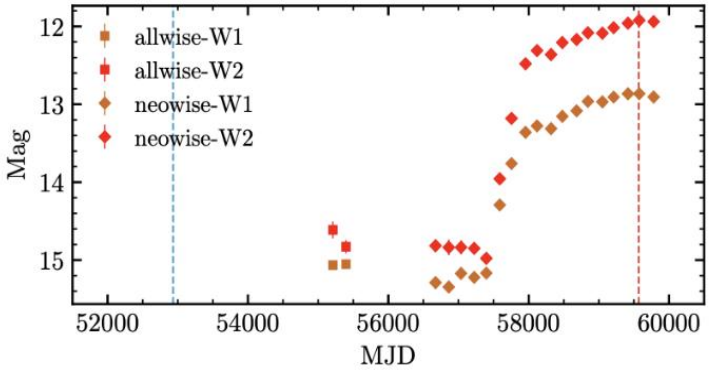
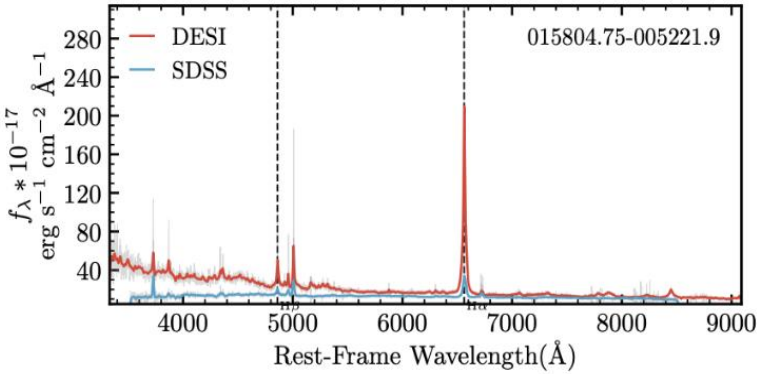
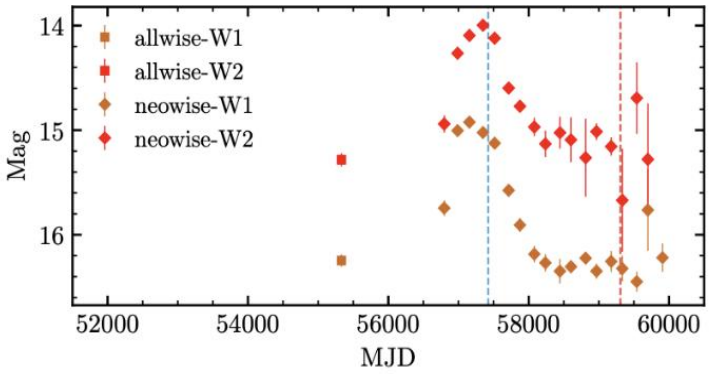
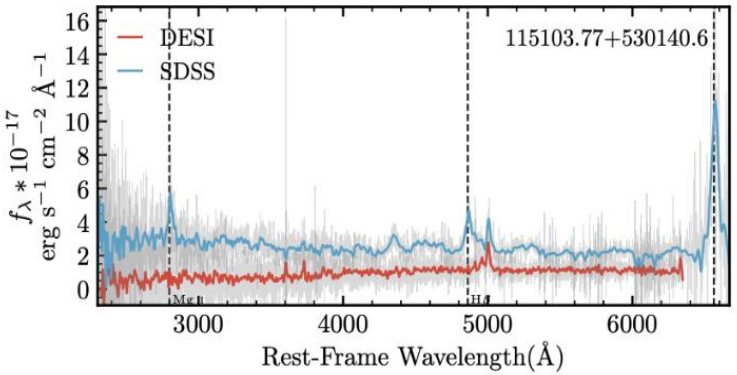
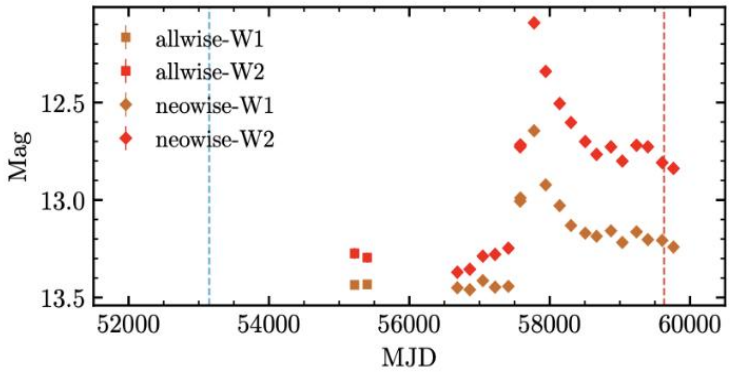
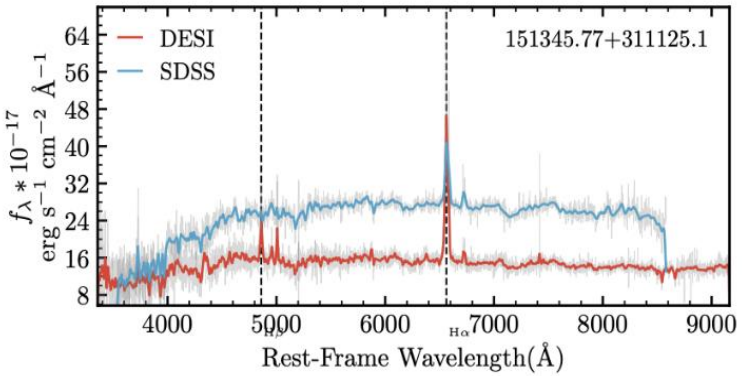


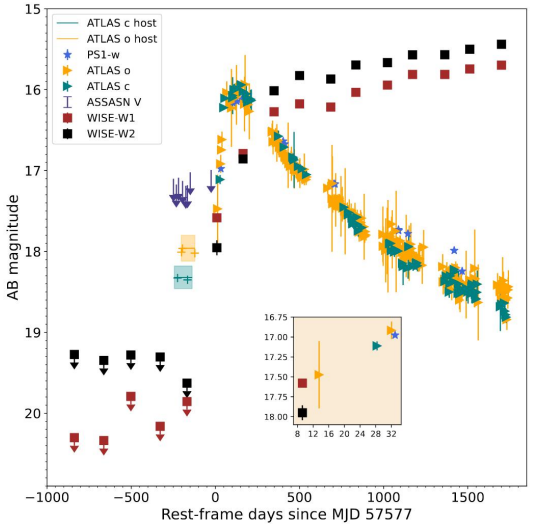


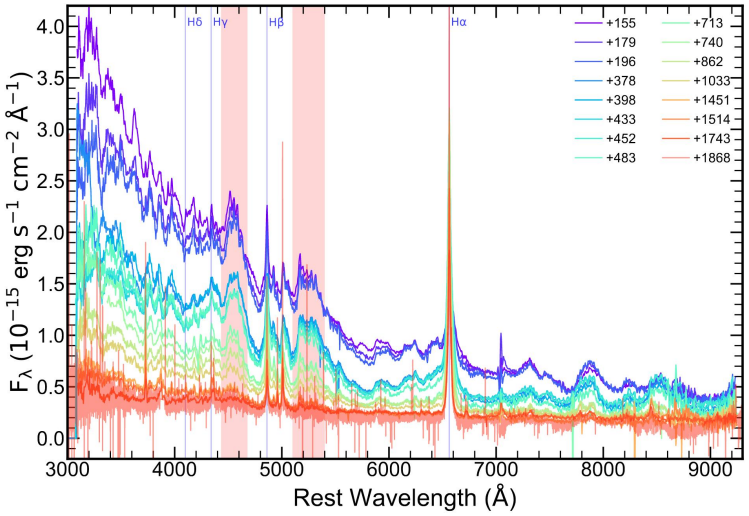




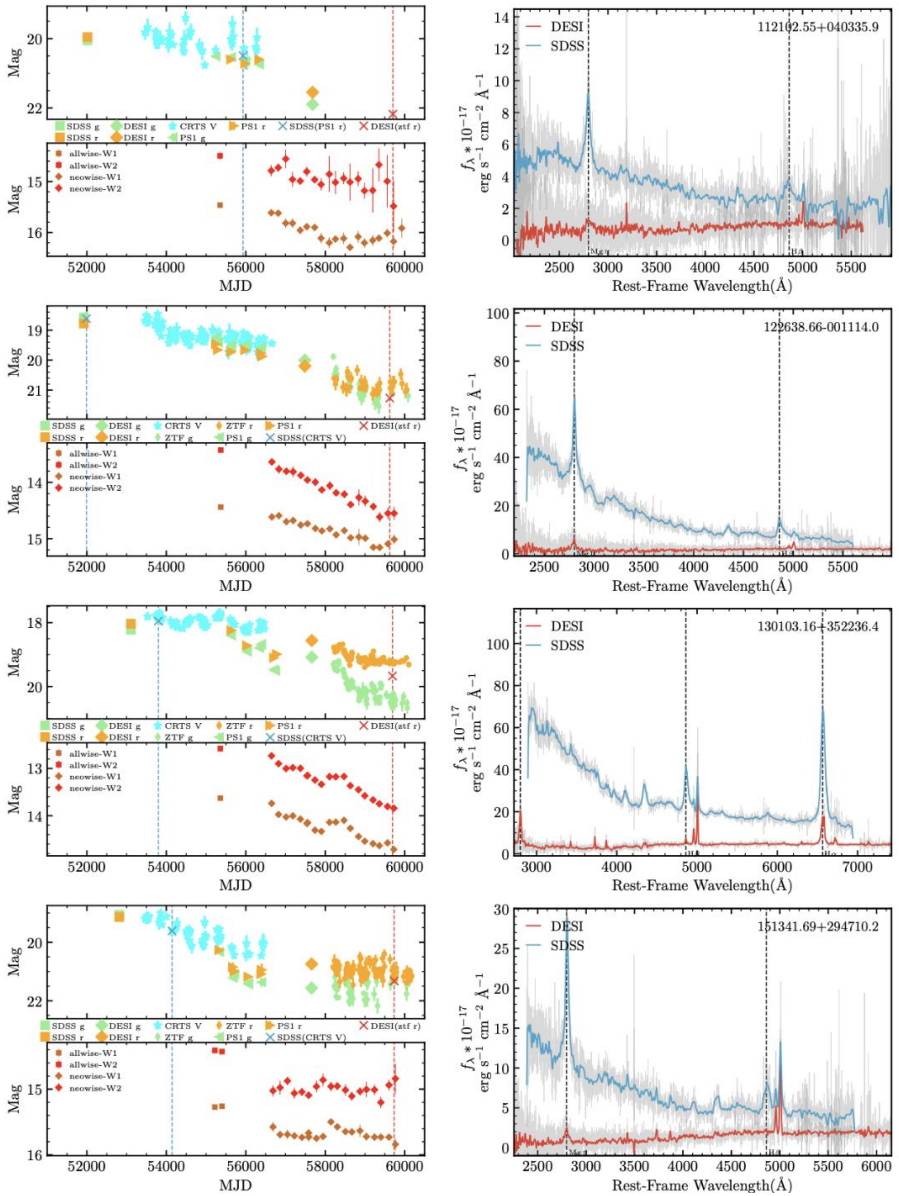


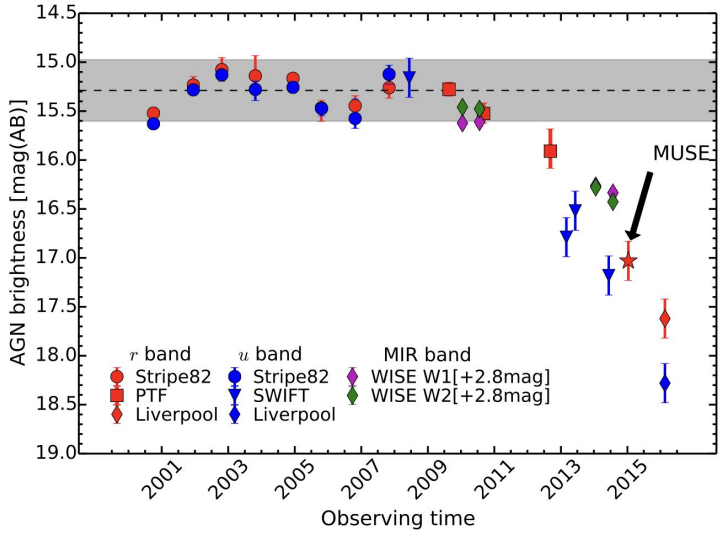


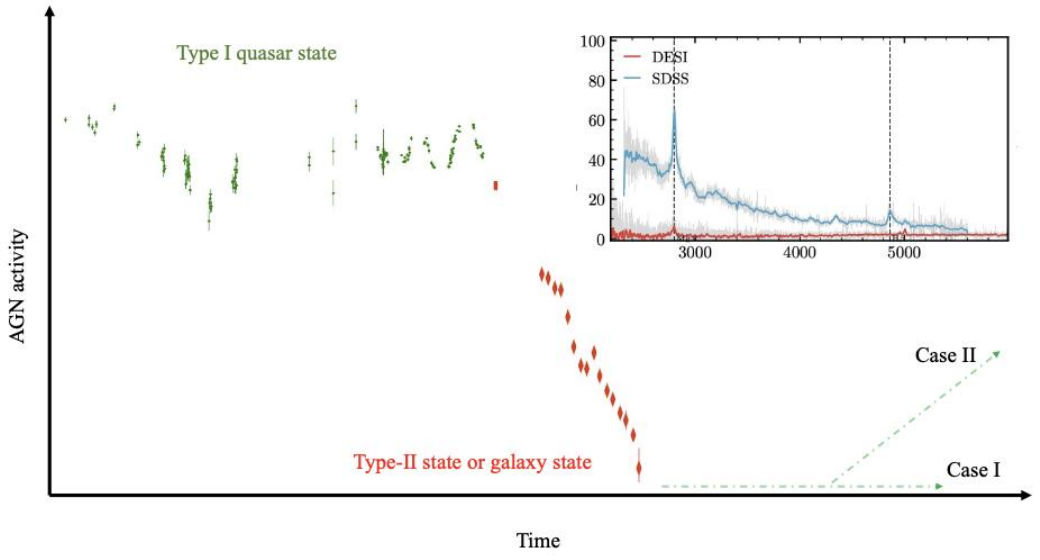




Peculiar Changing-look







Dark Energy Spectroscopic Instrument

U.S. Department of Energy Office of Science

New Classification and physical mechnism

Dark Energy Spectroscopic Instrument

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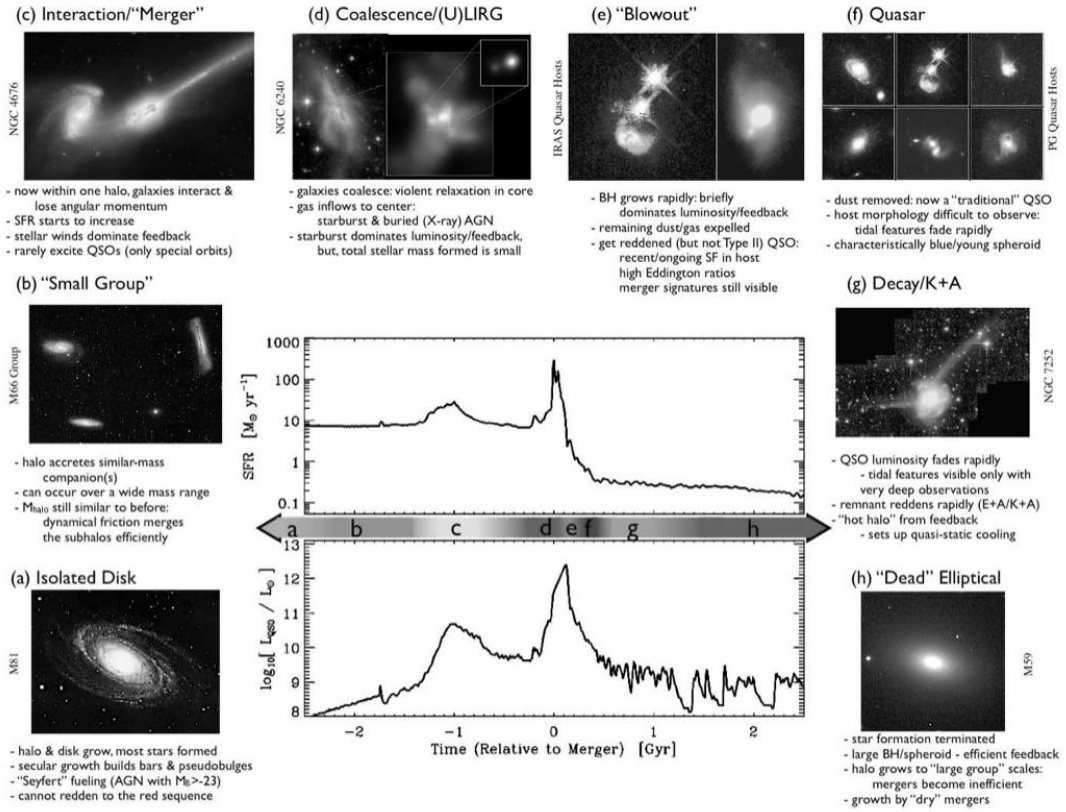
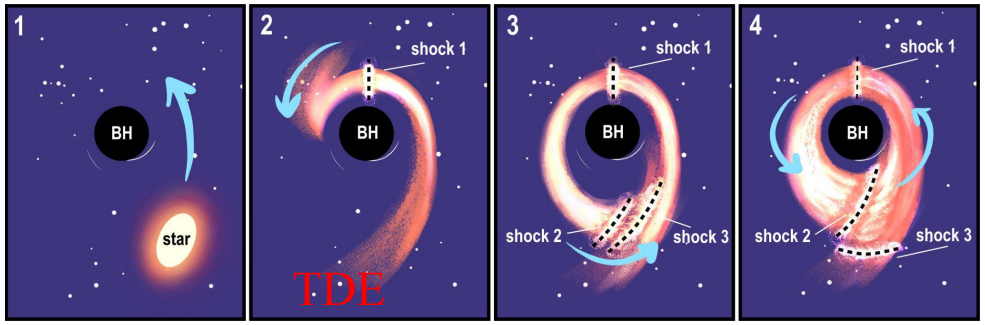
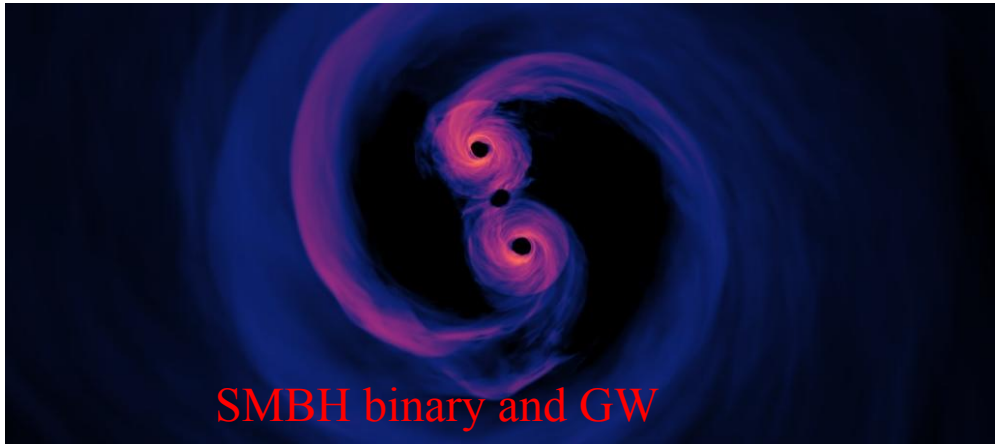
New classification (internal or external)

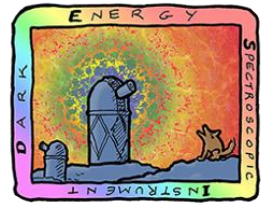
1) Intrisic variability accretion change vs. obscuration
2) flare or temporary AGN
3) external physical mechnism (Tidal disrupt events, SMBH binary , stellar BH binary in the accretion disk etc.)







Contents of Talk



Dark Energy Spectroscopic Instrument

U.S. Department of Energy Office of Science

- DESI Survey and First Data Release
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A Recurring CL-AGN with Asymmetric BEL

Dark Energy Spectroscopic Instrument

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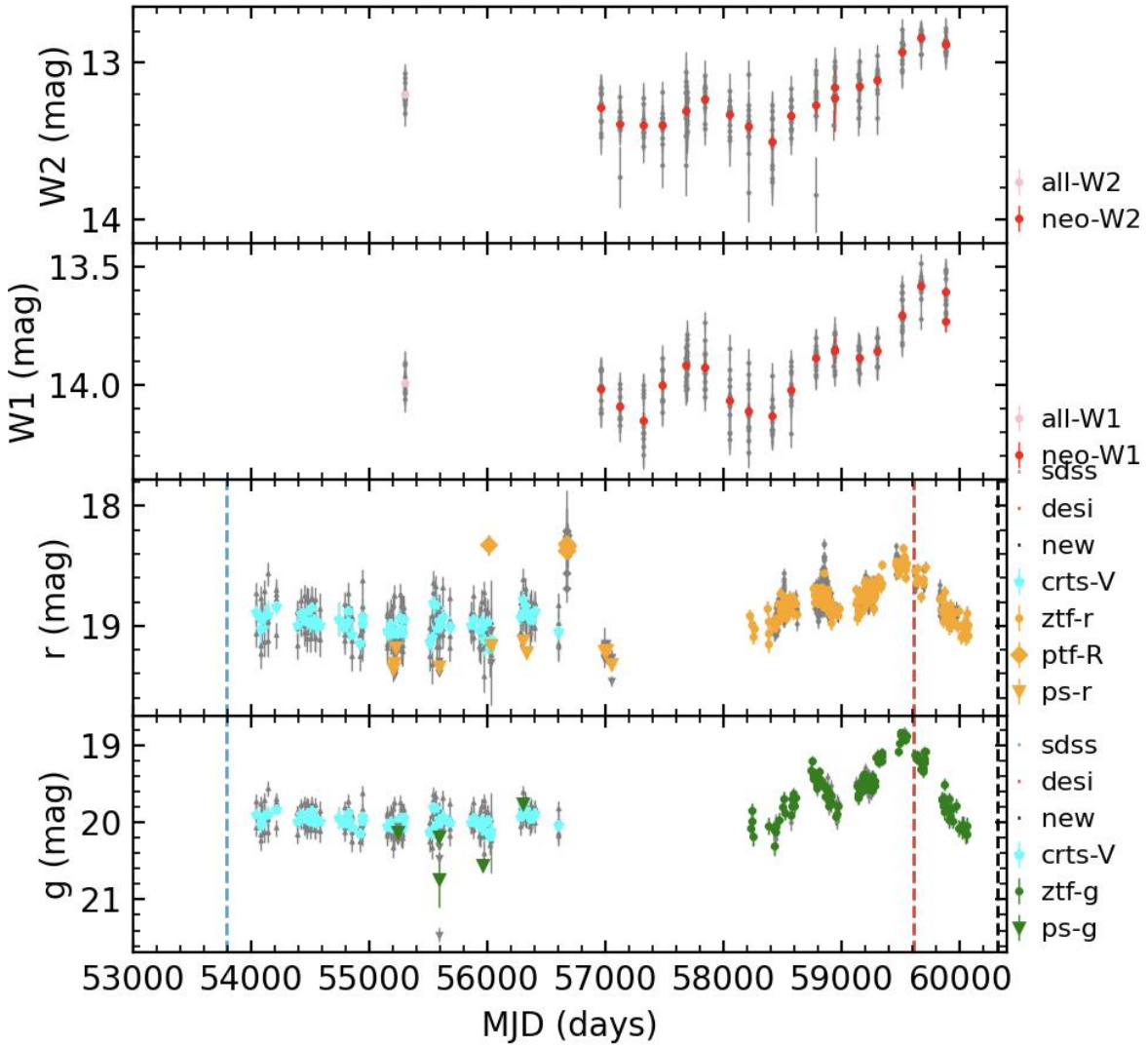
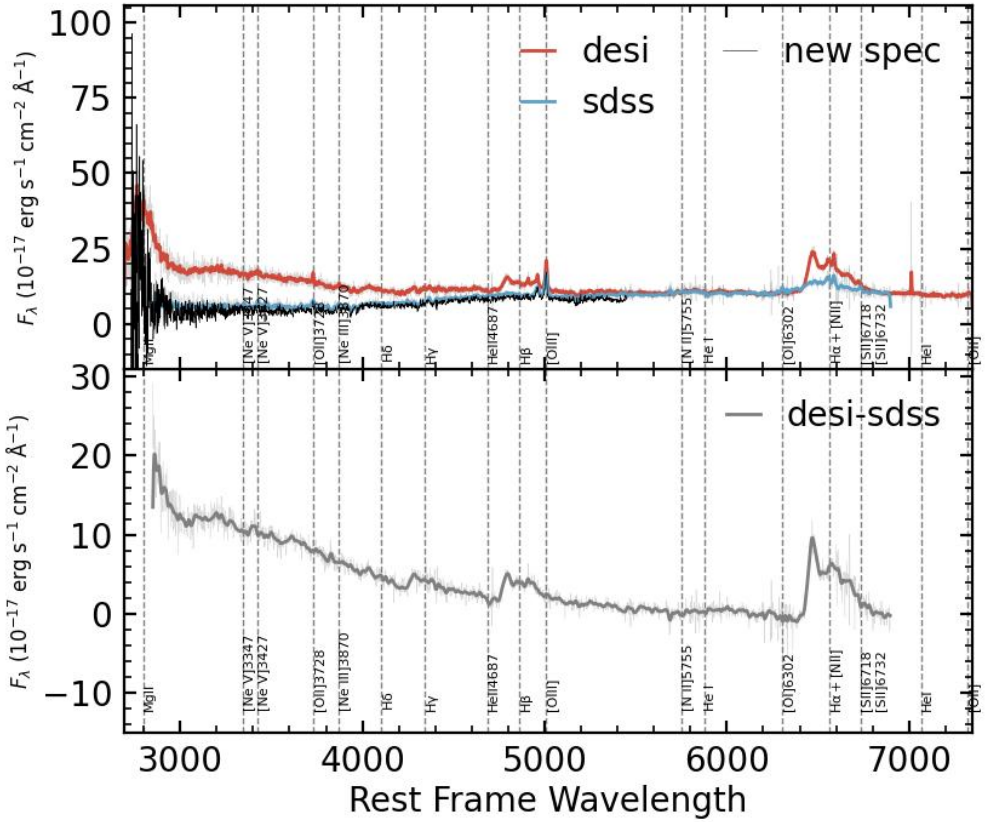


logR = 2.08

J075947.73+112507.3

Ra:119.9489 Dec:11.4187 z:0.337

W1:▯ W2:▯ W3:▯ W4:▯



Following-up observation from BTA

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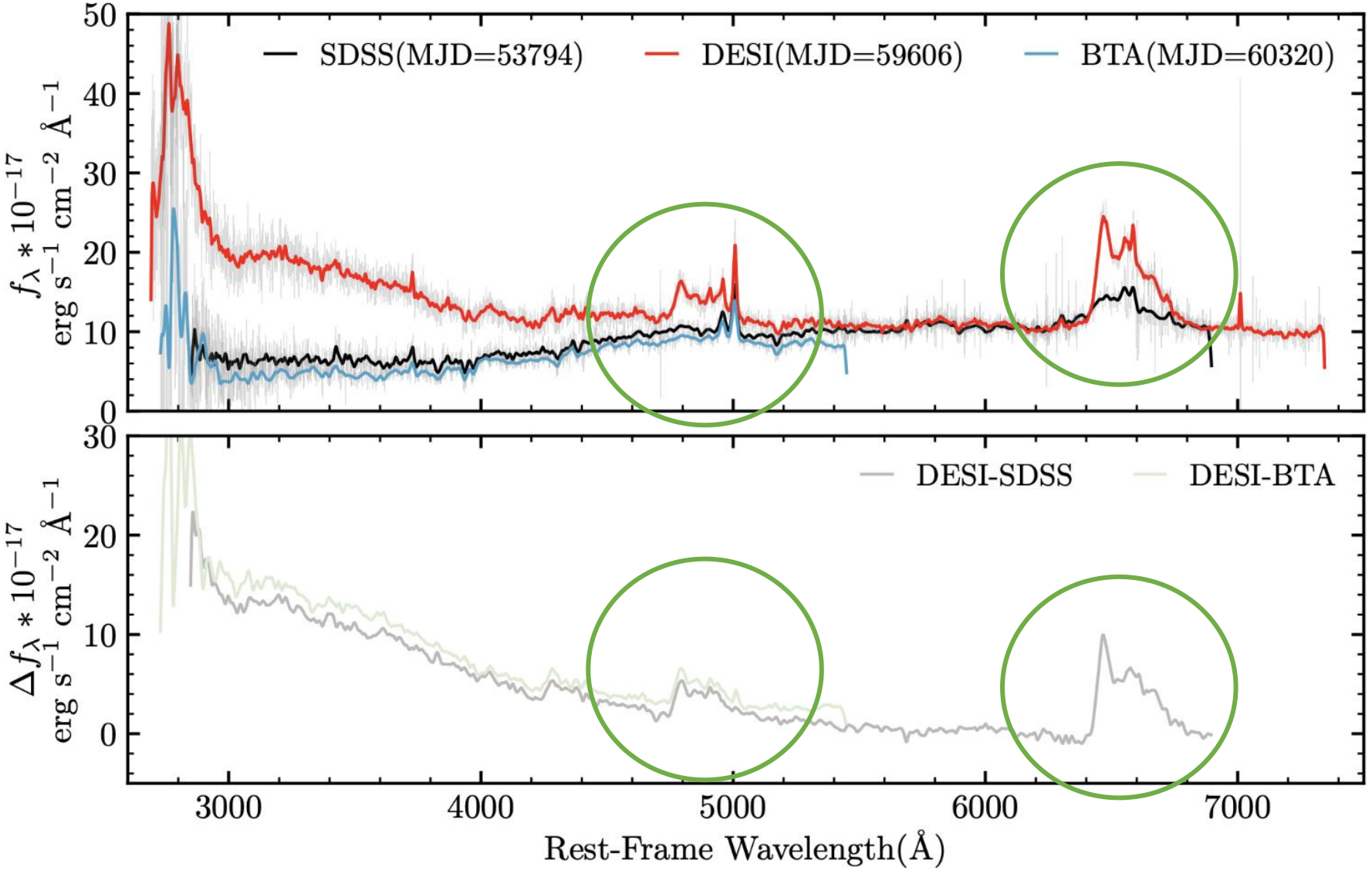
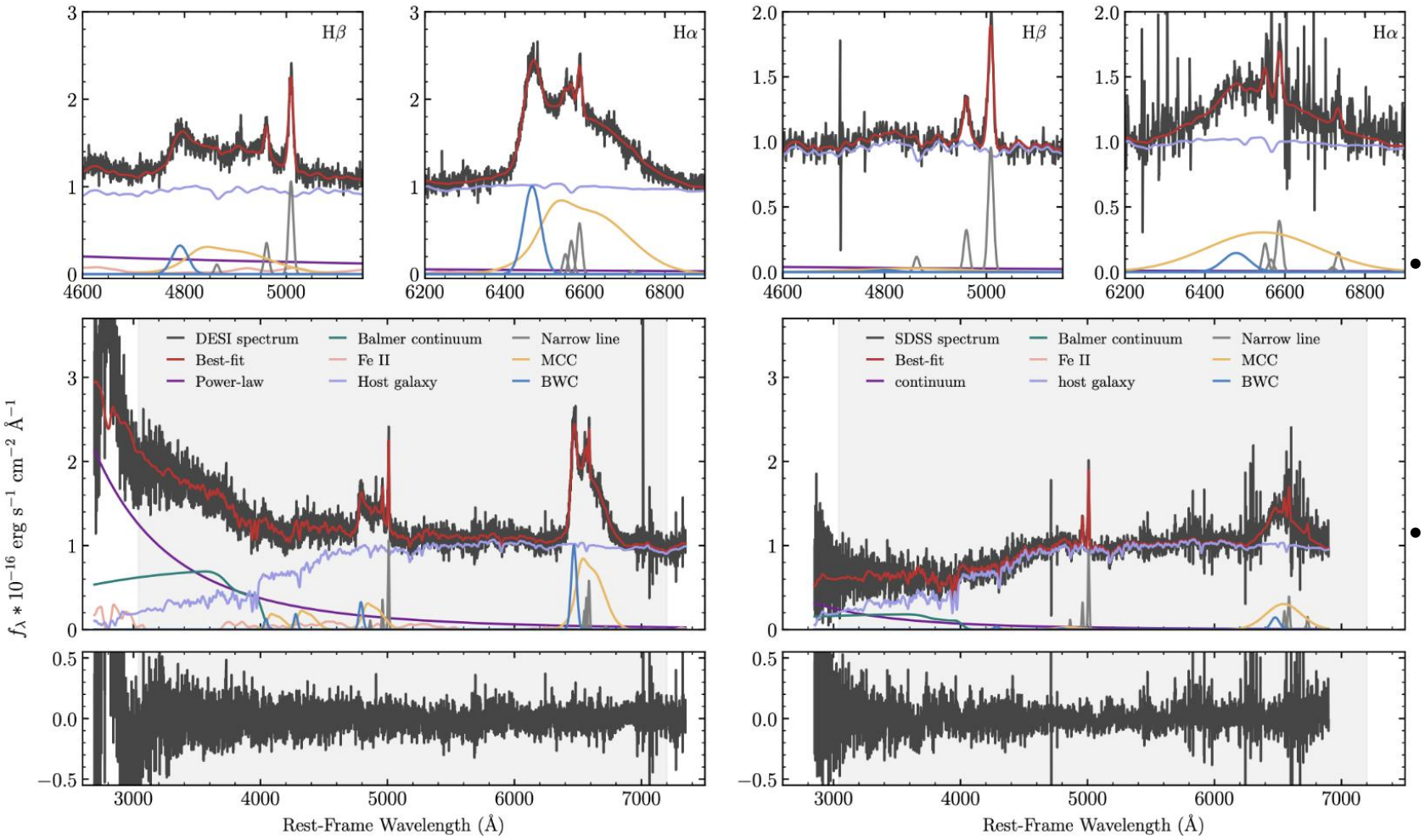


Asymmetric Profile



- Shift
  - DESI BWC : -4412 ± 37 km/s
  - DESI MCC : −1332 ± 328 km/s
  - SDSS BWC −3958±221km/s
  - SDSS MCC : -906±297 km/s
- FWHM
  - DESI BWC: 2333 ± 69 km/s
  - DESI MCC: 10736 ± 641 km/s
  - SDSS BWC: 3599 ± 670 km/s
  - SDSS MCC: 14955±2388 km/s
- Luminosity:
  - DESI BWC : $10^{42.34} \pm 0.04$ erg/s
  - DESI MCC : $10^{42.93} \pm 0.01$ erg/s
  - SDSS BWC: $10^{41.69} \pm 0.10$ erg/s
  - SDSS MCC : $10^{42.64} \pm 0.02$ erg/s

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Multiple Flares

Dark Energy Spectroscopic Instrument

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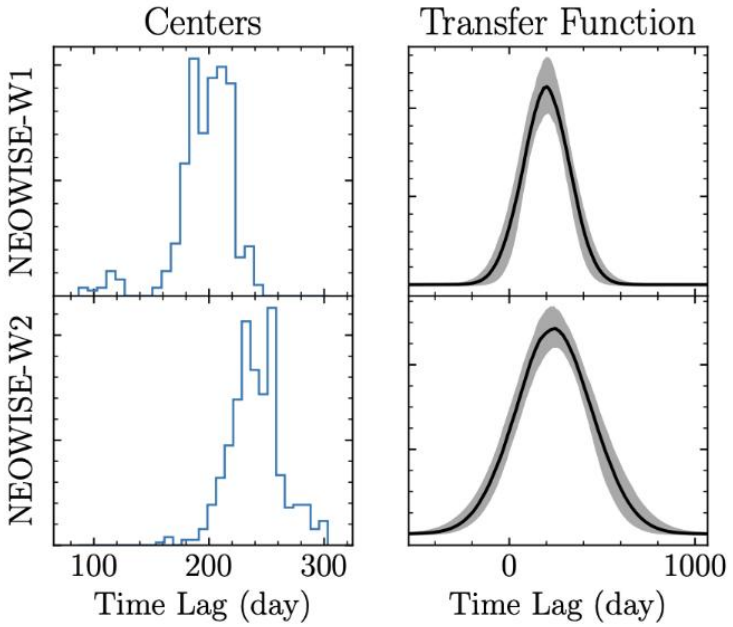

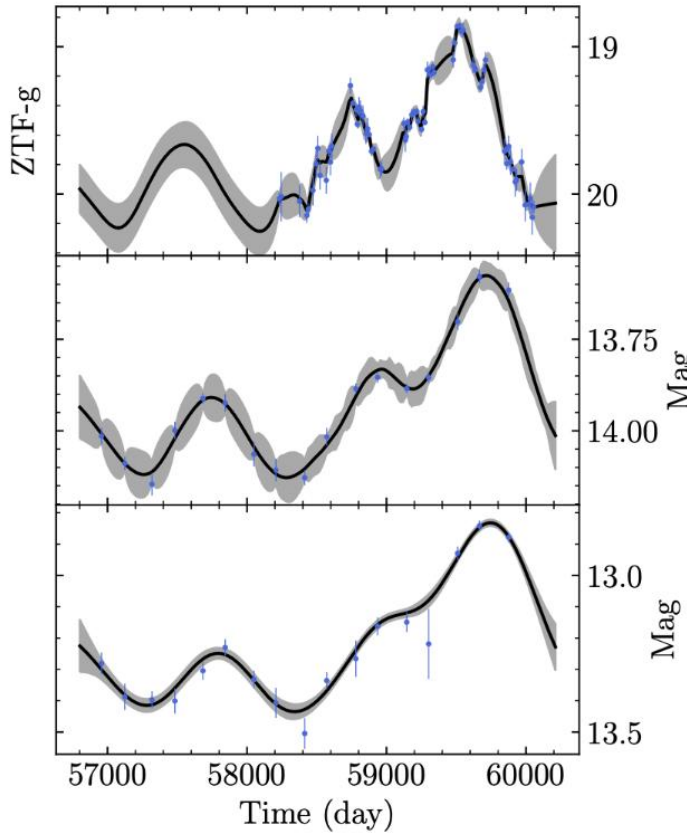

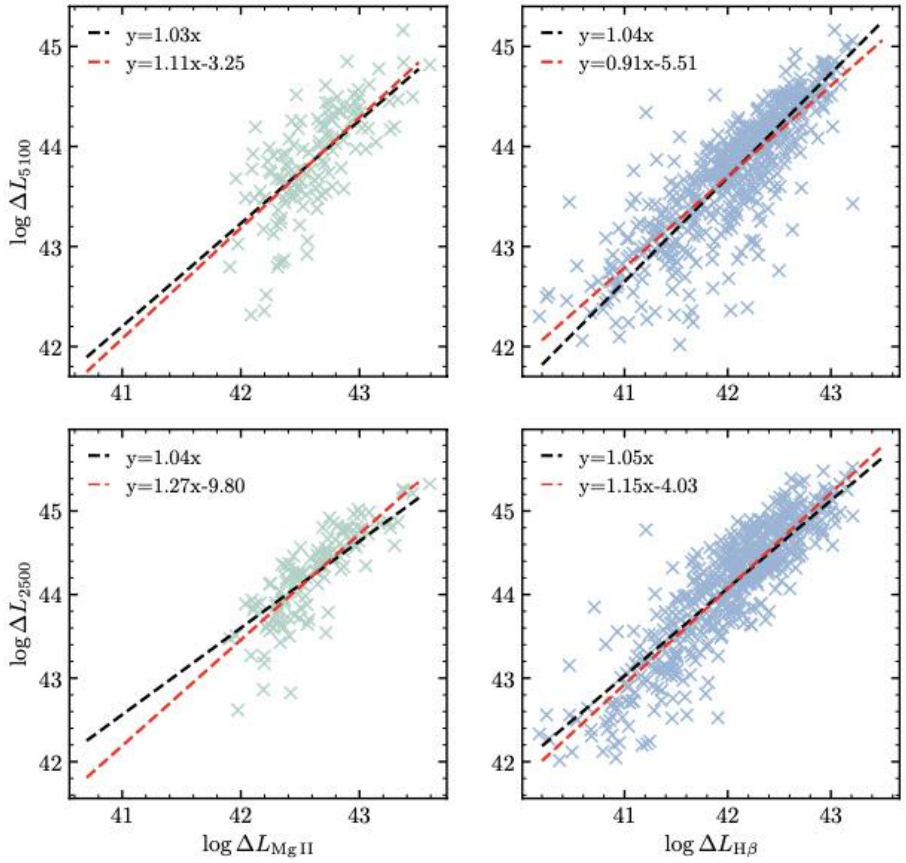

Physical Mechnism

Dark Energy Spectroscopic Instrument

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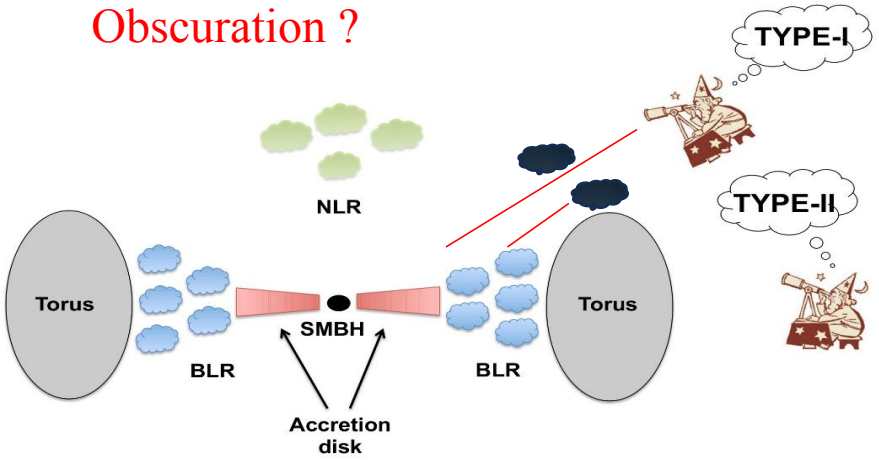
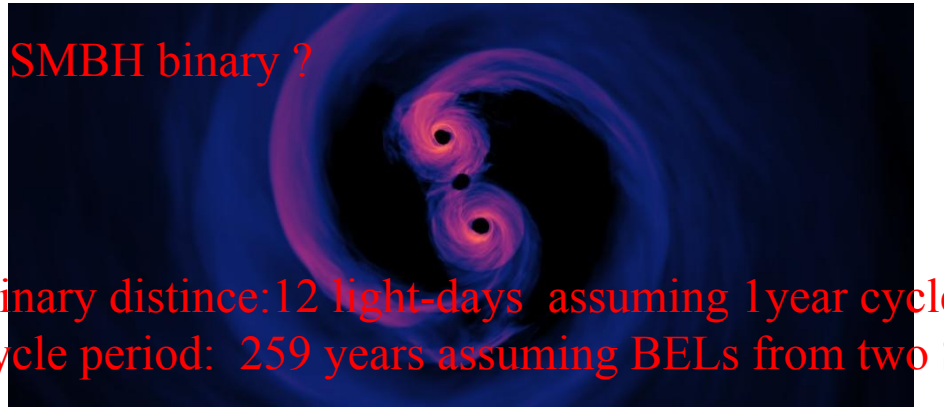
Obscuration ?



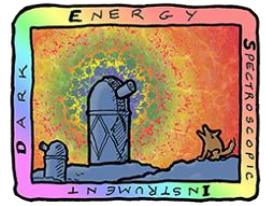
- Complex profile changes solely due to extinction
- Strong radio emission
- The short timescale for CL events
- The mid-infrared color change is less than 0.1 magnitude.



Binary distince:12 light-days assuming 1year cycle
cycle period: 259 years assuming BELs from two SMBH

Chaotic Accretion in a Ring Disk Model

Contents of Talk



Dark Energy Spectroscopic Instrument

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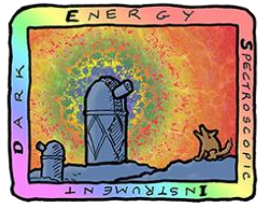
Summary



Dark Energy Spectroscopic Instrument

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1: We build a less bias CL-AGN sample with 561 objects.

2: A consistent ratio of 283:278 between turn-on and turn-off events in CL-AGNs

3: BPT diagram reveals no distinct differences between CL-AGNs and SDSS DR14Q.

4: A strong correlation between changes in the luminosity of BELs and continuum luminosity

5: A critical Eddington ratio for CL events is confiremed around 0.01%.

6: we are carrying out the multi-wavelength studies on the CL-AGN.

7: A special analysis would be contucted on recurring CL-AGN

Thank you!