

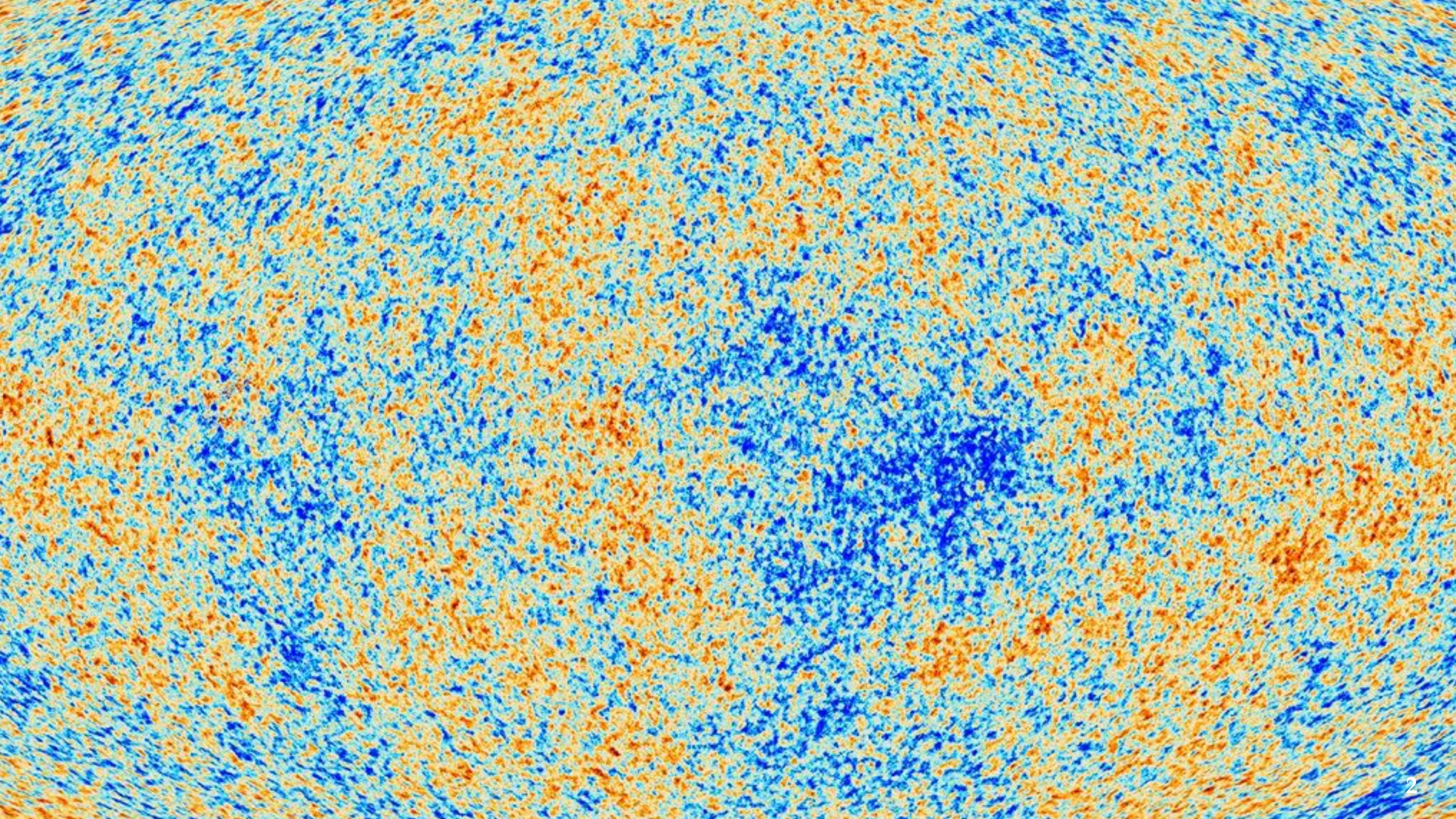
Supermassive Black Holes at Cosmic Dawn

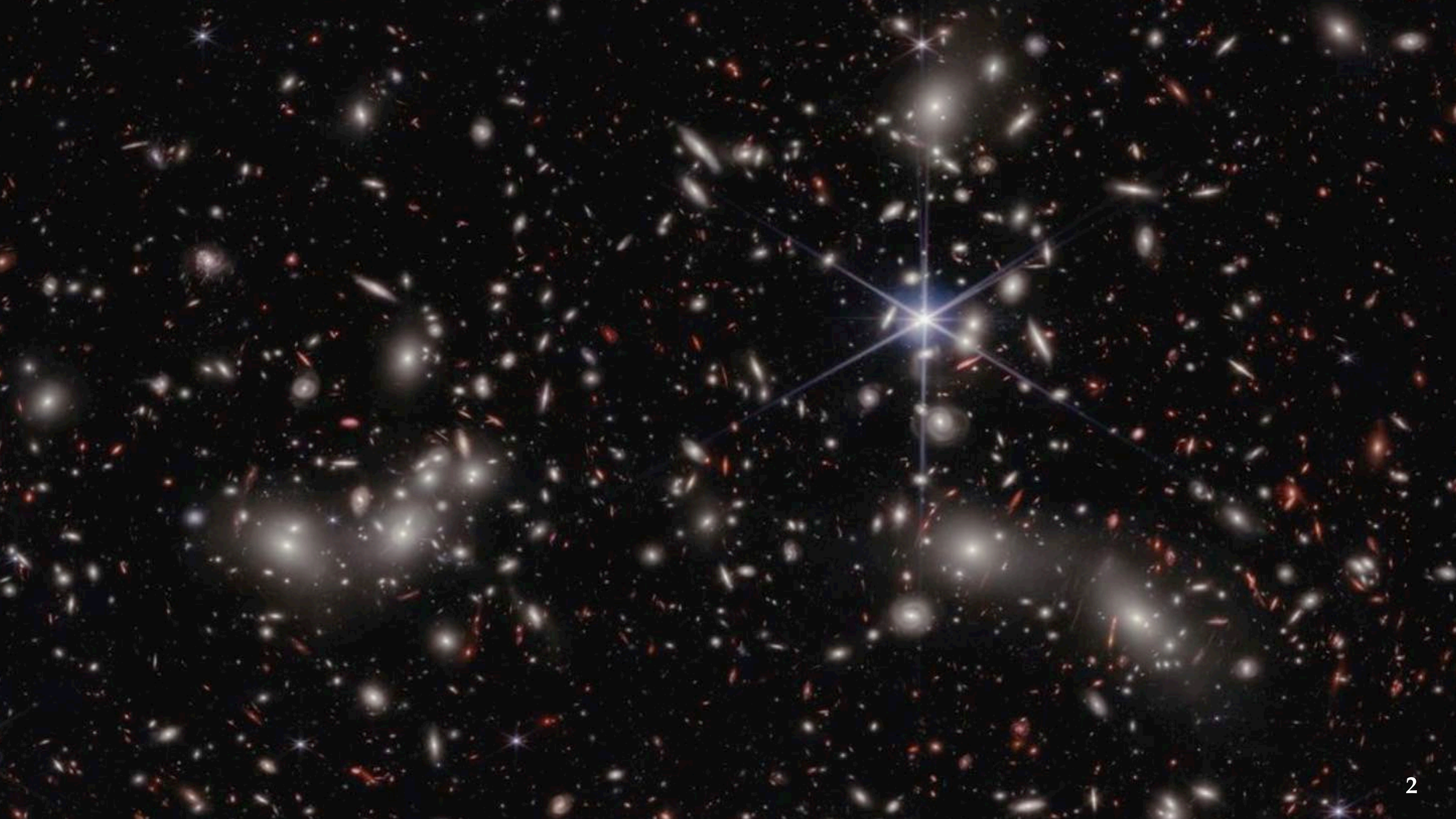
Luis C. Ho

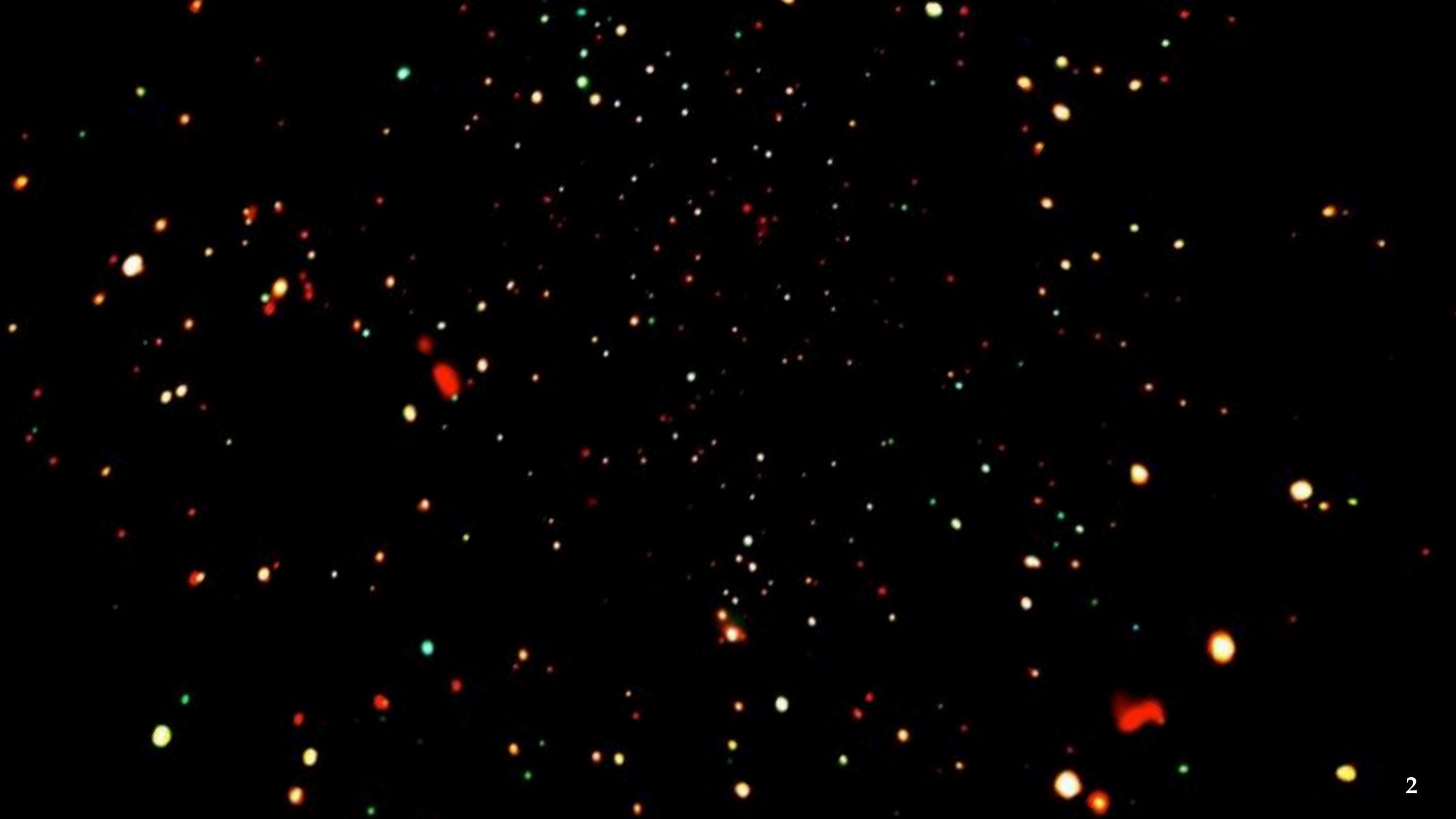
Kavli Institute for Astronomy and Astrophysics
Peking University, Beijing, China

Serbian Astronomical Conference

Belgrade, Serbia
2026.10.06

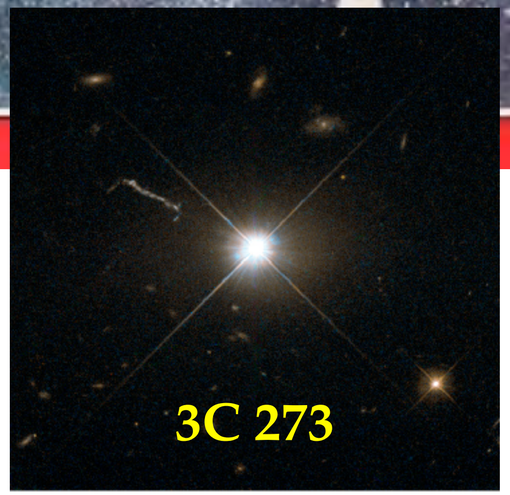




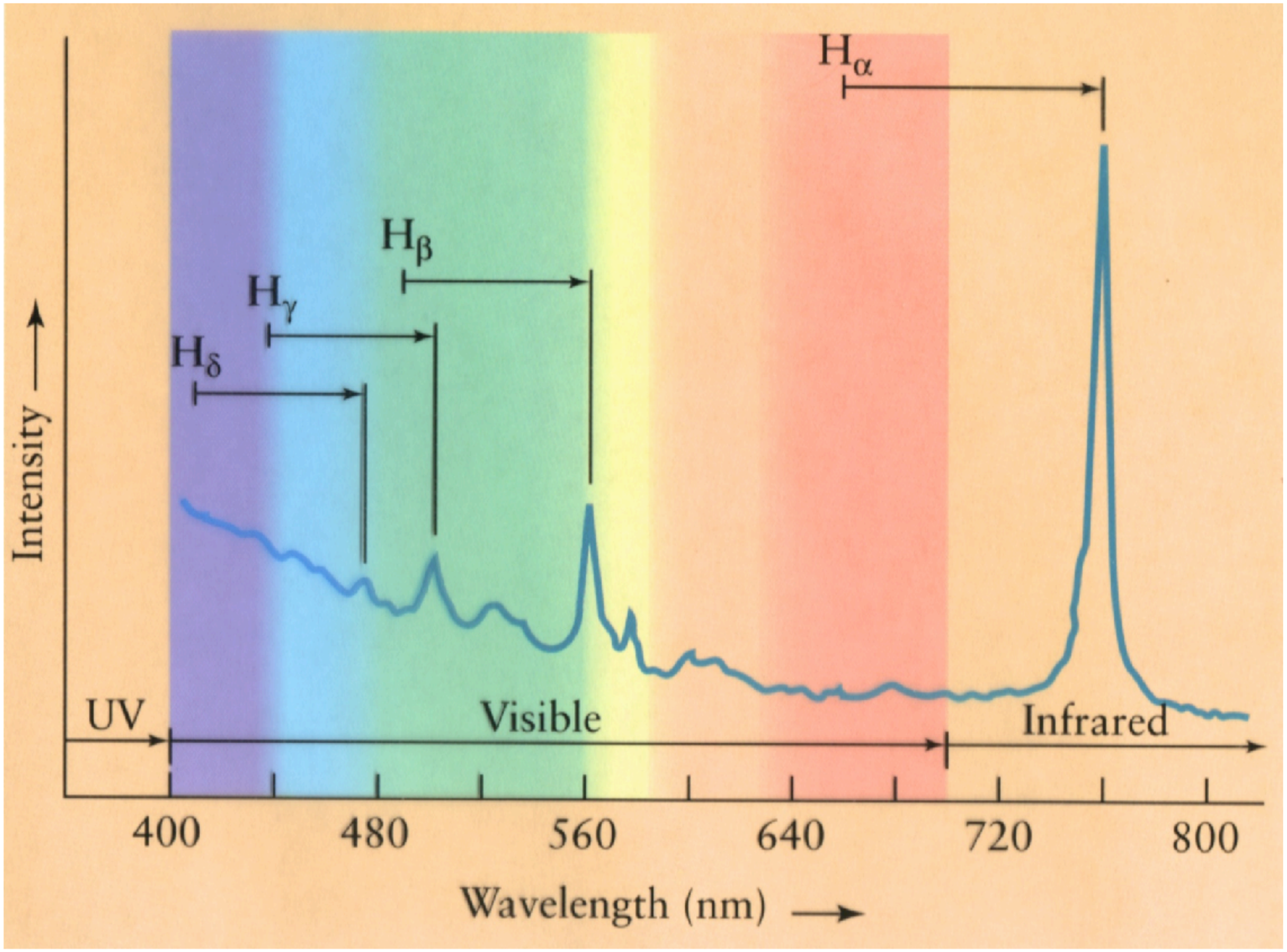


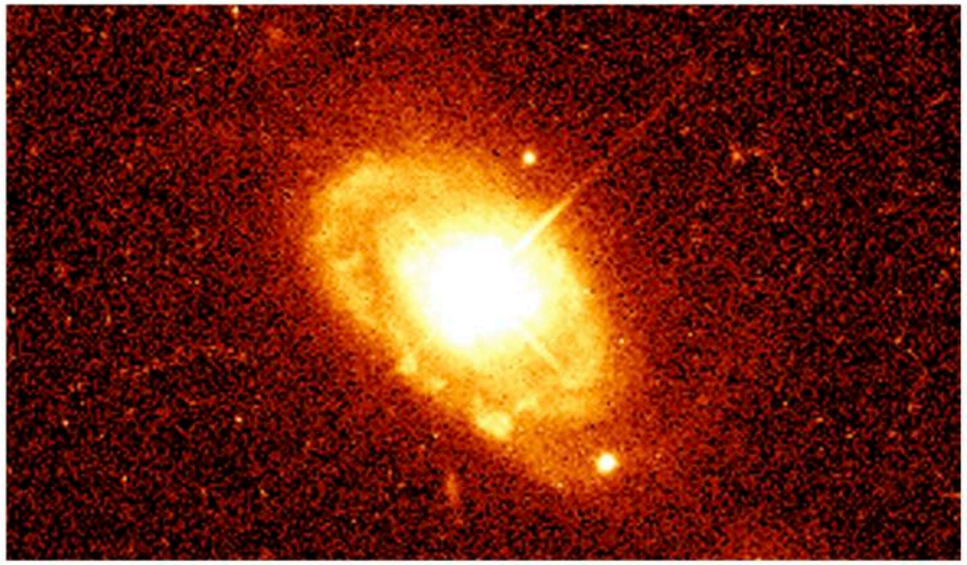




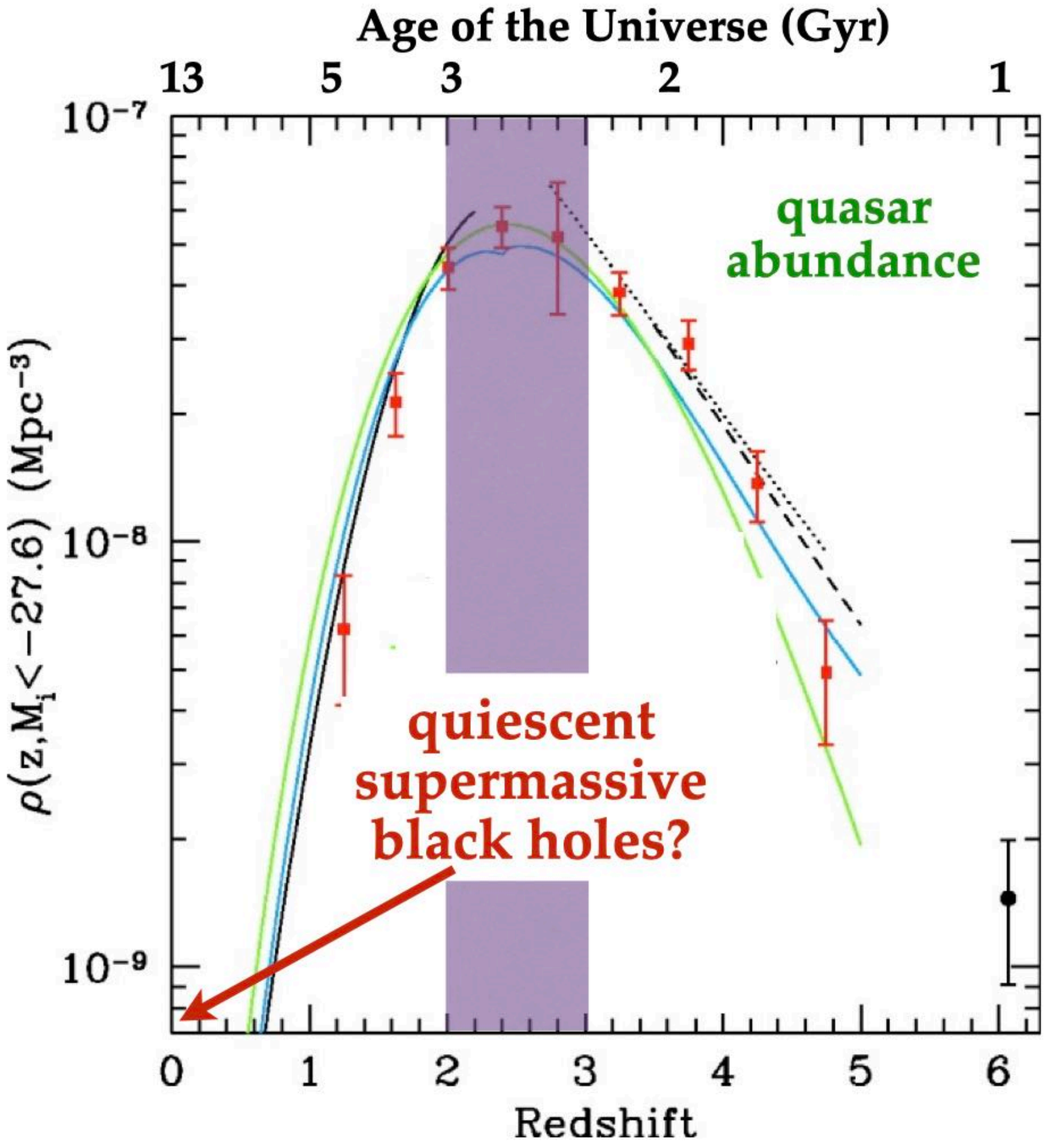


Spectrum of a quasar: blue continuum + redshifted broad emission lines





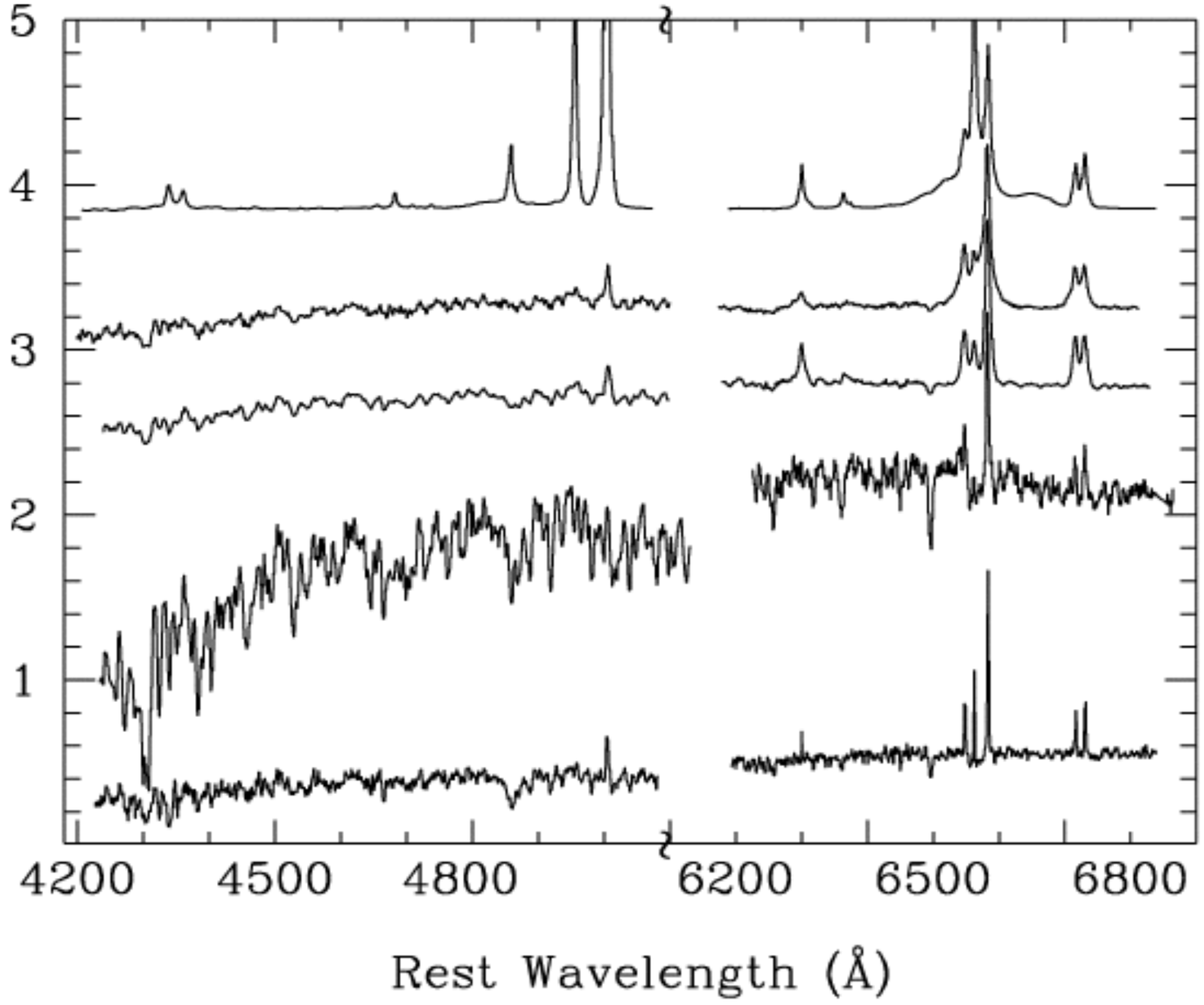



Age of the Universe (Gyr)
13
5
3
2
1
10^{-7}
10^{-8}
10^{-9}
$\rho(z,M_i<-27.6)$ (Mpc^{-3})
quasar abundance
quiescent supermassive black holes?
0
1
2
3
4
5
6
Redshift

Palomar Spectroscopic Survey of Nearby Galaxies

Ho, Filippenko & Sargent (1993, 1995, 1996 1997a-1997f, 2003, 2009); Ho (2008, ARA&A)

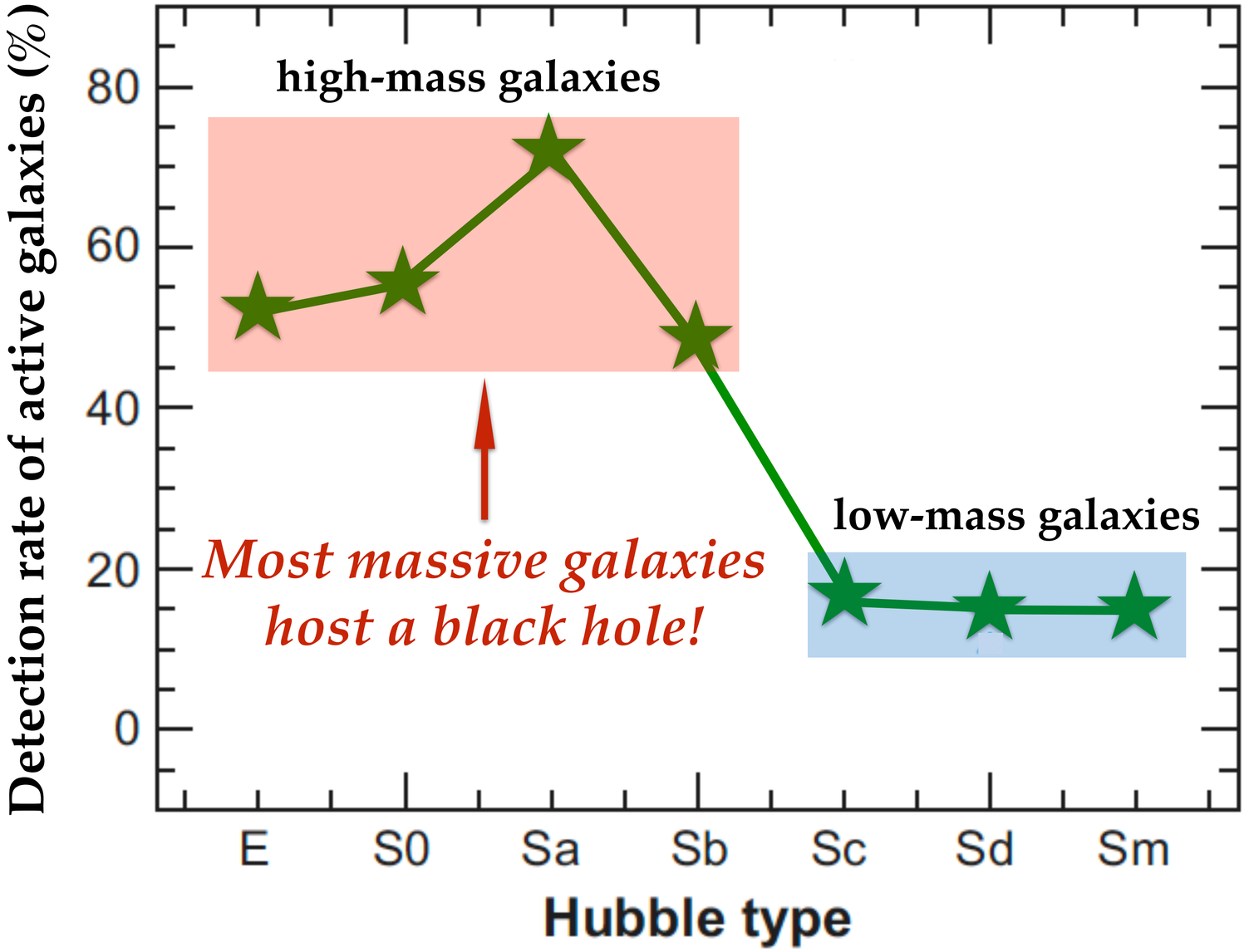




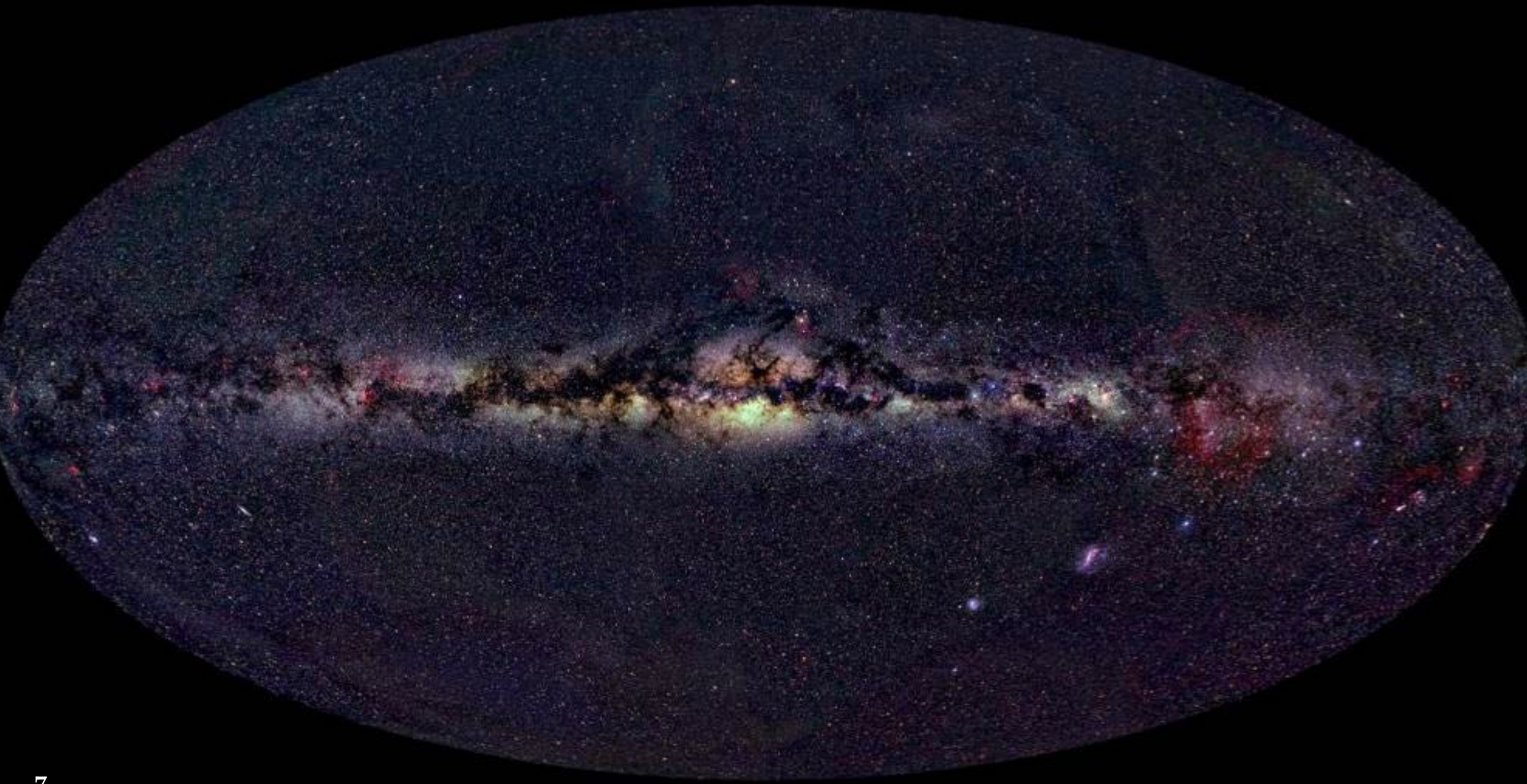
Palomar Spectroscopic Survey of Nearby Galaxies

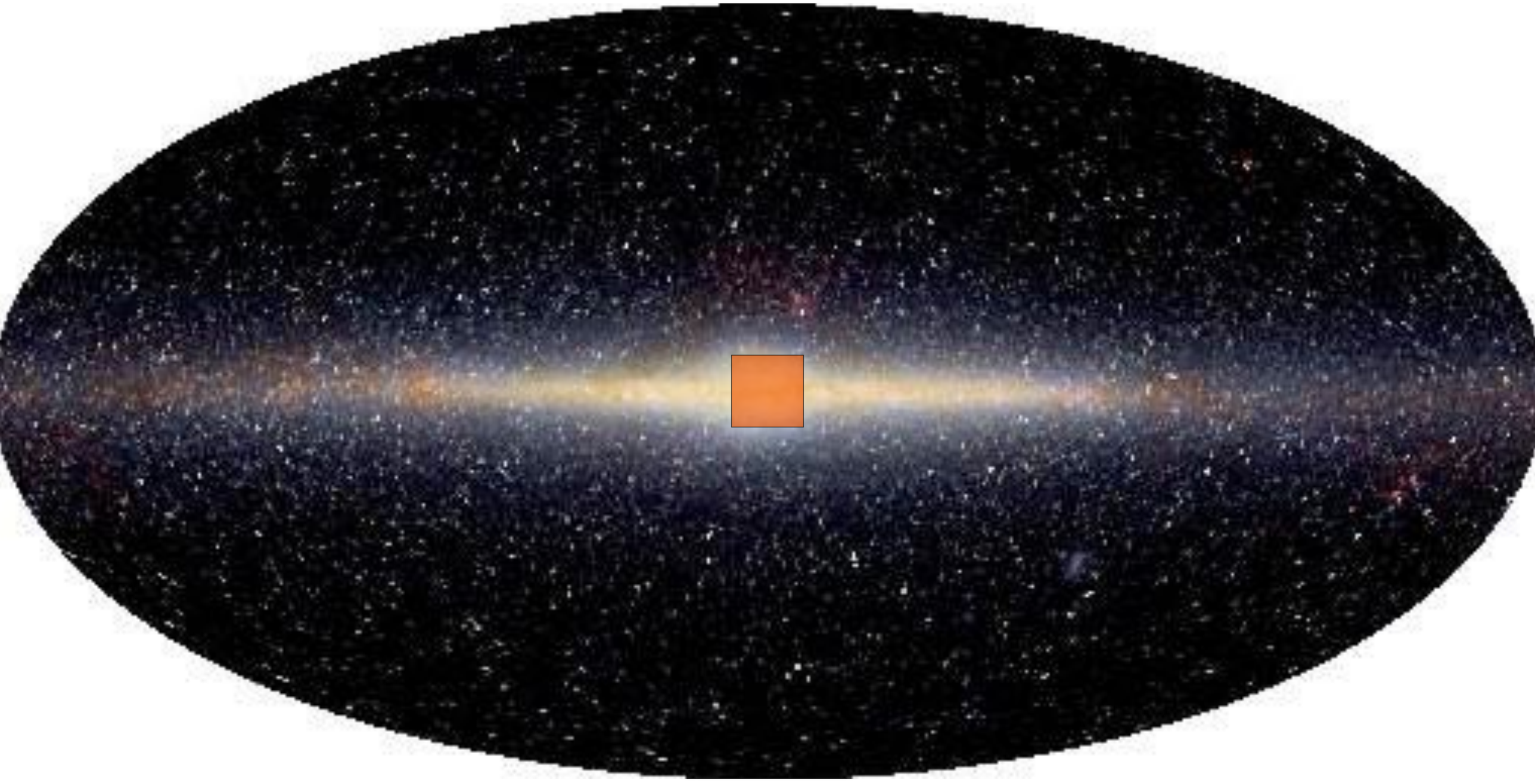
Ho, Filippenko & Sargent (1993, 1995, 1996 1997a-1997f, 2003, 2009); Ho (2008, ARA&A)

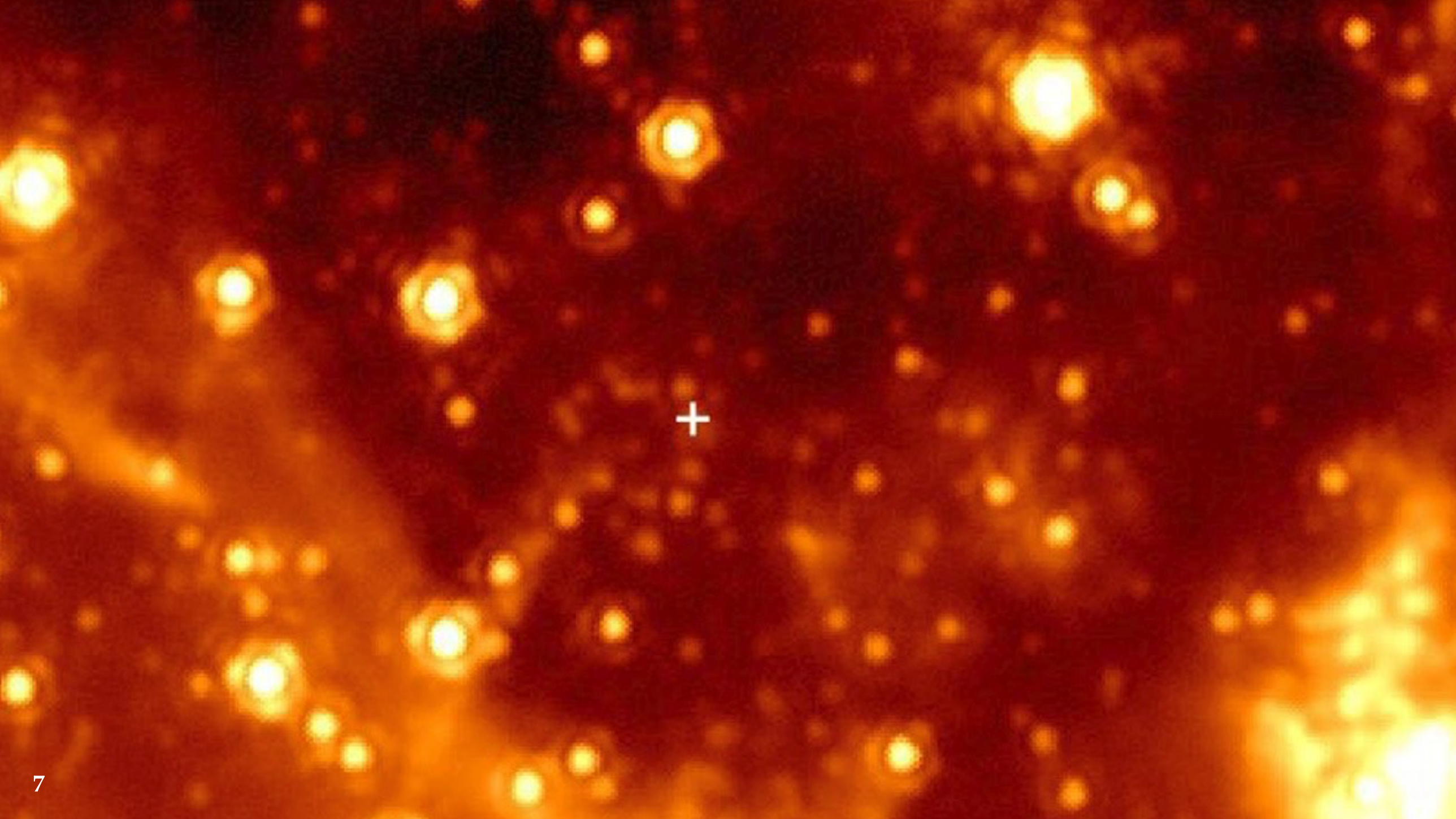


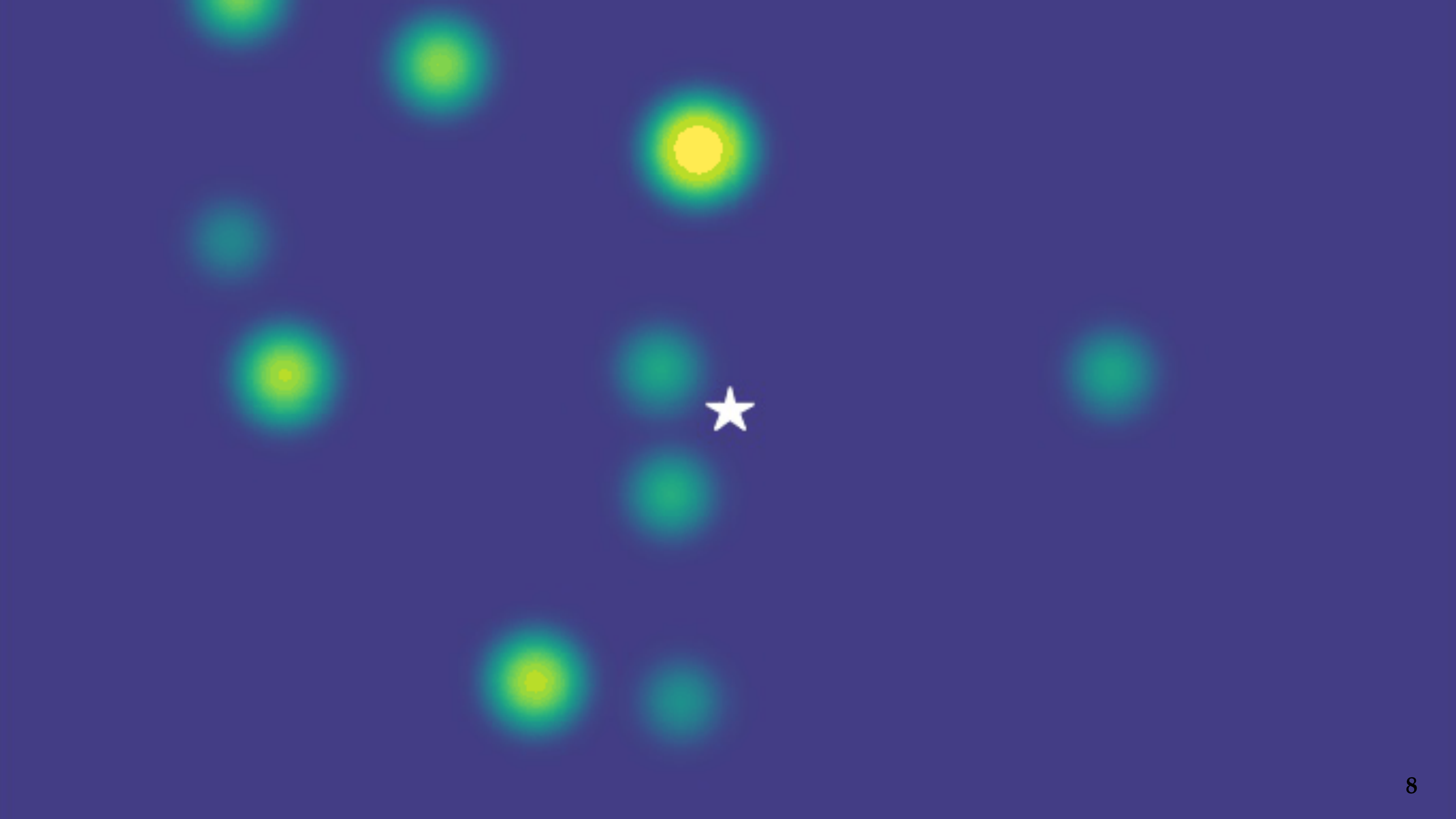












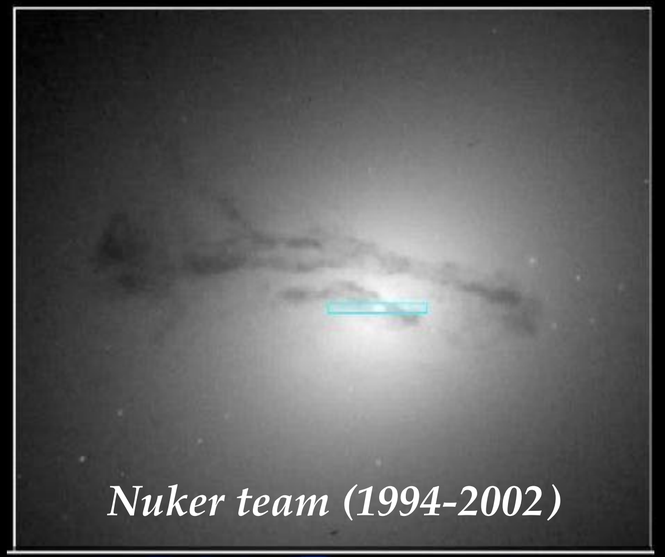
THE NOBEL PRIZE IN PHYSICS 2020



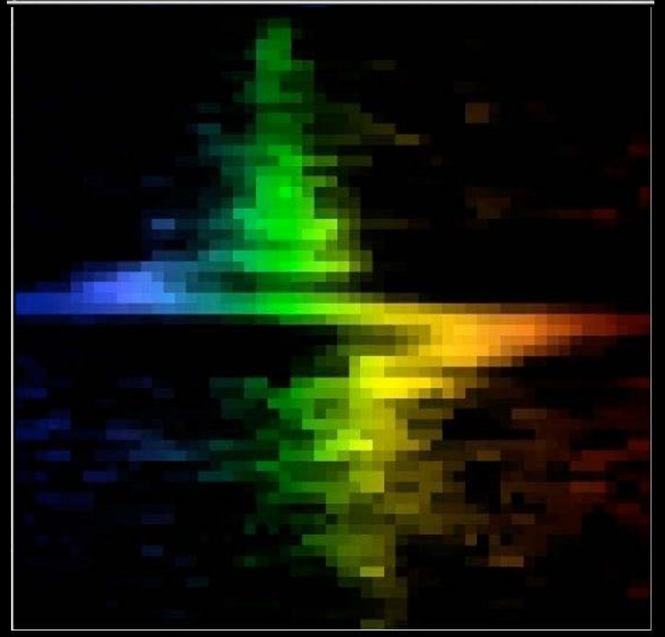
Illustrations: Niklas Elmehed

Dynamical detection of supermassive black holes in galaxies

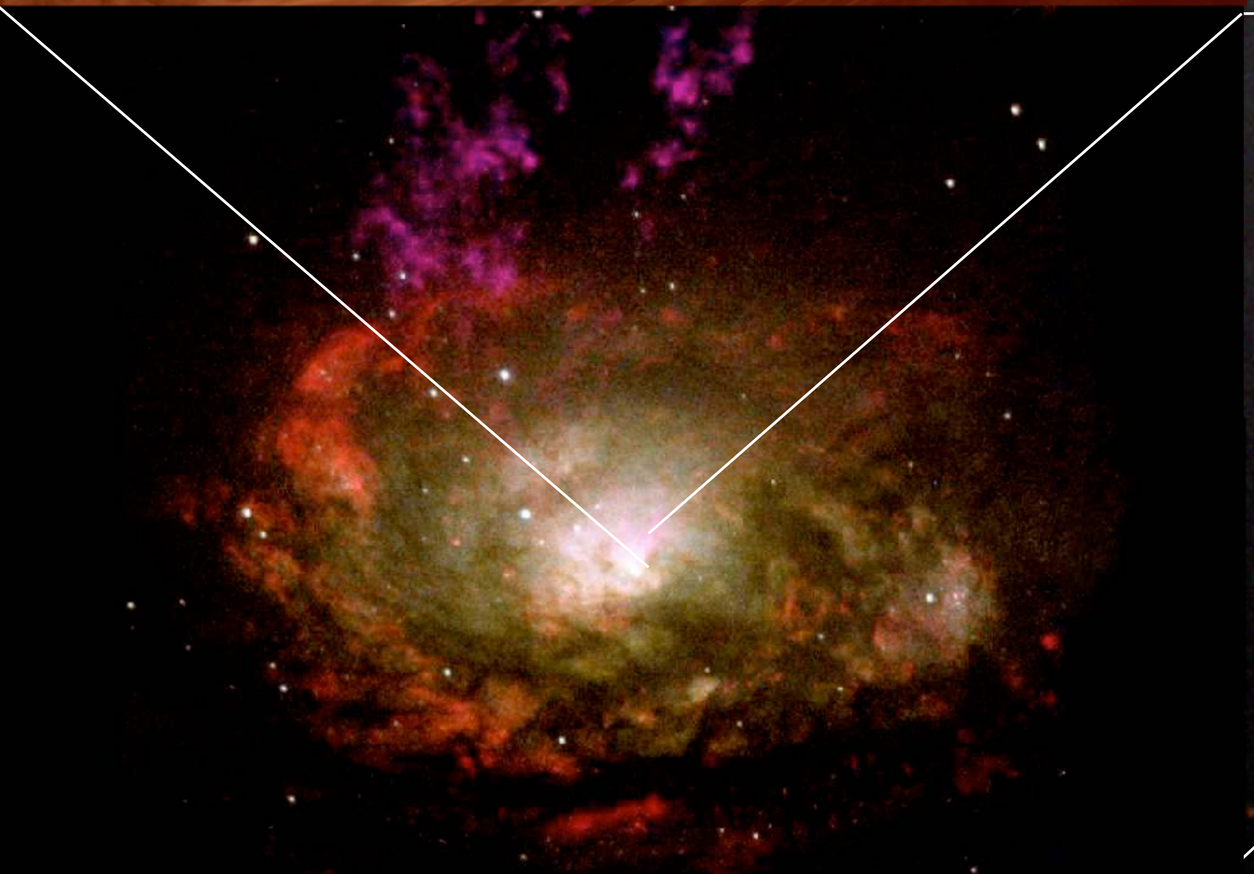




Nuker team (1994-2002)

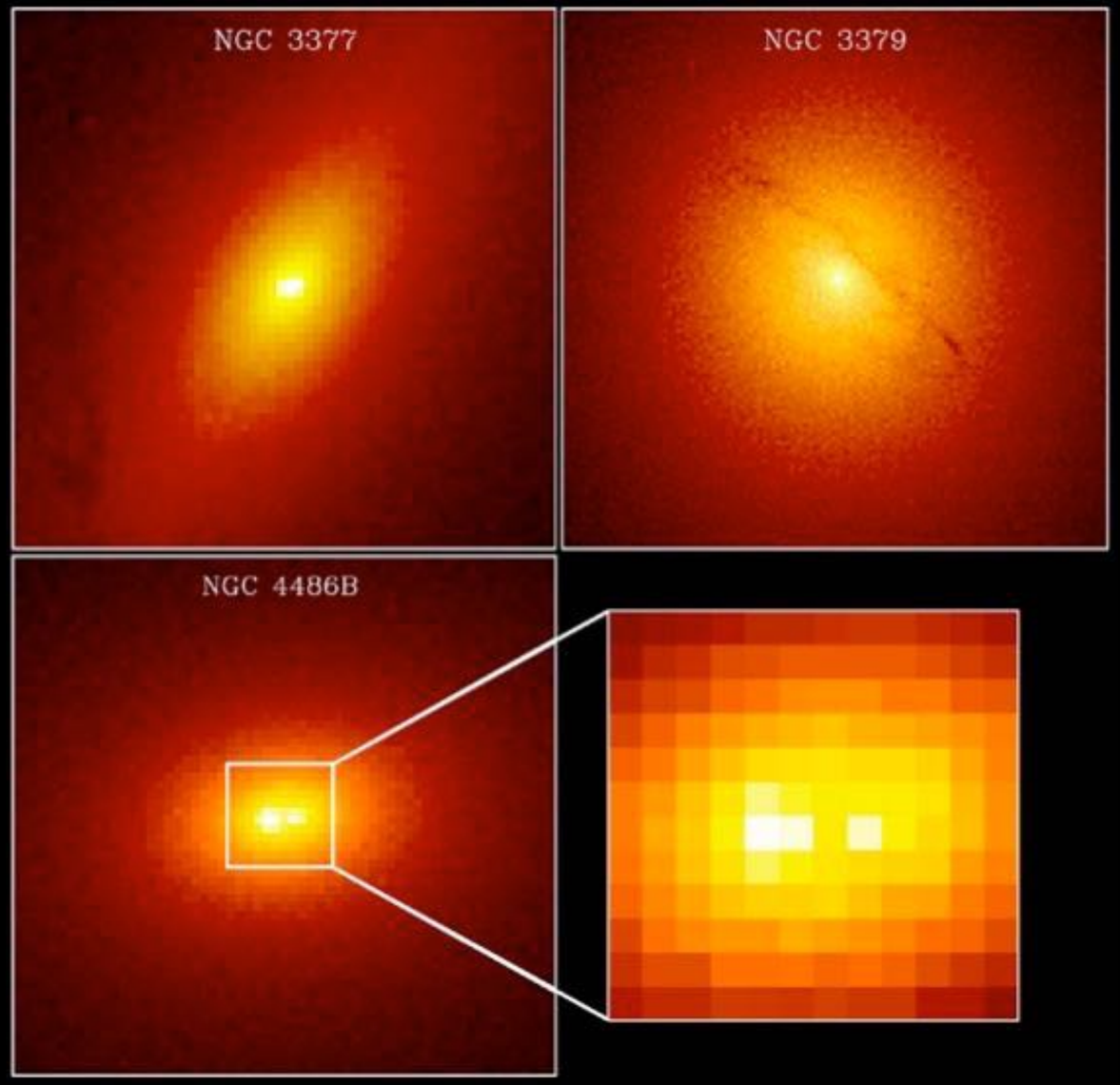








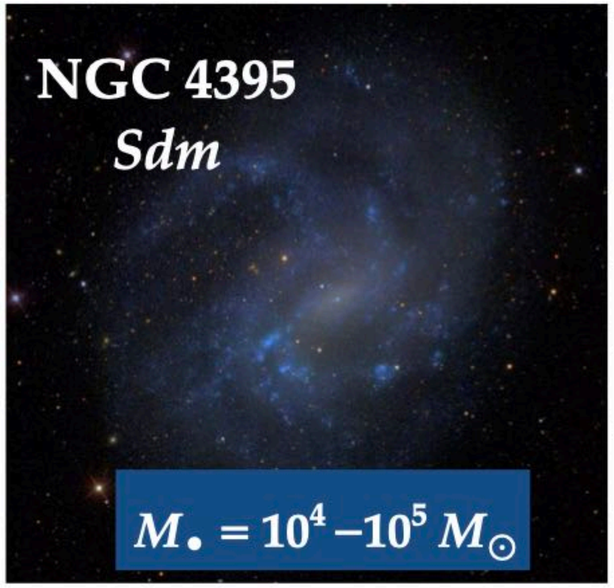
The ubiquity of black holes in galaxies

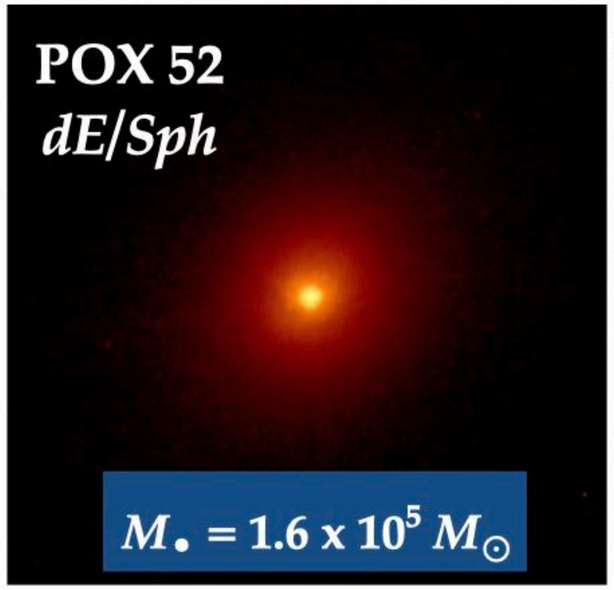


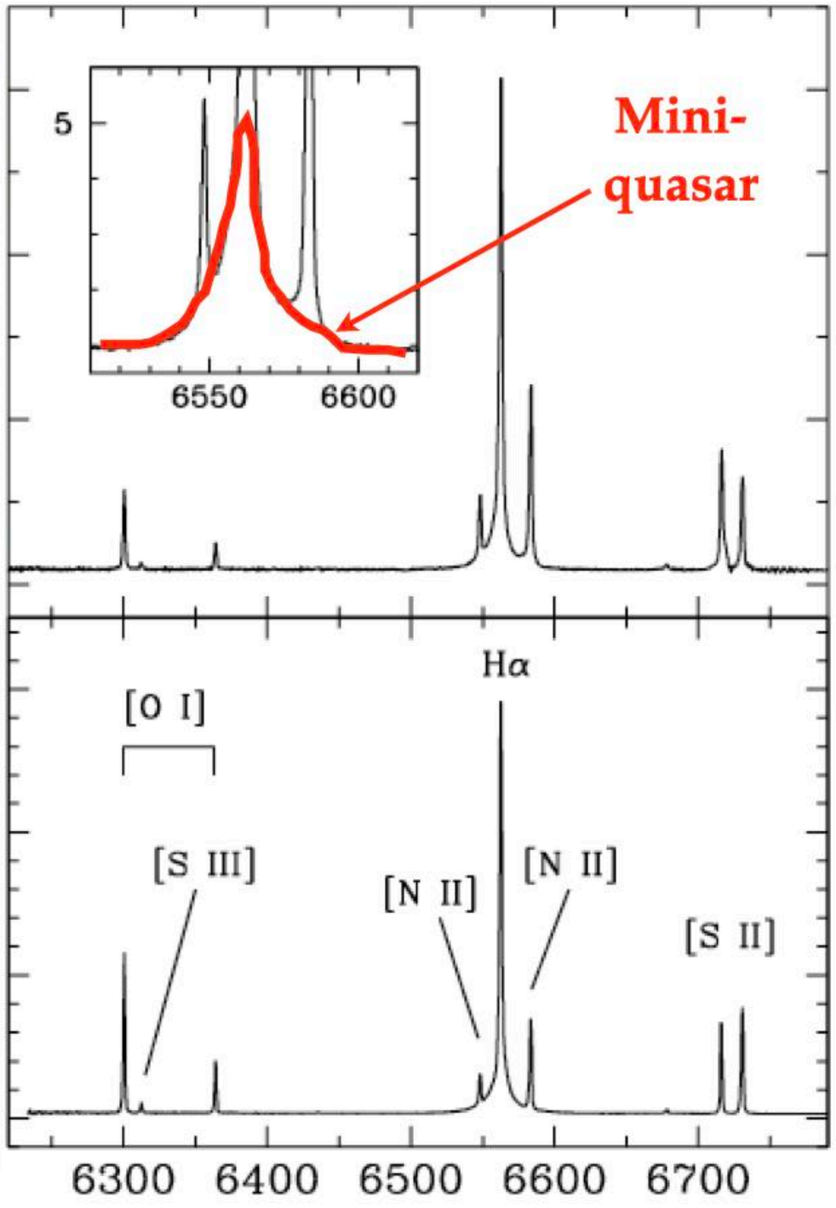


In galaxies with $M_* \gtrsim 10^{10}\,M_\odot$, the occupation fraction of SMBHs ($M_\bullet \approx 10^6 - 10^{10}\,M_\odot$) ≈ 100%

Discovery of Intermediate-mass Black Holes









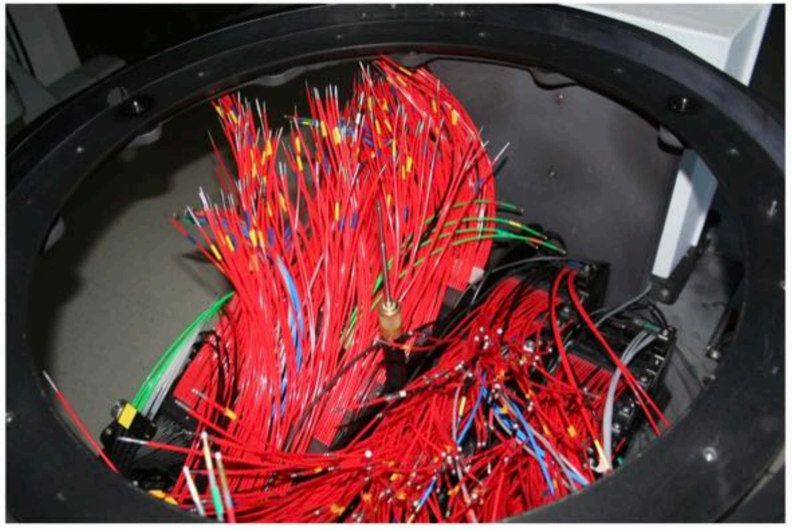
Filippenko, Ho & Sargent (1993)
Filippenko & Ho (2003)



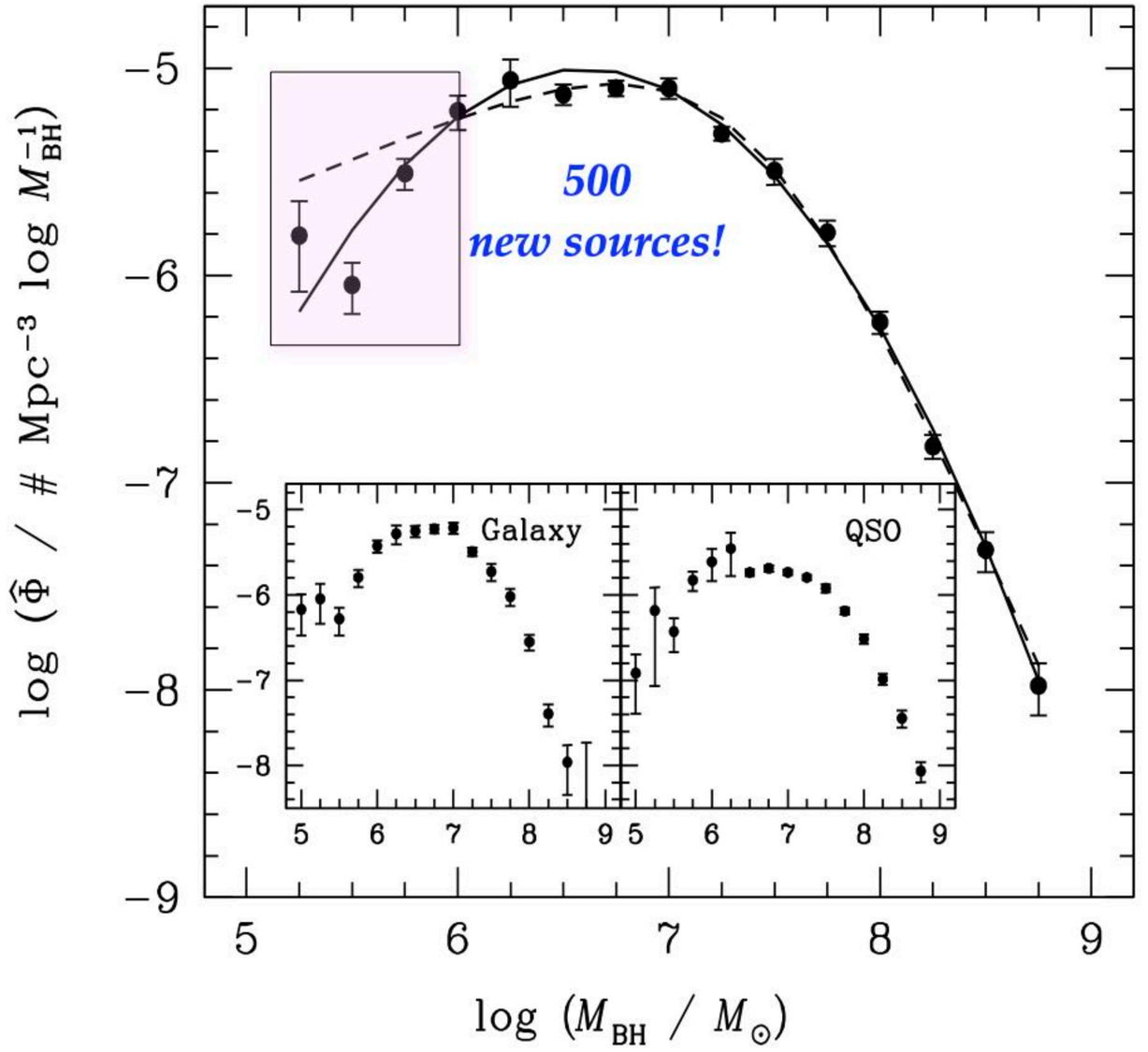
Barth, Ho et al. (2004)

Discovery of Intermediate-mass Black Holes



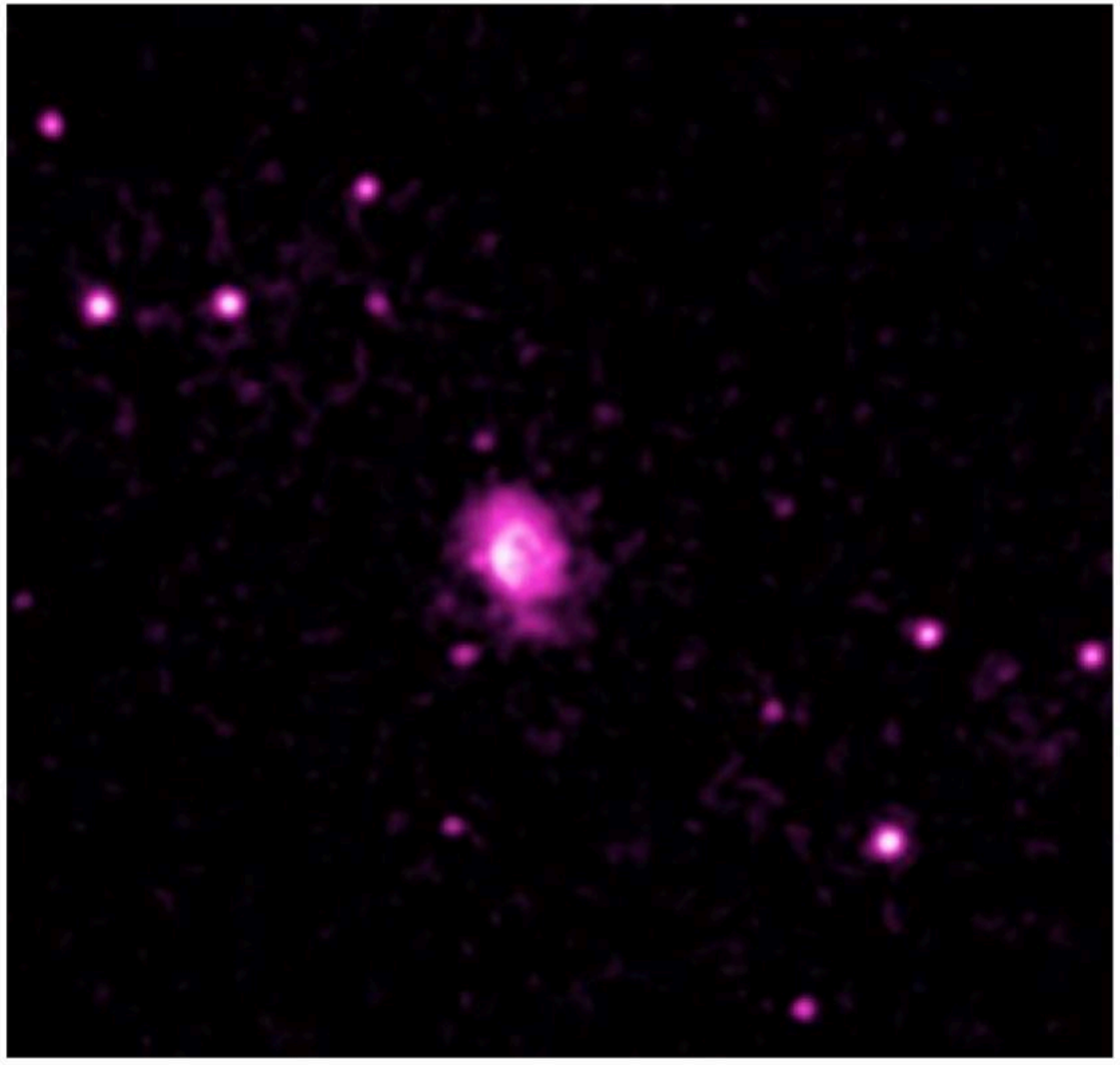


Greene & Ho (2004, 2007a, 2007b)



Demographics of Intermediate-mass Black Holes

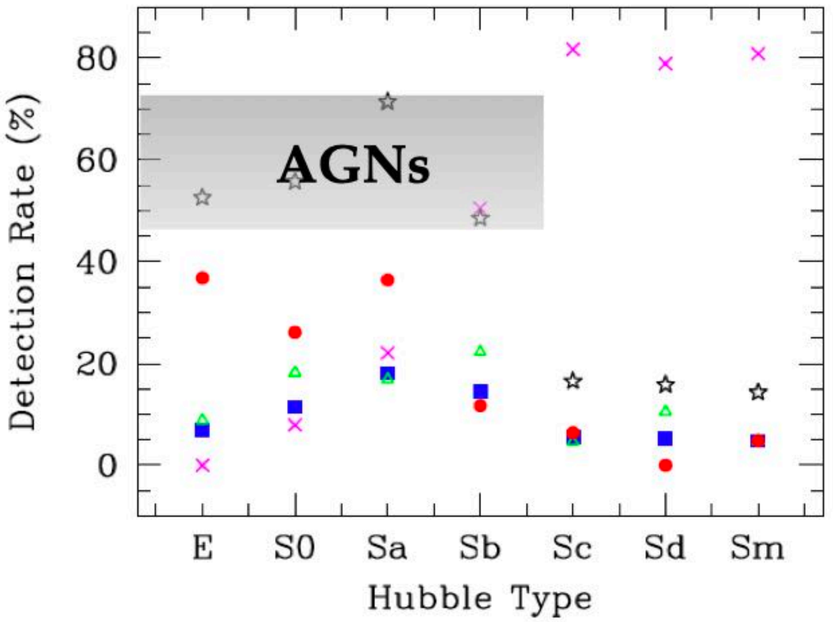
Desroches & Ho (2009); She, Ho & Feng (2017a,b); Bi, Feng & Ho (2020); Greene, Strader & Ho (2020, ARA&A)



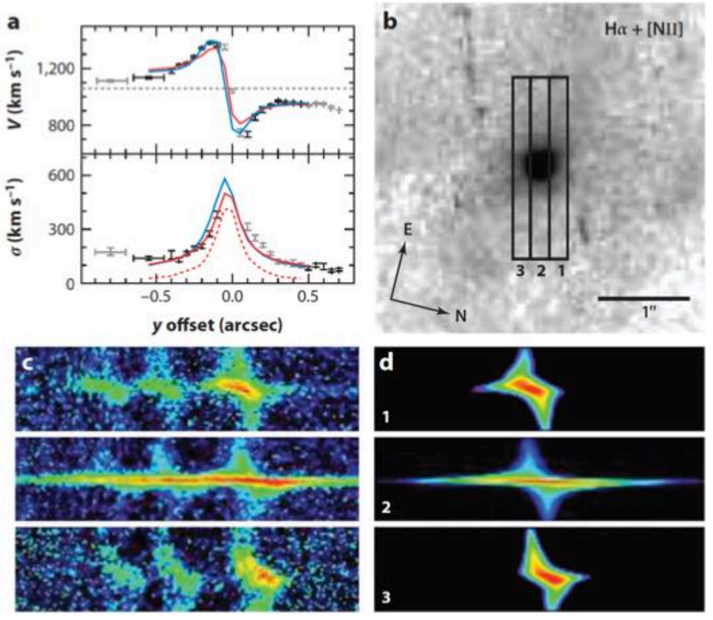
- Systematic searches for AGNs using optical spectroscopic surveys
- Most robust statistics from Chandra X-ray studies
- In galaxies with $M_* \approx 10^8 - 10^{10}\ M_\odot$, the occupation fraction of IMBHs ($M_\bullet \approx 10^5 - 10^6\ M_\odot$) $\gtrsim 50\%$

Demographics of Central Black Holes @ $z = 0$

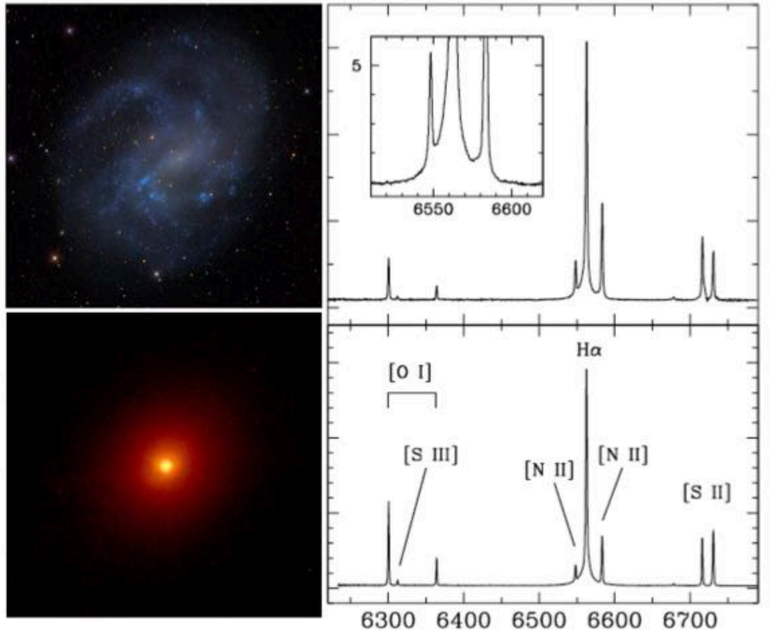
- In bulge galaxies, AGN detection rate ~70%: lower limit on BH occupation fraction
- In $M_* > 10^{10}\,M_\odot$ galaxies, occupation fraction ~100% for SMBHs with $M_{\rm BH} \approx 10^6 - 10^{10}\,M_\odot$
- In $M_* < 10^{10}\,M_\odot$ galaxies, occupation fraction $\gtrsim 50\%$ for IMBHs with $M_{\rm BH} \approx 10^4 - 10^6\,M_\odot$



Ho (2008, ARA&A)

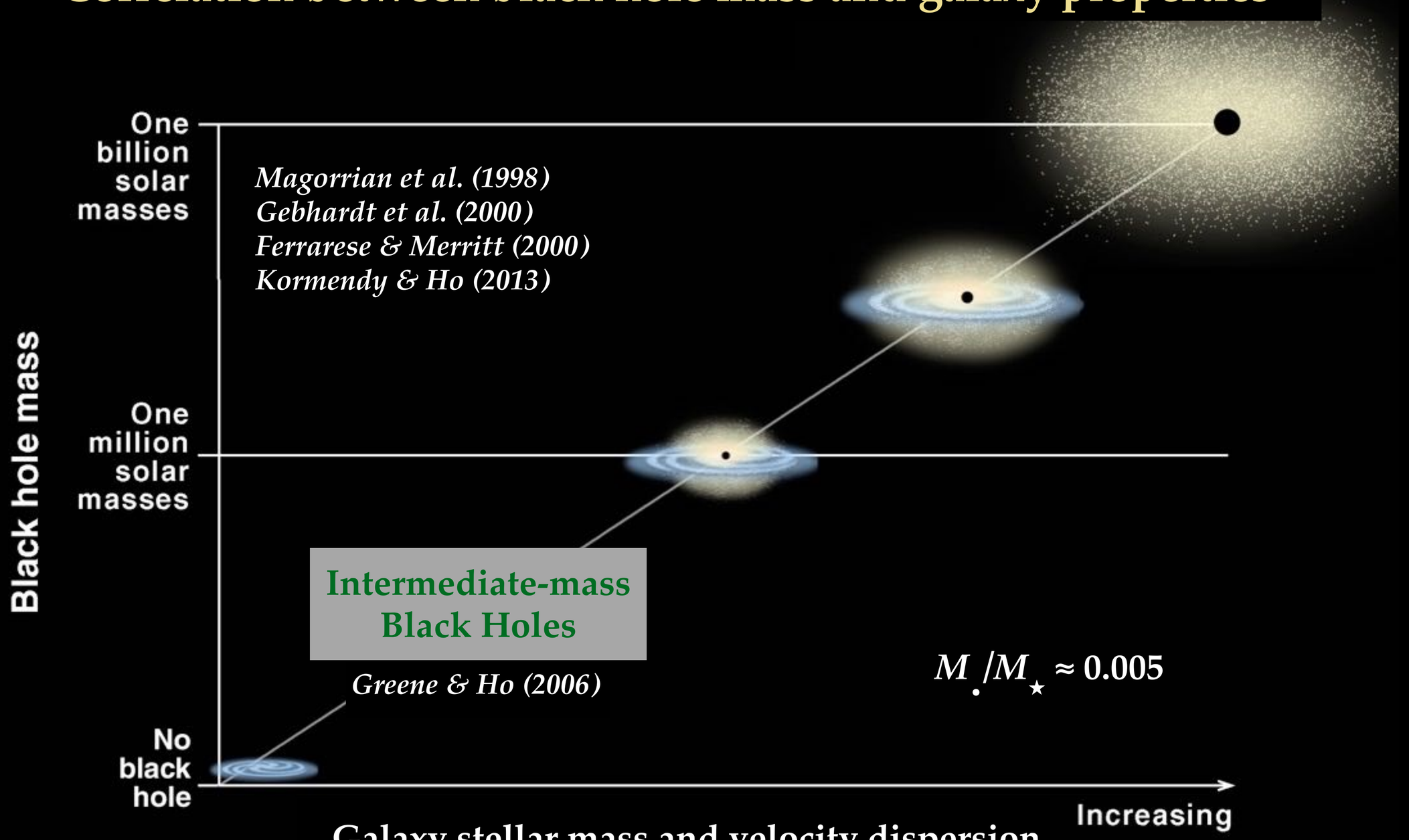


Kormendy & Ho (2013, ARA&A)

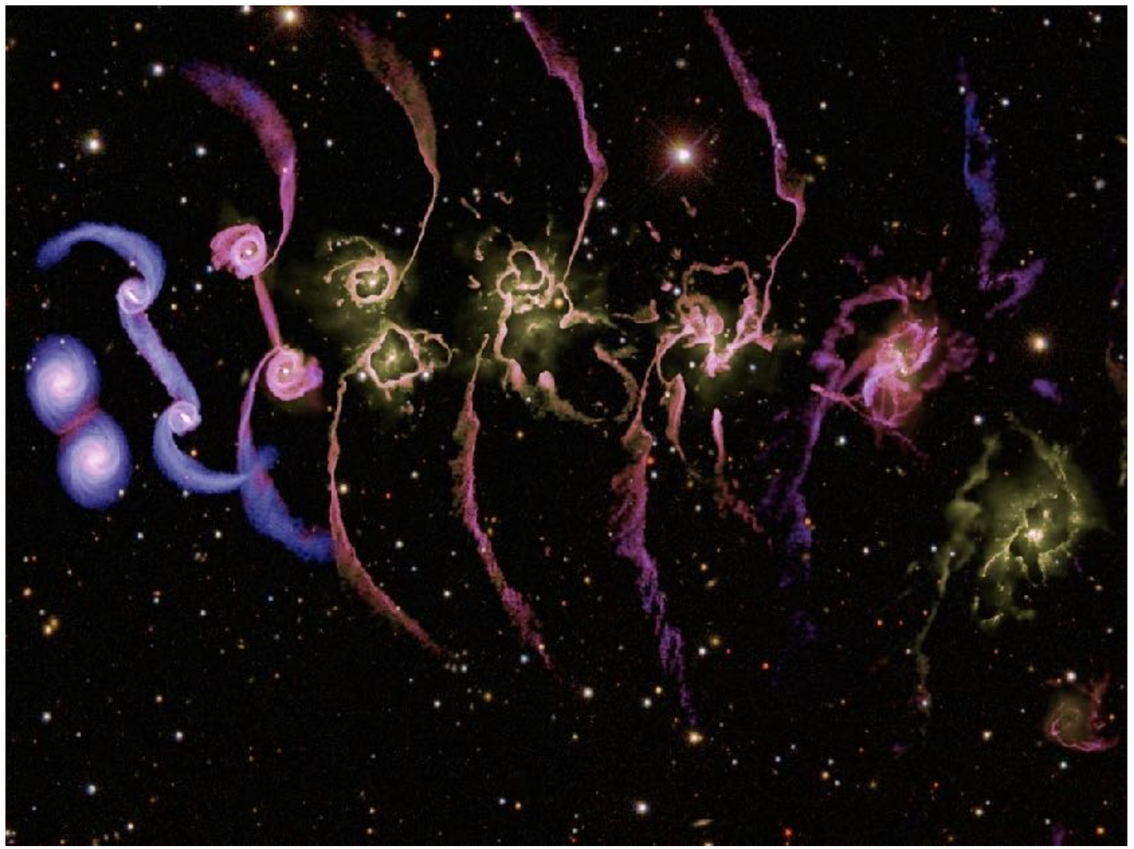


Greene, Strader & Ho (2020, ARA&A)

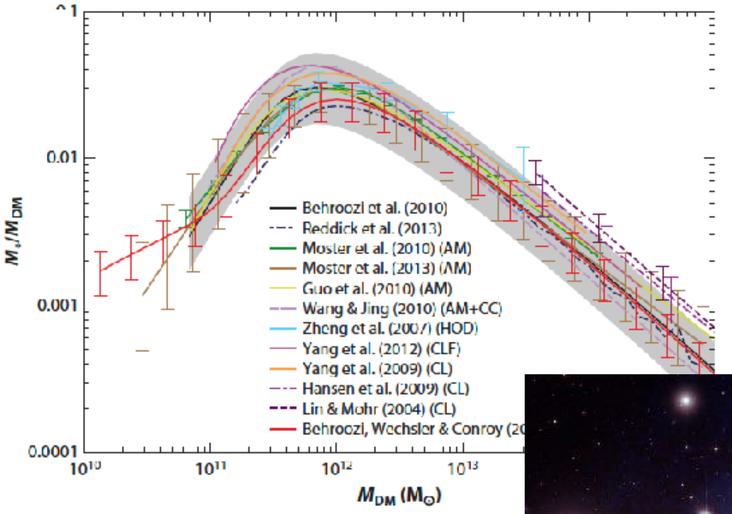
Correlation between black hole mass and galaxy properties



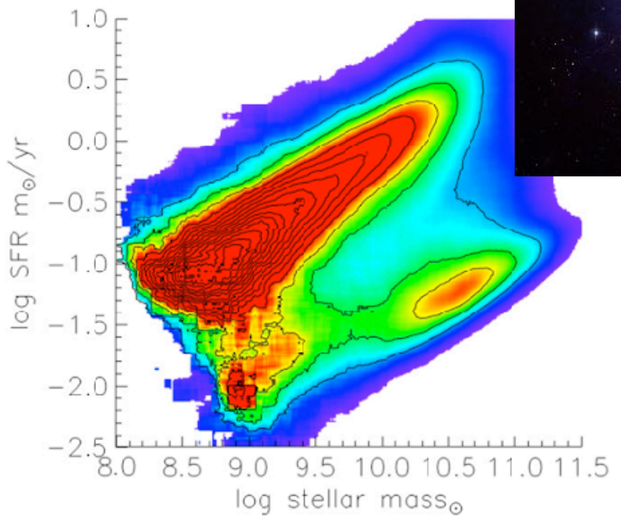
Black hole–galaxy coevolution and AGN feedback paradigms

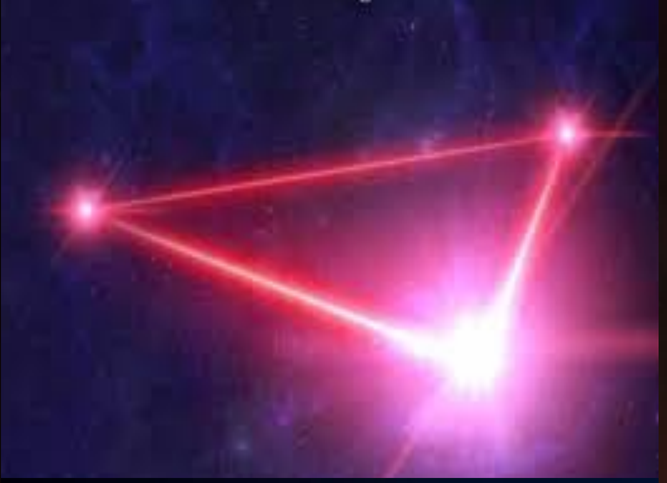


Silk & Rees (1999); Fabian (2012); EAGLE; Illustris; TNG …

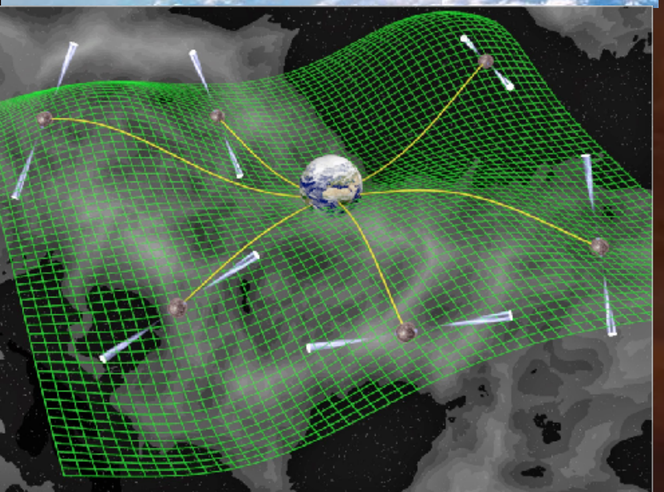




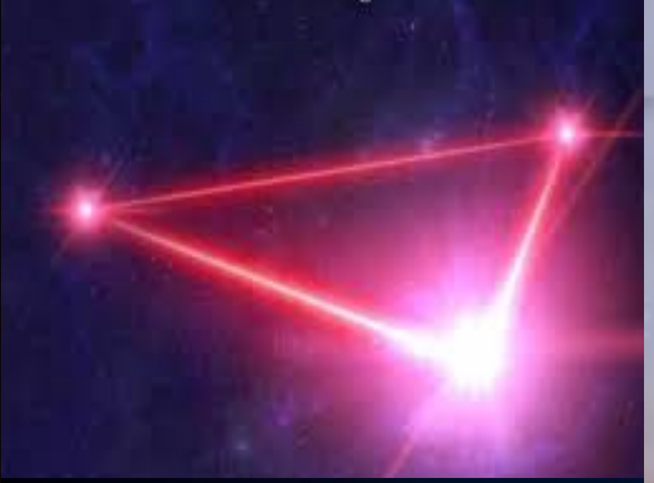




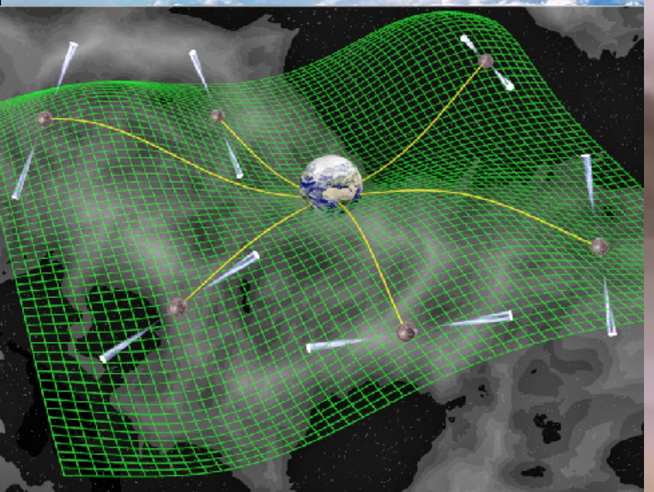




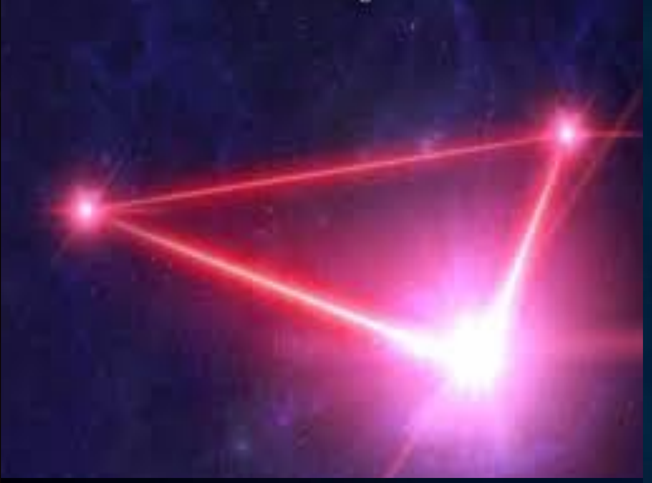




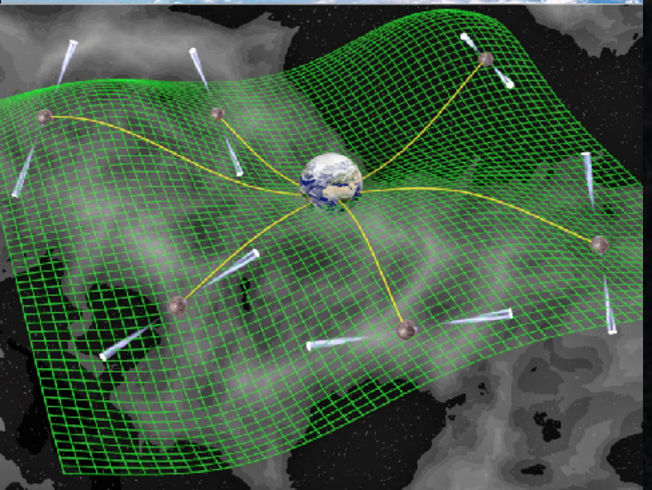




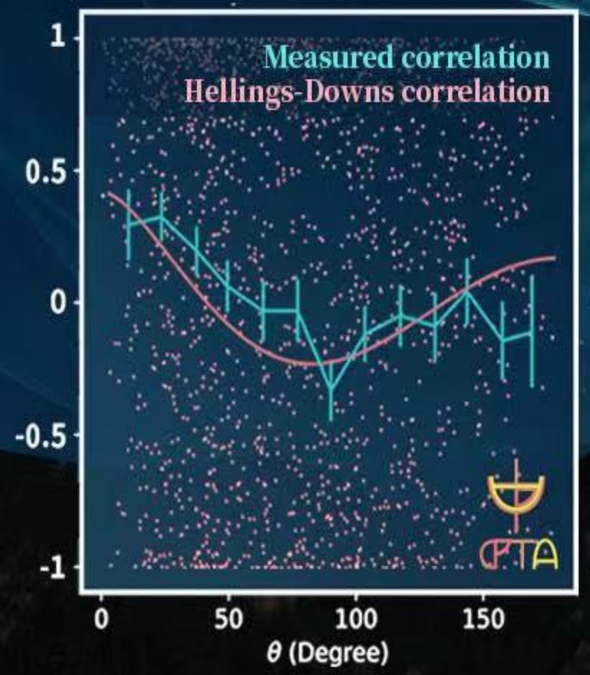




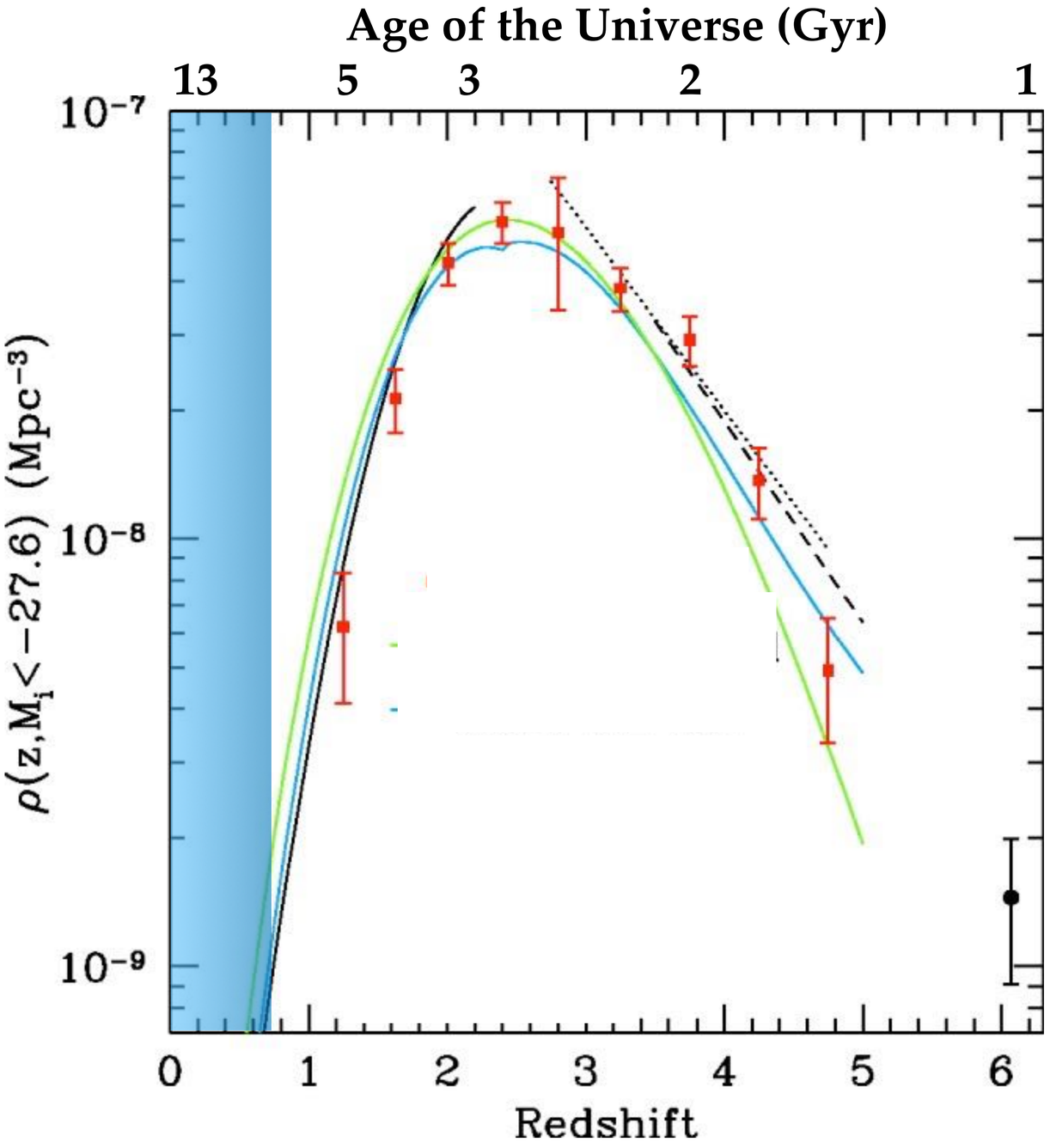




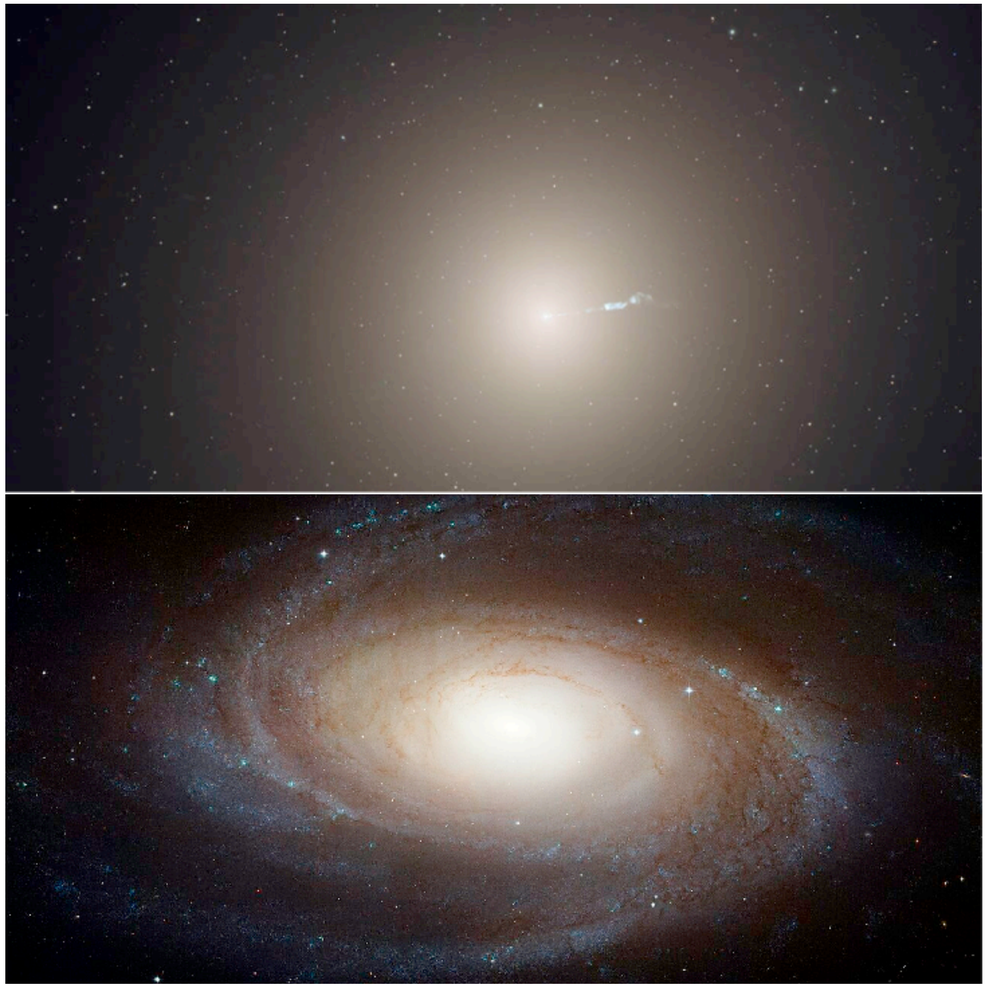
Evidence for nHz Gravitational Waves provided by the CPTA with FAST

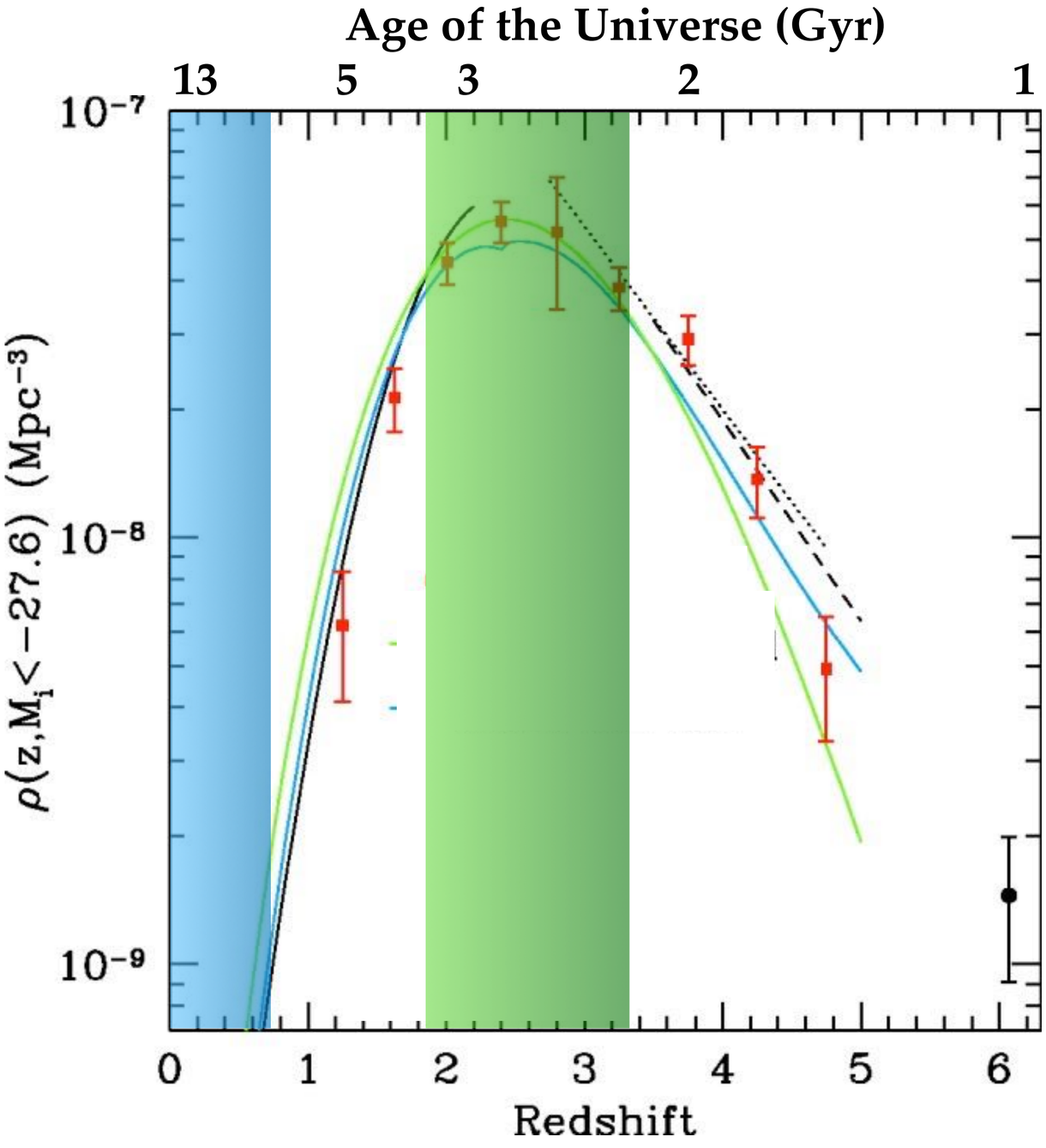


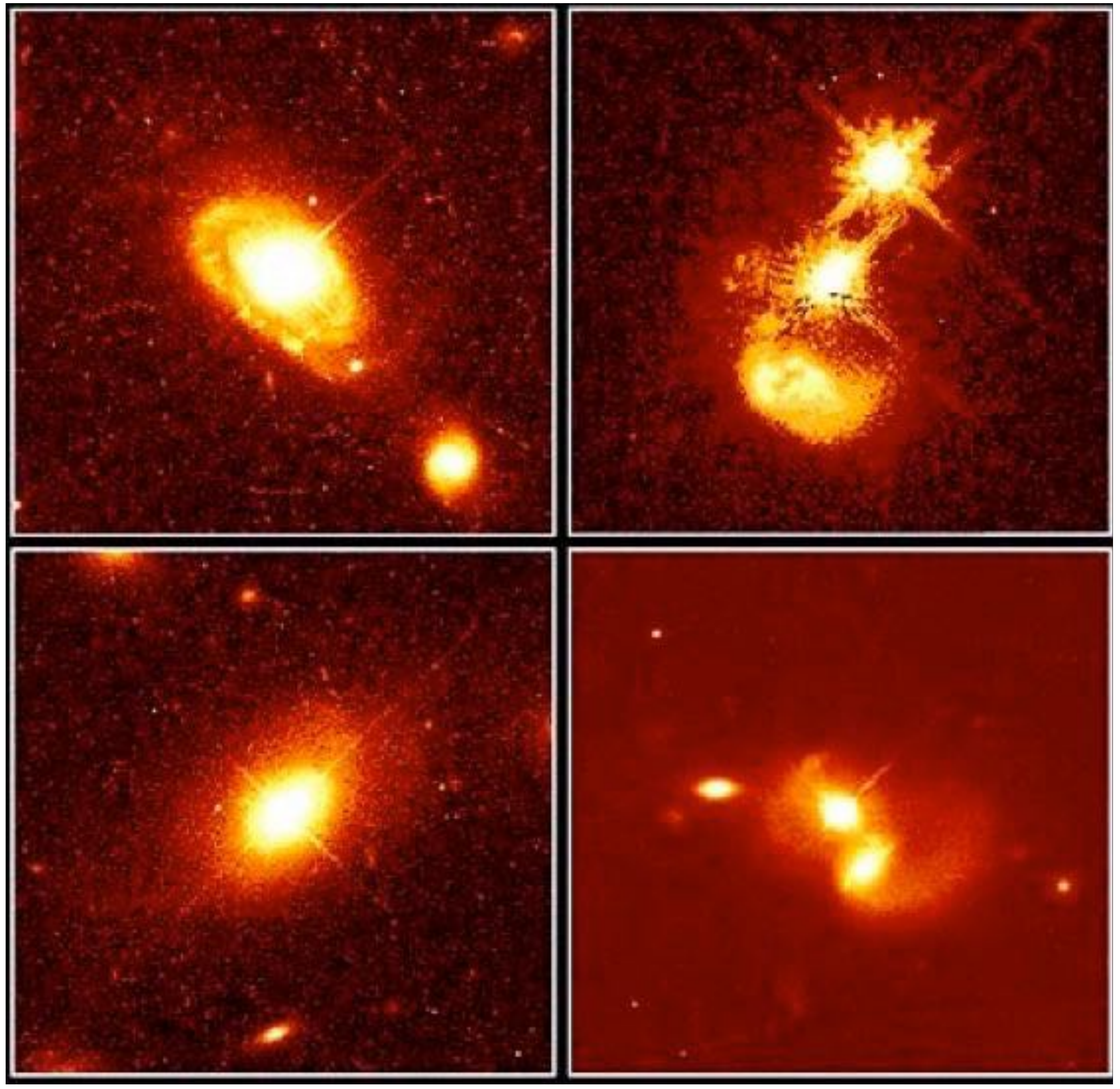
Xu, Chen, Guo et al. (2023)

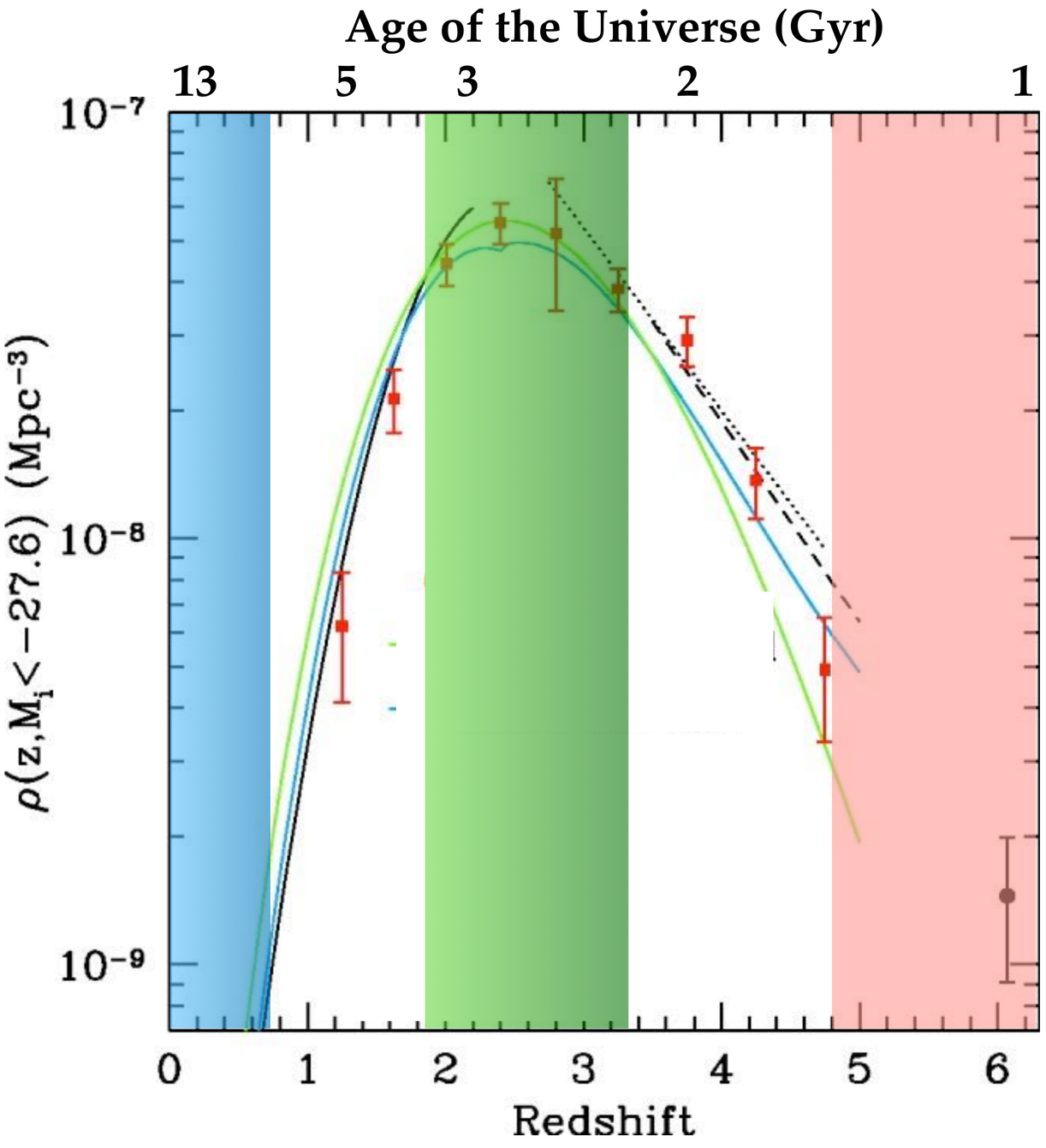


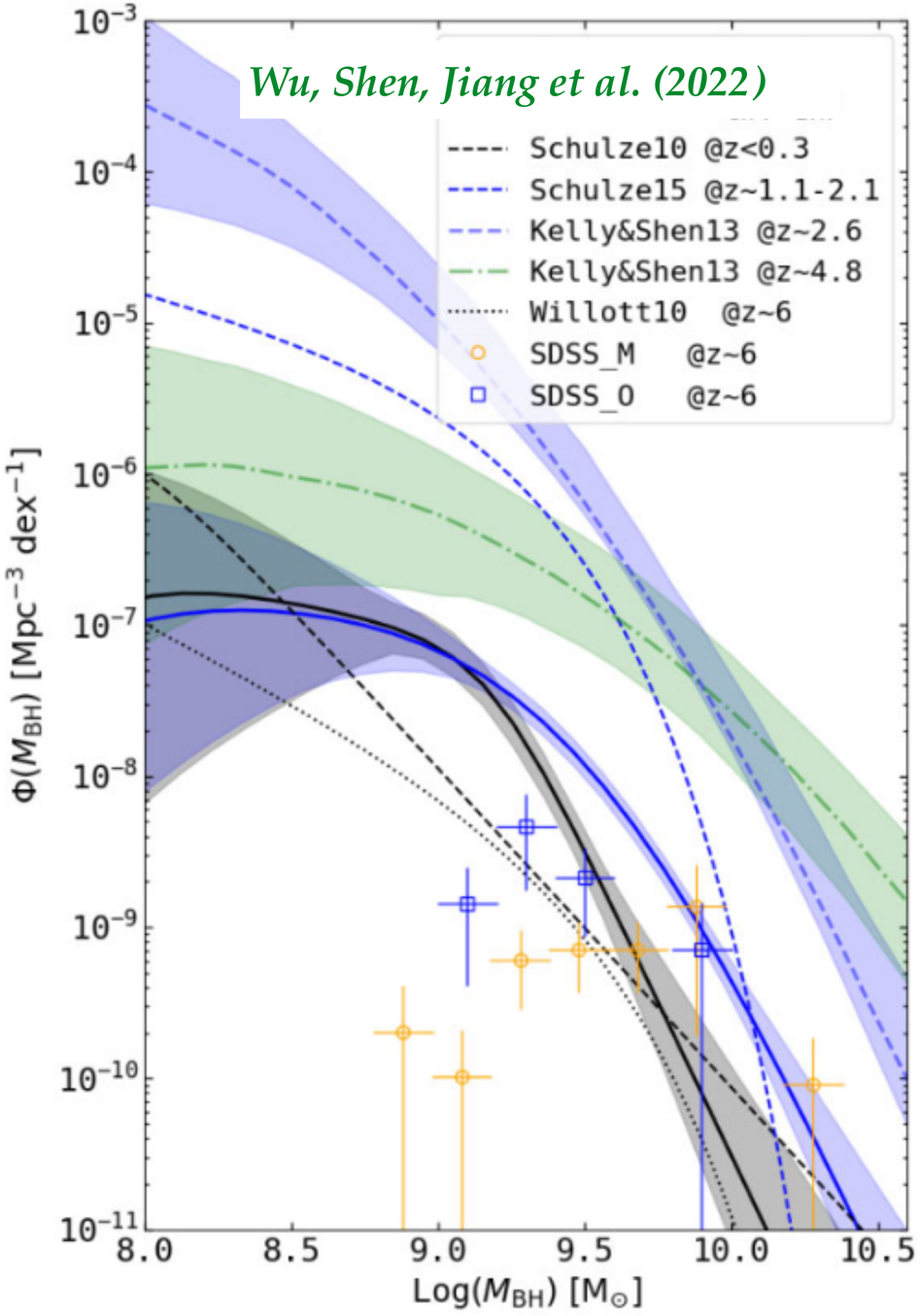
Nearby, Inactive Black Holes



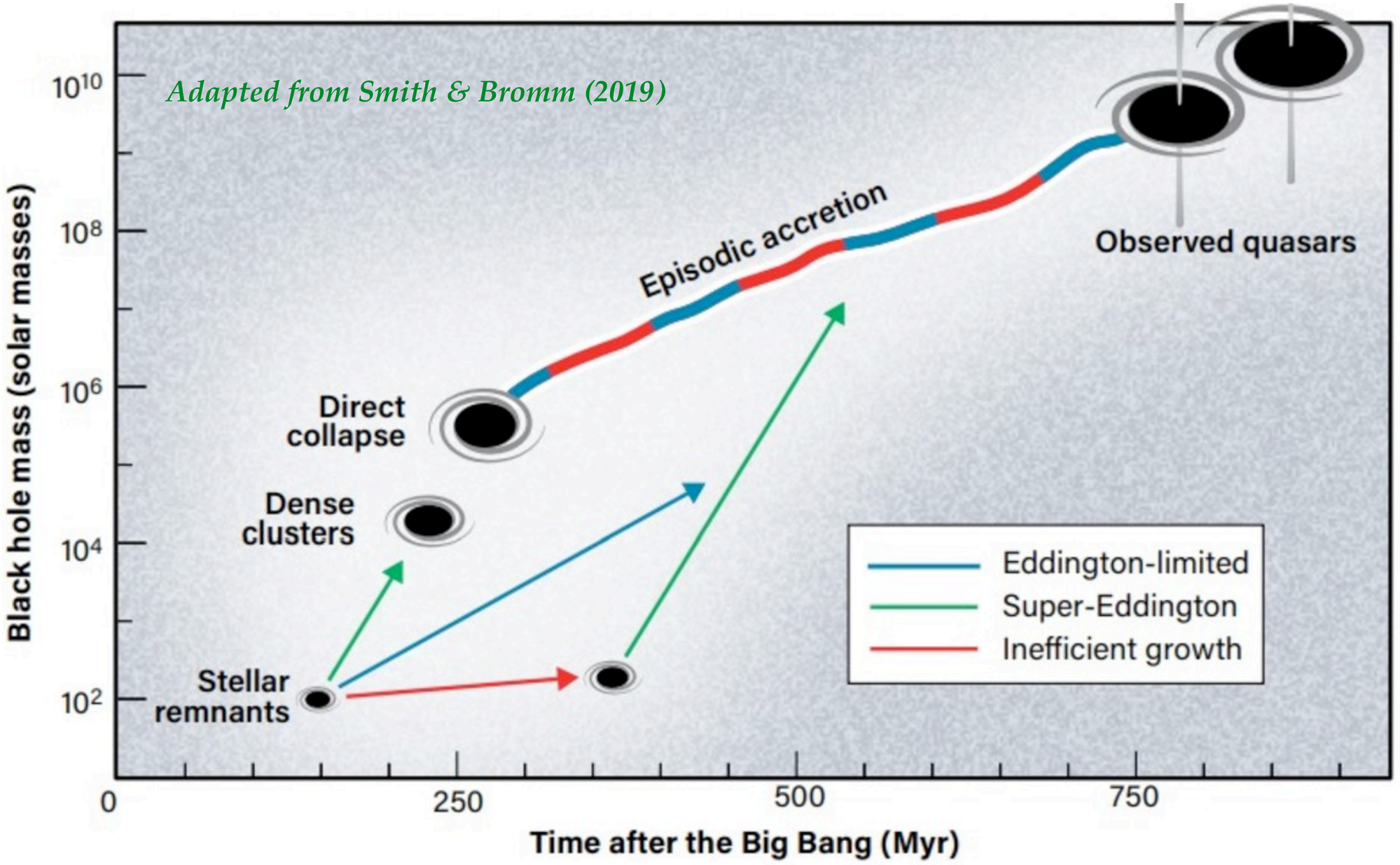

Age of the Universe (Gyr)
13
5
3
2
1
10^{-7}
10^{-8}
10^{-9}
$\rho(z,M_i<-27.6)$ (Mpc^{-3})
0
1
2
3
4
5
6
Redshift

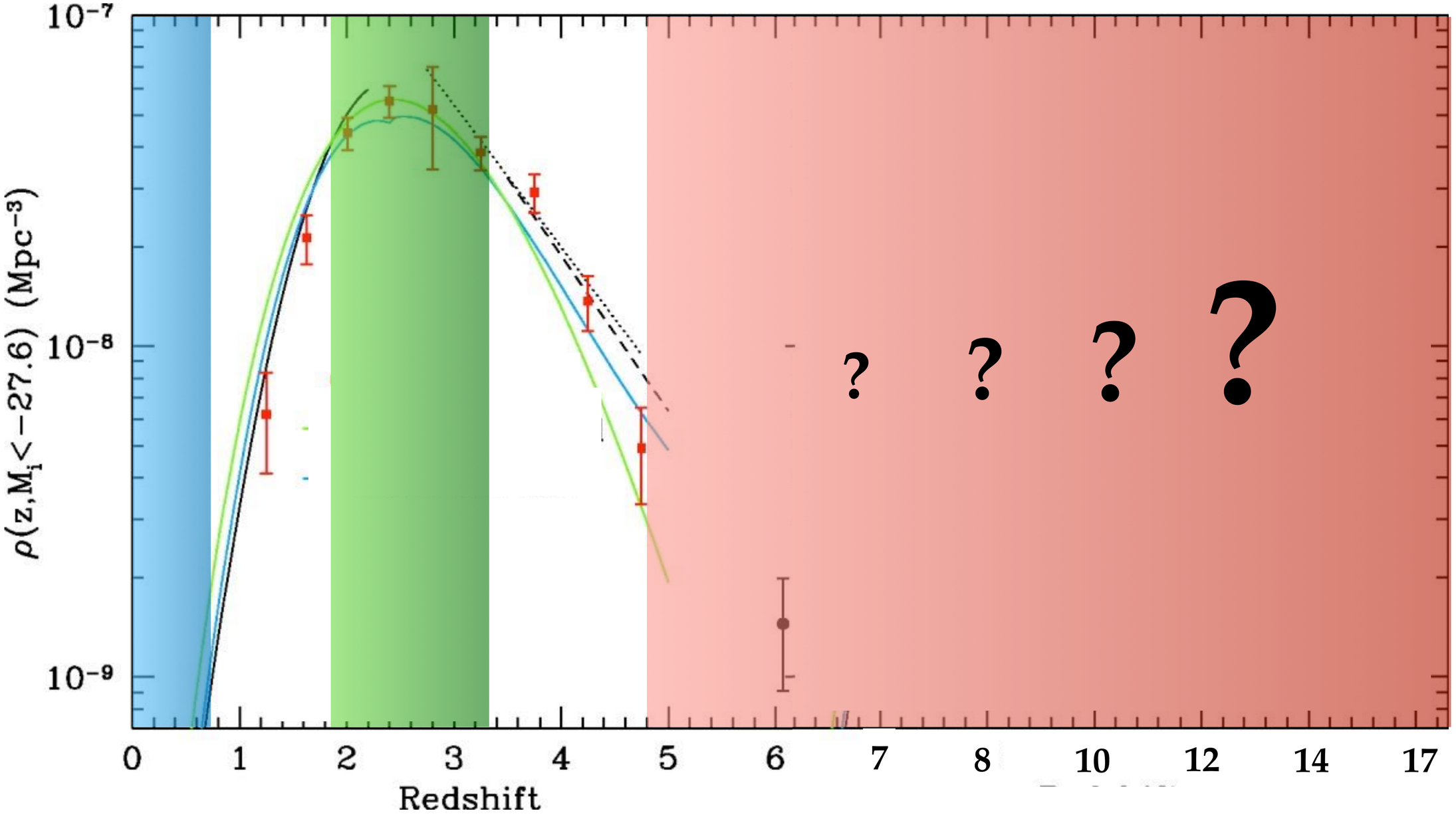


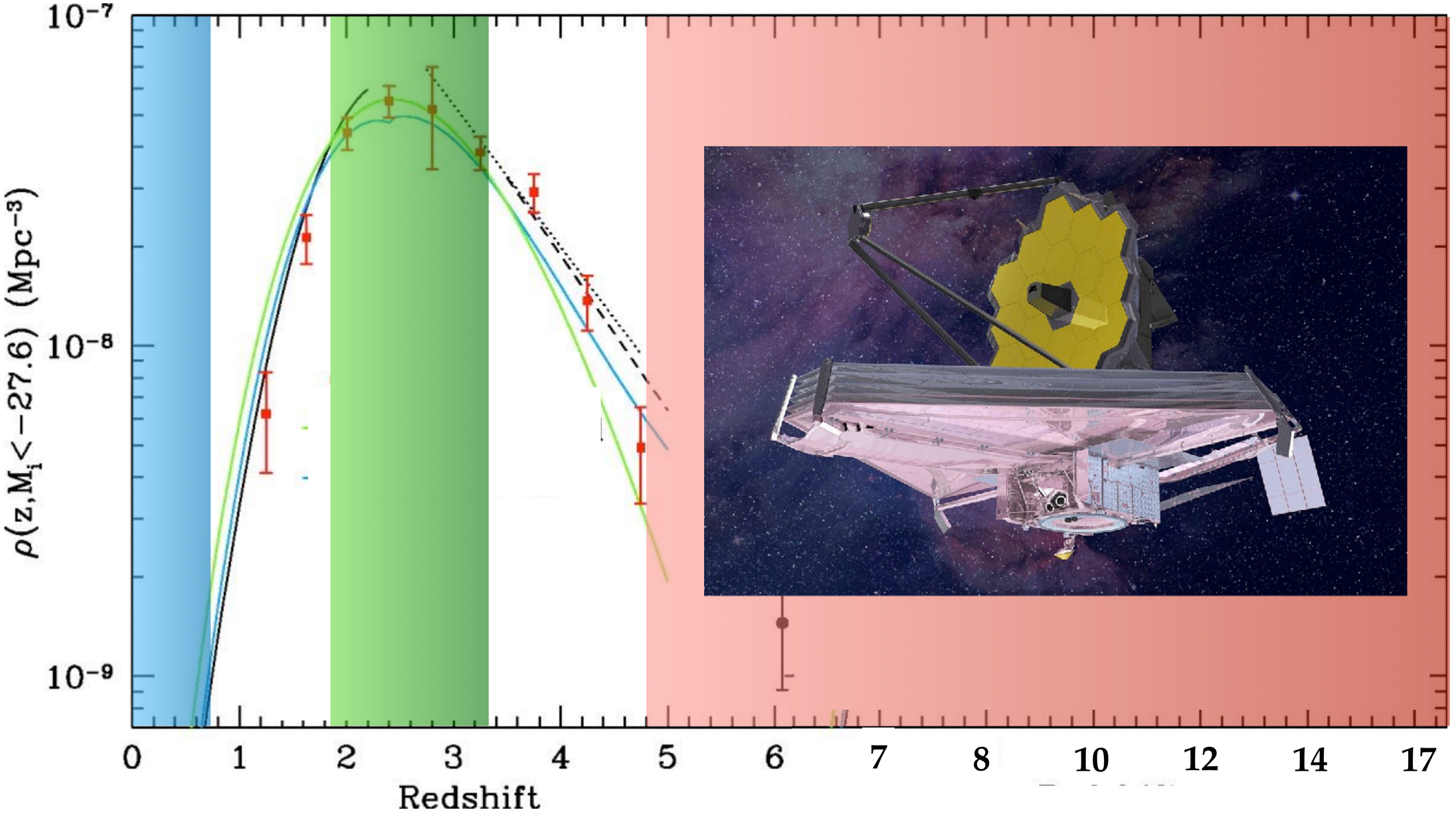

Age of the Universe (Gyr)
13
5
3
2
1
10^{-7}
10^{-8}
10^{-9}
$\rho(z, M_i < -27.6)$ (Mpc^{-3})
0
1
2
3
4
5
6
Redshift

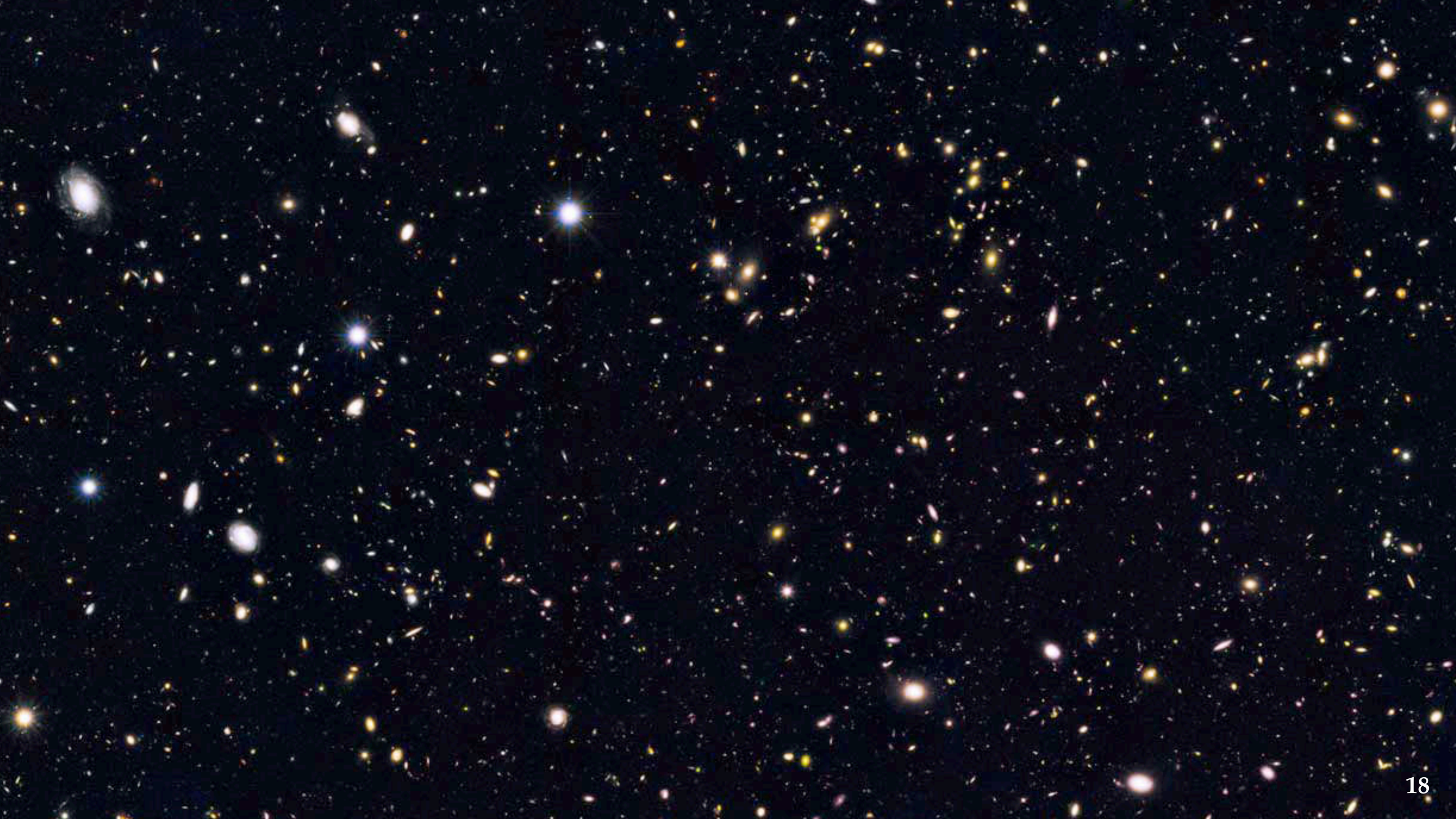

Wu, Shen, Jiang et al. (2022)
Schulze10 @z<0.3
Schulze15 @z~1.1-2.1
Kelly&Shen13 @z~2.6
Kelly&Shen13 @z~4.8
Willott10 @z~6
SDSS_M @z~6
SDSS_O @z~6
10^{-3}
10^{-4}
10^{-5}
10^{-6}
10^{-7}
10^{-8}
10^{-9}
10^{-10}
10^{-11}
$\Phi(M_{BH})$ [Mpc^{-3} dex^{-1}]
8.0
8.5
9.0
9.5
10.0
10.5
Log(M_{BH}) [$M_\odot$]

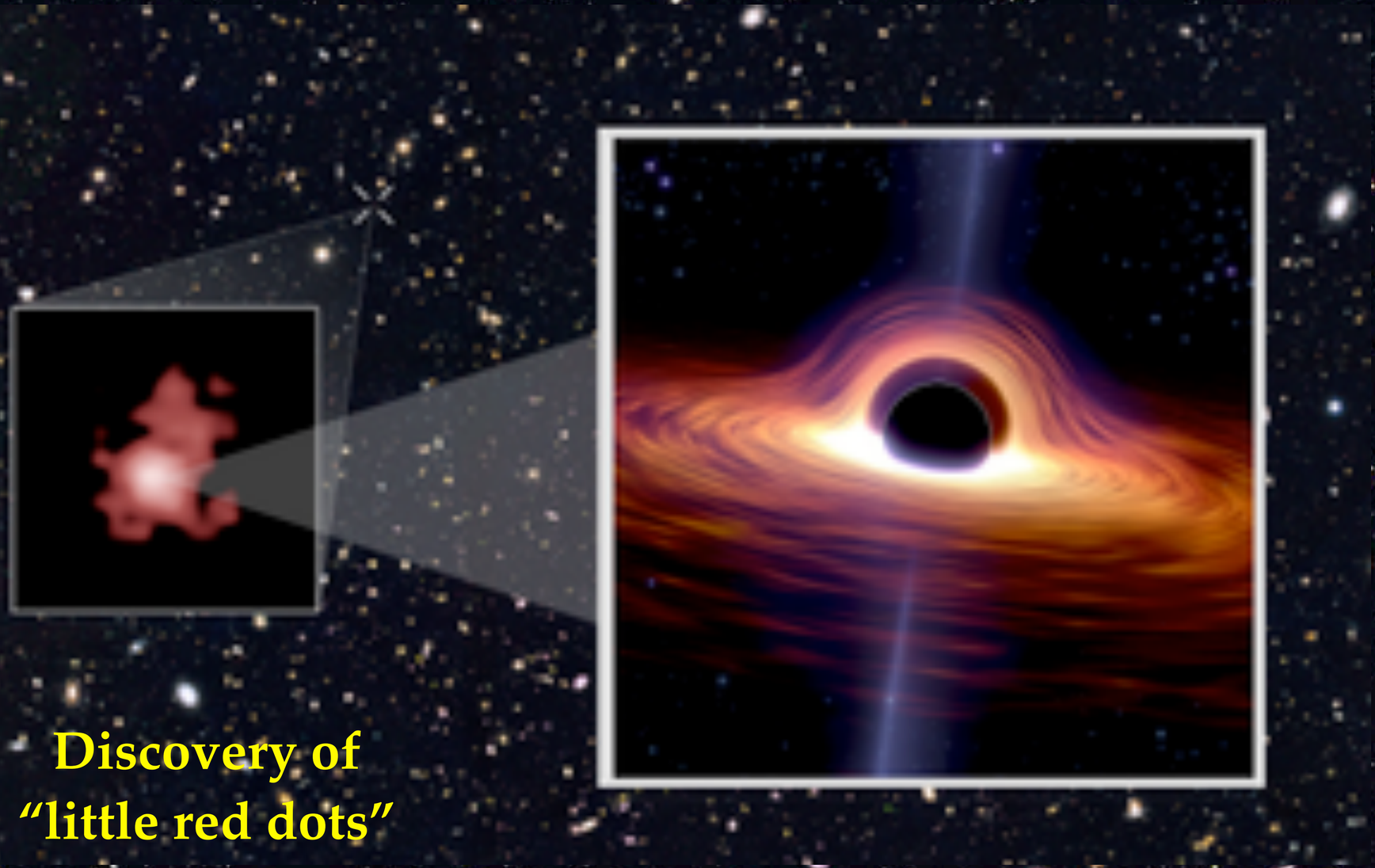
Growing the first supermassive black holes




10^{-7}
10^{-8}
10^{-9}
$\rho(z, M_i < -27.6)$ (Mpc^{-3})
0
1
2
3
4
5
6
7
8
10
12
14
17
Redshift
? ? ? ?


10^{-7}
10^{-8}
10^{-9}
$\rho(z, M_i < -27.6)$ (Mpc^{-3})
0
1
2
3
4
5
6
7
8
10
12
14
17
Redshift



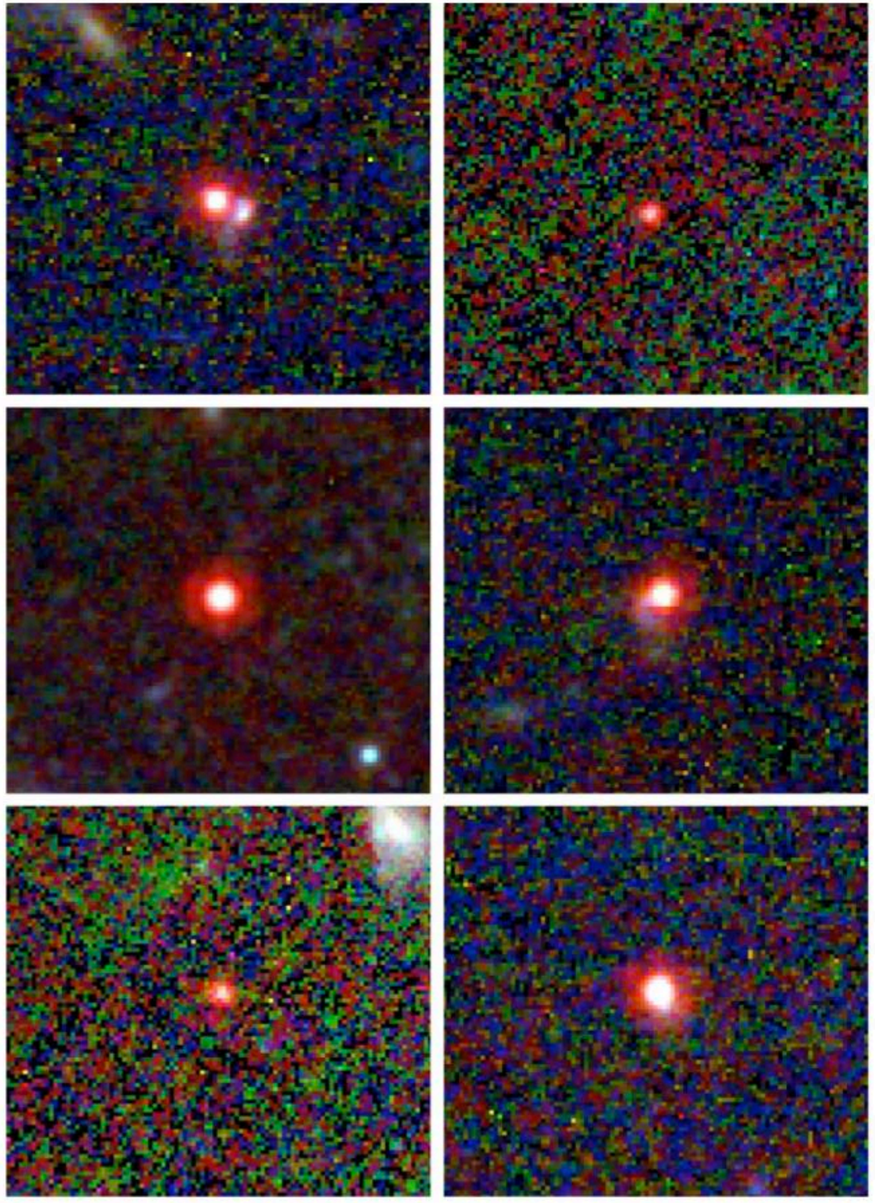


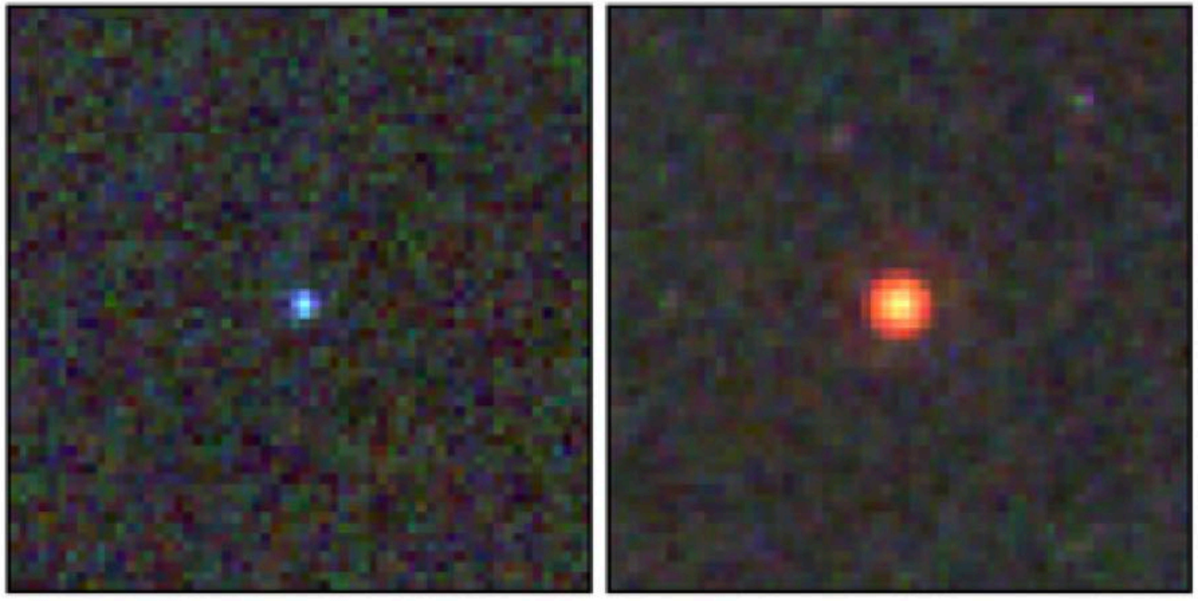
Discovery of
“little red dots”

Progenitors of quasars?

Discovery of the "Little Red Dots"

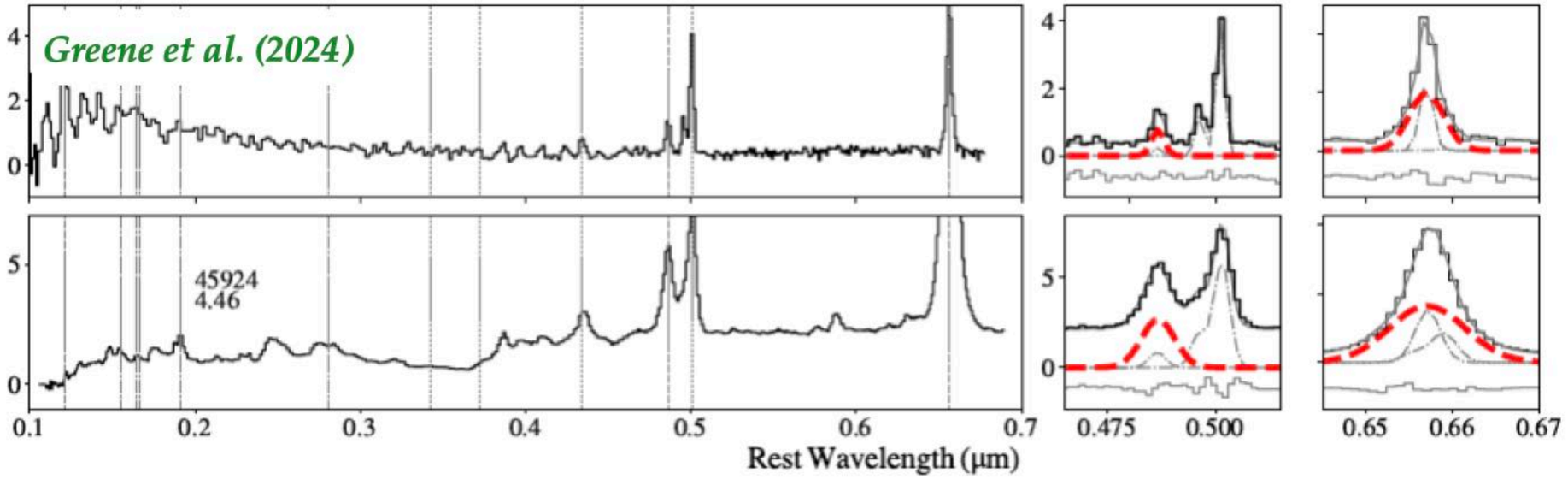
Kovceski et al. (2023); Harikane et al. (2023); Greene et al. (2024); Matthee et al. (2024); and many others

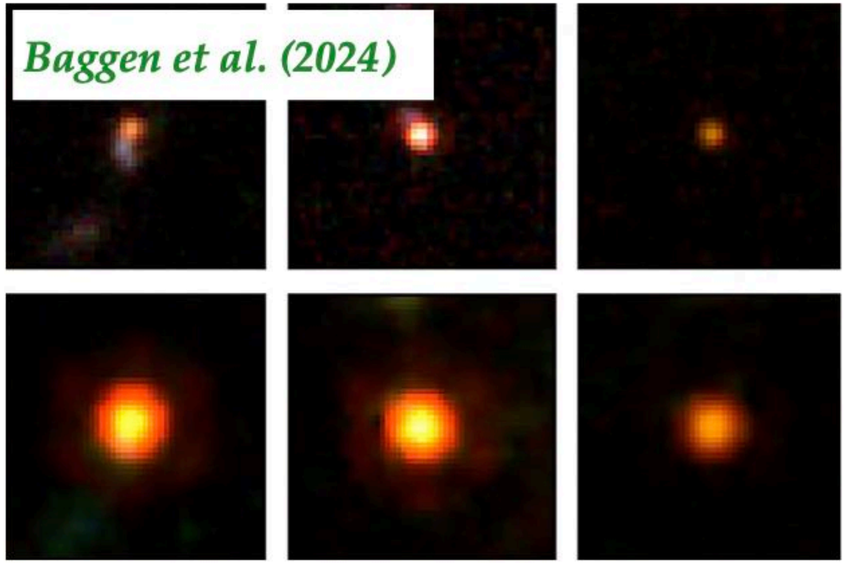


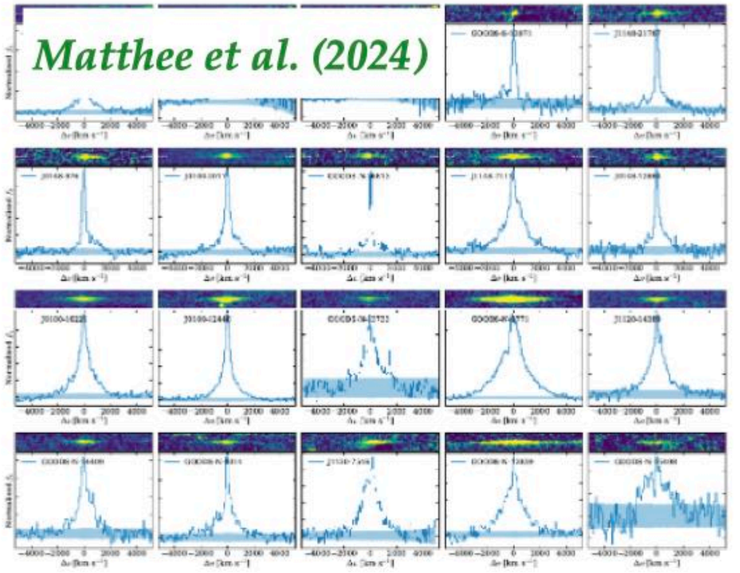


- **Extremely compact, point-like morphology**
- **Upper limits on size: $R_e \lesssim 30$ pc**
- **Often no sign of any underlying galaxy**

"Little Red Dots" as early, highly accreting AGNs with massive BHs



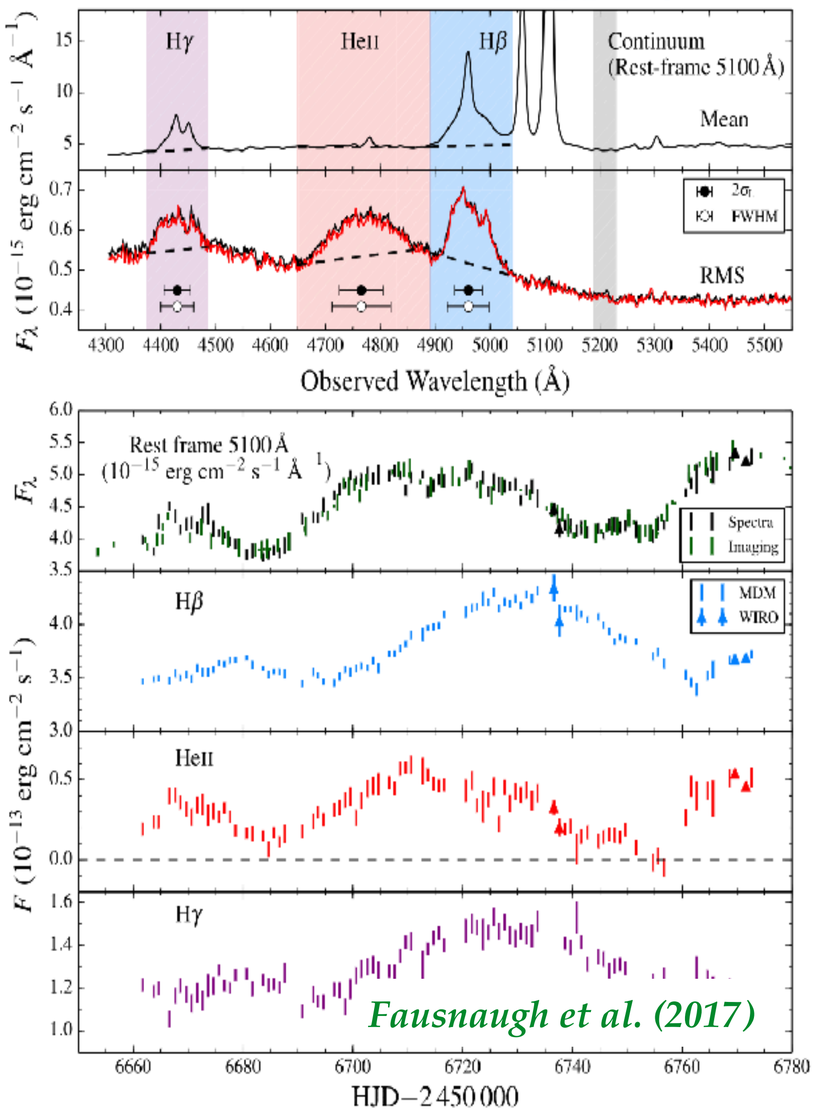




- > 70%–80% are extragalactic; $z \approx 4$–9
- Hα FWHM ≈ 1000–5000 km s^{-1}
- Massive BHs: $M_\bullet \approx 10^6$–$10^8\,M_\odot$
- Highly accreting: $L_{\rm bol}/L_{\rm Edd} \approx 0.1$–$1$
- Low gas-phase metallicities

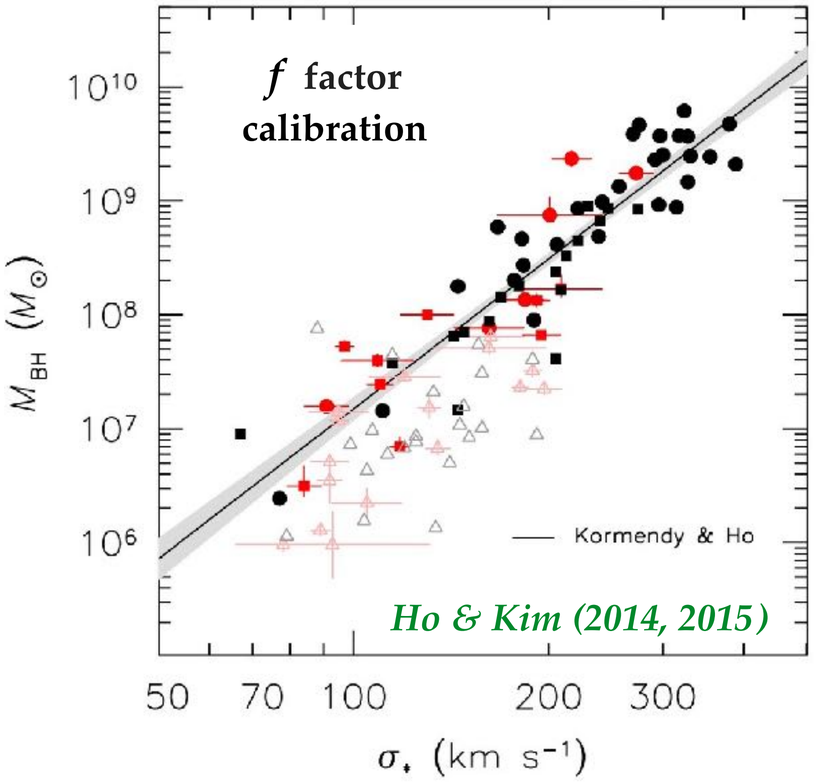
Are the BH masses reliable?

Reverberation mapping



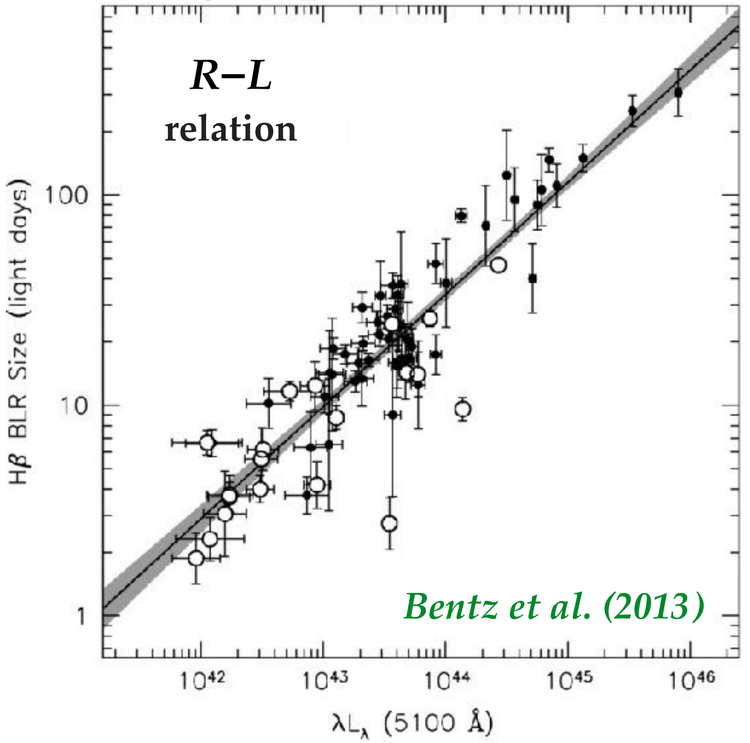
Fausnaugh et al. (2017)

Calibrations, assumptions



Ho & Kim (2014, 2015)

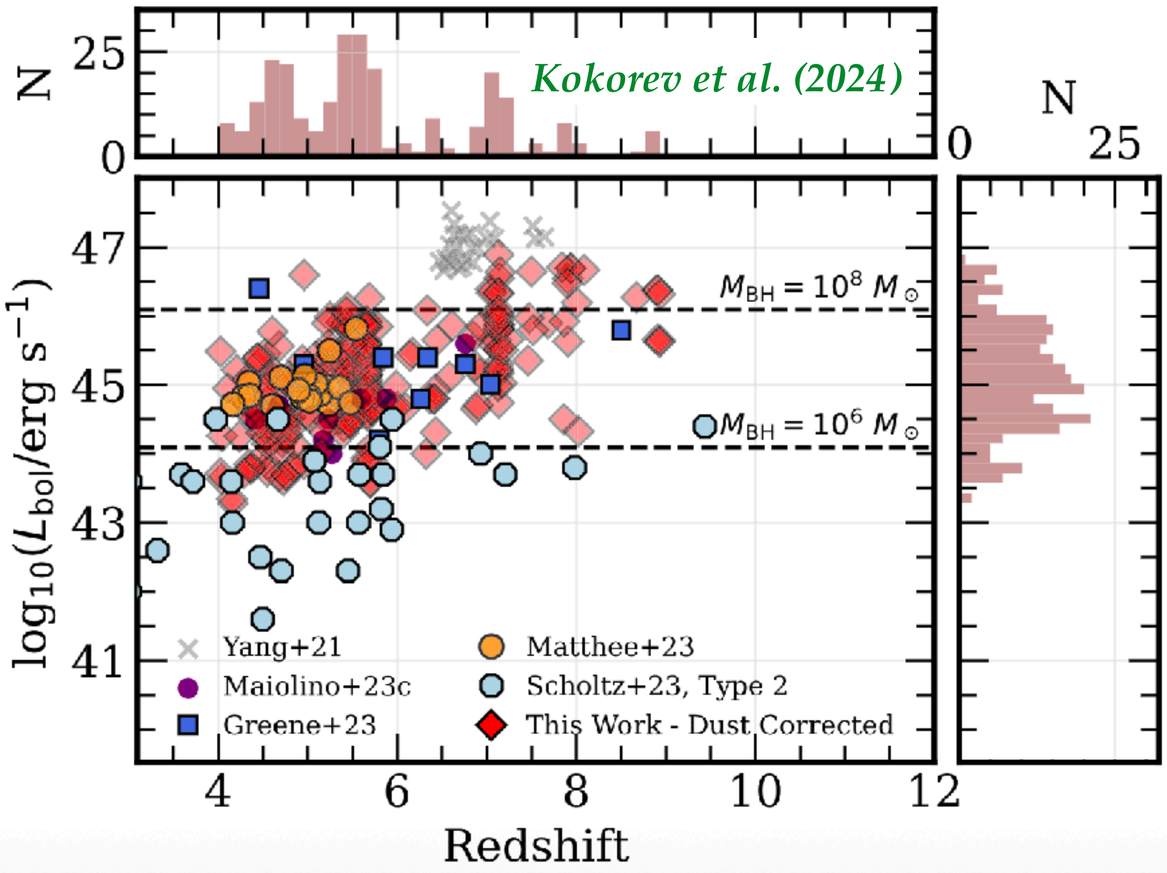
Single-epoch virial masses

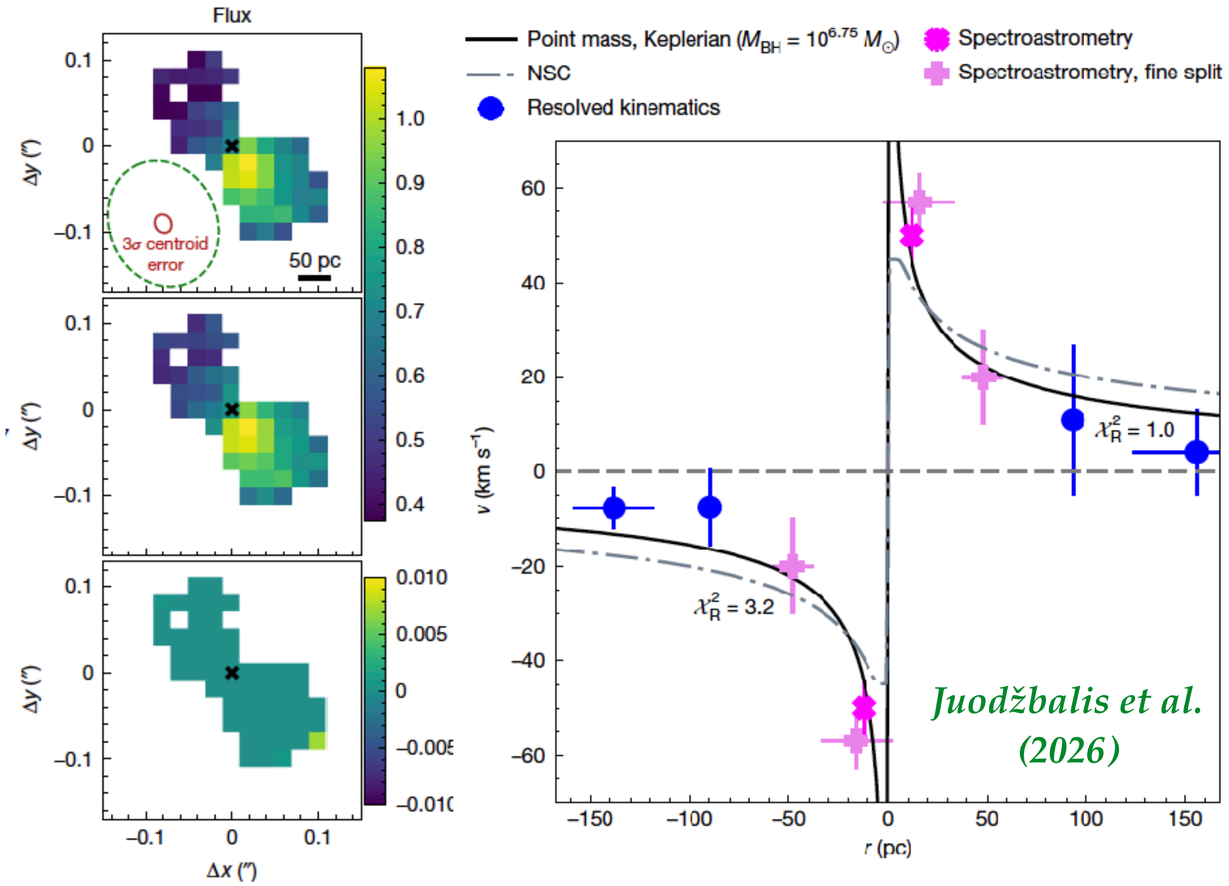


Bentz et al. (2013)

- **Can we trust the single-epoch virial masses at high *z*?**
- **Is the *R*–*L* relation based on RM of local AGNs applicable?**
- **Is the local *f*-factor calibration valid?**
- **Dependence on secondary parameters (e.g., L_{bol}/L_{Edd})?**

Are the BH masses reliable?





$L_{bol} \approx 10^{44} - 10^{46}$ erg s^{-1}

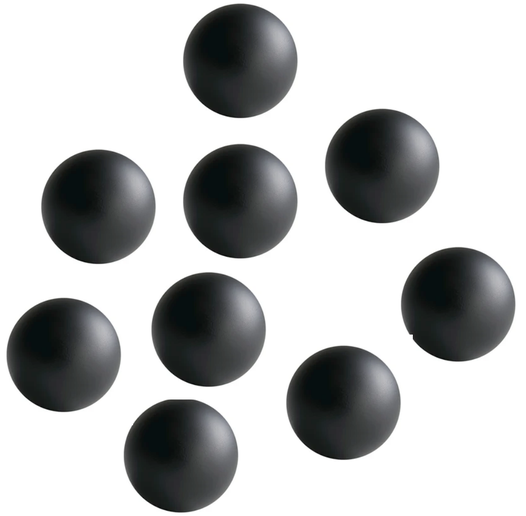
$M \gtrsim 10^6 - 10^8\ M_\odot$

Masses not precise but must be large

Direct, dynamical BH mass of QSO1 is consistent with single-epoch virial mass from broad Hα

Is the massive object really a BH?

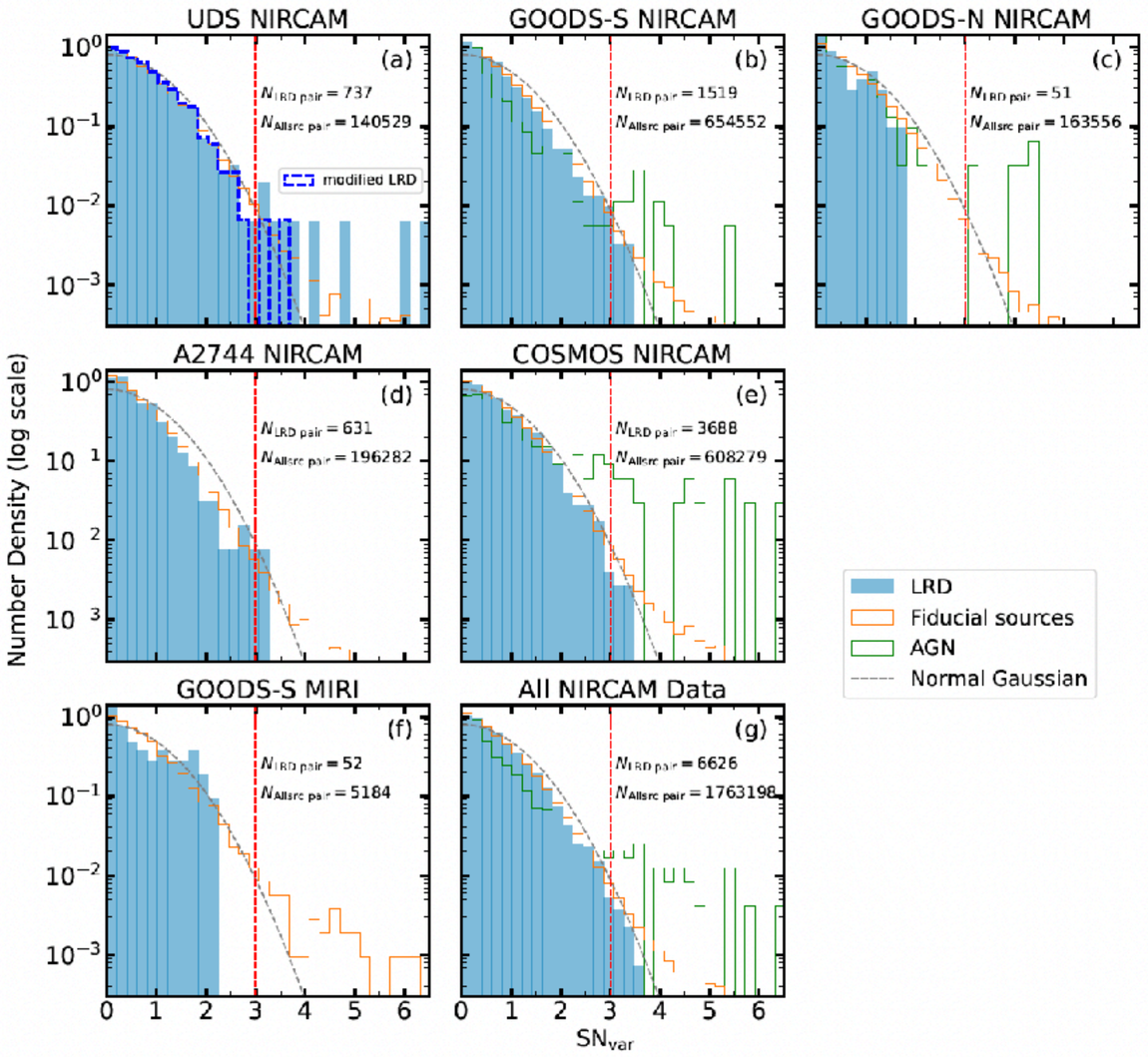




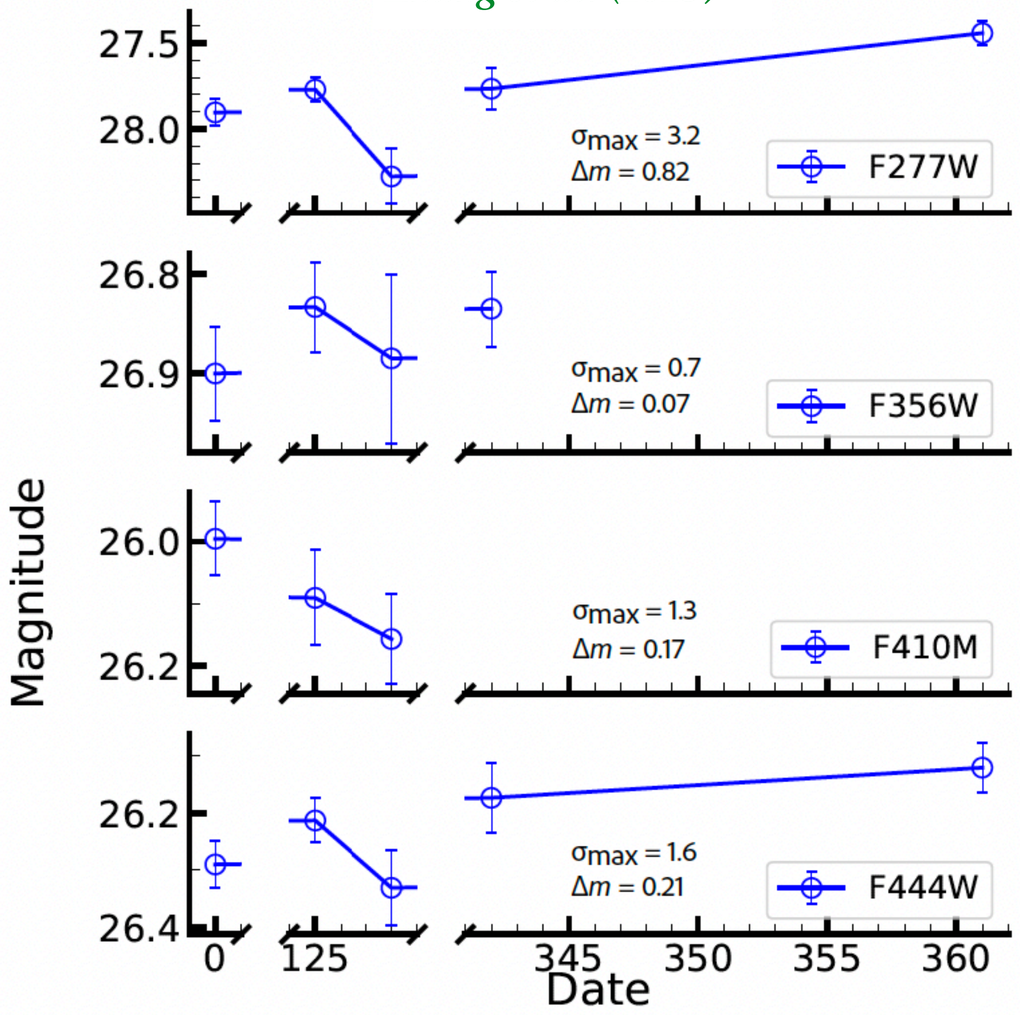




Some LRDs vary!



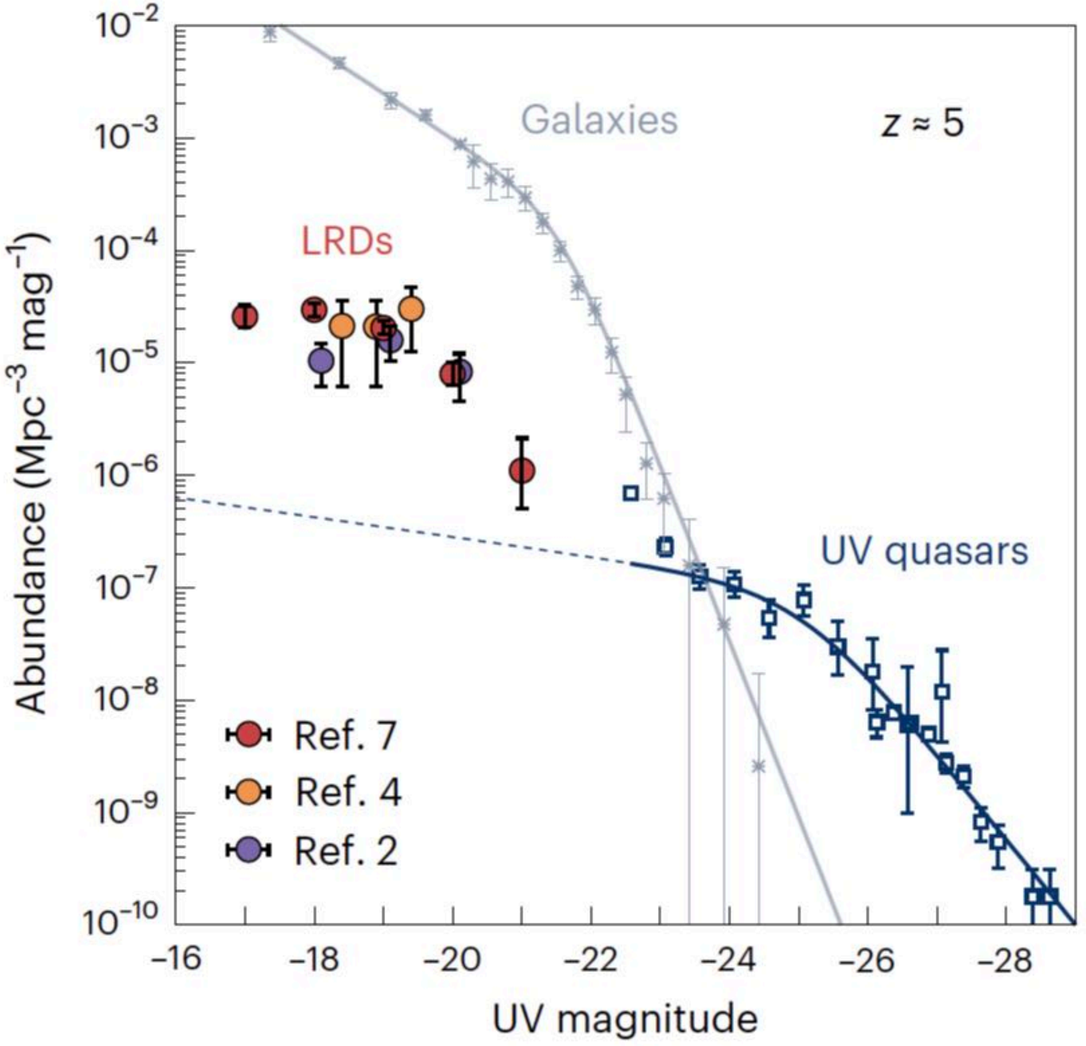
Zhang et al. (2025)



Variability also detected by Furtak et al. (2025), Ji et al. (2025), Lin et al. (2026), Zhang et al. (2026)

"Little Red Dots" are very abundant, may evolve rapidly

Kocevski et al. (2024); Kokorev et al. (2024); Maiolino et al. (2024), etc.

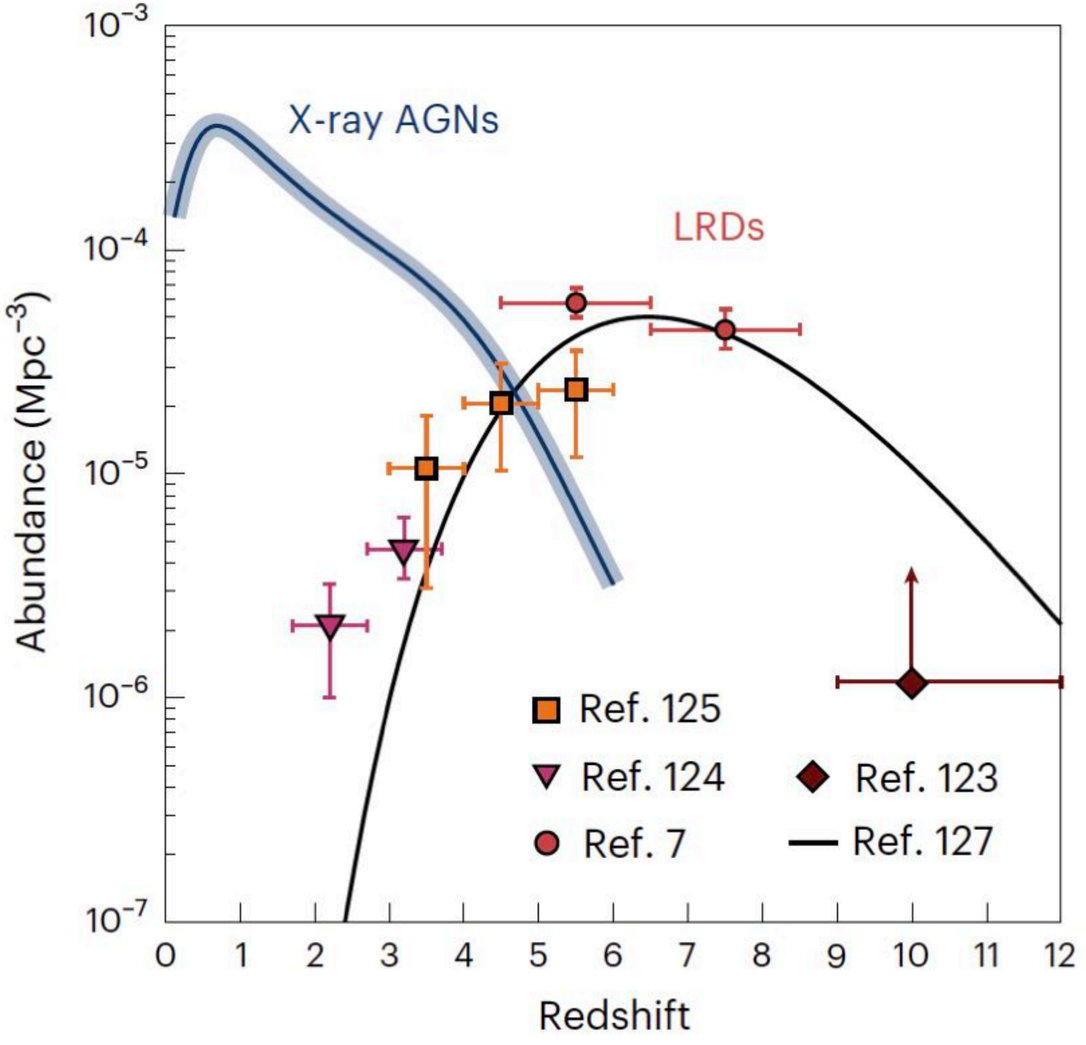




- **High space density,** ~100 times that of quasars
- Abundance ~1% of the general galaxy population

"Little Red Dots" are very abundant, may evolve rapidly

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- **High space density,** ~100 times that of quasars
- Abundance ~1% of the general galaxy population

- **Apparent decline at $z \lesssim 4$.** Selection effect?

LRDs have four unusual, distinct spectral features

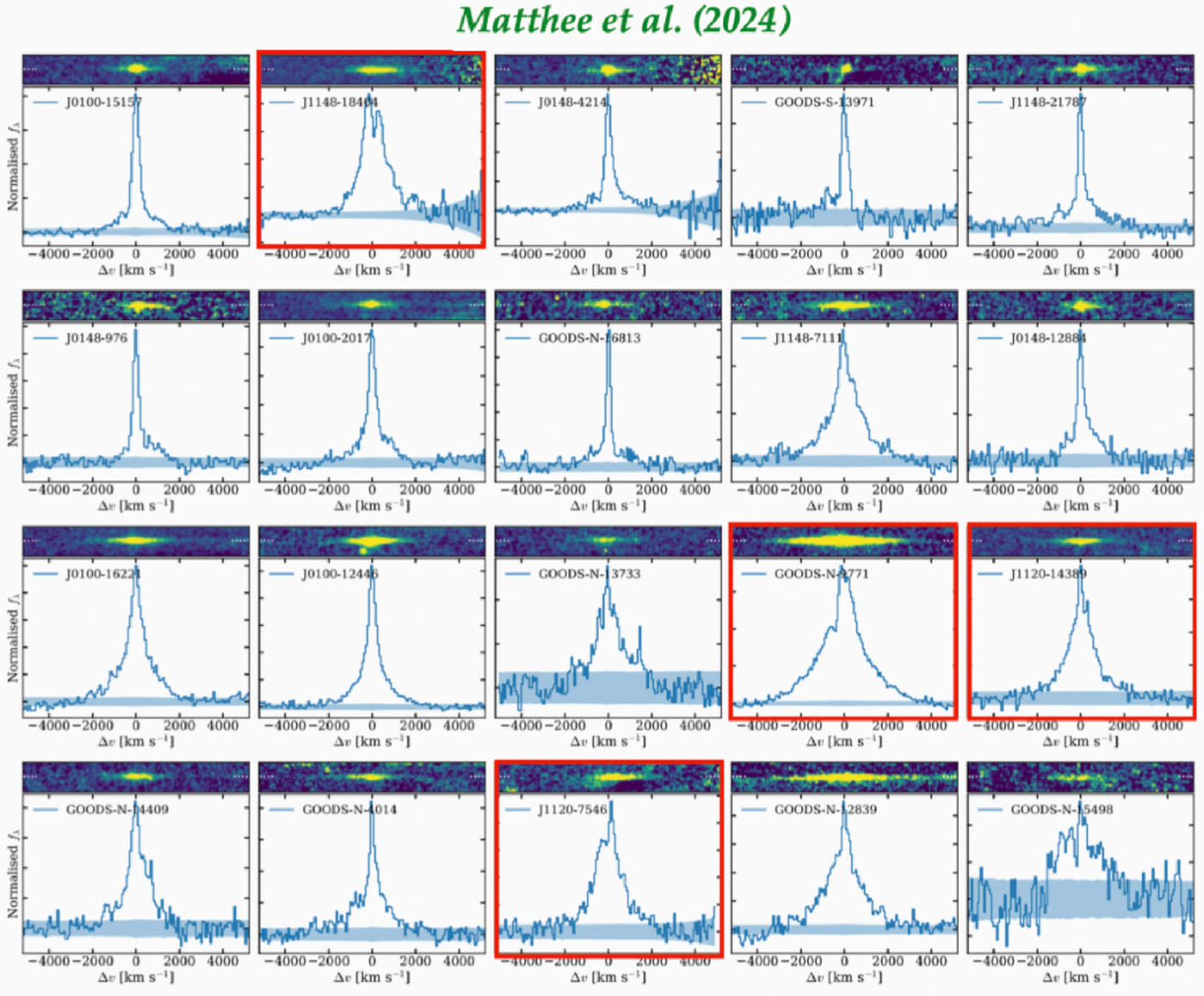
Absorption

Break

Continuum

Decrement

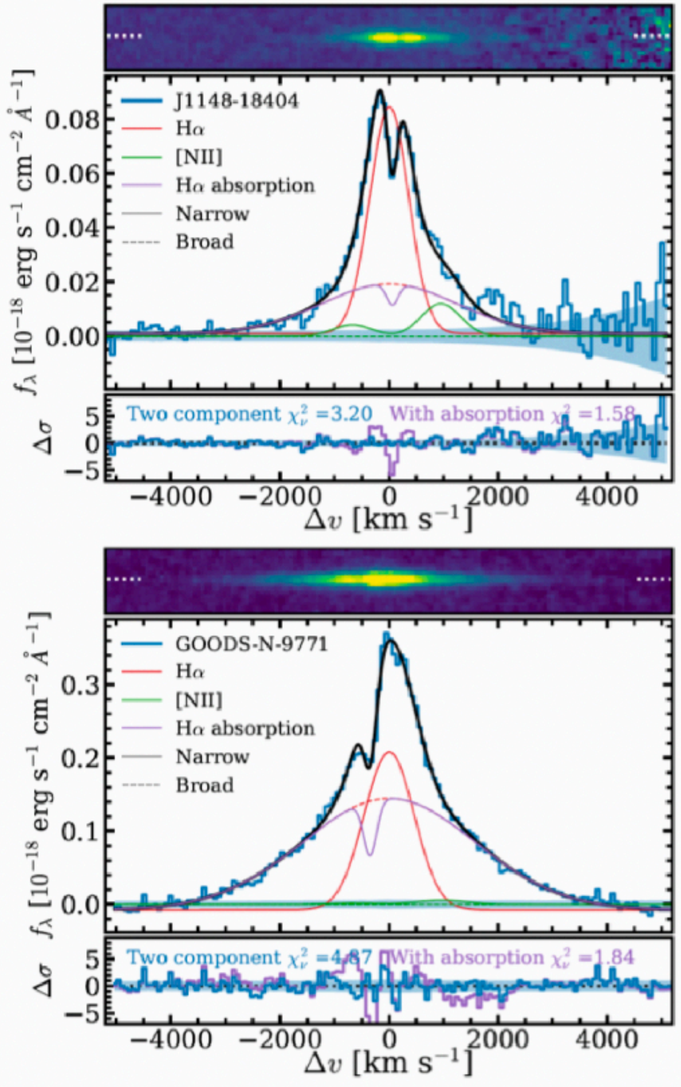
Absorption of Balmer lines



- Balmer absorption in ≳10%–20% LRDs, on top of emission lines

Absorption of Balmer lines

Matthee et al. (2024)

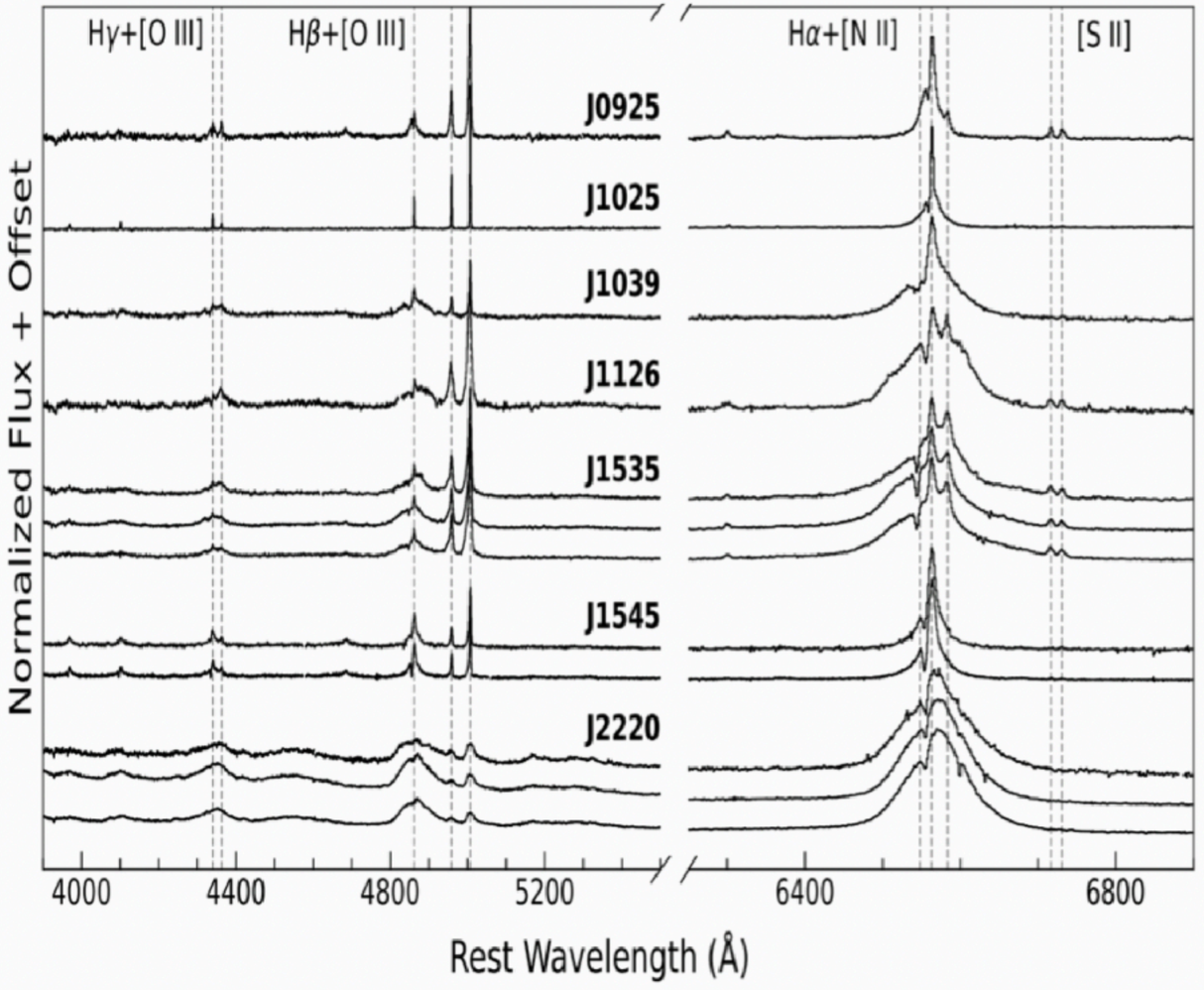


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- Important inference: existence of dense gas (collisionally populate H to $n = 2$) of relatively high covering factor

Absorption of Balmer lines

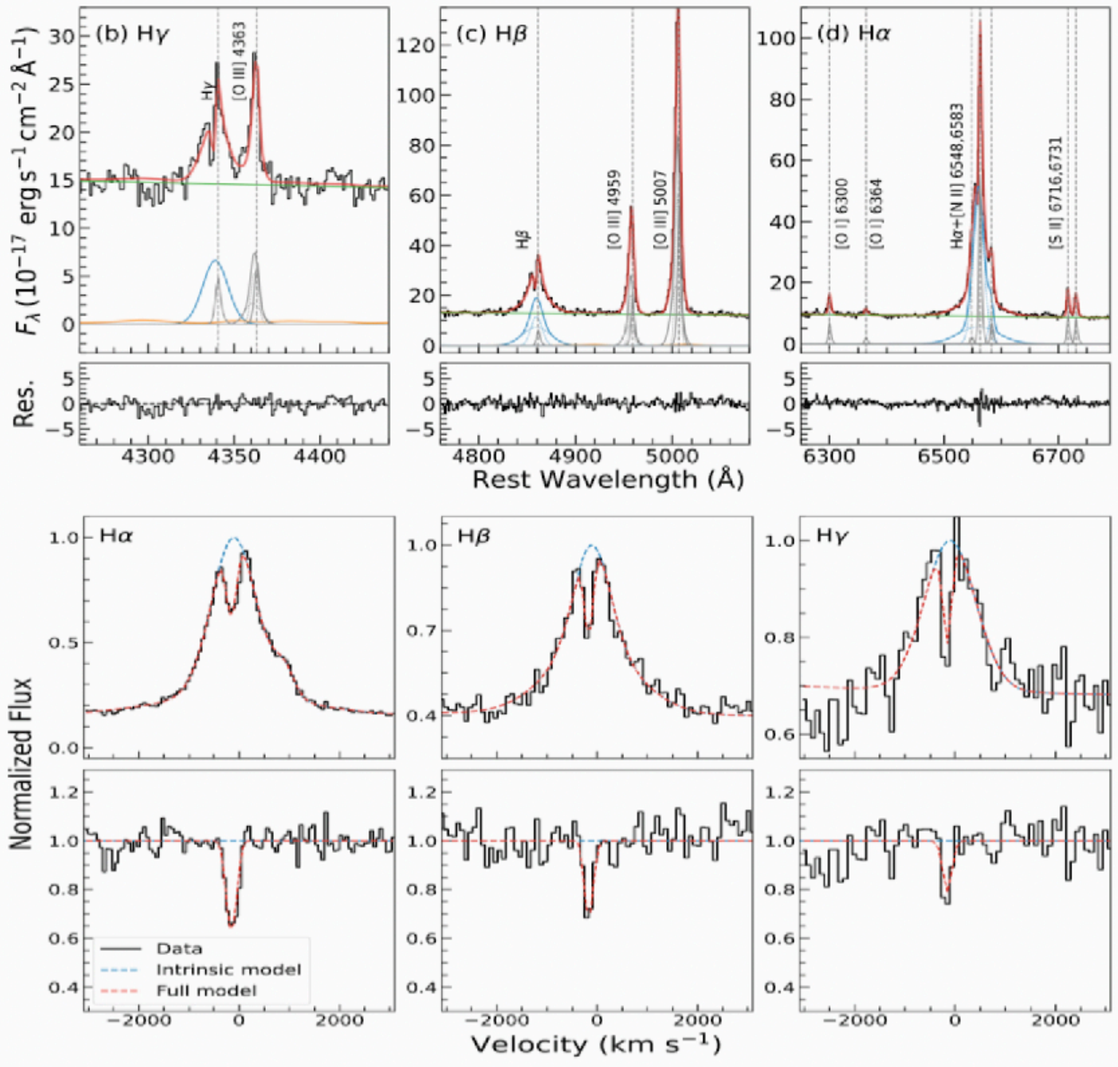
Shangguan, Chen, Ho et al. (2026)



- Balmer absorption in ≳10%–20% LRDs, on top of emission lines
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- This phenomenon is very rare locally
- Only 7/15,000 = 0.05% at $z < 0.35$

Absorption of Balmer lines

Shangguan, Chen, Ho et al. (2026)



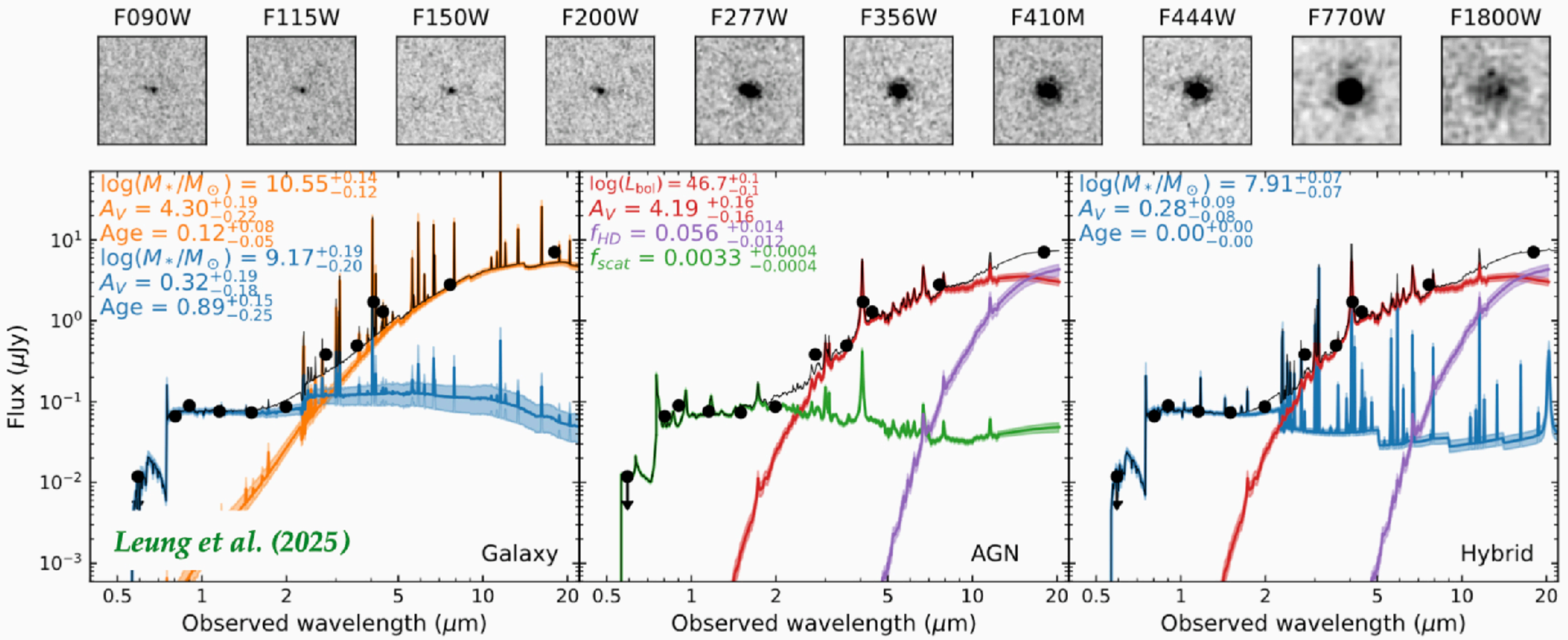
- Balmer absorption in ≳10%–20% LRDs, on top of emission lines

- Important inference: existence of dense gas (collisionally populate H to $n = 2$) of relatively high covering factor

- This phenomenon is very rare locally
- Only 7/15,000 = 0.05% at $z < 0.35$

- Simultaneous decomposition of emission and absorption components of Hα, Hβ, and Hγ
- Measure covering factor of absorbers
- In optically thin regime, the EW ratio of Hα : Hβ : Hγ = 9.8 : 1 : 0.3
- Deviation from nominal ratios implies a covering factor $C_f < 1$

Balmer Break

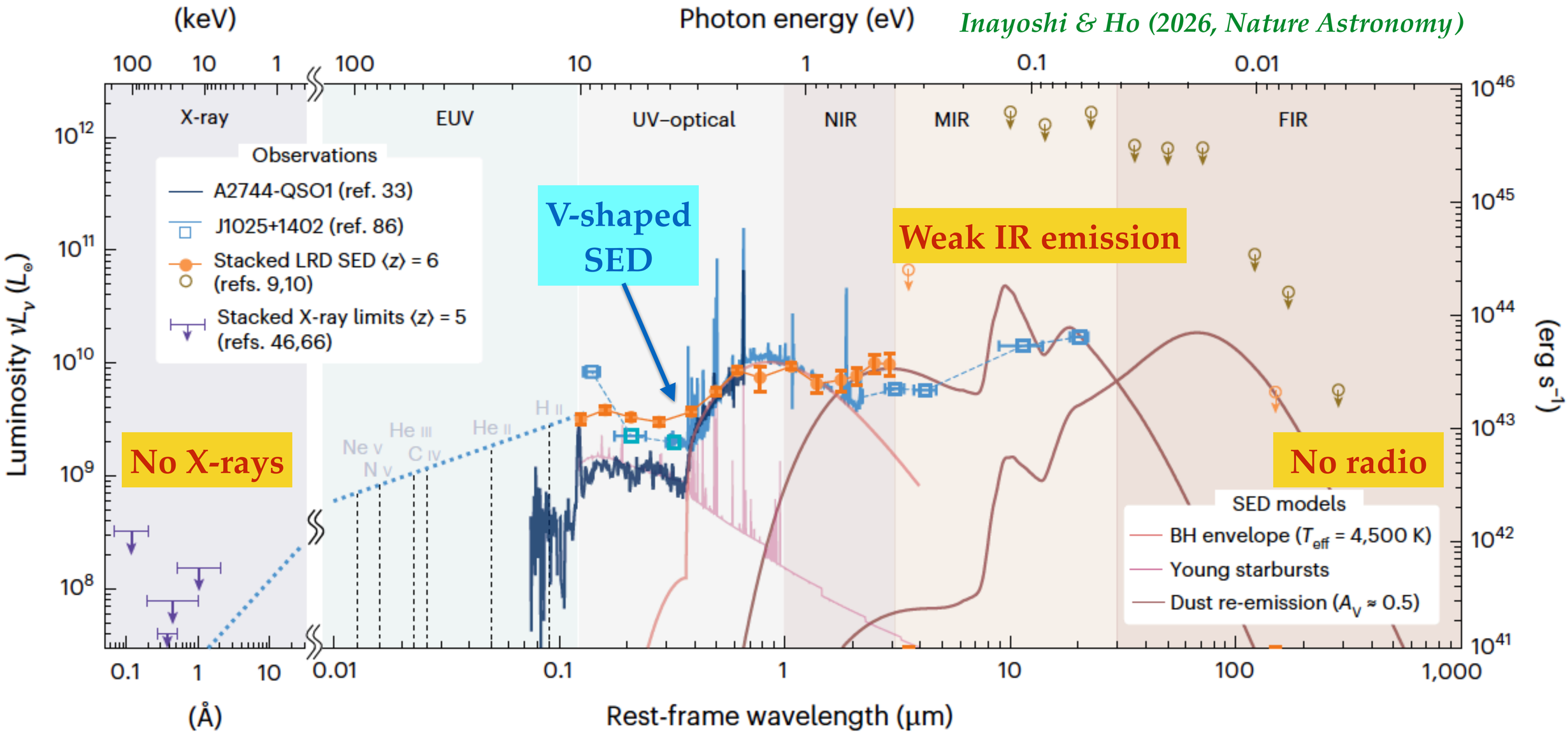


- **V-shaped SED**, many interpretations, controversial: pure galaxy, pure AGN; creative combinations thereof

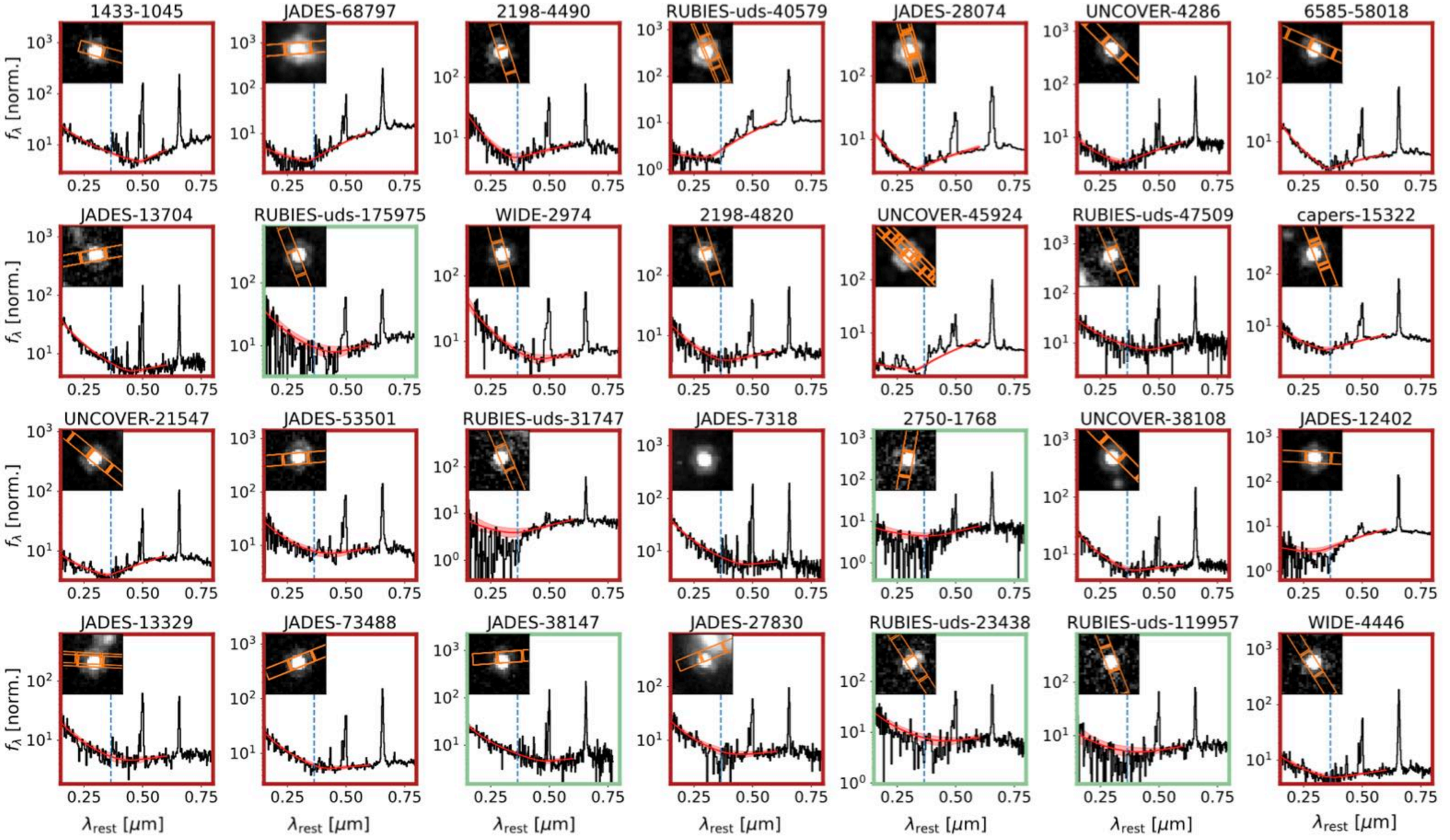
- **Significant dust reddening?**
- No X-rays; no radio emission

Balmer Break

Inayoshi & Ho (2026, Nature Astronomy)



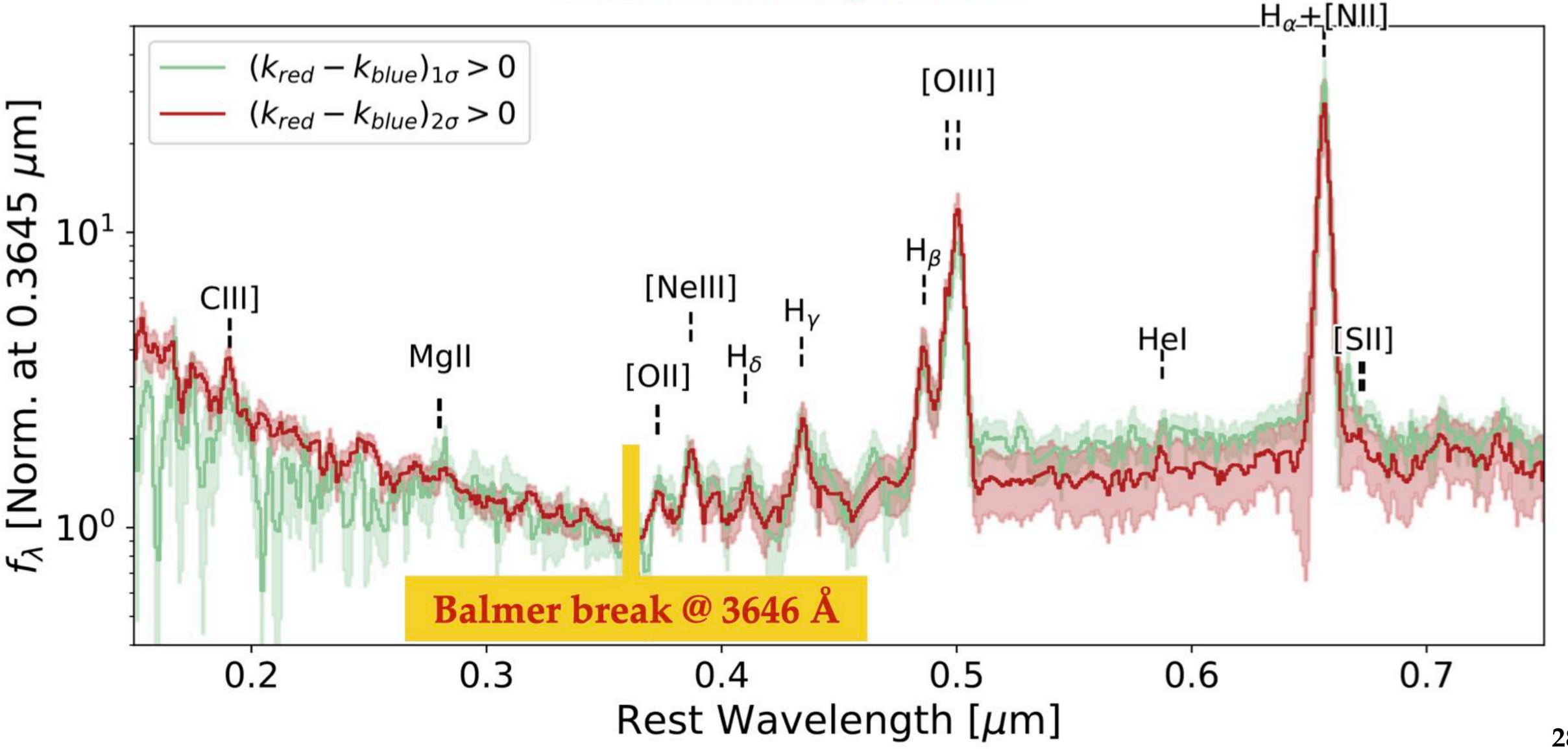
What causes the break in the SED?



What causes the break in the SED?

Stacking reveals inflection point consistent with the Balmer limit

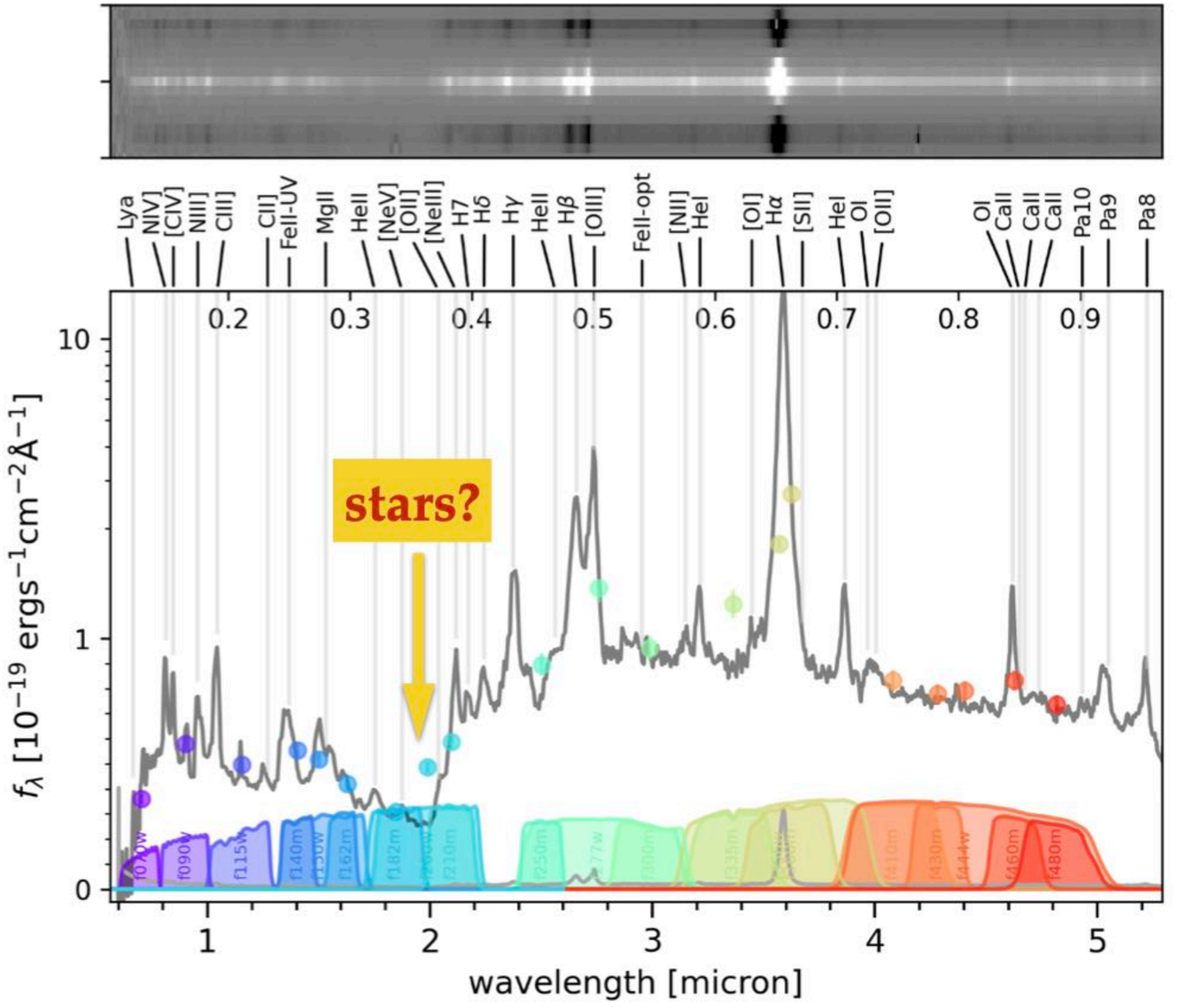
Setton, Greene, de Graaff, et al. (2025)

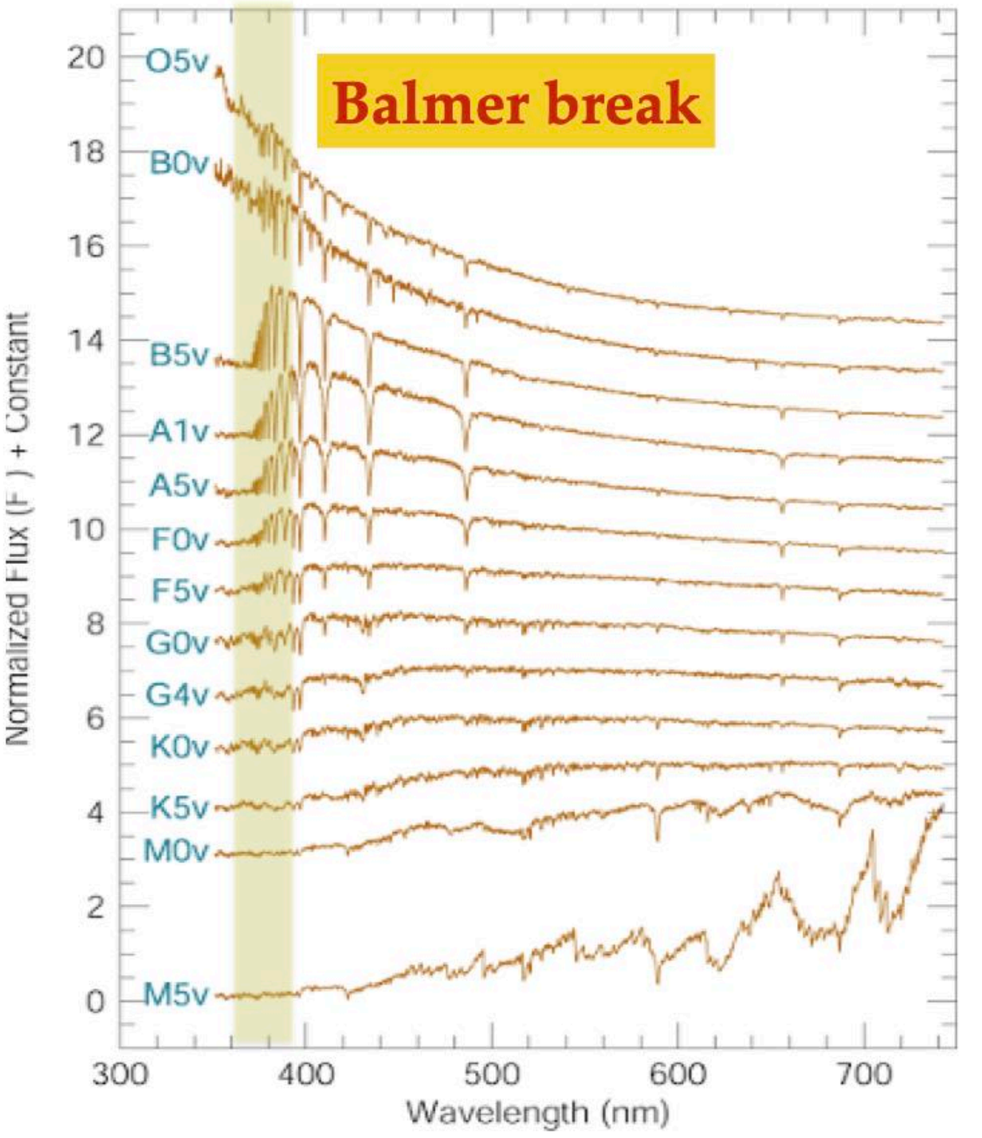


What causes the break in the SED?

Definitive signature of evolved stellar population

Labbé, Greene, Matthee et al. (2026)

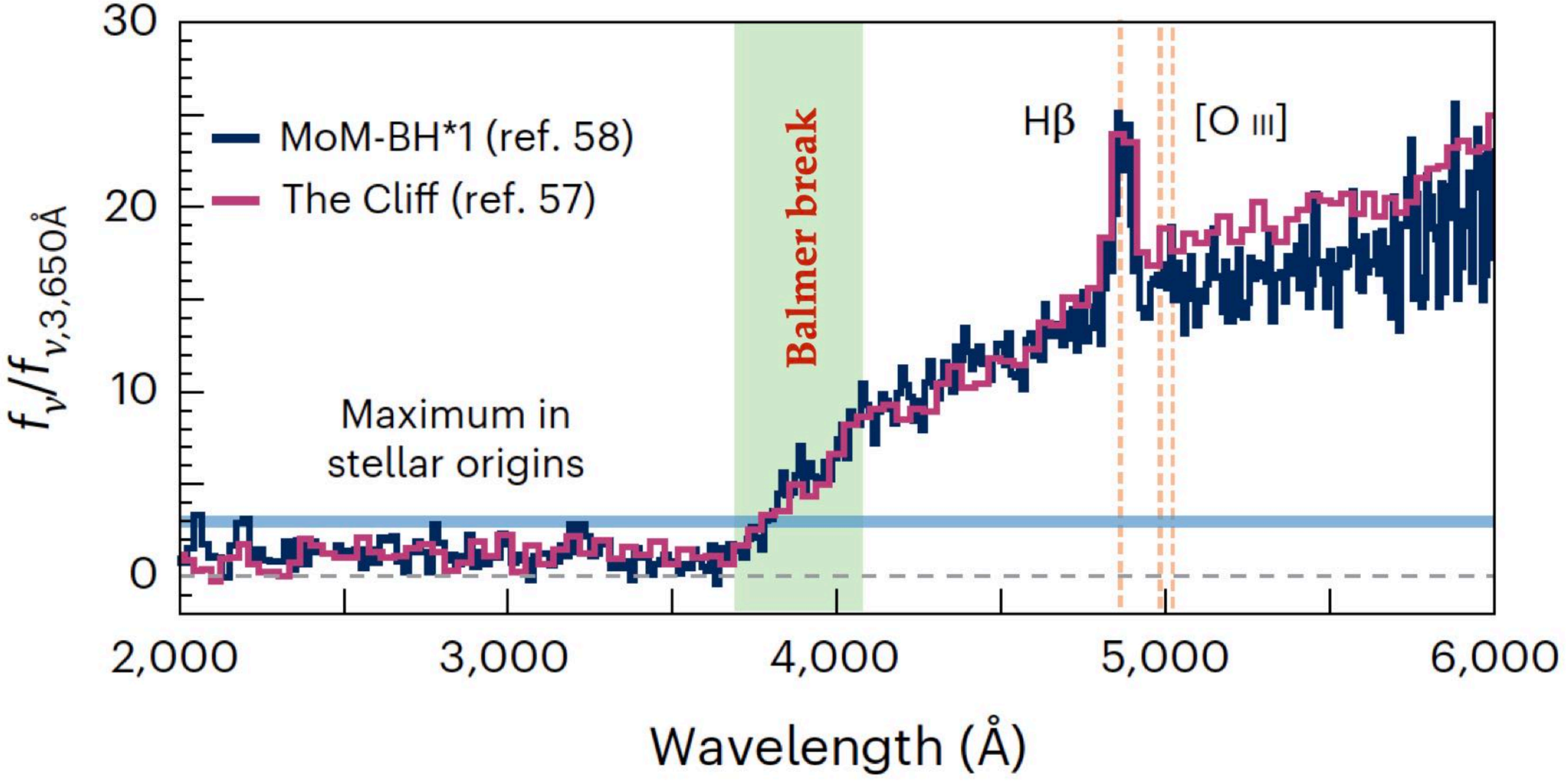




What causes the break in the SED?

Break strength and shape inconsistent with stars

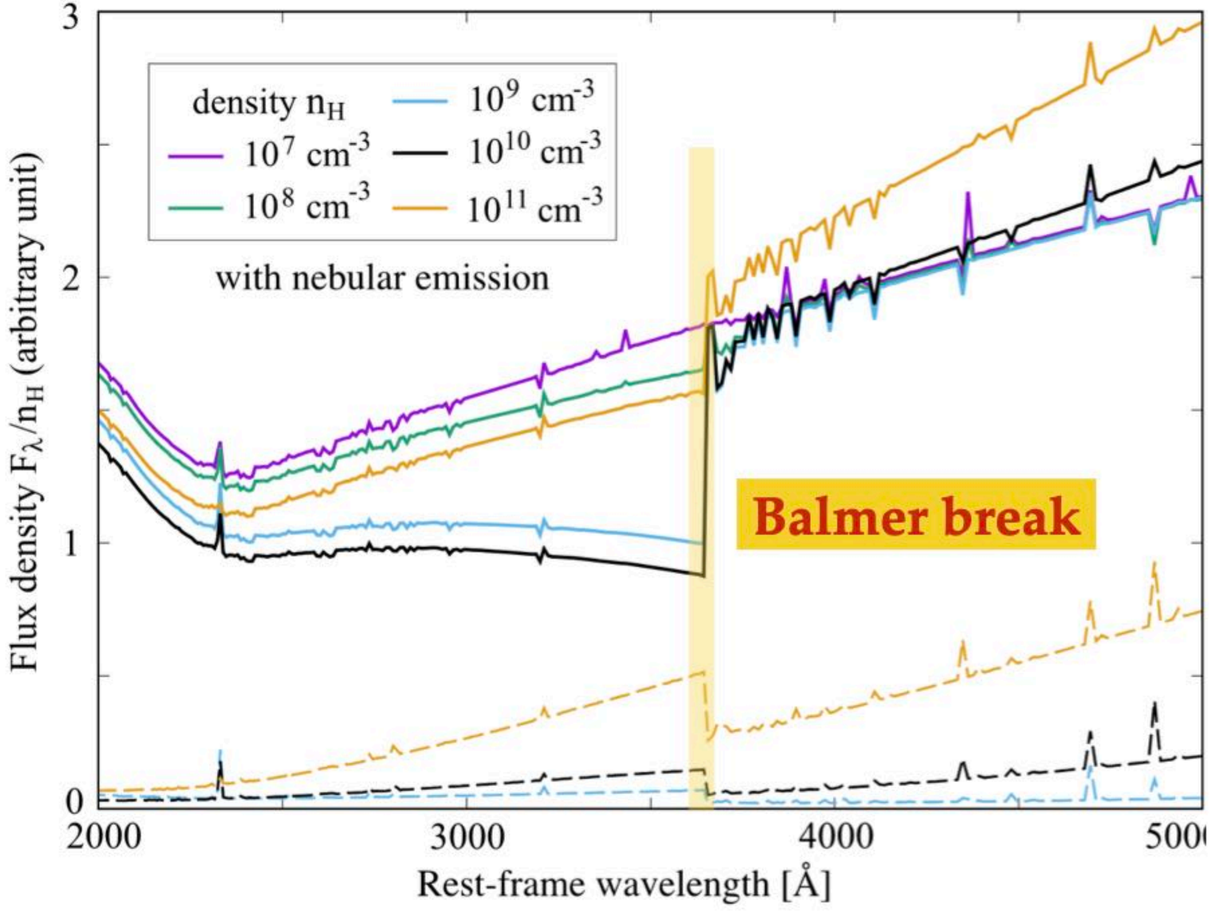
de Graaff, Rix, Naidu et al. (2025), Naidu, Matthee, Katz et al. (2026)

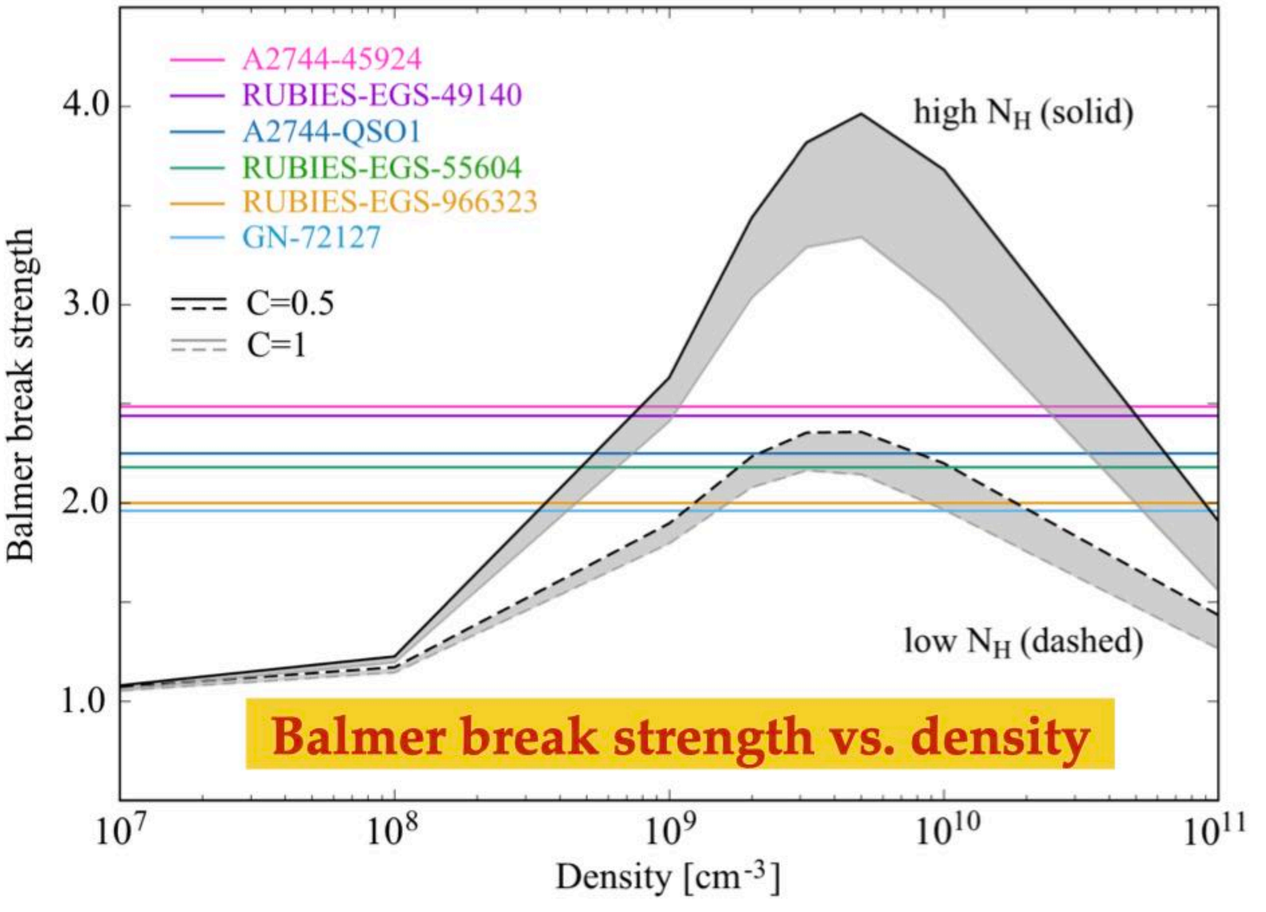


What causes the break in the SED?

Optically thick, dense gas

Inayoshi & Maiolino (2025)



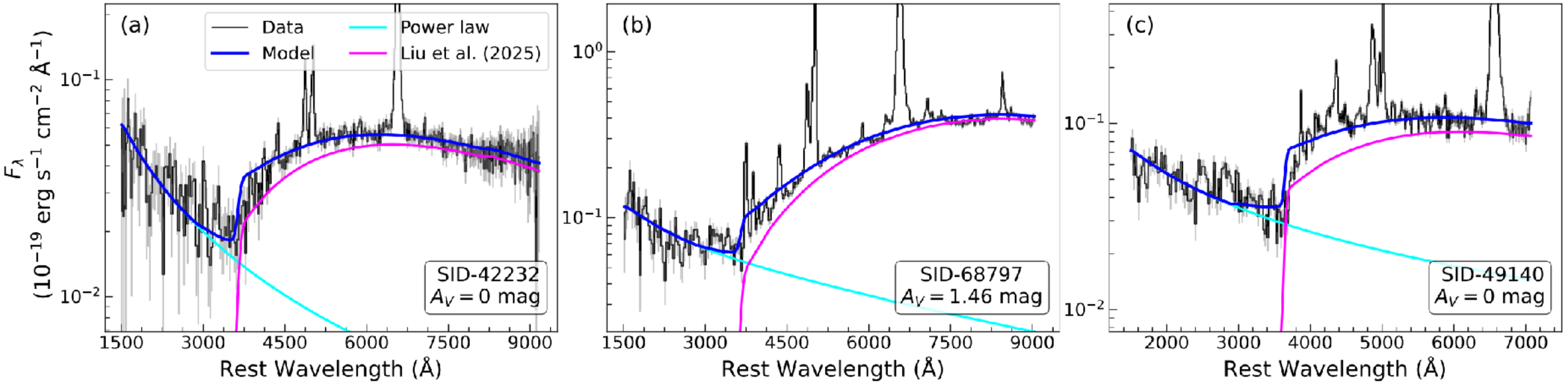


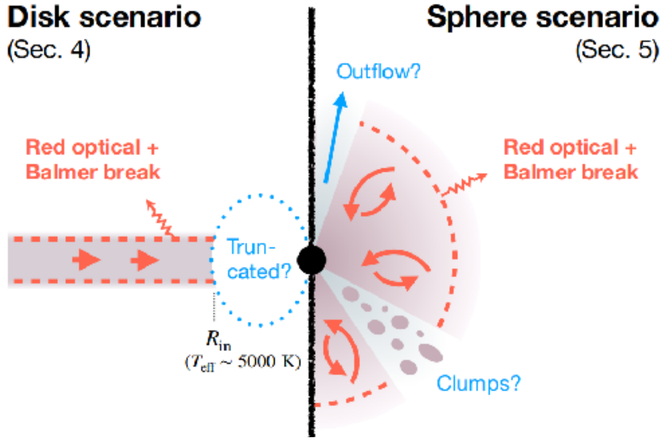
Balmer break produced by absorption from dense gas ($n_H > 10^9$–10^{10} cm^{-3})

The densities needed for the Balmer break are similar to those that produce Balmer absorption

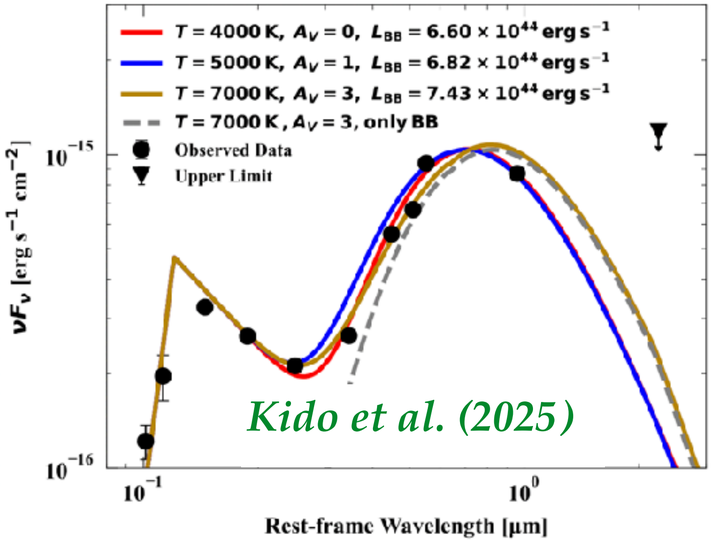
Optical Continuum

Chen, Shangguan, Ho et al. (2026)





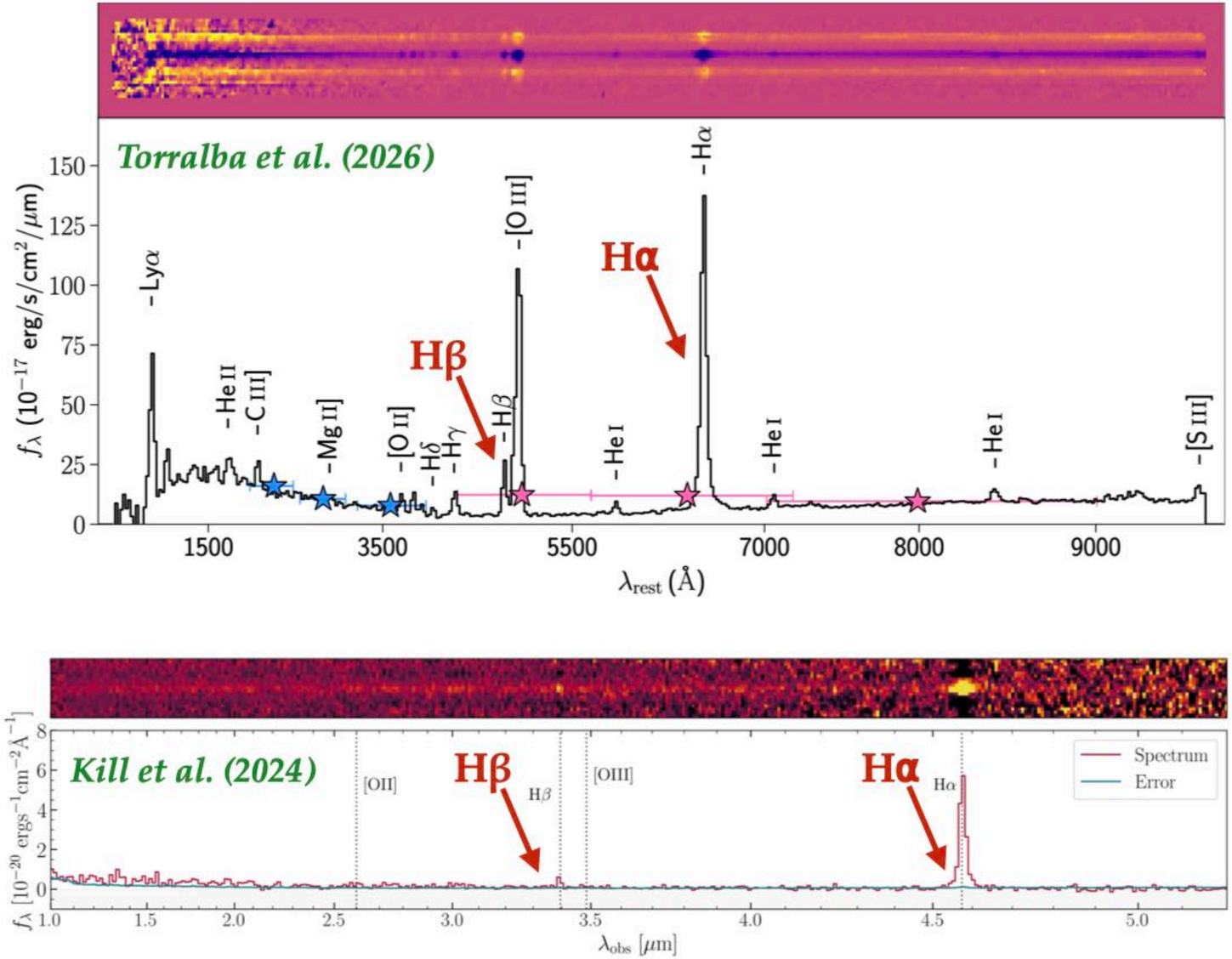
Liu et al. (2025)



Kido et al. (2025)

- **Optical continuum can be fit with ~4000-6000 K blackbody**
- **UV continuum from accretion disk reprocessed to optical continuum by dense gas**

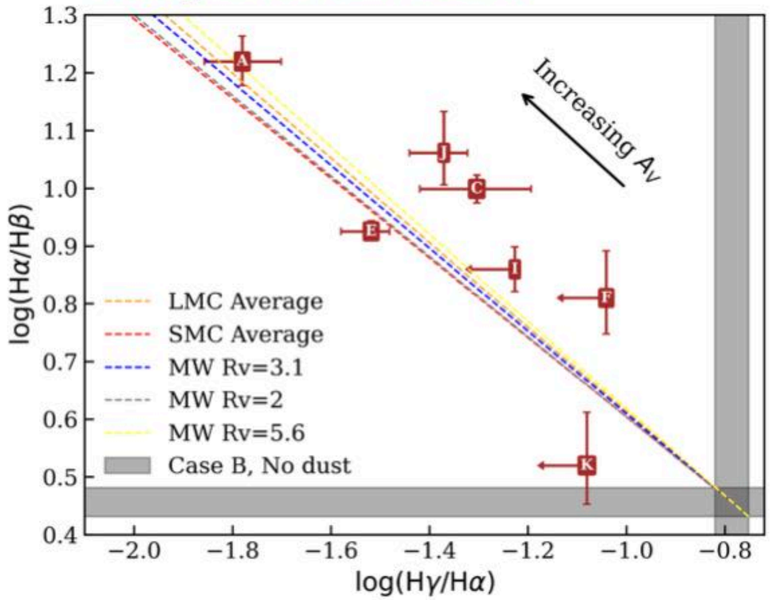
Balmer Decrement

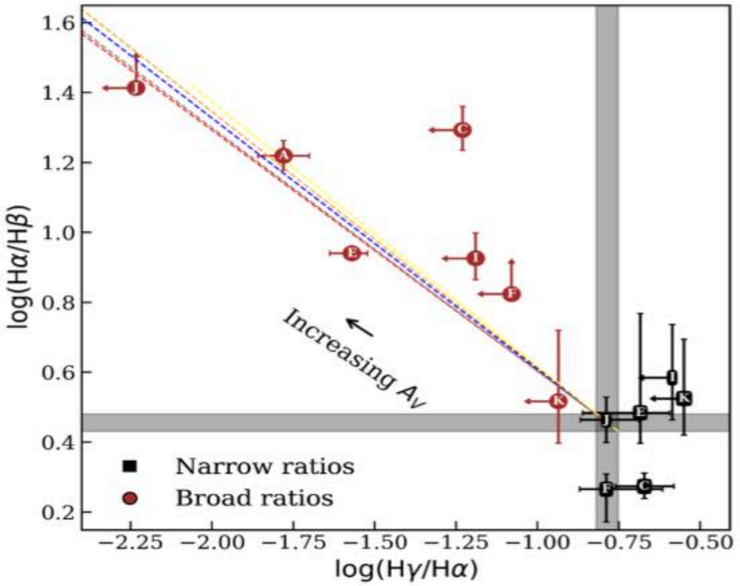


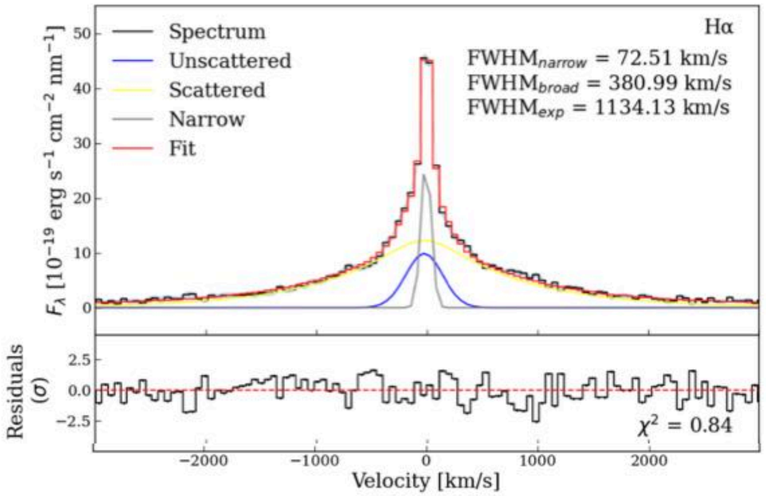
- **Hα/Hβ very high (>10), much larger than typical $z = 0$ AGNs (Hα/Hβ ≈ 3–4)**
- **Inferred A_V violates MIR constraints**

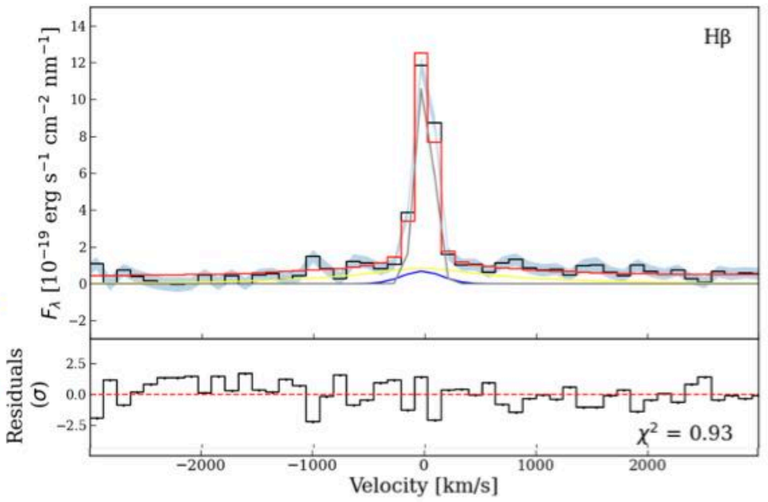
Balmer Decrement

Nikopoulos et al. (2026)







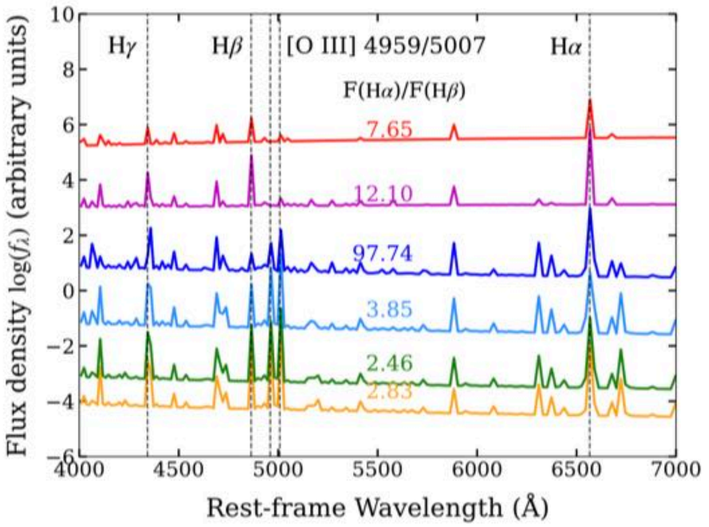


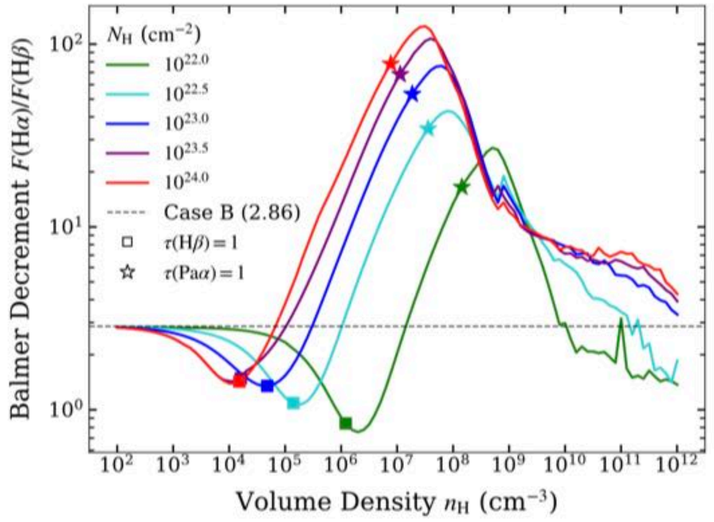
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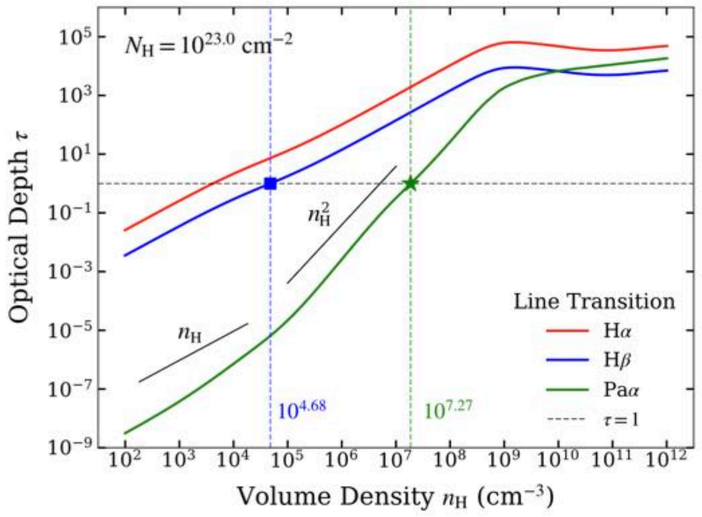
- **Hα/Hβ (broad) » Hα/Hβ (narrow)**
- **Excludes dust reddening** as origin of high Balmer decrements of broad lines

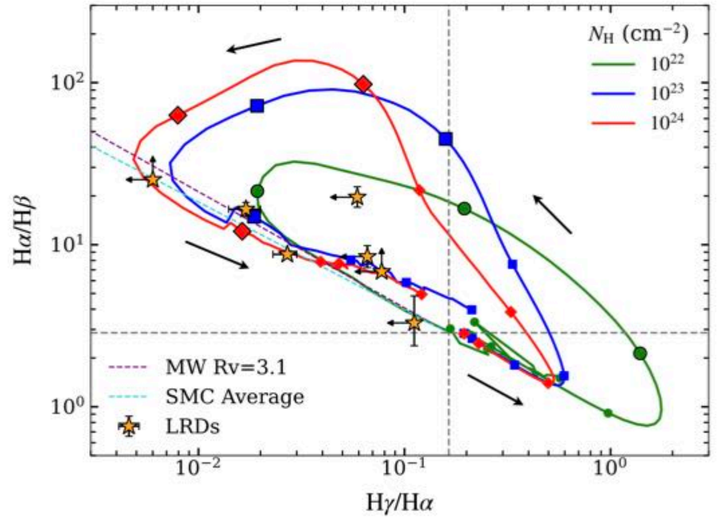
Balmer Decrement

Yan et al. (2026)









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- Inferred A_V violates MIR constraints

- **Hα/Hβ (broad) » Hα/Hβ (narrow)**
- **Excludes dust reddening** as origin of high Balmer decrements of broad lines

- **Radiative transfer effects in dense gas ($n_H > 10^7$ cm^{-3})**, including high optical depths and resonance scattering of Balmer lines, naturally generate Balmer decrements above Case B value (Baldwin 1975; Netzer 1975)

The Astrophysical Journal, 2026, submitted

ABCD: The Nuclear Structure of the Little Red Dots Revealted through Absorption, Break, Continuum, and Decrement

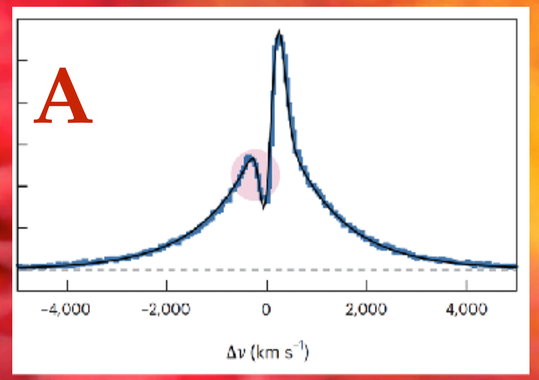
Chang-Hao Chen (陈昌灏),[1,2] Jinyi Shangguan (上官晋沂),[1,2] Luis C. Ho,[1,2] Zijian Zhang (张子键),[1,2] Kohei Inayoshi,[1,2] and Ruancun Li (李阮存)[3]

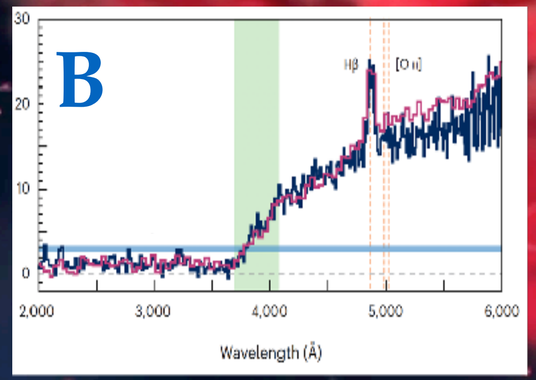


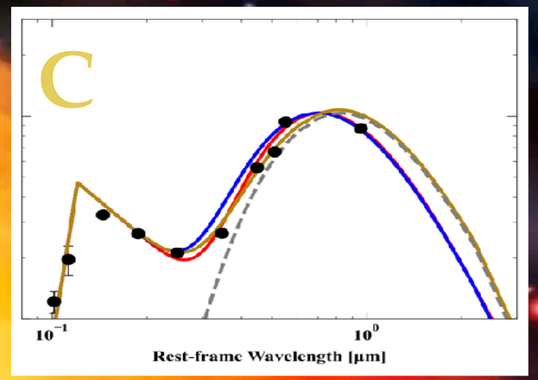
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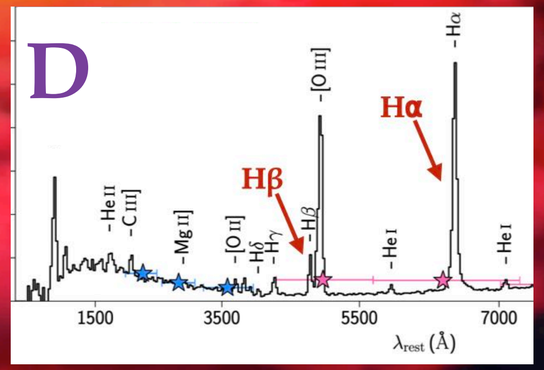
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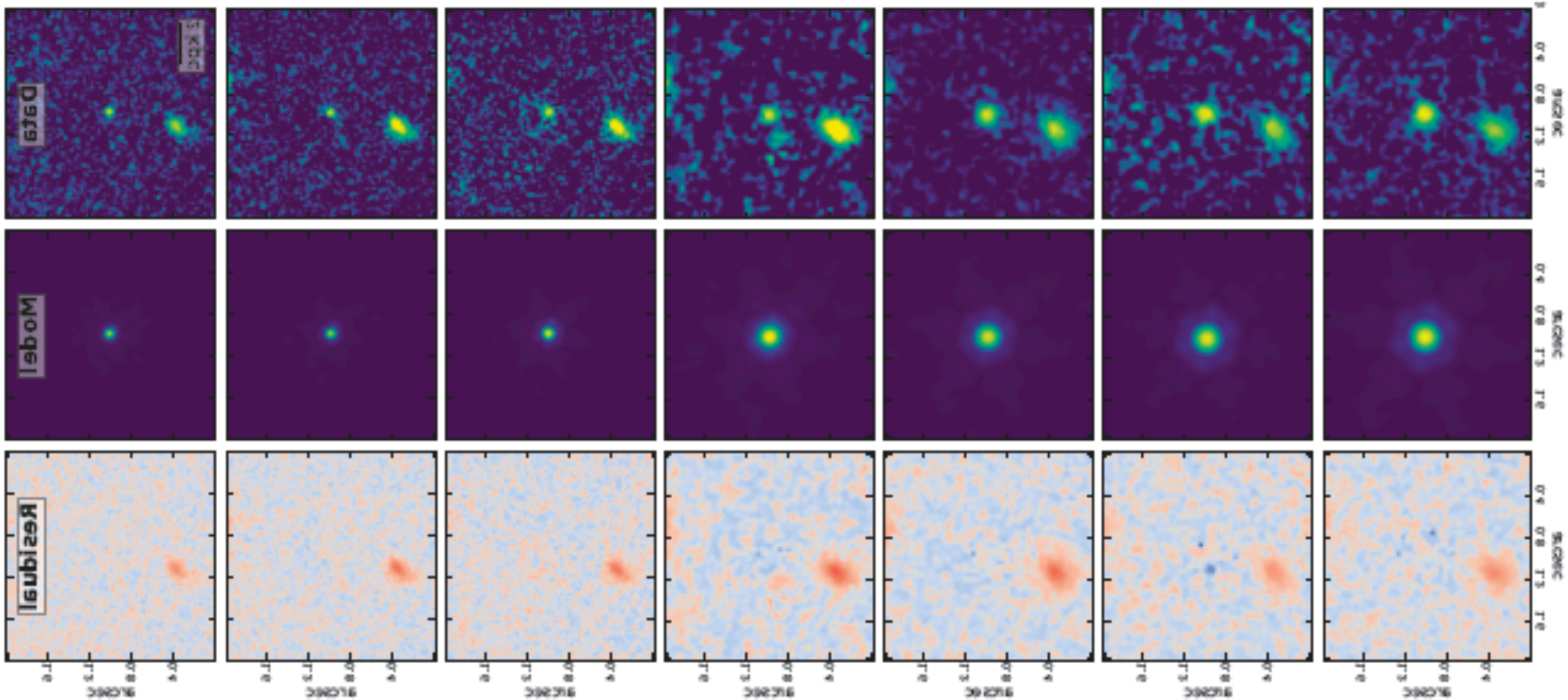


What is the intrinsic nature of the "little red dots"?

Inayoshi & Ho (2026, Nature Astronomy)

	AGN	Enshrouded AGN	Galaxy	Notes
Morphology	✔ BHs		✕ Compact galaxies	No obvious host galaxies in most LRDs. Extremely high stellar density if all emission is from stars.
Broad-line emission	✔ Broad-line regions		? WRs/SNe	In stellar scenarios, some stellar activity (WR winds and SNe) or a very deep stellar potential could yield broad lines, but each case has some issues (see text).
Variability	✔ Weak/non-zero variability		✕ No variability	Super-Eddington accretion exhibits weak variability, consistent with most LRDs. Some LRDs with clear variability contradict the stellar scenario.
Balmer break, absorption, decrement	✔ Dense gaseous absorbers	✔ Gas envelopes	✕ Evolved galaxies	Absorption on stellar continua is too weak to imprint absorption on top of broad-line emission. Some LRDs exhibit breaks too deep to be consistent with starlight.
Blue UV	? Scattered light of AGN	? Clumpy absorbers/ Additional stars	✔ Unobscured galaxy	The uniformity of V-shaped SEDs requires a fine-tuning of the relative contribution. UV part can be explained by reasonable stellar mass and SFR.
Red optical	✕ Dust-reddened AGN	✔ Optically thick gaseous envelope	✕ Dusty star formation	The stellar mass required in the galaxy scenario is too massive to form in high-redshift halos.
Faint NIR	✕ Hot dust	✔ Thermal spectrum from gaseous envelope	✔ Stellar spectrum	Bright NIR in dust-reddened AGN violates MIRI. A gaseous envelope naturally explains flat IR spectrum.
X-ray weak	✔ Super-Eddington/ Compton thickness		✔ Intrinsically weak	Corona cools down in super-Eddington accretion flows with outflows and funnel-like density structures.
Radio weak	✔ Radio-quiet AGN		✔ Intrinsically weak	Radio non-detection of LRDs is consistent with current detection limits for radio-quiet AGNs.
ALMA weak	✔ Consistent		✕ Cold dust emission	ALMA constraints limit dust mass. Star formation does not dominate LRD energy.

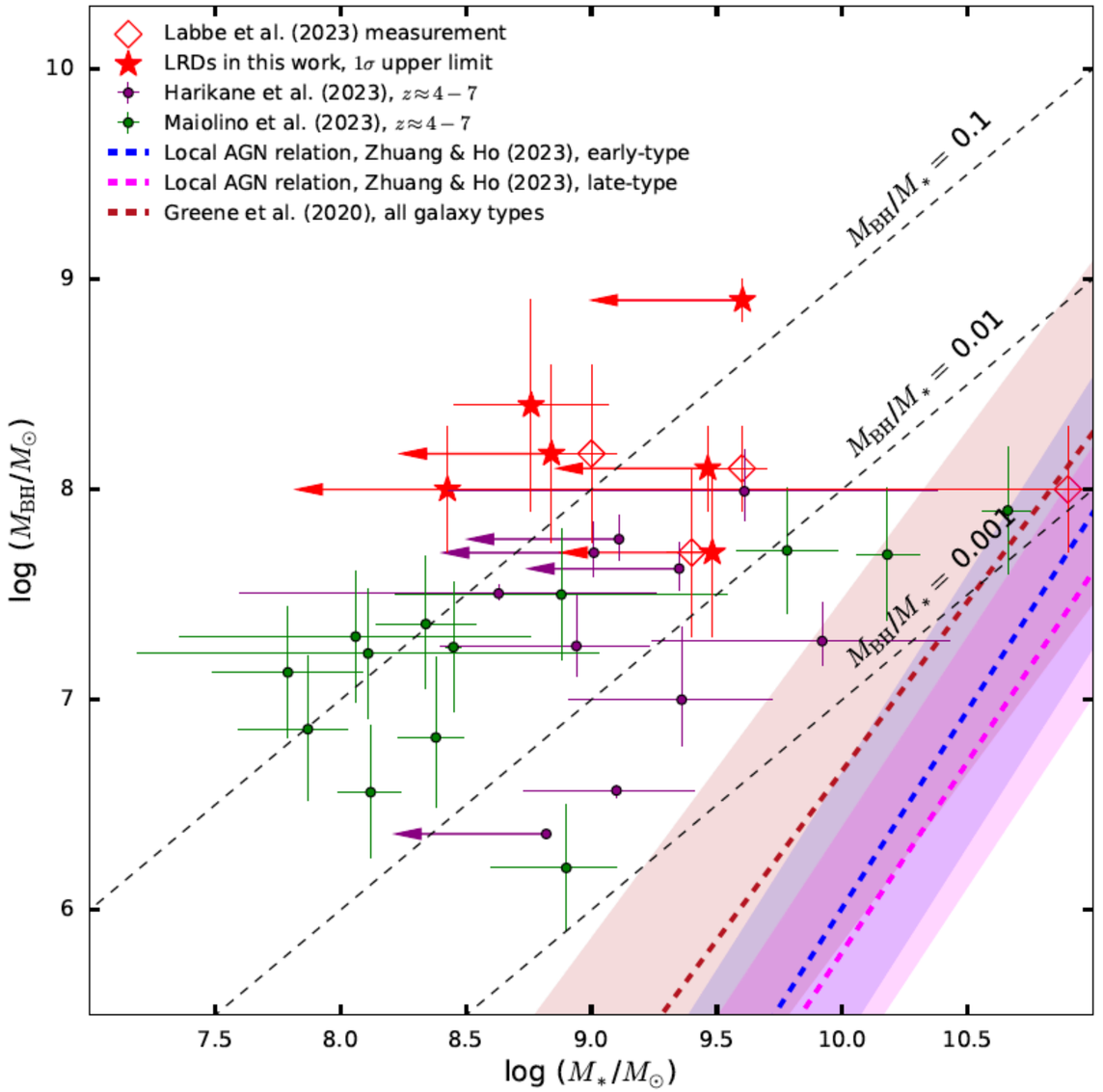
Where is the galaxy?



The Astrophysical Journal, 983:60 (25pp), 2025 April 10

The Host Galaxy (If Any) of the Little Red Dots

Chang-Hao Chen (陈昌灏)[1,2], Luis C. Ho[1,2], Ruancun Li (李阮存)[1,2], and Ming-Yang Zhuang (庄明阳)[3]



- No host emission detected
- Stringent upper limits placed on the stellar masses of the host galaxies

- Extremely overmassive BHs or very undermassive galaxies
- BH forms earlier or faster than galaxy

Normal host galaxy
($R_e \approx 5$ kpc)



$M_\bullet \approx 10^6 - 10^8\, M_\odot$

Host galaxy of LRD
($R_e < 0.05$ kpc)

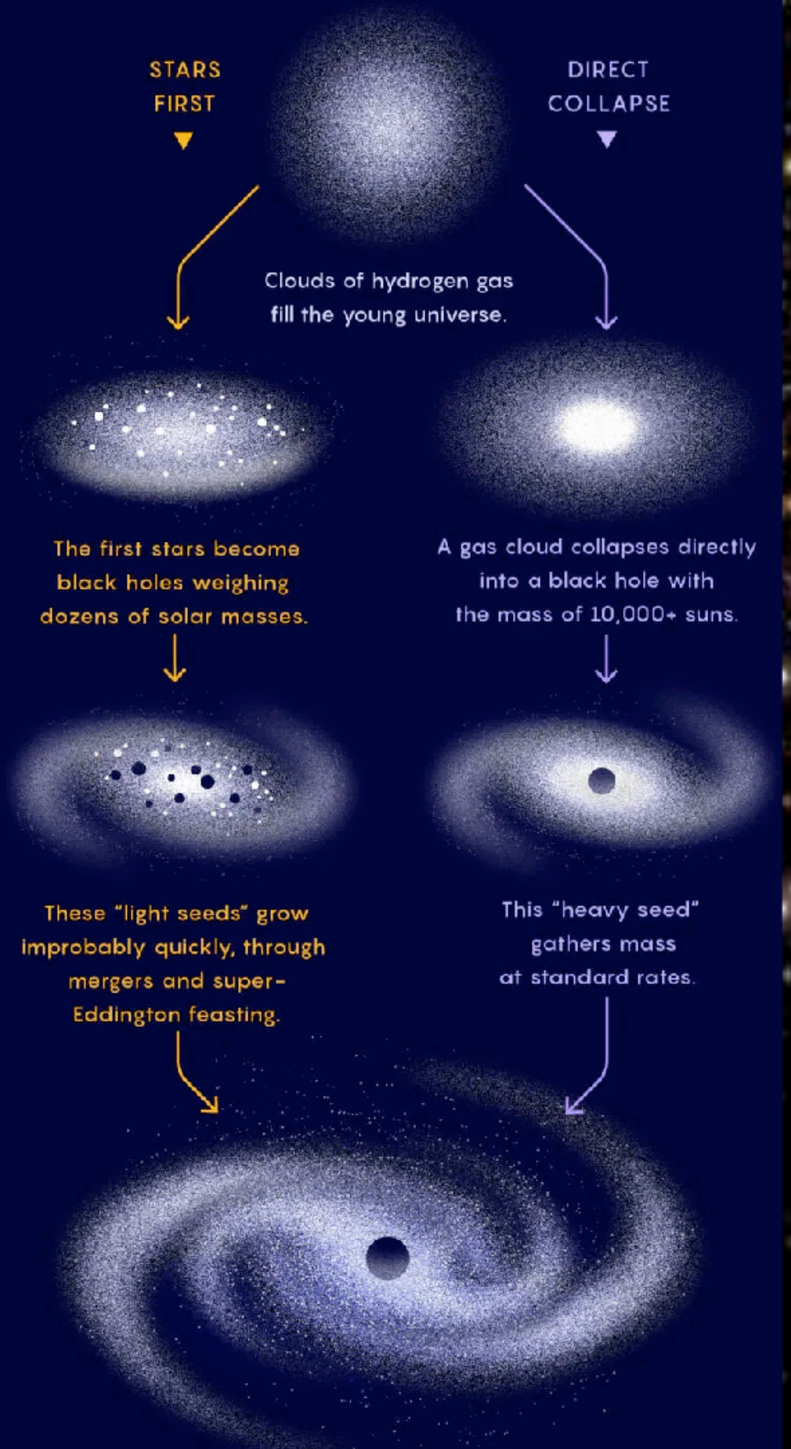
$M_\bullet \approx 10^6 - 10^8\, M_\odot$



LRDs consistent with "pure" AGNs

Powered by $M_{\rm BH} \approx 10^6 - 10^8\,M_\odot$

Very little (if any) evidence of stars

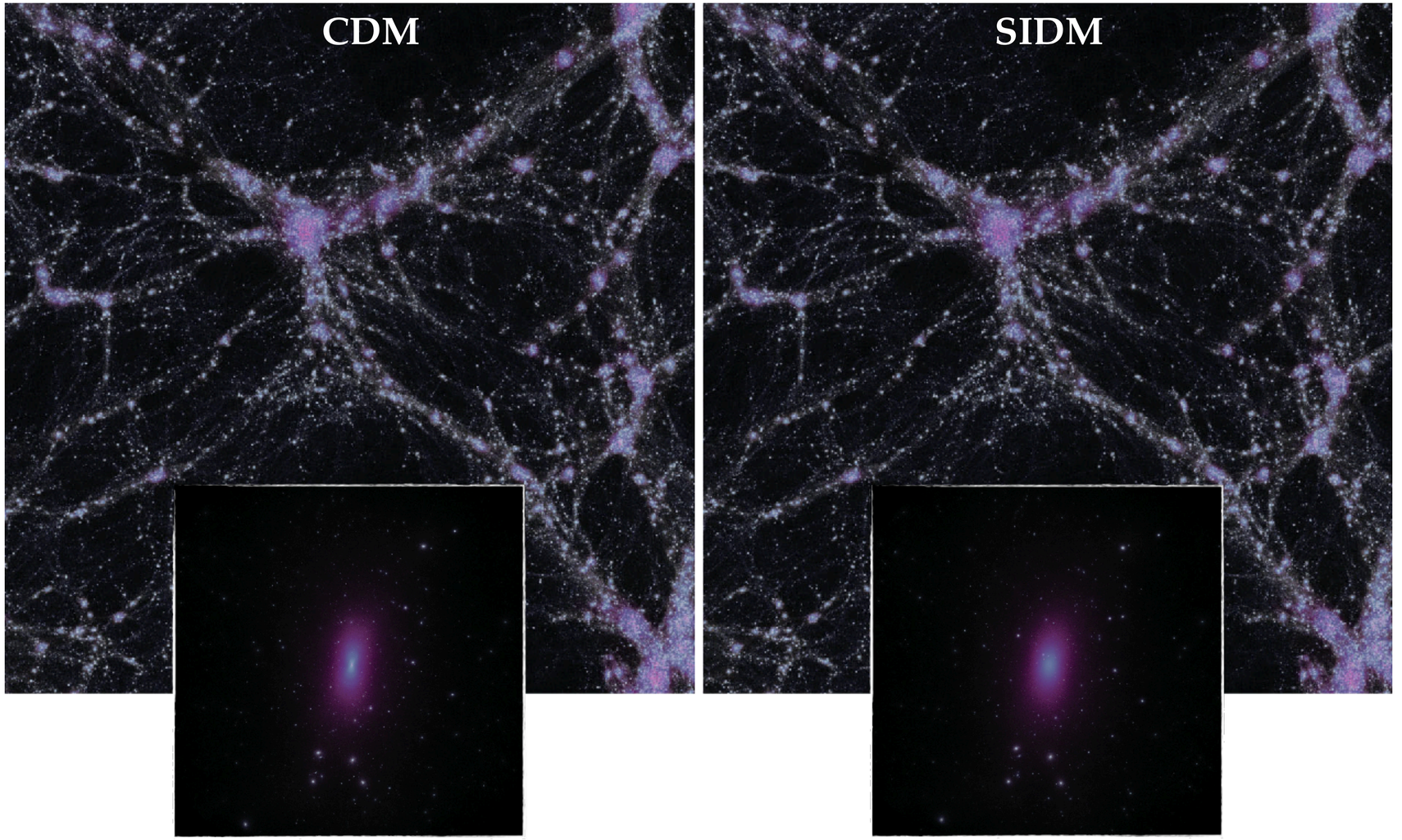


What is the formation mechanism of the first massive black holes?

The Astrophysical Journal, 2026, **996**, L19

Formation of the Little Red Dots from the Core-collapse of Self-interacting Dark Matter Halos

Fangzhou Jiang [1,*] Zixiang Jia,[2] Haonan Zheng,[1] Luis C. Ho,[1,2] Kohei Inayoshi,[1] Xuejian Shen,[3,4] Mark Vogelsberger,[4] and Wei-Xiang Feng[5]

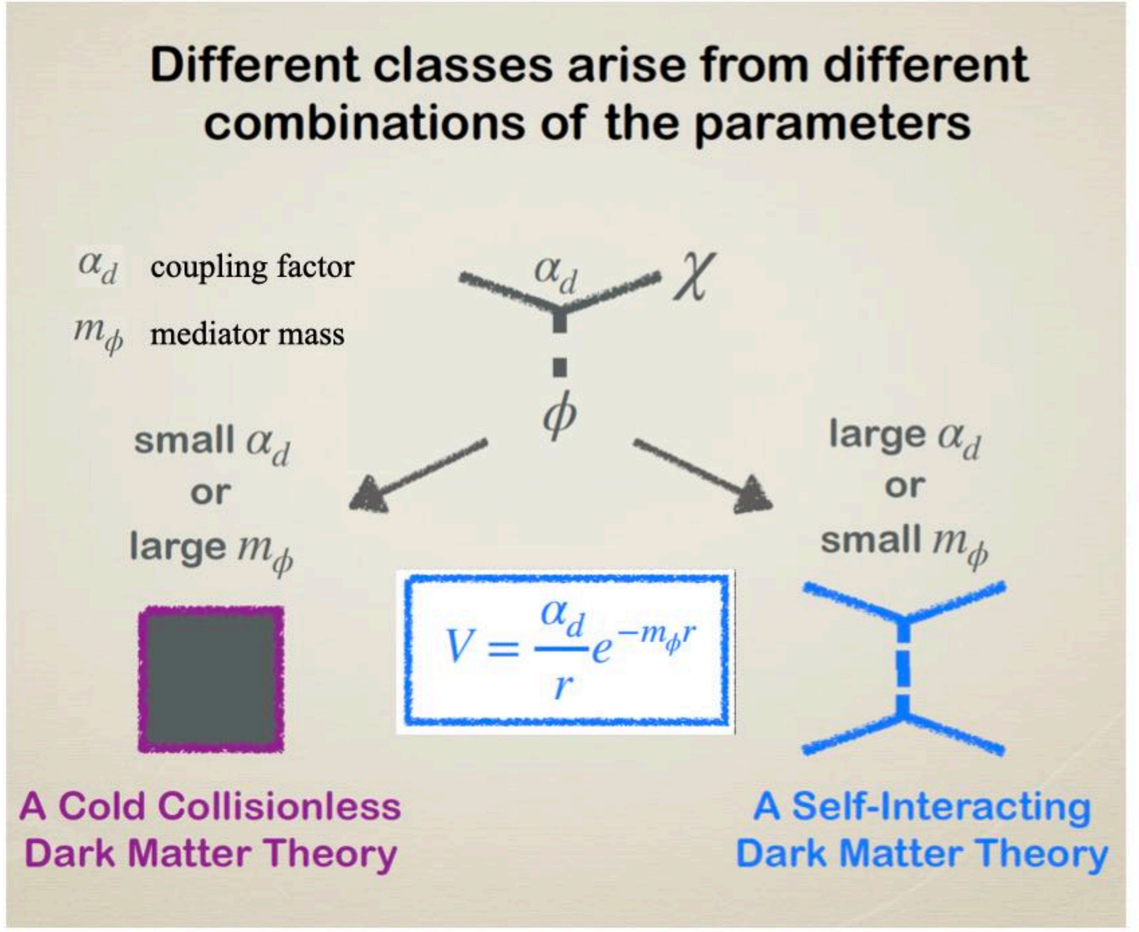


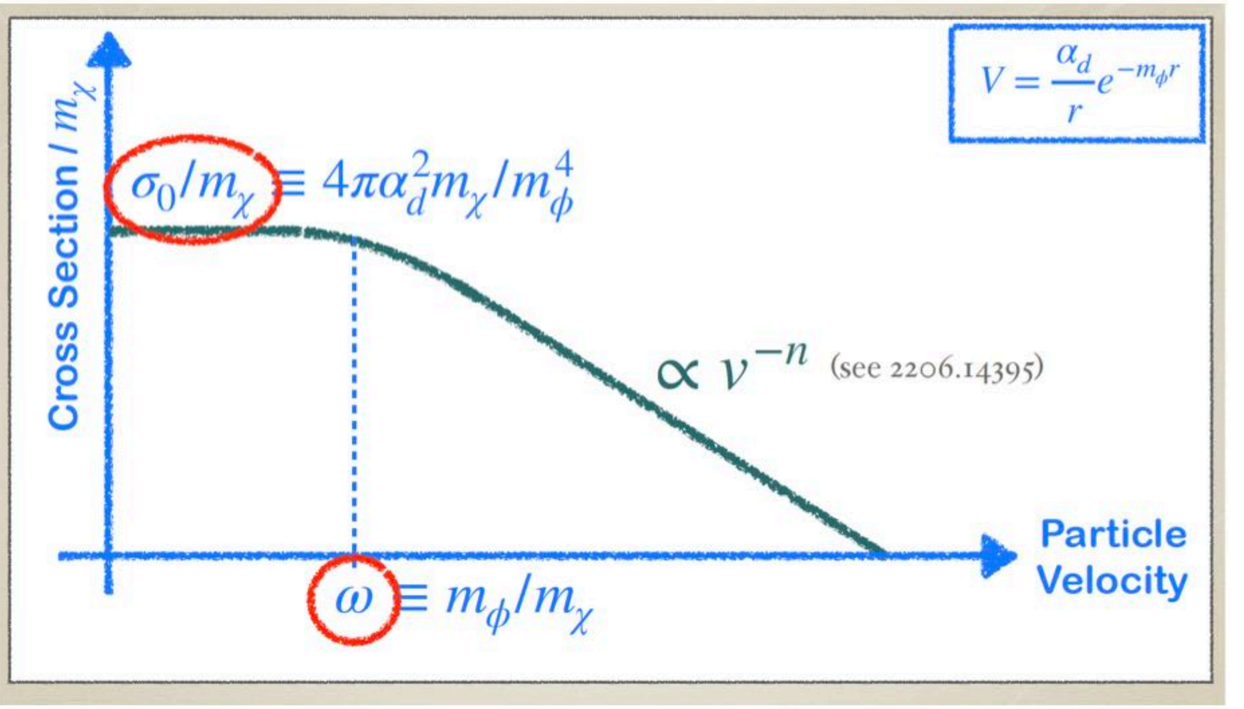
Self-interacting dark matter (SIDM): inherits the large-scale success of CDM, but modifies halo center

The Astrophysical Journal, 2026, **996**, L19

Formation of the Little Red Dots from the Core-collapse of Self-interacting Dark Matter Halos

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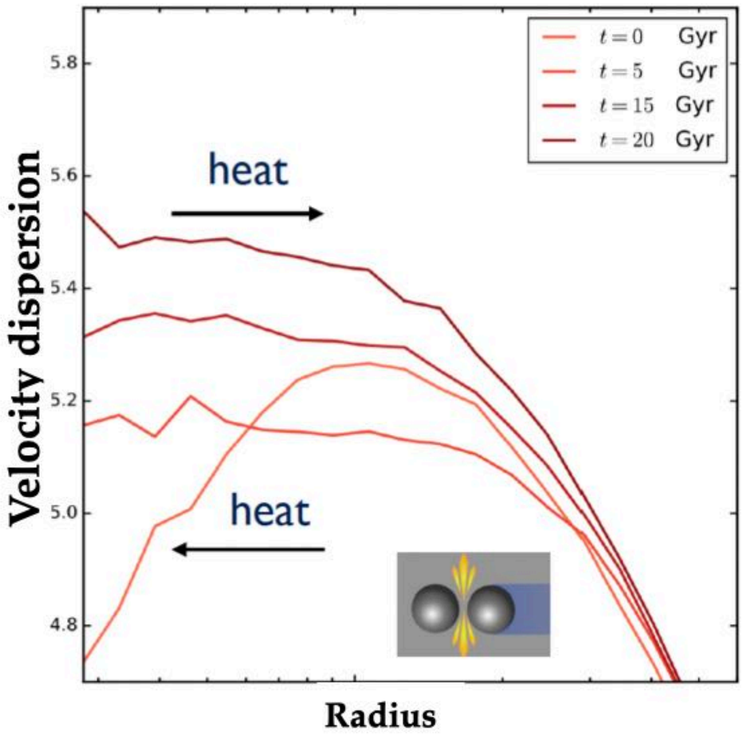
- SIDM and CDM are simply two extreme ends of interactions obeying Yukawa-like potential

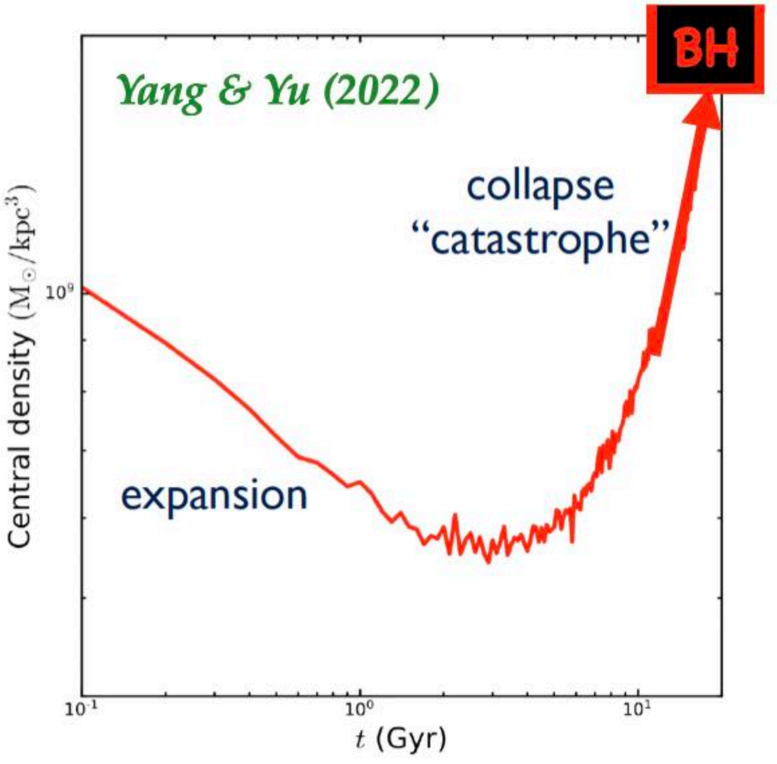
- Strength of self-interaction is determined by cross section
- Cross section is given by two parameters: low-velocity cross section σ_0 ; velocity scale ω above which cross section decays quickly — this guarantees that SIDM effects are marginal in massive galaxies

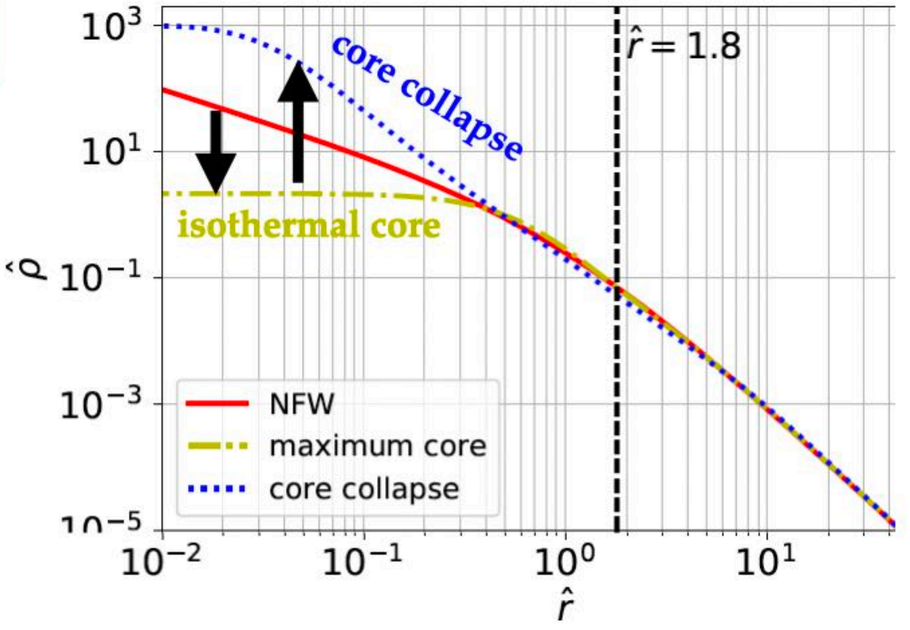
The Astrophysical Journal, 2026, **996**, L19

Formation of the Little Red Dots from the Core-collapse of Self-interacting Dark Matter Halos

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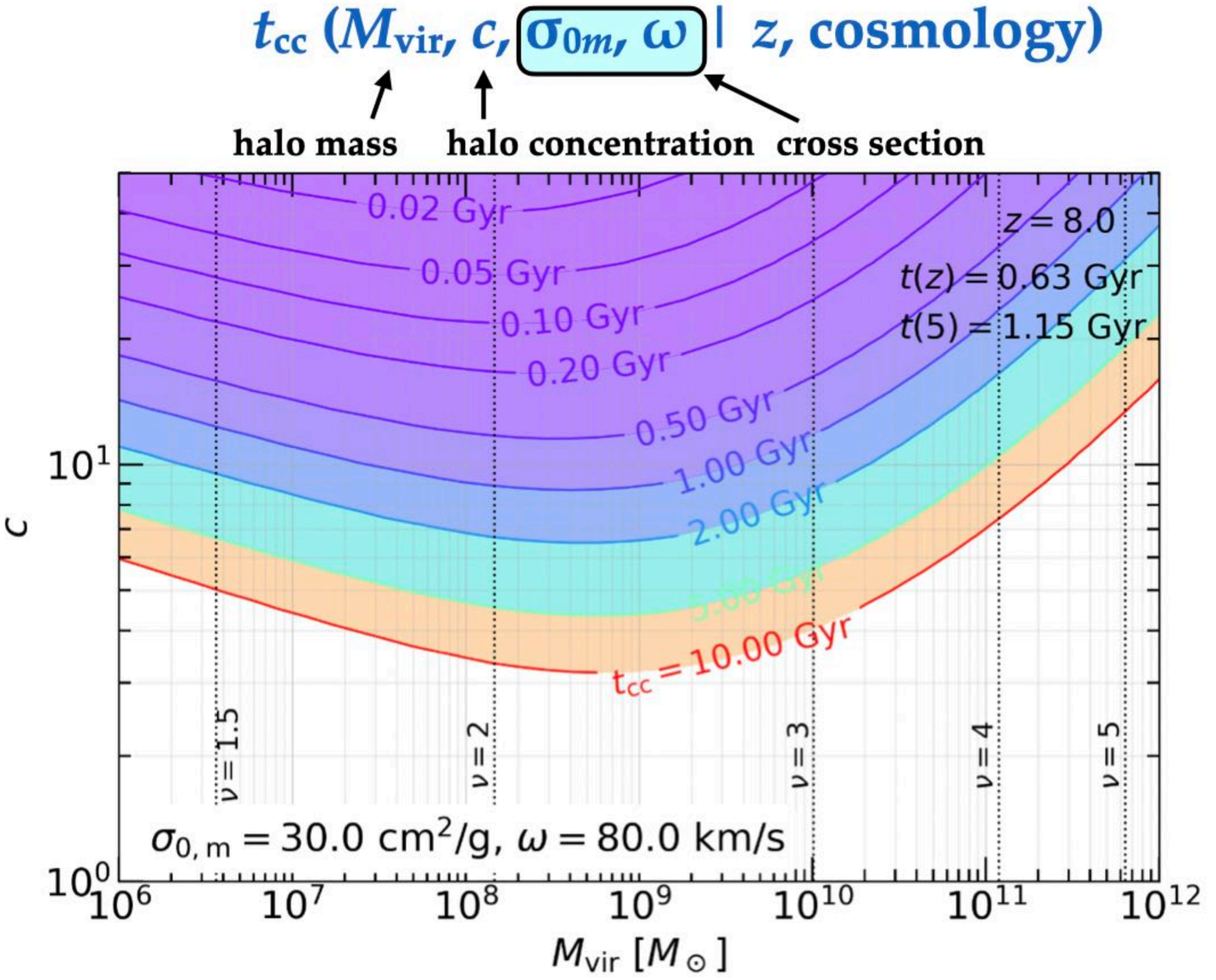
Yang S., Jiang* + arXiv: 2305.05067*

- **Self-interaction of DM particles thermalizes halo center, isothermal expansion phase, core forms**
- **Isothermal core hotter than outskirt -> self-gravitating systems have negative heat capacity -> core collapse**
- **Core collapse -> 1% halo mass turns into seed BH, independent of halo mass or halo concentration; relativistic calculations in *Feng et al. (2021, 2022)***
- **If core collapse occurs before reionization, can form "naked" BHs, explain LRDs**

The Astrophysical Journal, 2026, **996**, L19

Formation of the Little Red Dots from the Core-collapse of Self-interacting Dark Matter Halos

Fangzhou Jiang [1,*] Zixiang Jia,[2] Haonan Zheng,[1] Luis C. Ho,[1,2] Kohei Inayoshi,[1] Xuejian Shen,[3,4] Mark Vogelsberger,[4] and Wei-Xiang Feng[5]

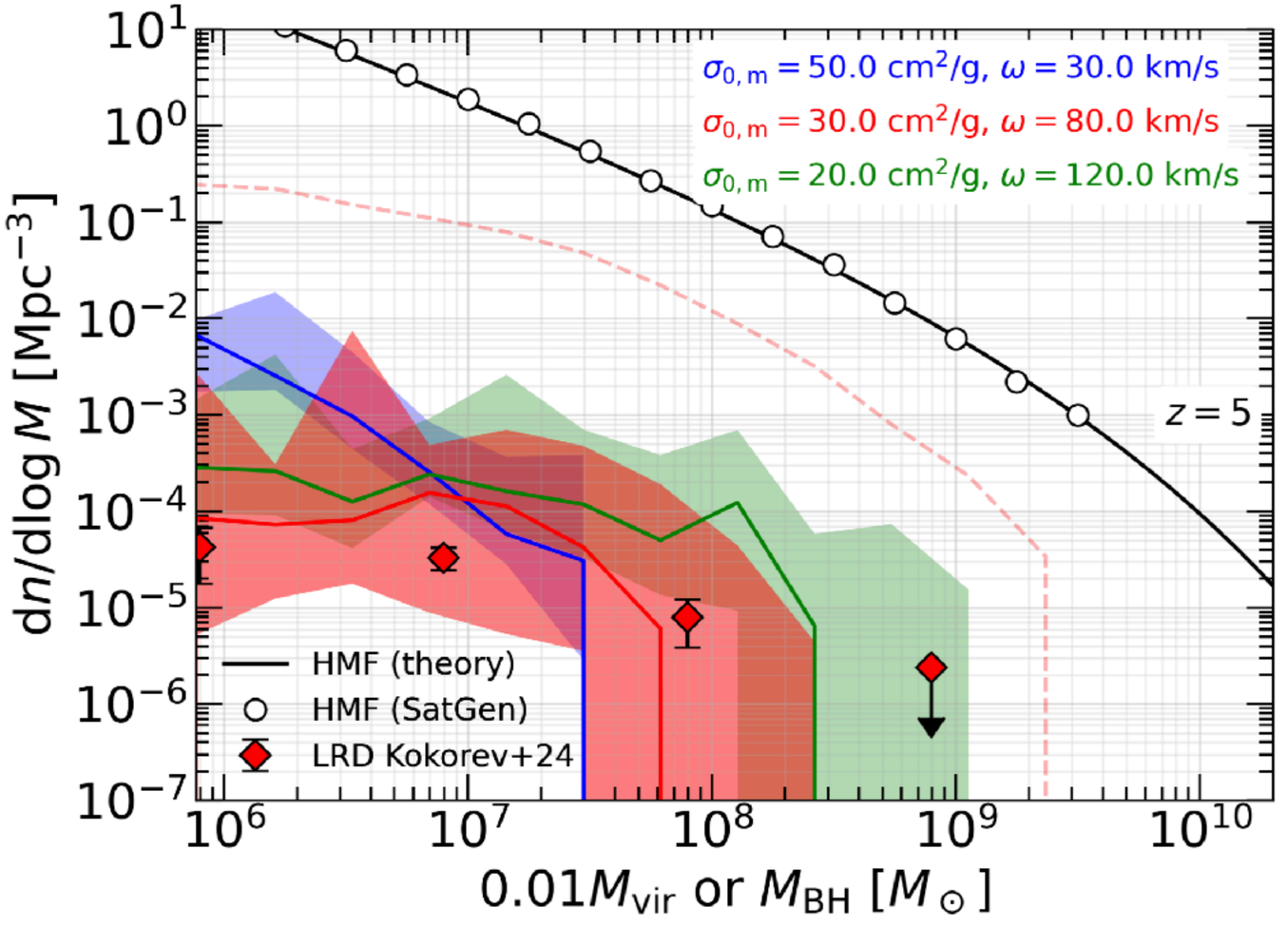


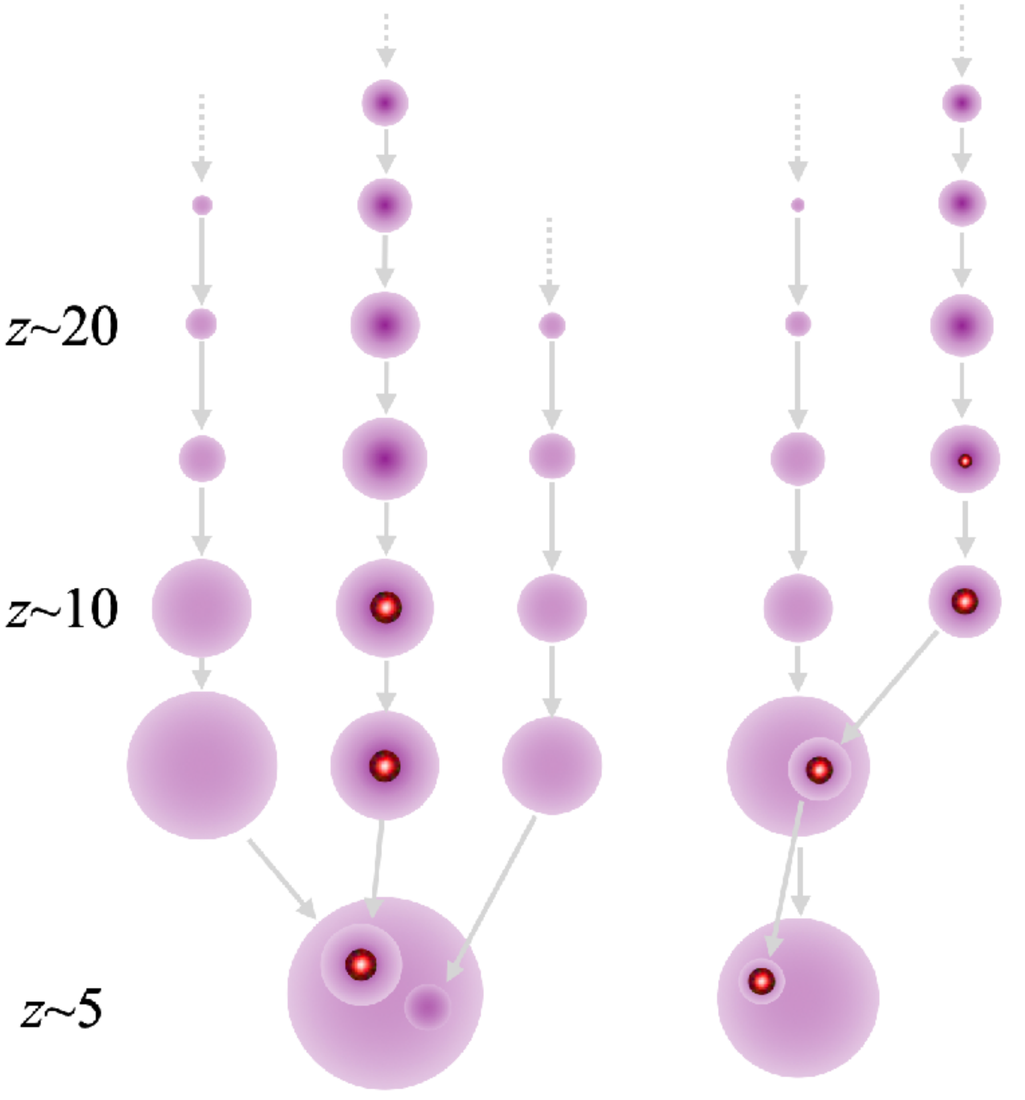
- **Time to core collapse and thus seed BH depends on halo mass, halo concentration, and cross section: higher concentration, larger cross section -> faster core collapse** *(Balberg+Shapiro 2002; Pollack+2015; Yang+2023)*
- **Given cross-section, there is a characteristic halo mass where t_{cc} is shortest for a given concentration**
- **To understand the mass trend:**
  - **Mass too low -> DM density too low -> inefficient self-interaction**
  - **Mass too high -> cross section too small (because of velocity dependence) -> inefficient self-interaction**
- **To form BH seeds in the early Universe, halos cannot be too light or too heavy, and need to be highly concentrated**

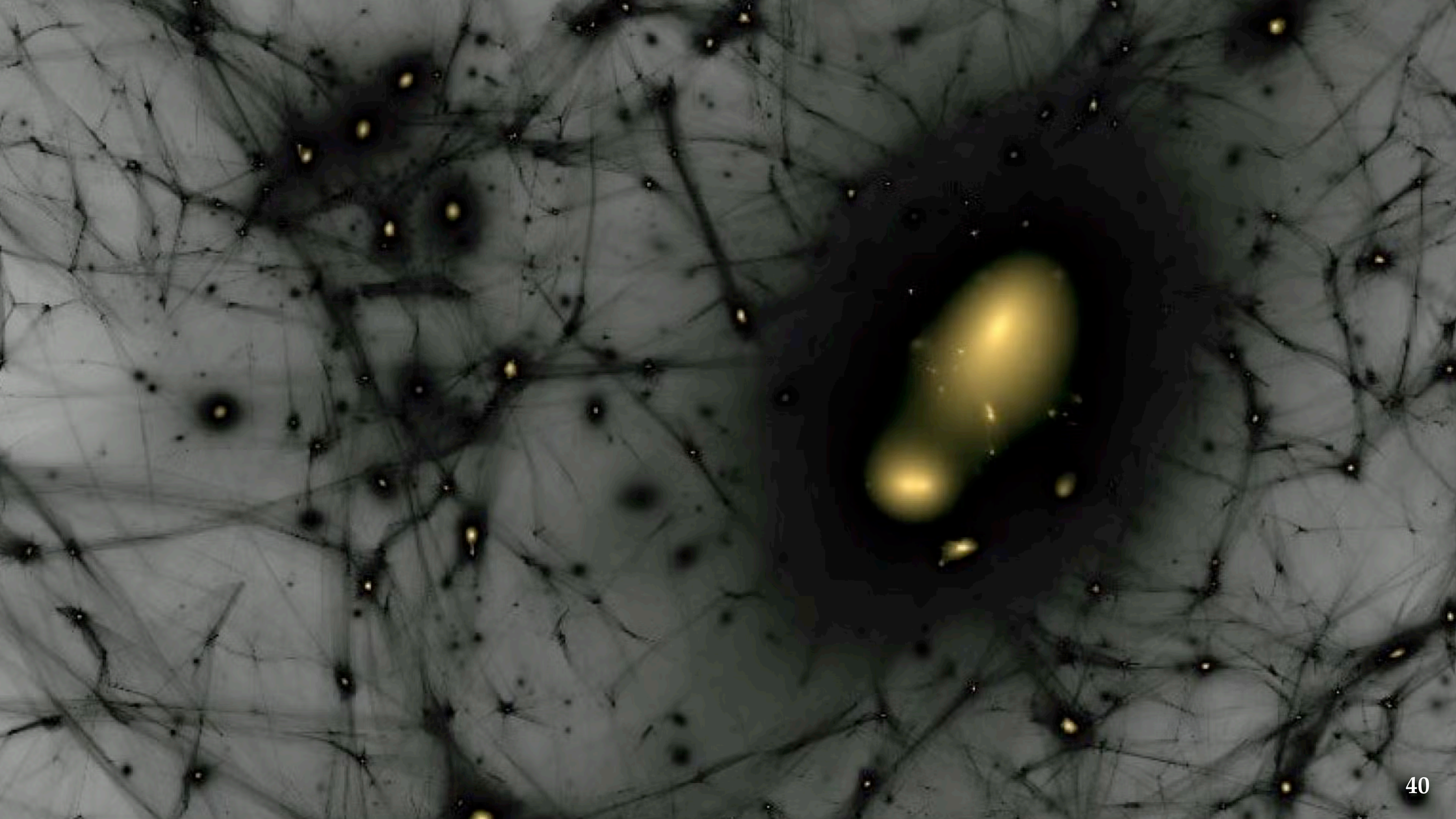
The Astrophysical Journal, 2026, **996**, L19

Formation of the Little Red Dots from the Core-collapse of Self-interacting Dark Matter Halos

Fangzhou Jiang [1,*] Zixiang Jia,[2] Haonan Zheng,[1] Luis C. Ho,[1,2] Kohei Inayoshi,[1] Xuejian Shen,[3,4]
Mark Vogelsberger,[4] and Wei-Xiang Feng[5]







Alternative Models: Primordial Black Holes

A&A, 690, A182 (2024)
https://doi.org/10.1051/0004-6361/202451481
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Astronomy & Astrophysics

Exploring a primordial solution for early black holes detected with JWST

Pratika Dayal*

The Astrophysical Journal Letters, 1000:L19 (8pp), 2026 March 20
https://doi.org/10.3847/2041-8213/ae4bd0
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OPEN ACCESS

Primordial Black Holes as Seeds for Extremely Overmassive Active Galactic Nuclei Observed by JWST

Saiyang Zhang (張賽暘)[1,2], Boyuan Liu (劉博遠)[3,4], Volker Bromm[2,5], and Florian Kühnel[6,7]

The Astrophysical Journal, 992:136 (10pp), 2025 October 10
https://doi.org/10.3847/1538-4357/ae061c
© 2025. The Author(s). Published by the American Astronomical Society.
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A Novel Formation Channel for Supermassive Black Hole Binaries in the Early Universe via Primordial Black Holes

Saiyang Zhang[1,2], Boyuan Liu[3,4], and Volker Bromm[2,5]

Primordial black holes in cosmological simulations: growth prospects for supermassive black holes

Lewis R. Prole, John A. Regan, Daxal Mehta, Peter Coles, Pratika Dayal

A&A, 706, A72 (2026)
https://doi.org/10.1051/0004-6361/202555959
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Astronomy & Astrophysics

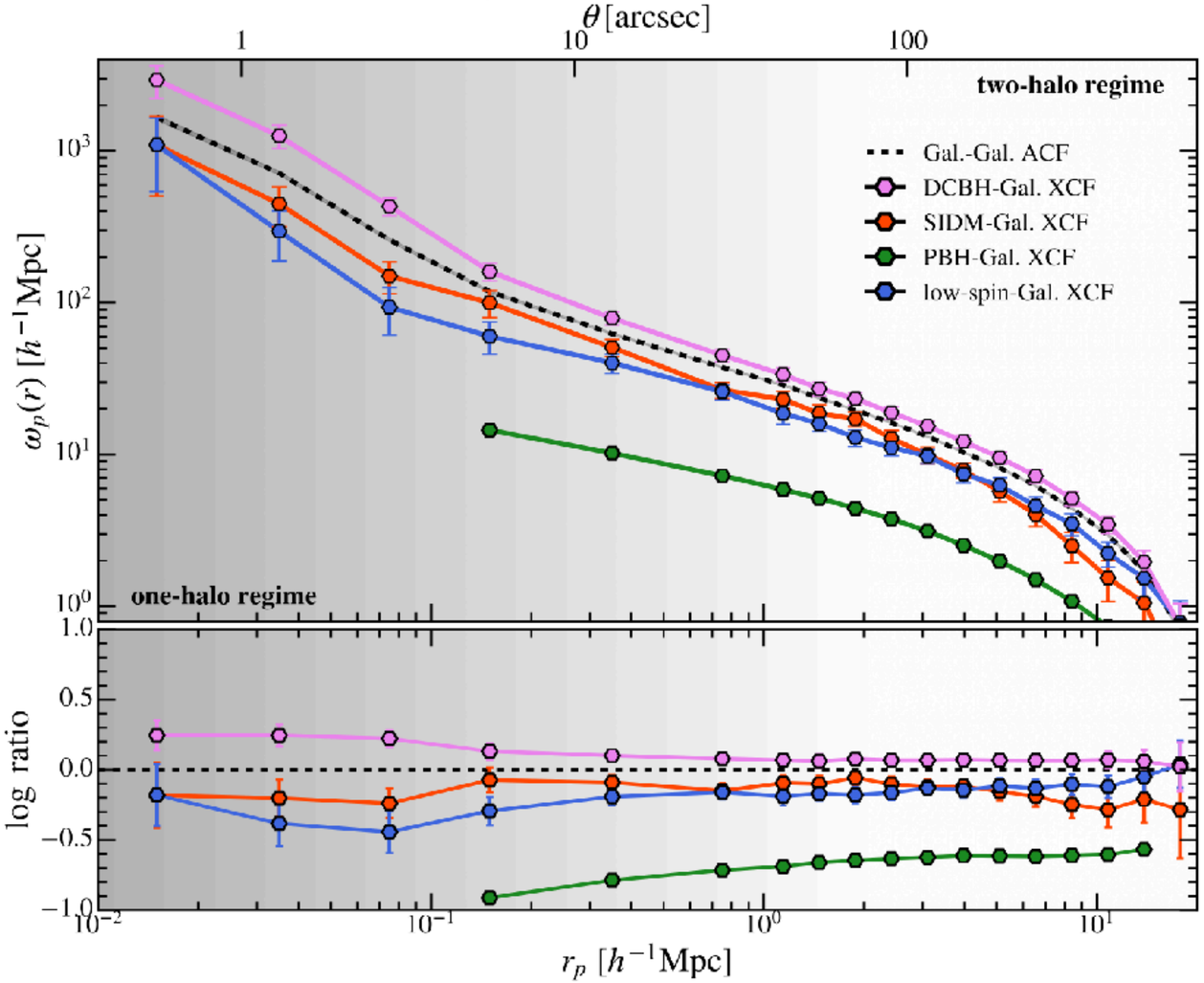
The properties of primordially-seeded black holes and their hosts in the first billion years: implications for JWST

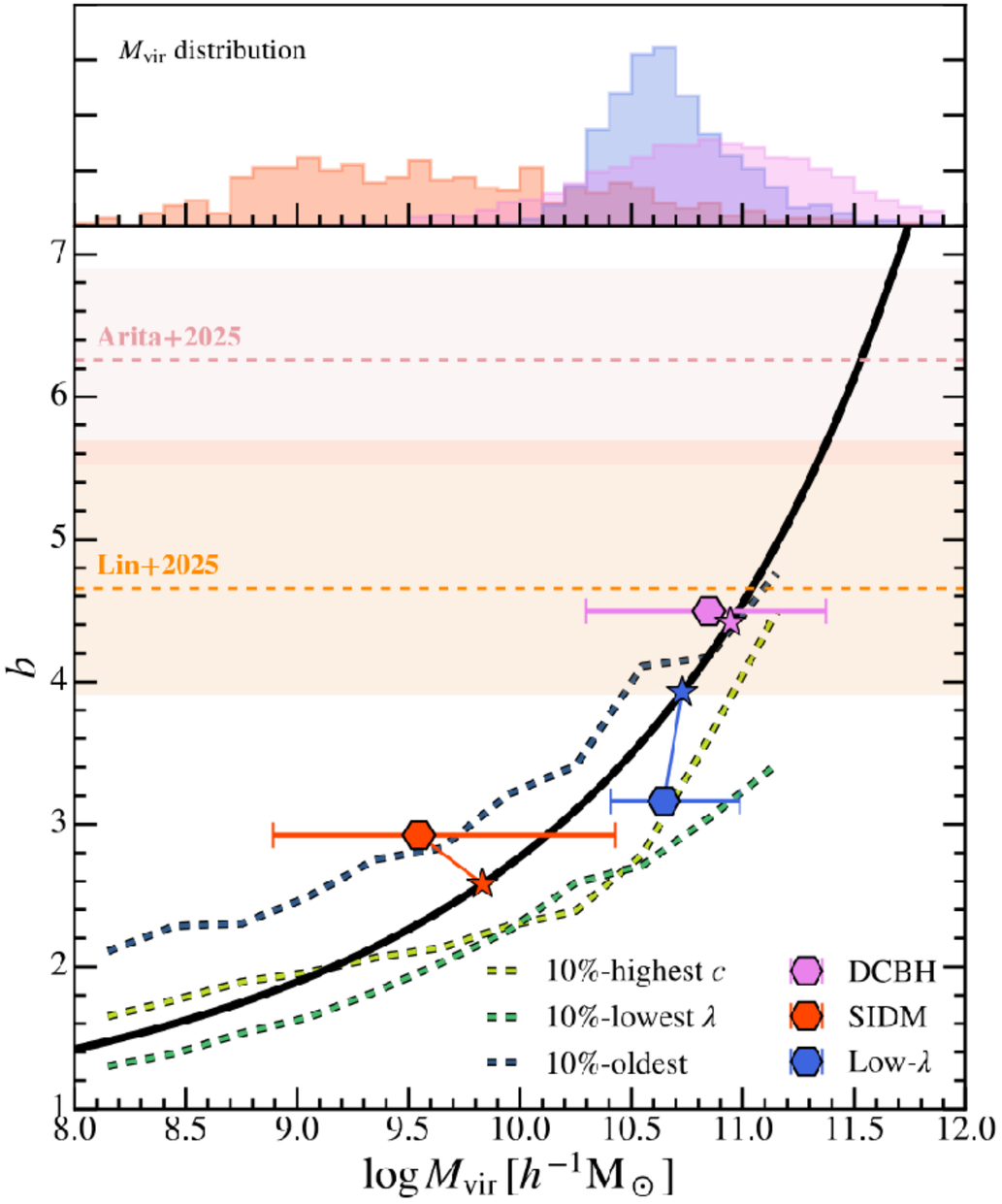
Pratika Dayal[1,2,3,4,*] and Roberto Maiolino[5,6,7]

Monthly Notices of the ROYAL ASTRONOMICAL SOCIETY
MNRAS 552, 1–16 (2026) https://doi.org/10.1093/mnras/stag1712

Halo assembly bias in the early Universe: a clustering probe of the origin of the Little Red Dots

Zihao Wang,[1] Fangzhou Jiang,[2★] Haonan Zheng,[2★] Xuejian Shen,[3] Zixiang Jia,[1] Luis C. Ho,[2] Kohei Inayoshi[2] and Linhua Jiang[2]

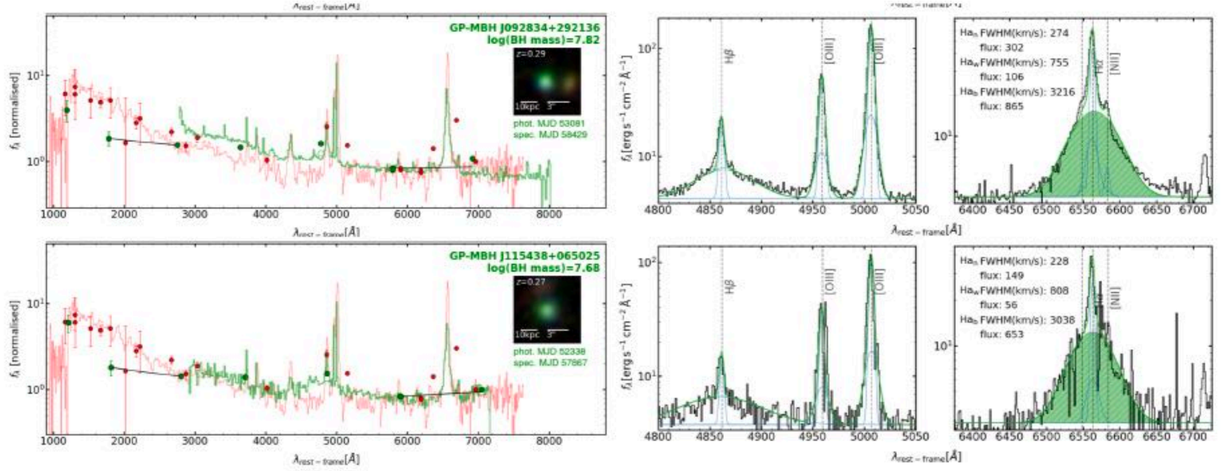


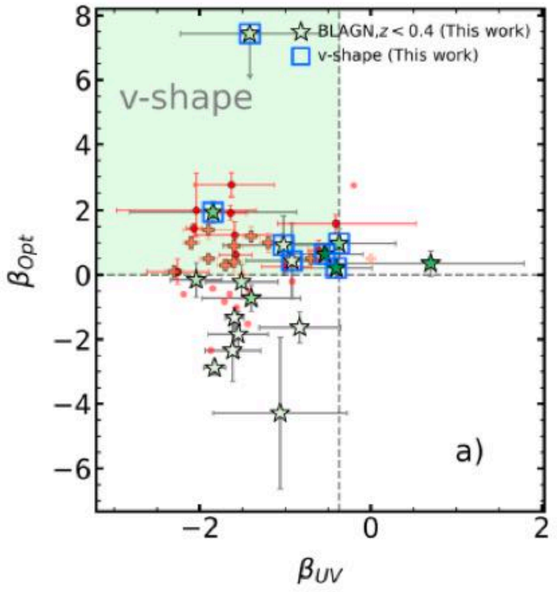


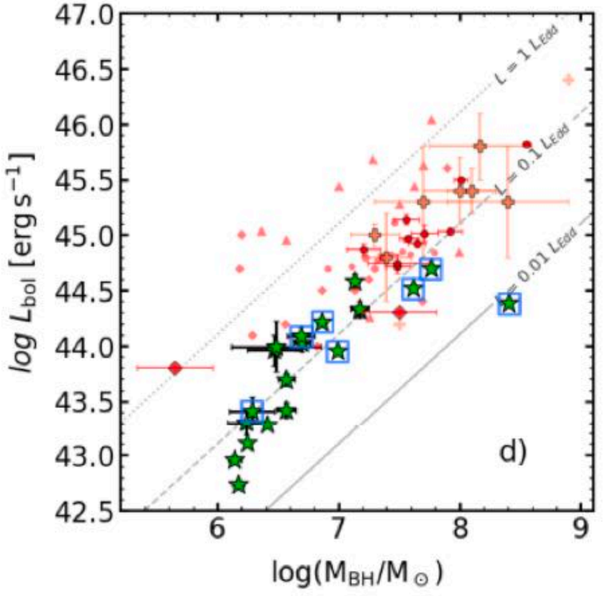
The Astrophysical Journal Letters, 980:L34 (9pp), 2025 February 20

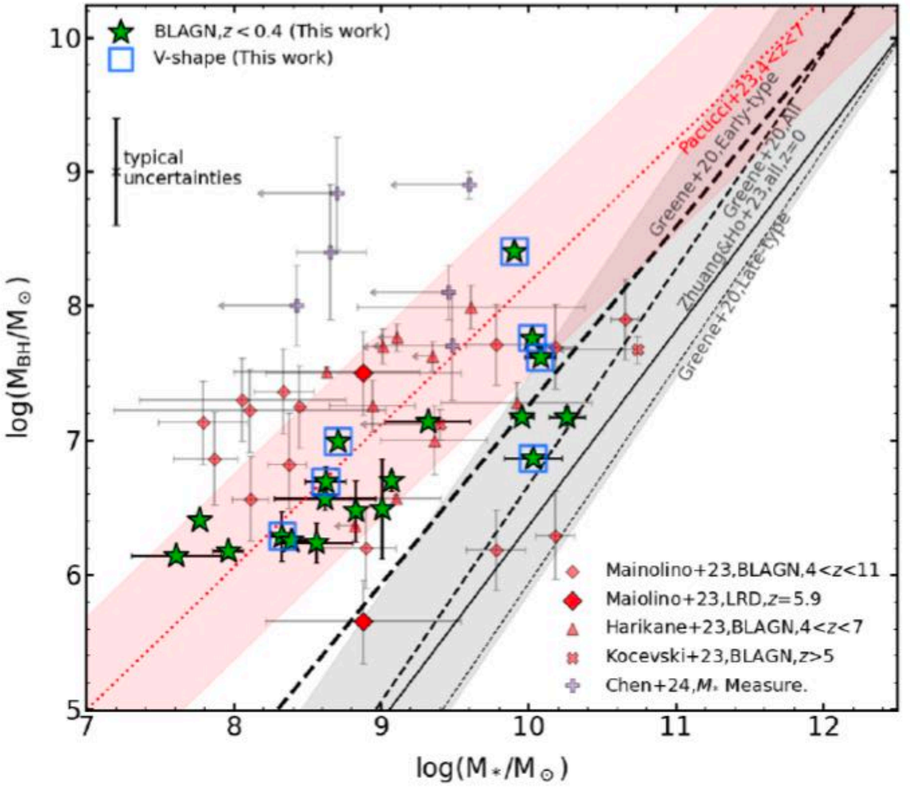
Discovery of Local Analogs to JWST's Little Red Dots

Ruqiu Lin[1,2], Zhen-Ya Zheng[1,2], Chunyan Jiang[1], Fang-Ting Yuan[1], Luis C. Ho[3,4], Junxian Wang[5], Linhua Jiang[3,4], James E. Rhoads[6], Sangeeta Malhotra[6], L. Felipe Barrientos[7], Isak Wold[8,9], Leopoldo Infante[10,11], Shuairu Zhu[1,2], Xiang Ji[1], and Xiaodan Fu[1]







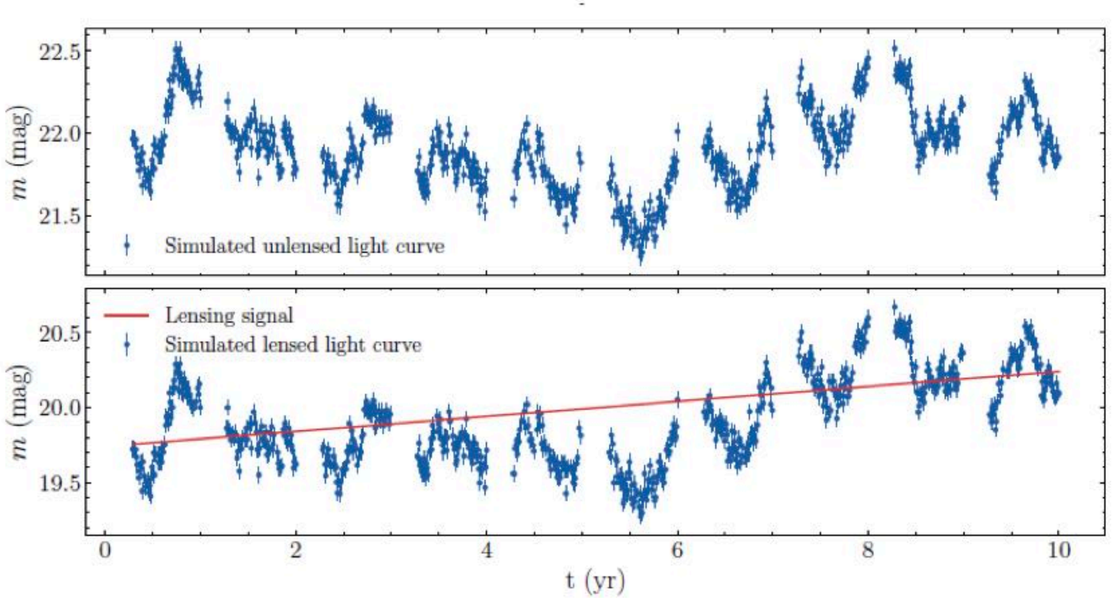


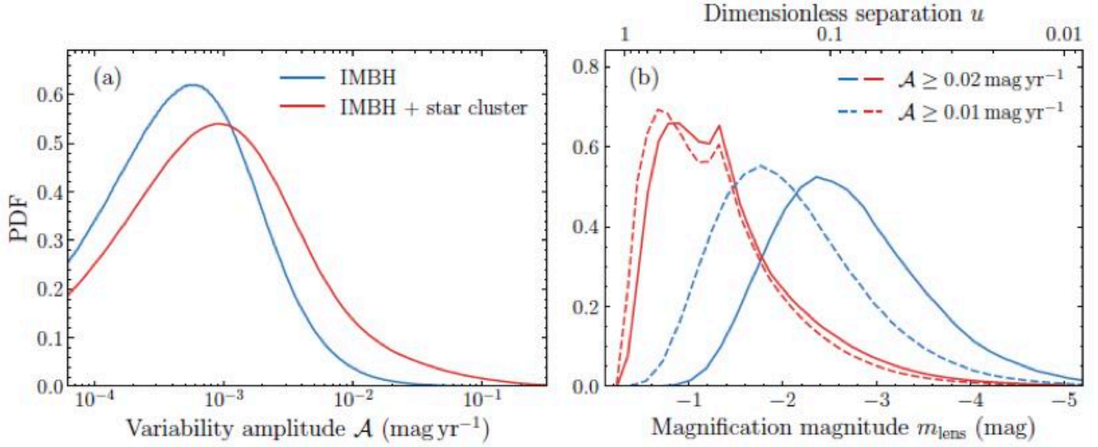
- Green Pea galaxies at $z < 0.4$ with broad Hα emission
- Local analogs of LRDs?
- Similar V-shaped SEDs, overmassive BHs

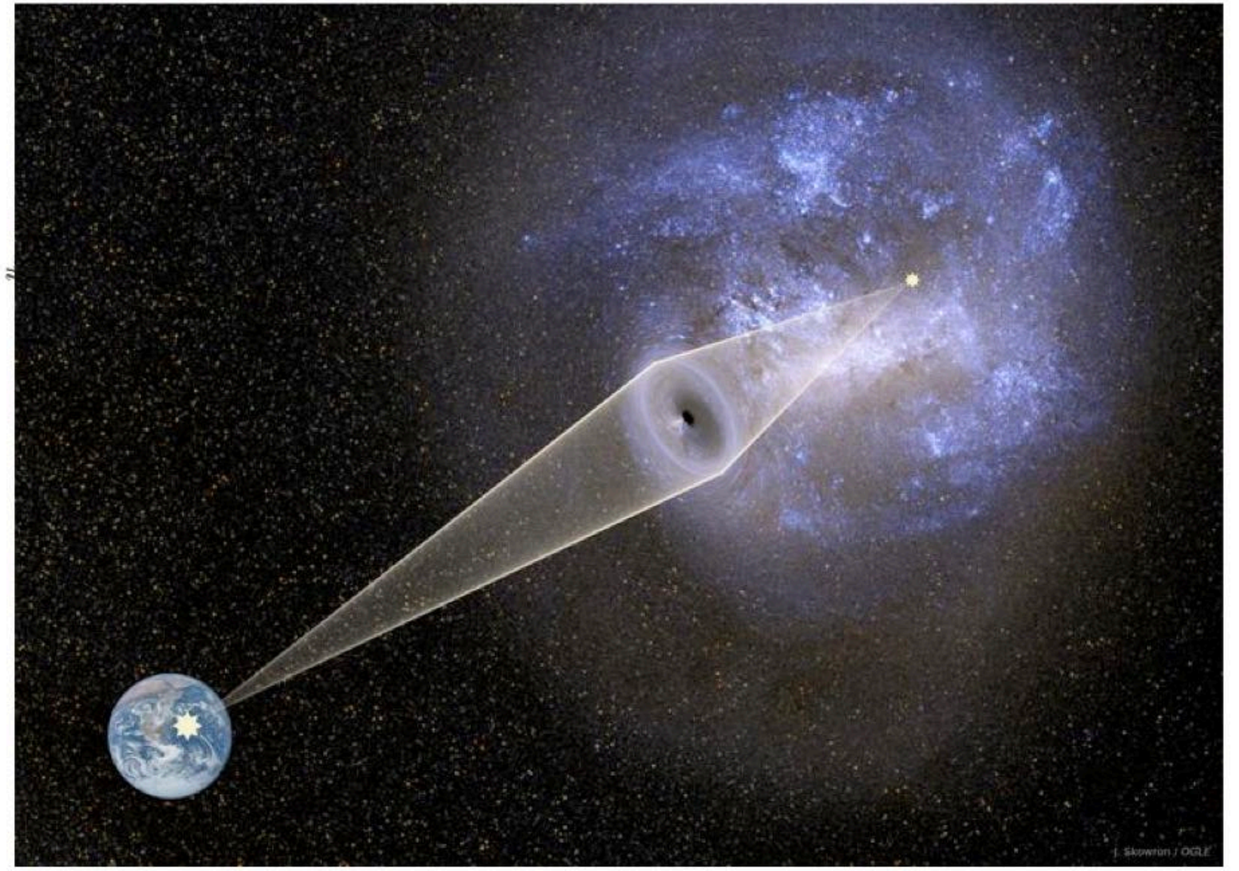
The Astrophysical Journal, 985:197 (17pp), 2025 June 1

Detecting Intermediate-mass Black Holes Using Quasar Microlensing

Zihao Wu[1,2,3] and Luis C. Ho[2,3]

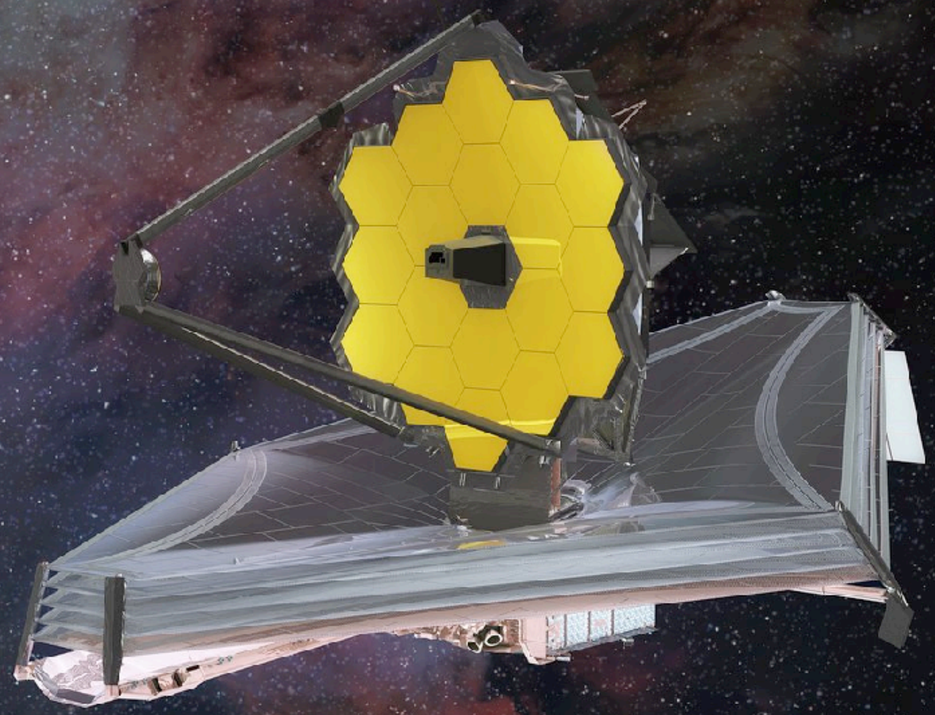






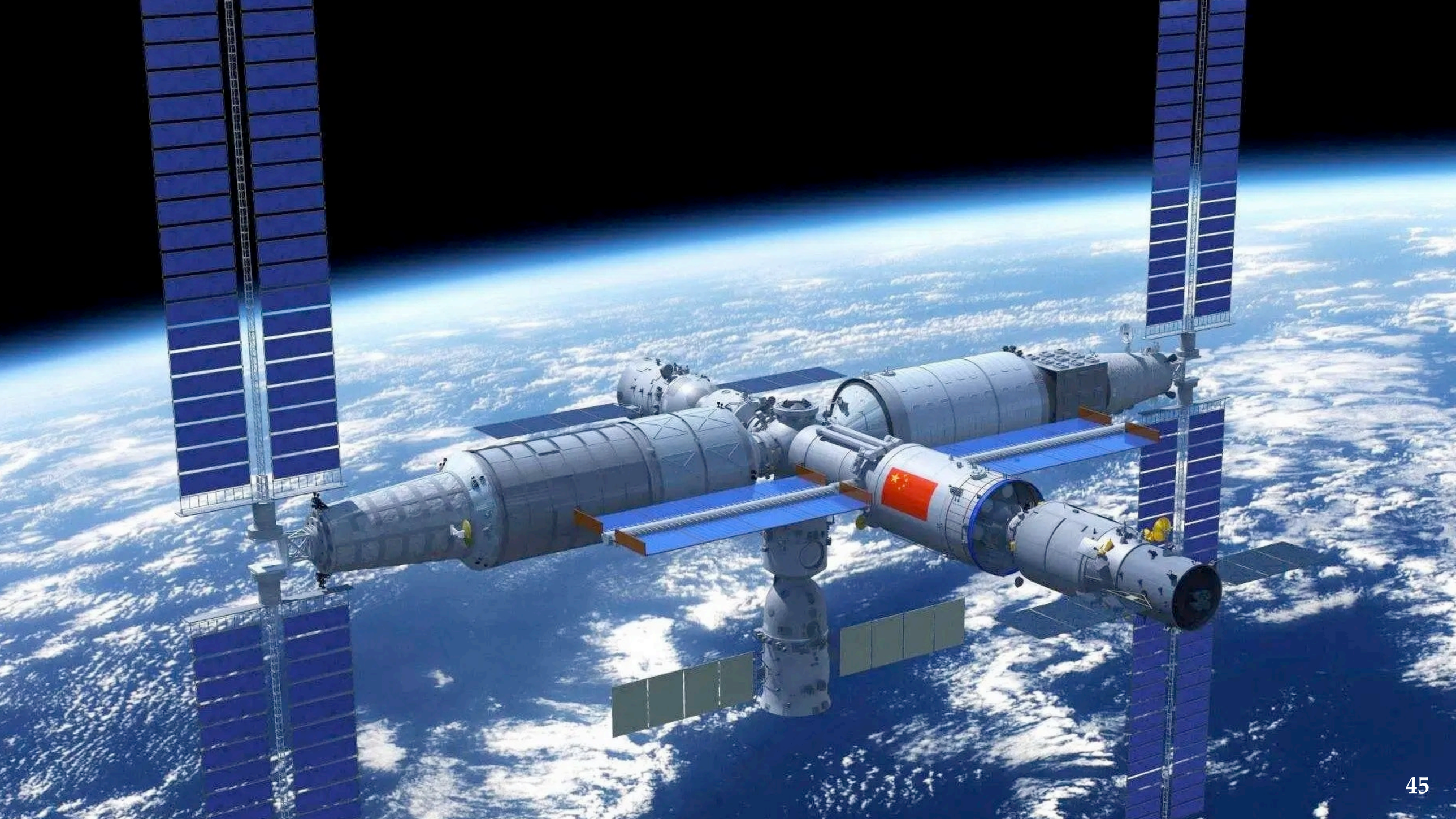
- After 10 years operation, **LSST could detect ~30 events; increase to ~300 events after 20 years**
- Number increases by a factor of 10 if IMBHs are surrounded by stellar clusters

James Webb Space Telescope (2022)

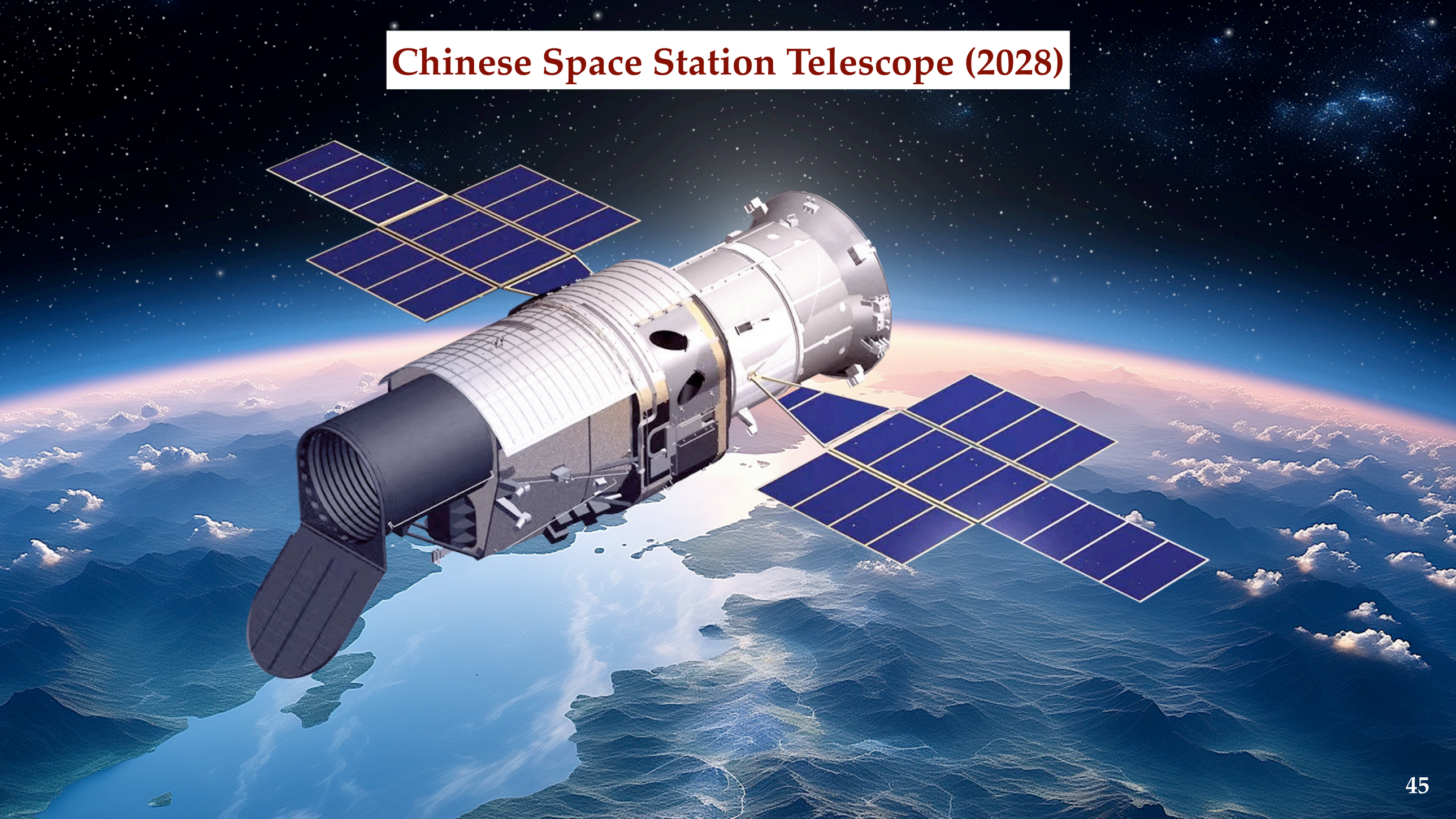


Roman Space Telescope (2027)

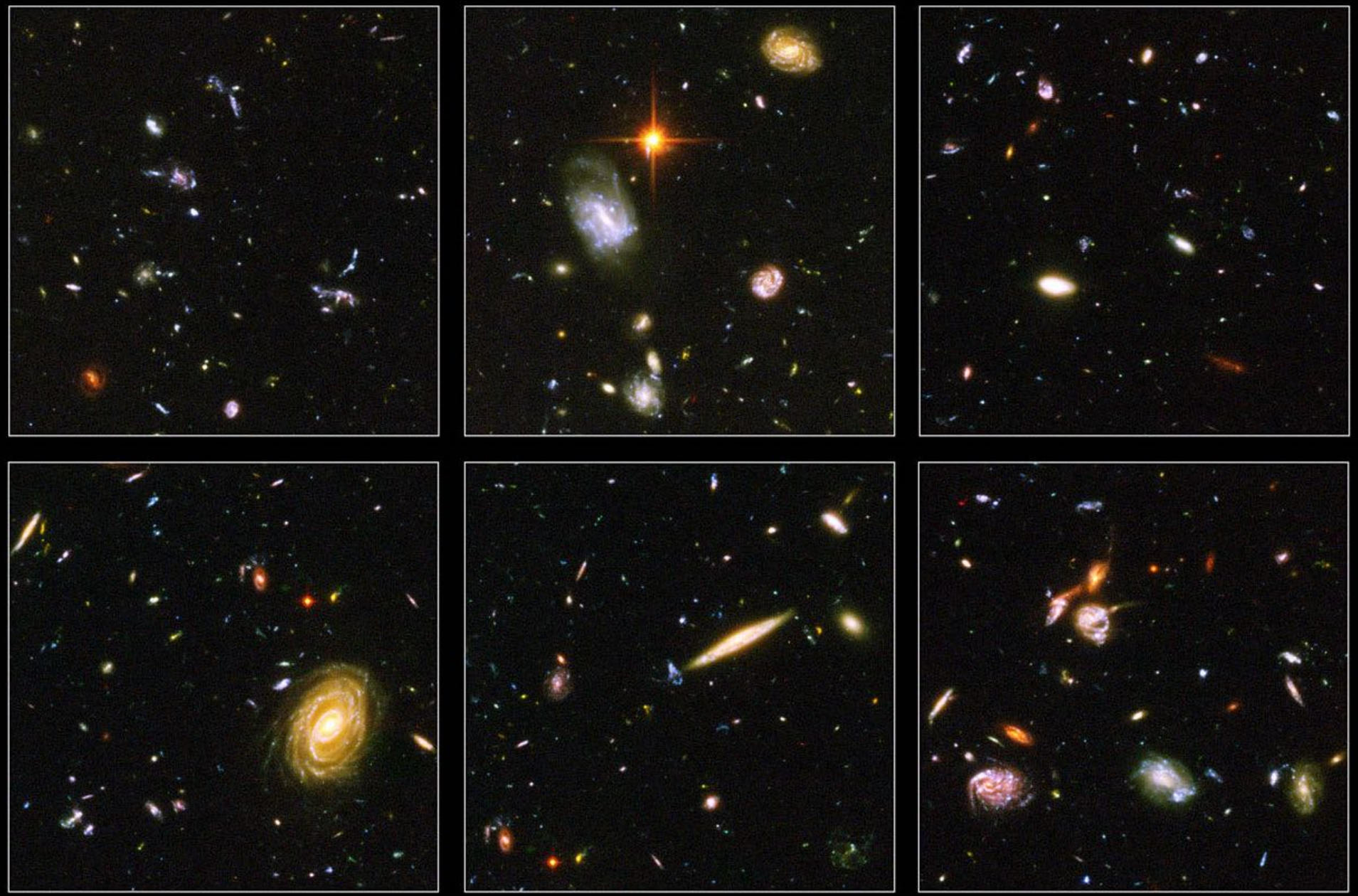




Chinese Space Station Telescope (2028)




Hubble Space Telescope
(1990-present)




Kavli Institute for Astronomy and Astrophysics, Peking University
北京大学科维理天文与天体物理研究所





中国空间站工程巡天望远镜
北京大学科学中心

Chinese Space Station Telescope
Peking University Science Center

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Kormendy & Ho (2013, ARA&A): *Coevolution of Supermassive Black Holes and Galaxies*

Greene, Strader & Ho (2020, ARA&A): *Intermediate-mass Black Holes*

Inayoshi & Ho (2026, Nature Astronomy): *A Critical Evaluation of the Physical Nature of the Little Red Dots*

Jiang & Ho (2026, Universe): *Non-baryonic Formation Mechanisms of Massive Black Holes in the Little Red Dots*