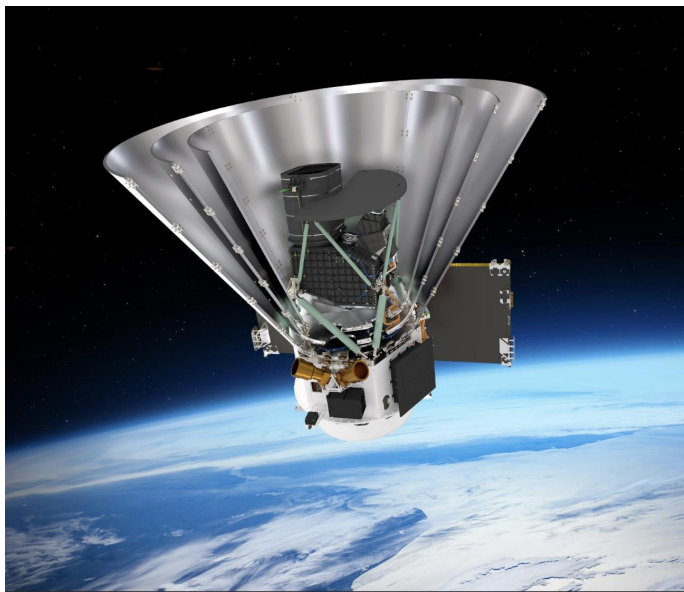
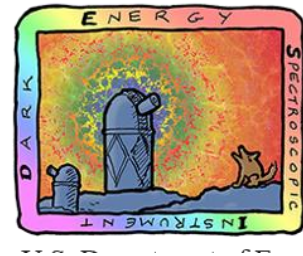




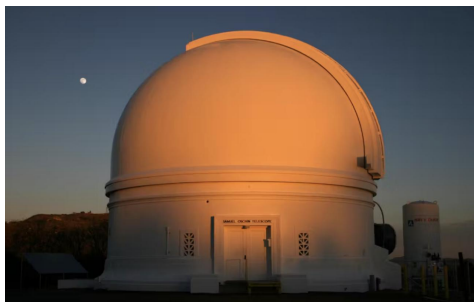
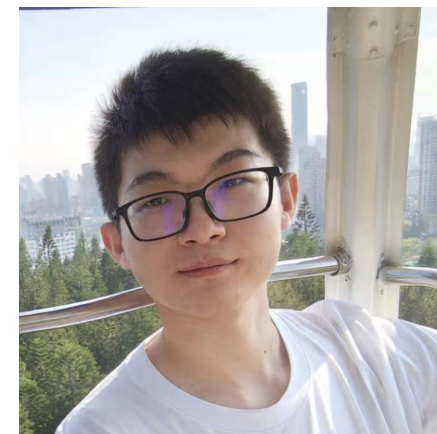
Probing Active Galactic Nuclei and Their Black Holes in the SPHEREx Era



Wei-Jian Guo (guowj@bao.ac.cn)

National Astronomical Observatories, CAS

- ❖ Reionization Era: $z > 5$
- ❖ Cosmic Noon: $1.5 < z < 4$
- ❖ Local Universe: $z < 1$



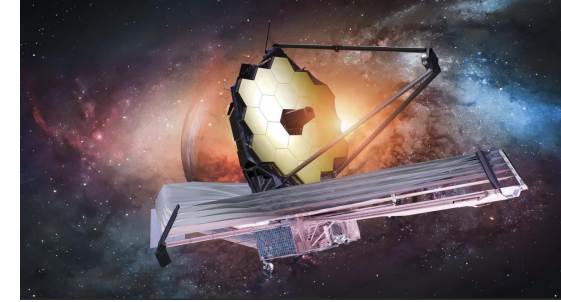
ZTF



DESI

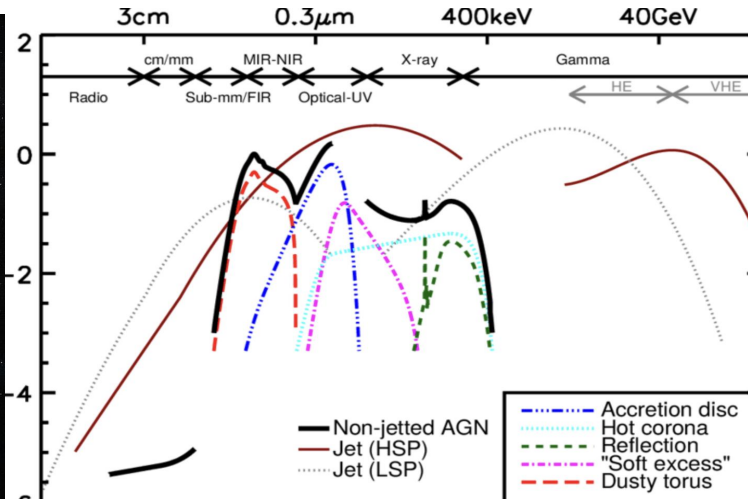


VLT



JWST

Active Galactic Nuclei and SPHEREx



❖ Context: NIR and MIR

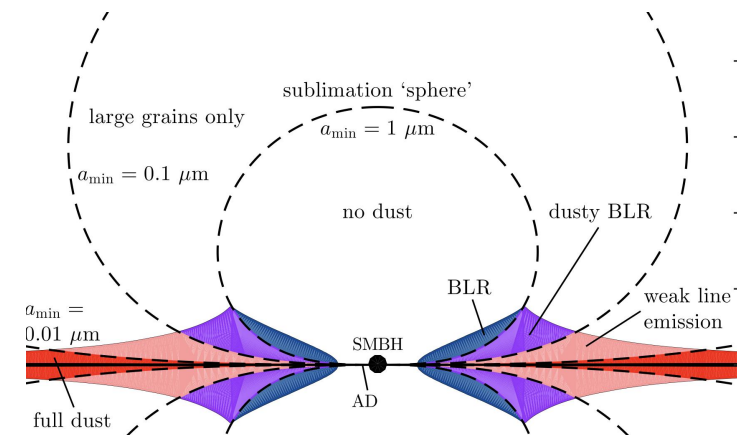
❖ Deep: Reverberation Mapping

- key 1: High-z R-L relation
- key 2: Cosmological Distance
- key 3: AGN and SMBH properties

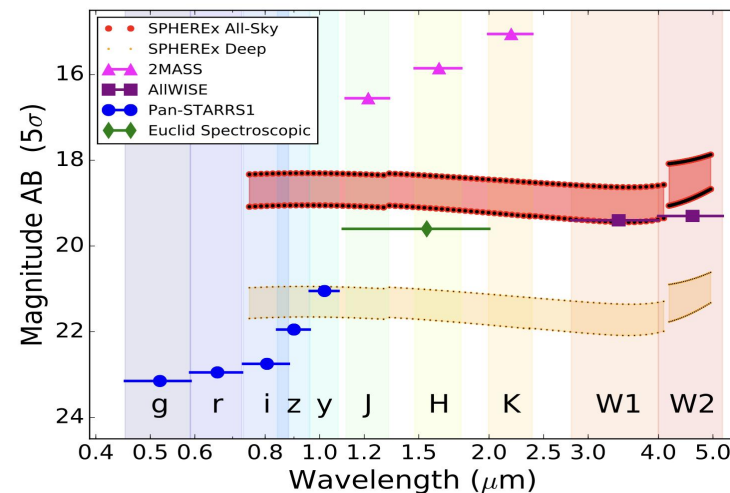
❖ All-sky: Little Red Dot

- key 1: LRDs Cosmic evolution
- key 2: IR properties of low-z LRD

❖ Summary

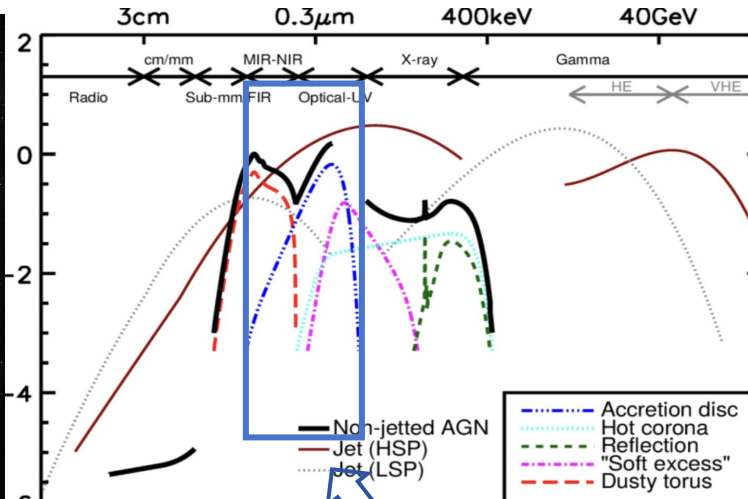


Baskin 2018

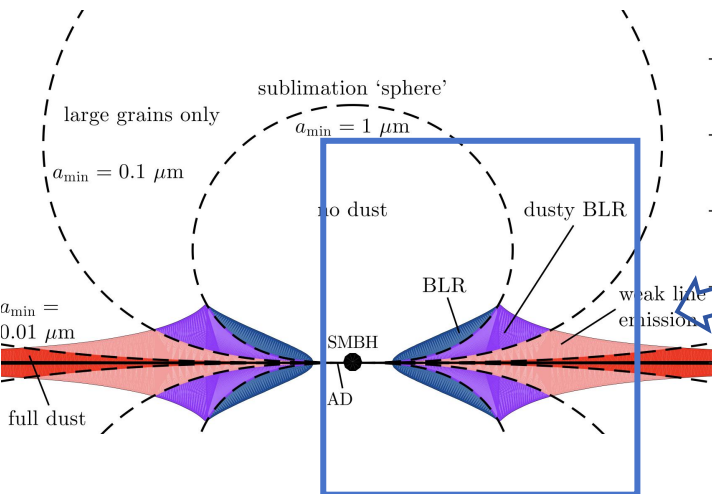


Brendan 2024

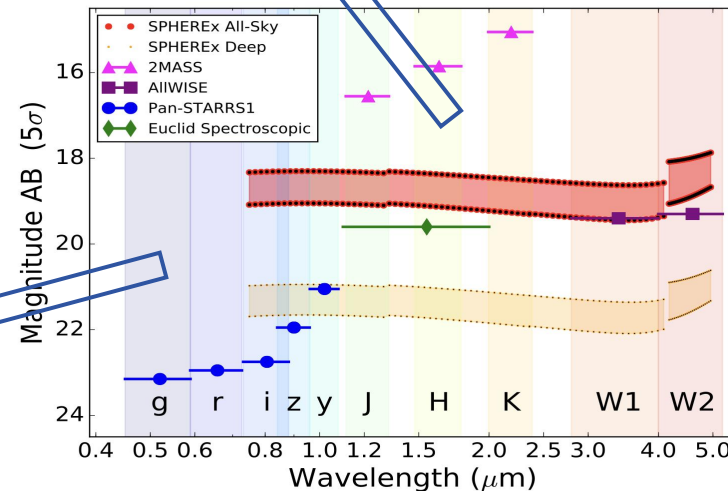
Active Galactic Nuclei and SPHEREx



- ❖ Context: NIR and MIR
- ❖ Deep: Reverberation Mapping
 - key 1: High-z R-L relation
 - key 2: Cosmological Distance
 - key 3: AGN and SMBH properties



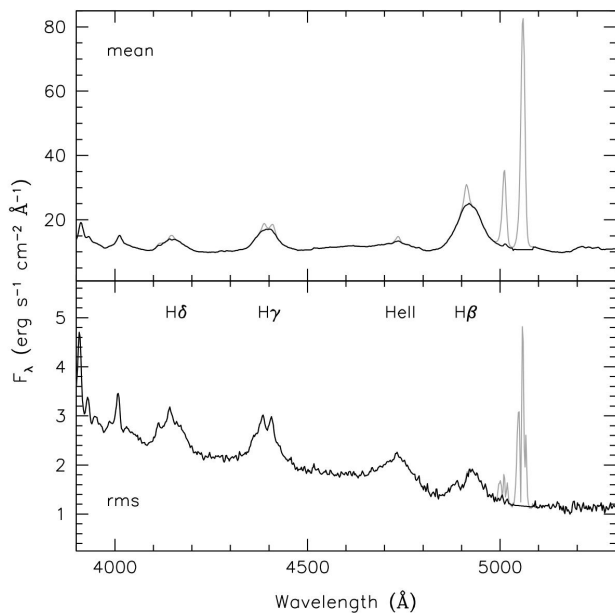
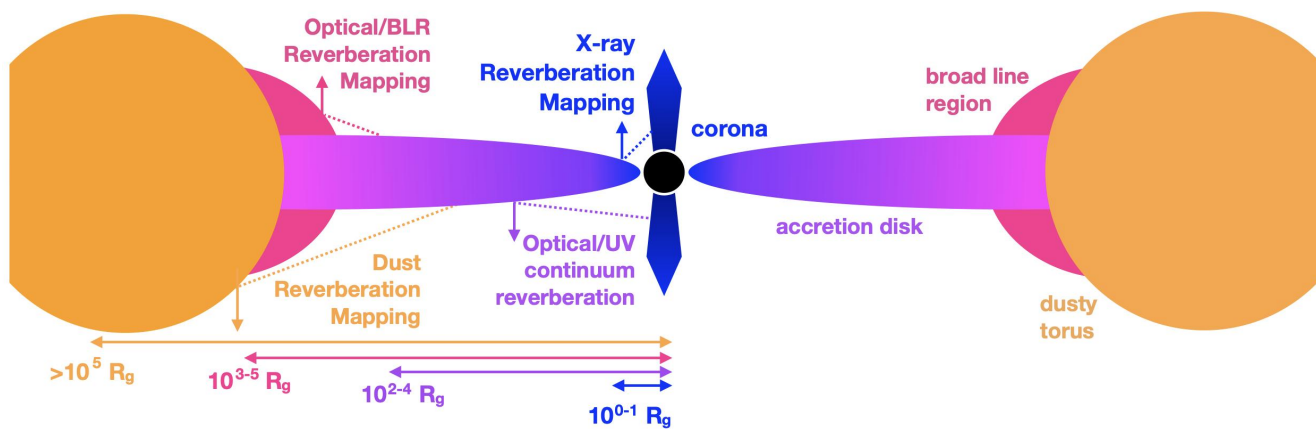
Baskin 2018



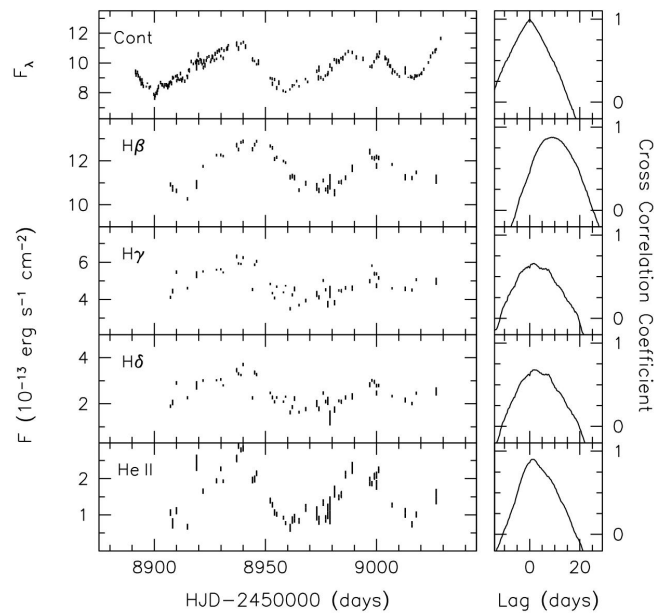
Brendan 2024

- ❖ All-sky: Little Red Dot
 - key 1: LRDs Cosmic evolution
 - key 2: IR properties of low-z LRD
- ❖ Summary

Reverberation Mapping - Reionization Era $z > 5$



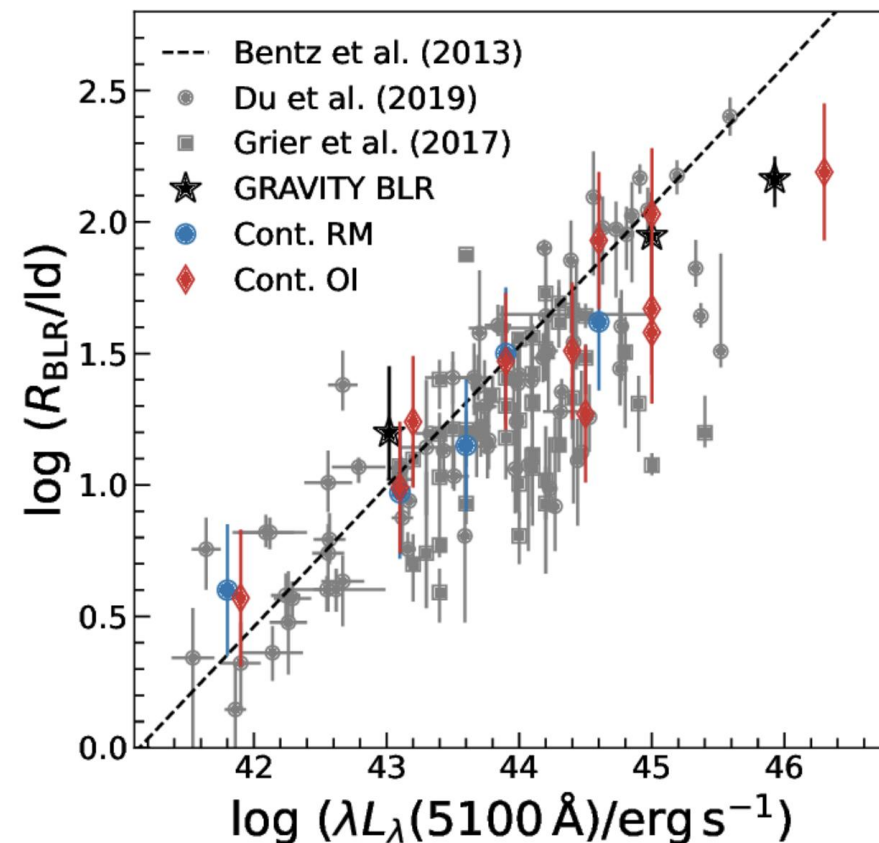
Cackett 2022



Broad line region

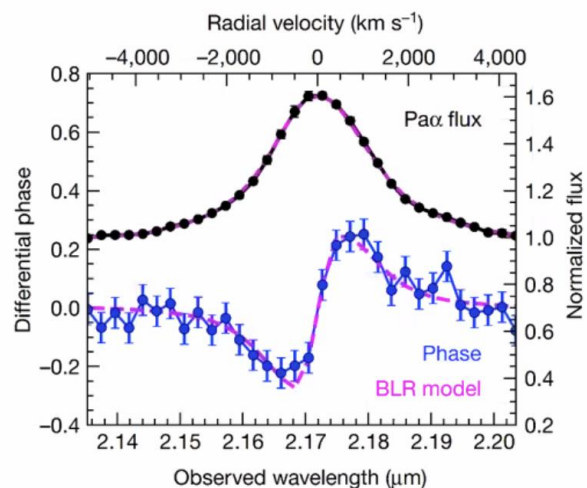
Infrared and Optical broad emission line RM:

$H\alpha$, $H\beta$, $Pa\alpha$, $Pa\beta$ lag measurements at can extend the R-L relation

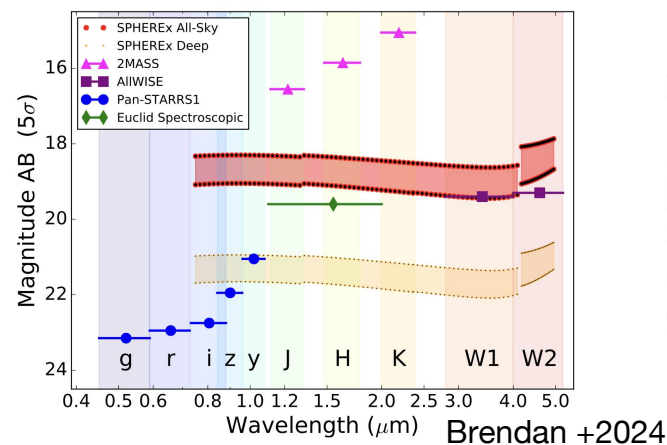


Reverberation Mapping- Cosmological Distance at Cosmic Noon

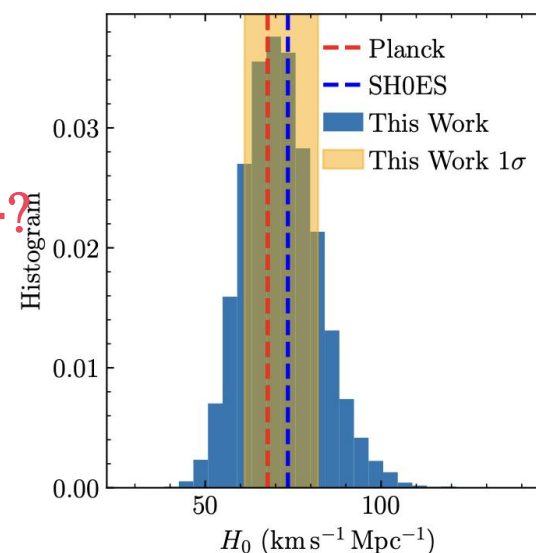
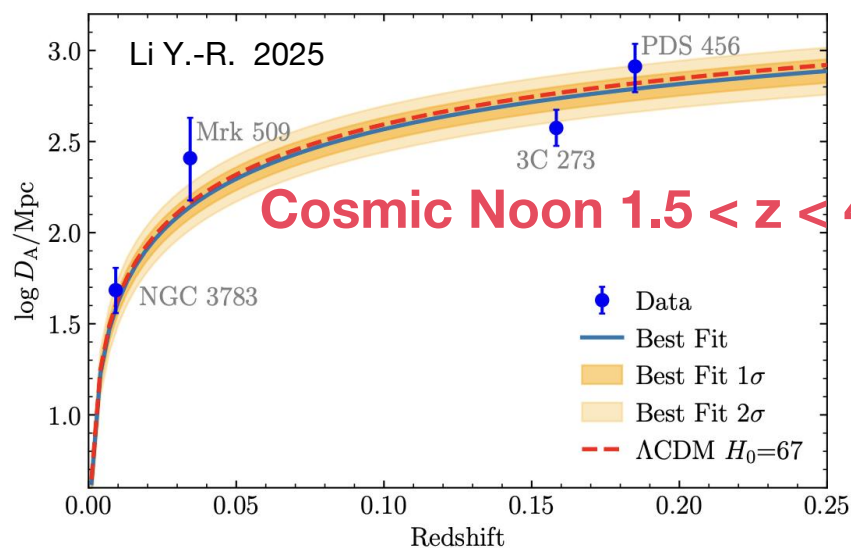
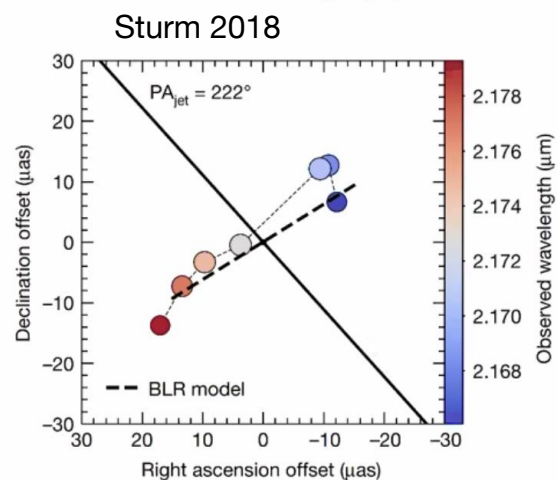
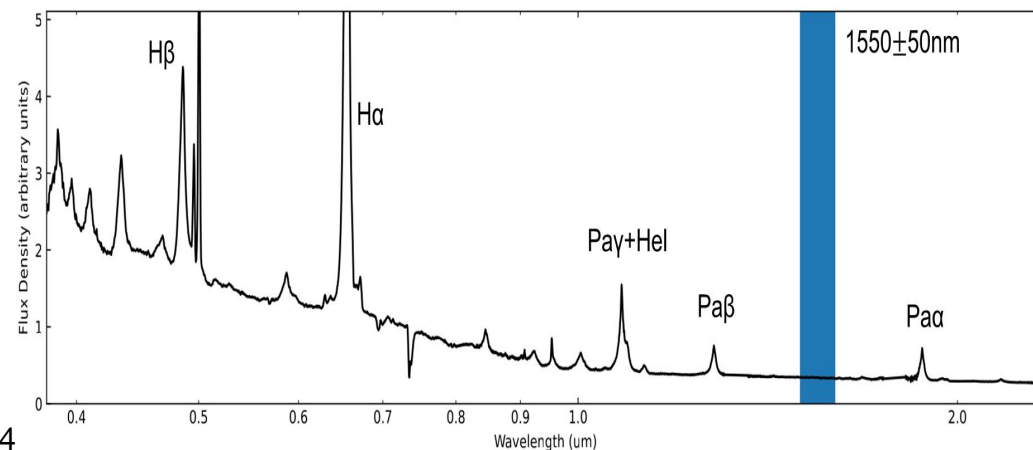
GRAVITY: 2 - 2.4 μ m



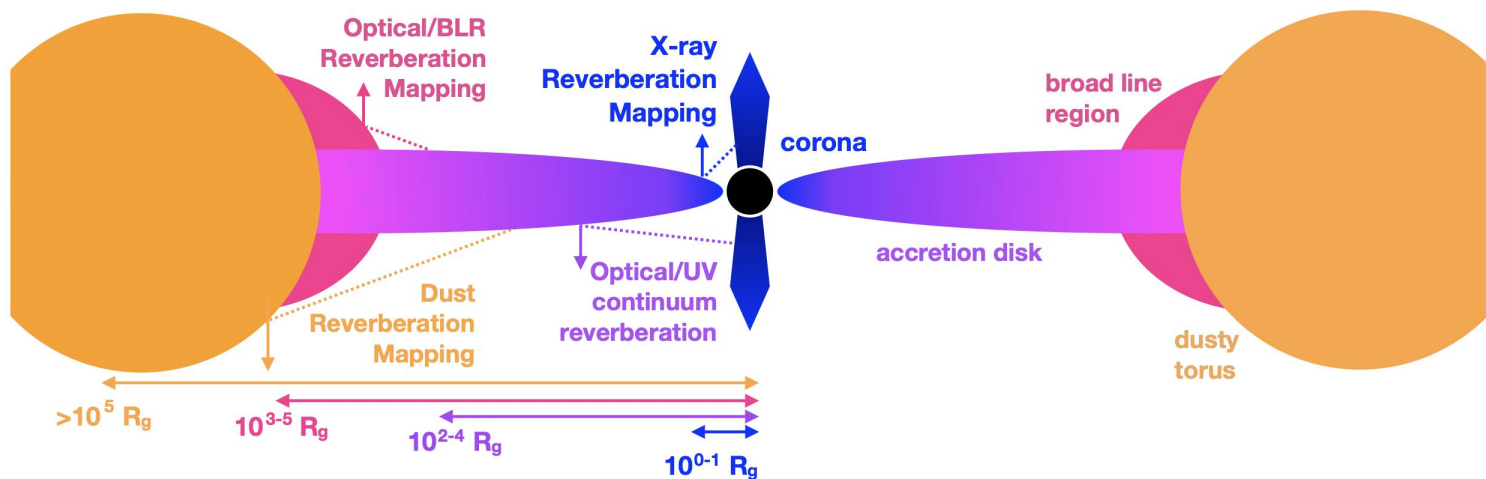
SPHEREx: 0.8 - 5.0 μ m



SPHEREx RM (H α , H β , Pa α , Pa β) + GRAVITY+



Reverberation Mapping - Local Universe: $z < 1$

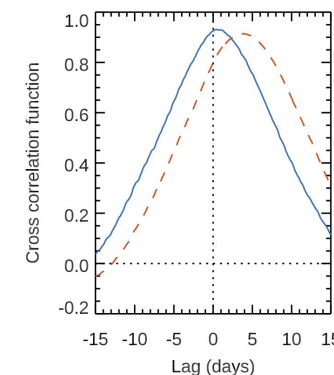
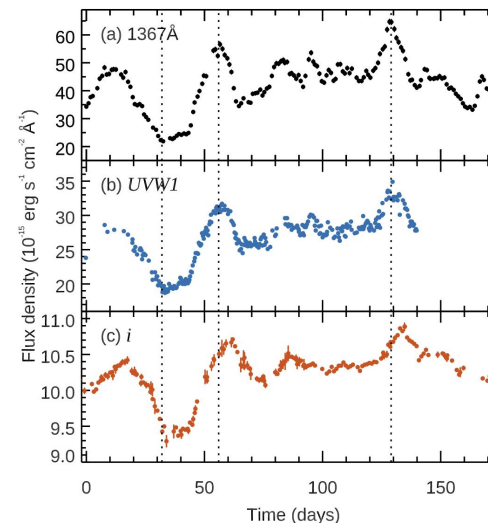


Continuum Reverberation Mapping:

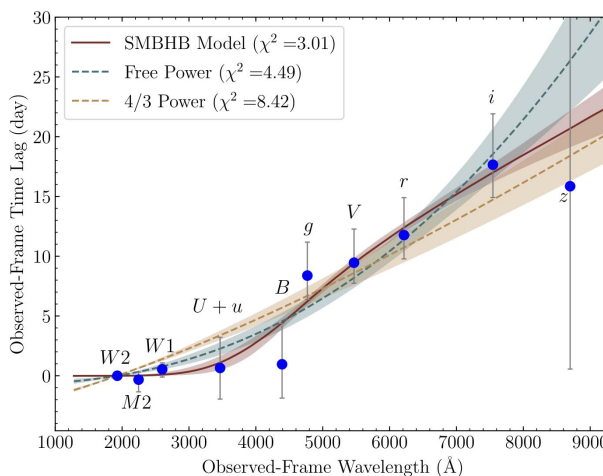
- 1) Accretion disk size
- 2) Supermassive black hole binary

Dust Reverberation Mapping:

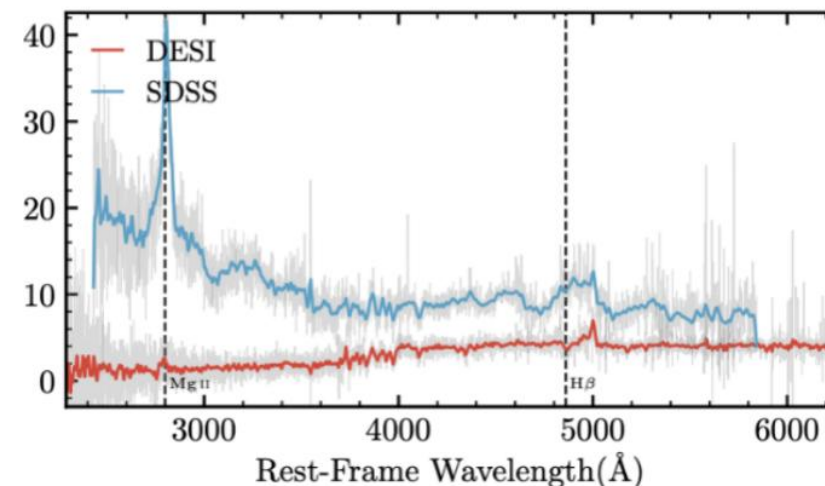
- 1) BLR origins
- 2) Changing-look AGN
- 3) Torus properties



Cackett 2022

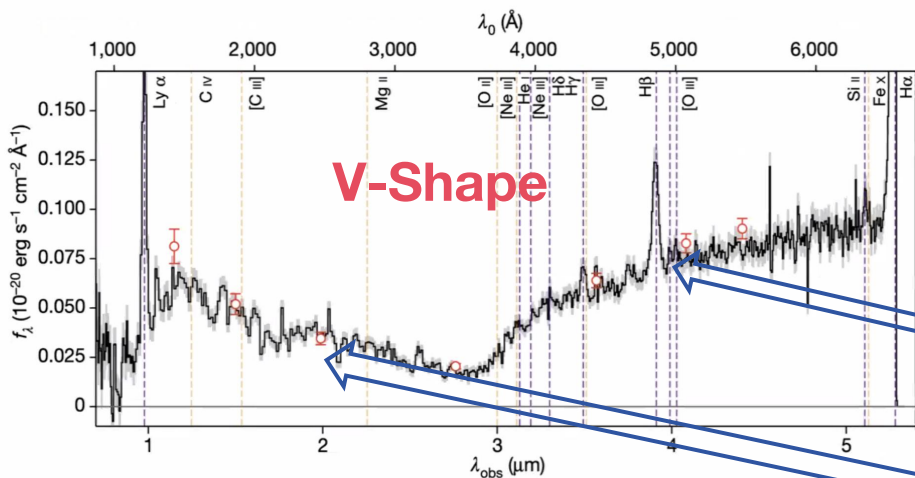


Fu Y.-X. 2025

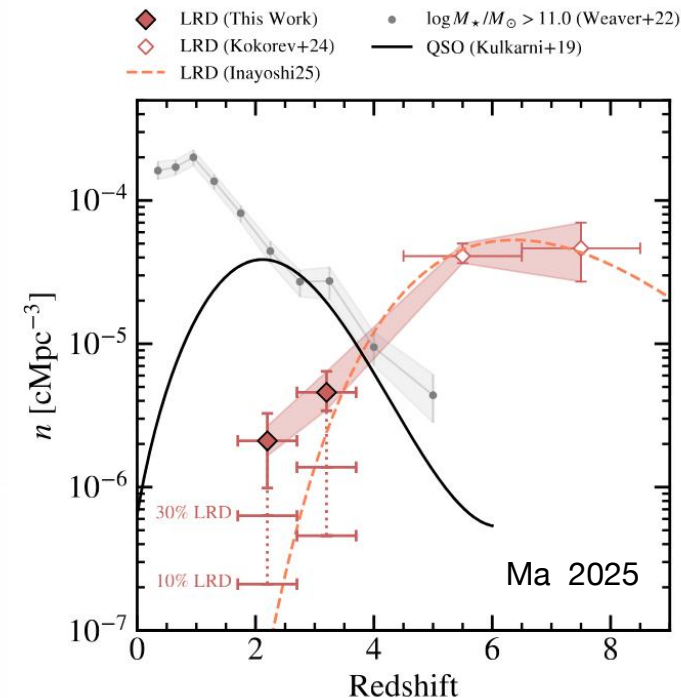
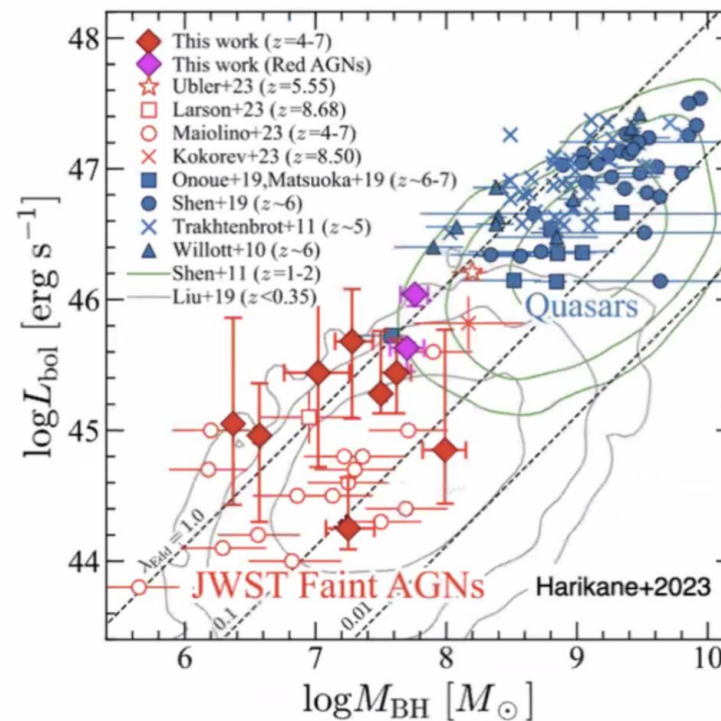


Guo W.-J. 2025

Little Red Dot: Cosmic Noon $1.5 < z < 4$



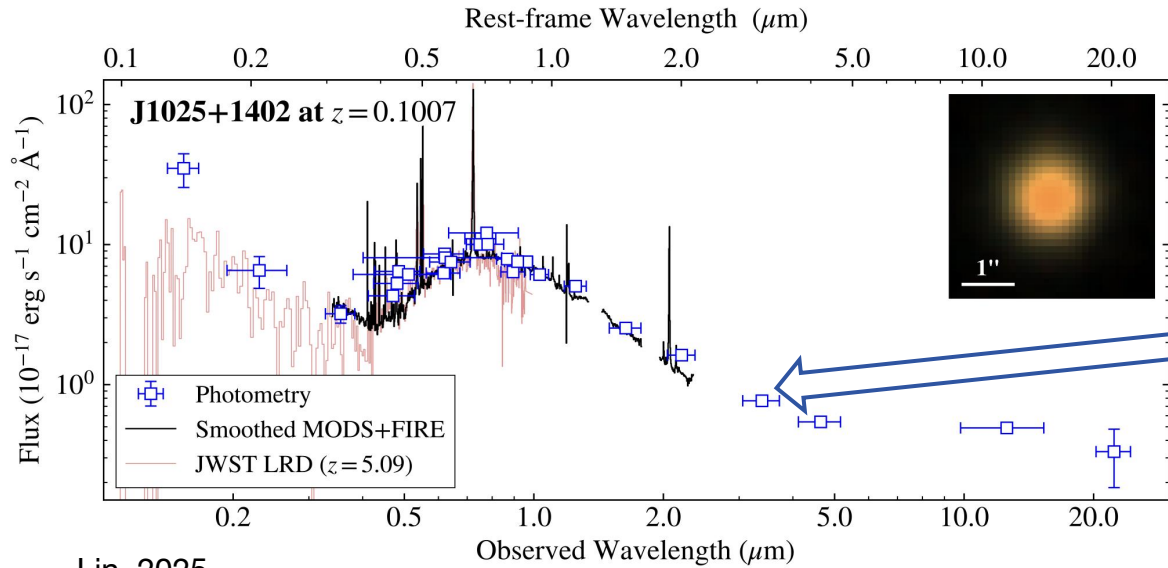
- Two-component scenario (e.g., **unobscured galaxy** + **obscured AGN**)
- **Balmer-break** like feature observed in some LRDs



Number density of LRDs evolution

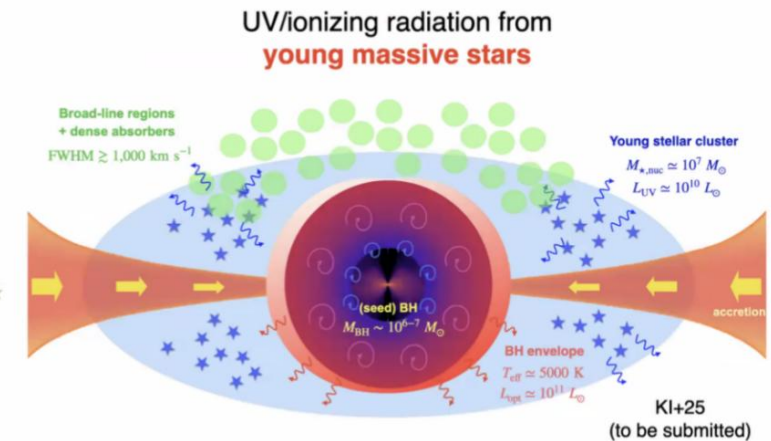
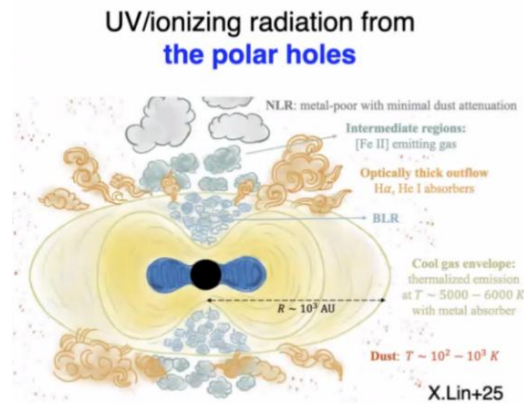
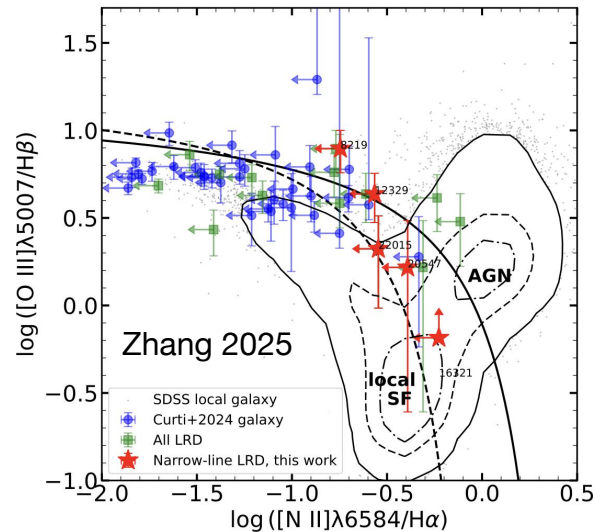
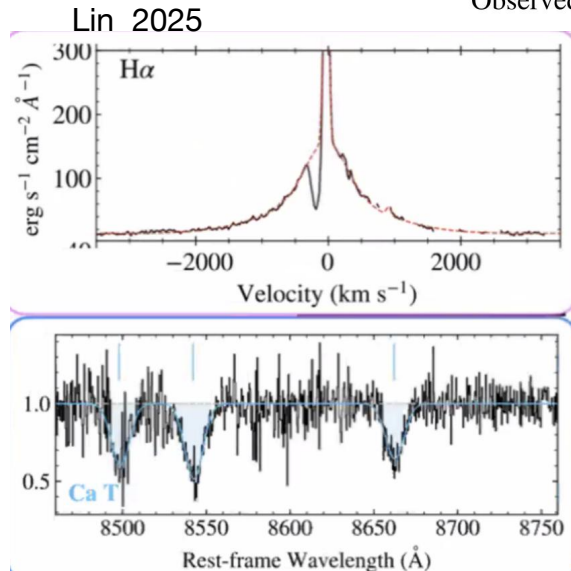
- **SPHEREx-Optical** (0.8um - 5.0um)
- **DESI-UV** (0.36um - 0.98um)

Little Red Dot: Local Universe $z < 1$



Determine Physical model of LRD to local analogs

- SPHEREx-NIR/MIR (0.8 μm - 5.0 μm)
- DESI-UV/Optical (0.36 μm - 0.98 μm)



Summary

❖ Deep: Reverberation Mapping

- Black hole mass measurements at Reionization Era $z > 5$
- Cosmological Distance at Cosmic Noon $1.5 < z < 4$
- AGN and SMBH properties at Local Universe $z < 1$

❖ All-sky: Little Red Dot

- Determine Physical model of LRD and cosmic evolution

Wish the Thinkshop great success!