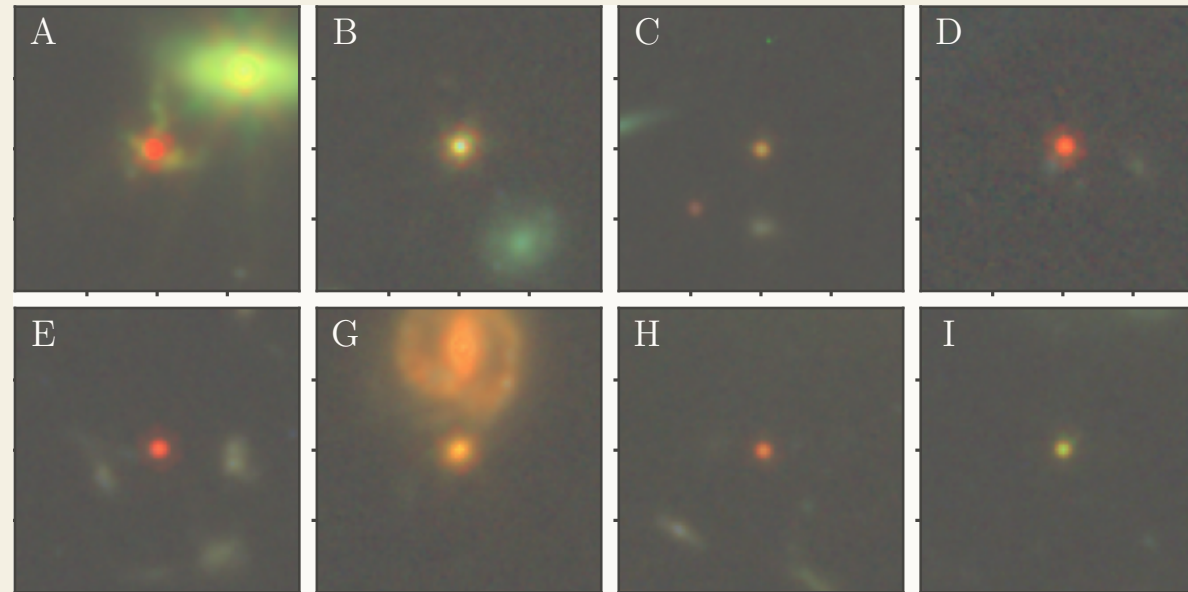


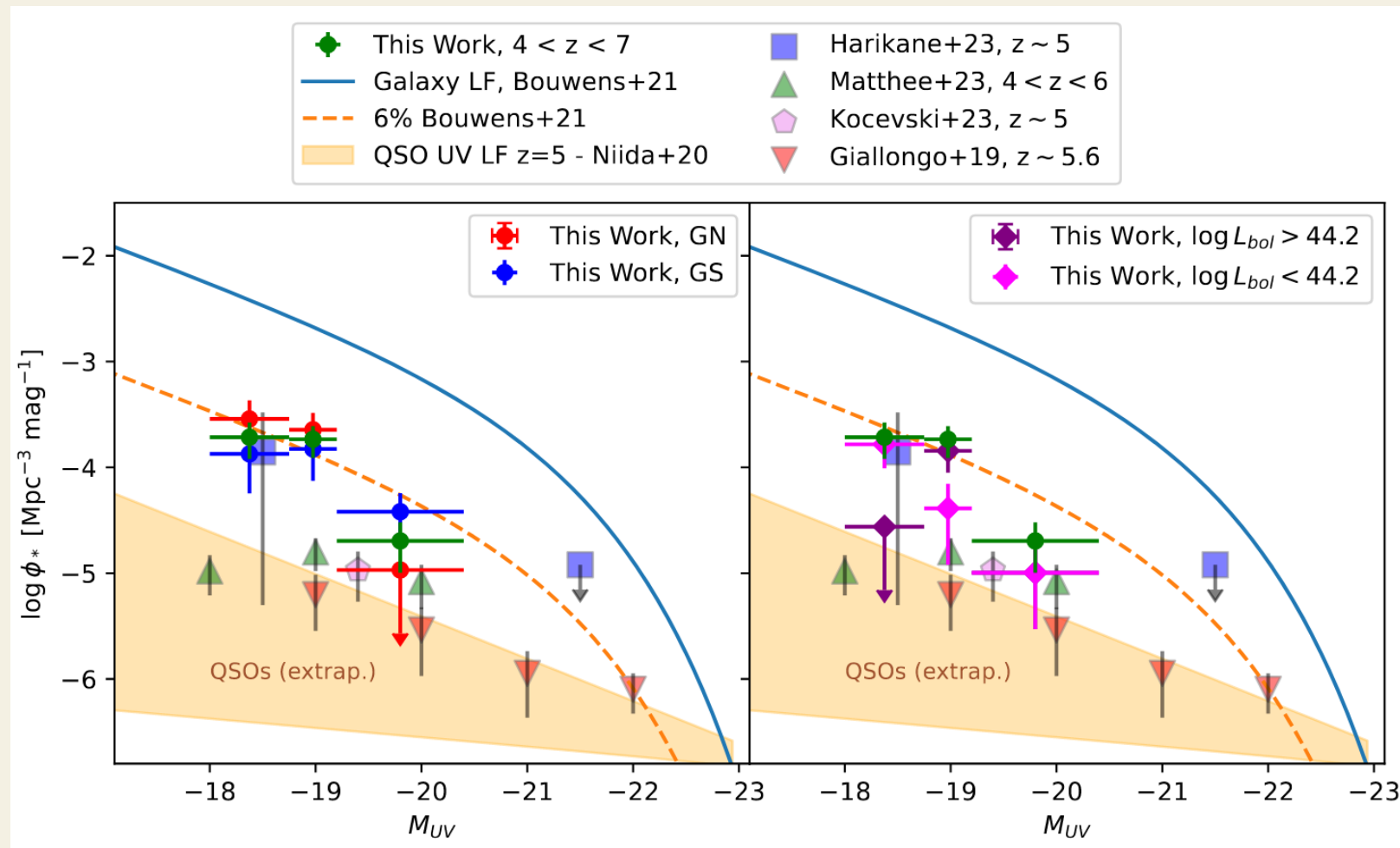


A distinct type of intrinsically narrow-line AGN in dense gas cocoons at high redshift

Vadim Rusakov, Darach Watson

Giorgos Nikopoulos, Gabriel Brammer, Rashmi Gottumukkala, Thomas Harvey, Kasper E. Heintz, Rasmus Nielsen, Stuart Sim, Albert Sneppen, Aswin Vijayan, Nathan Adams, Duncan Austin, Cristopher Conselice, Caio Goolsby, Sune Toft, Joris Witstok

JWST's Broad Line Objects



Juodzbališ+25

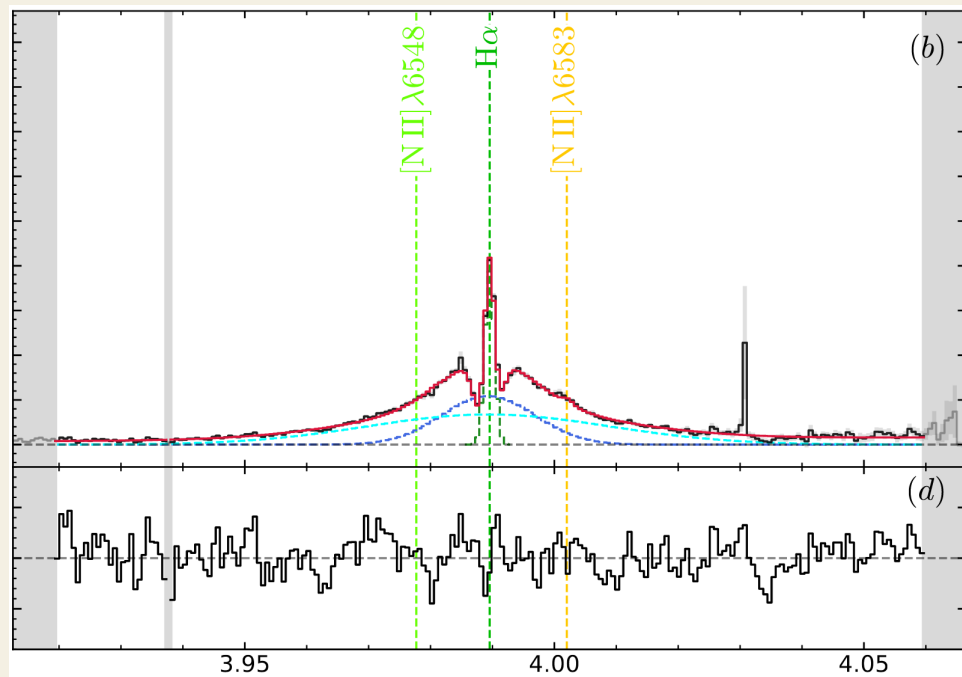
See also, e.g.,

Harikane+23
Kocevski+24
Kokorev+24,
Matthee+24,
Taylor+24,
Maiolino+25

Characteristics:

- Higher number density (than expected from QSO)
- Weaker X-rays **(mostly not detected)* (Akins+24, Yue+24, Ananna+24, Kokubo+24, Maiolino+25)
- Weaker Radio emission **(mostly not detected)* (Akins+24, Mazzolari+24, Gloudemans+25, Setton+25)
- Weaker optical variability **(mostly not detected)* (Kokubo & Harikane 24, Furtak+25, Ji+25)

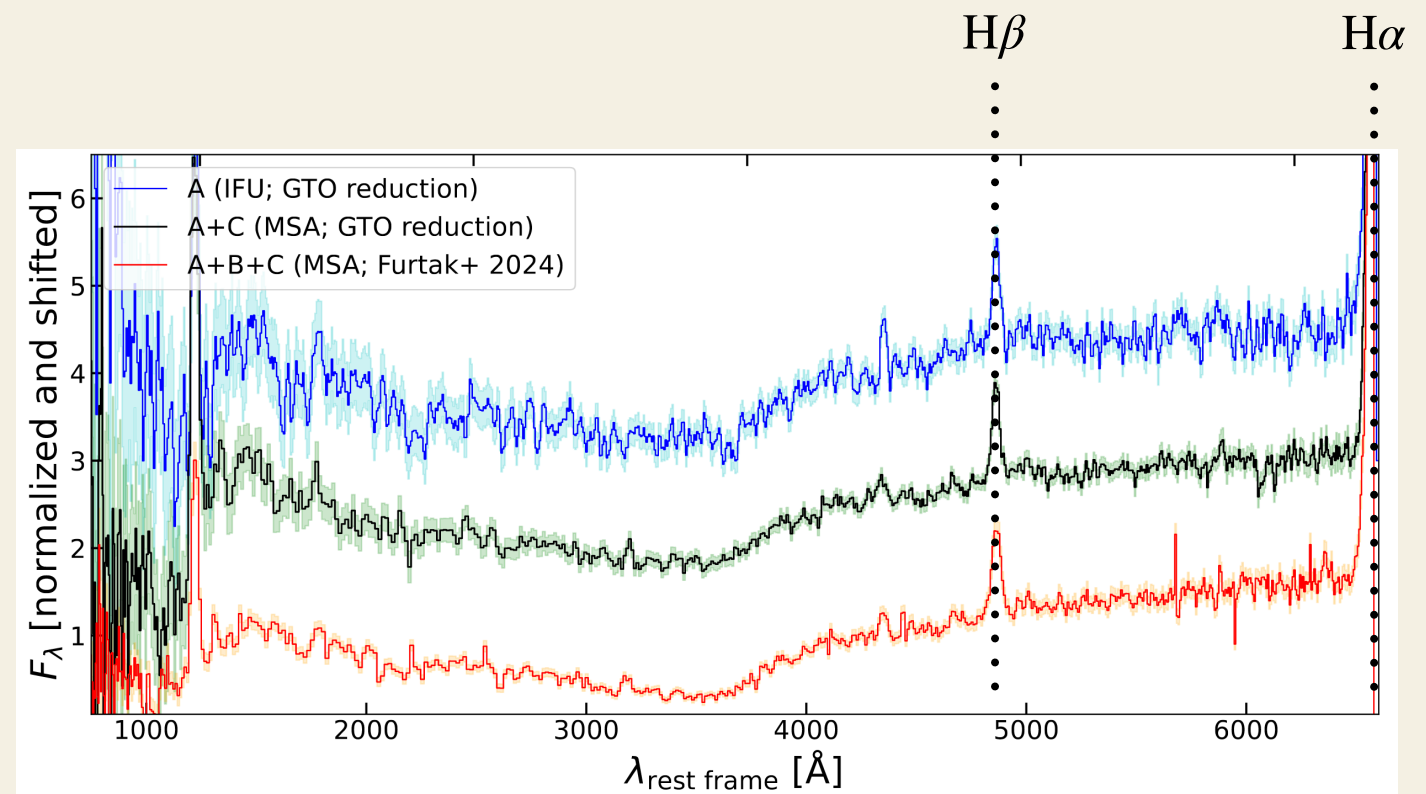
JWST's Broad Line Objects



D'Eugenio+25

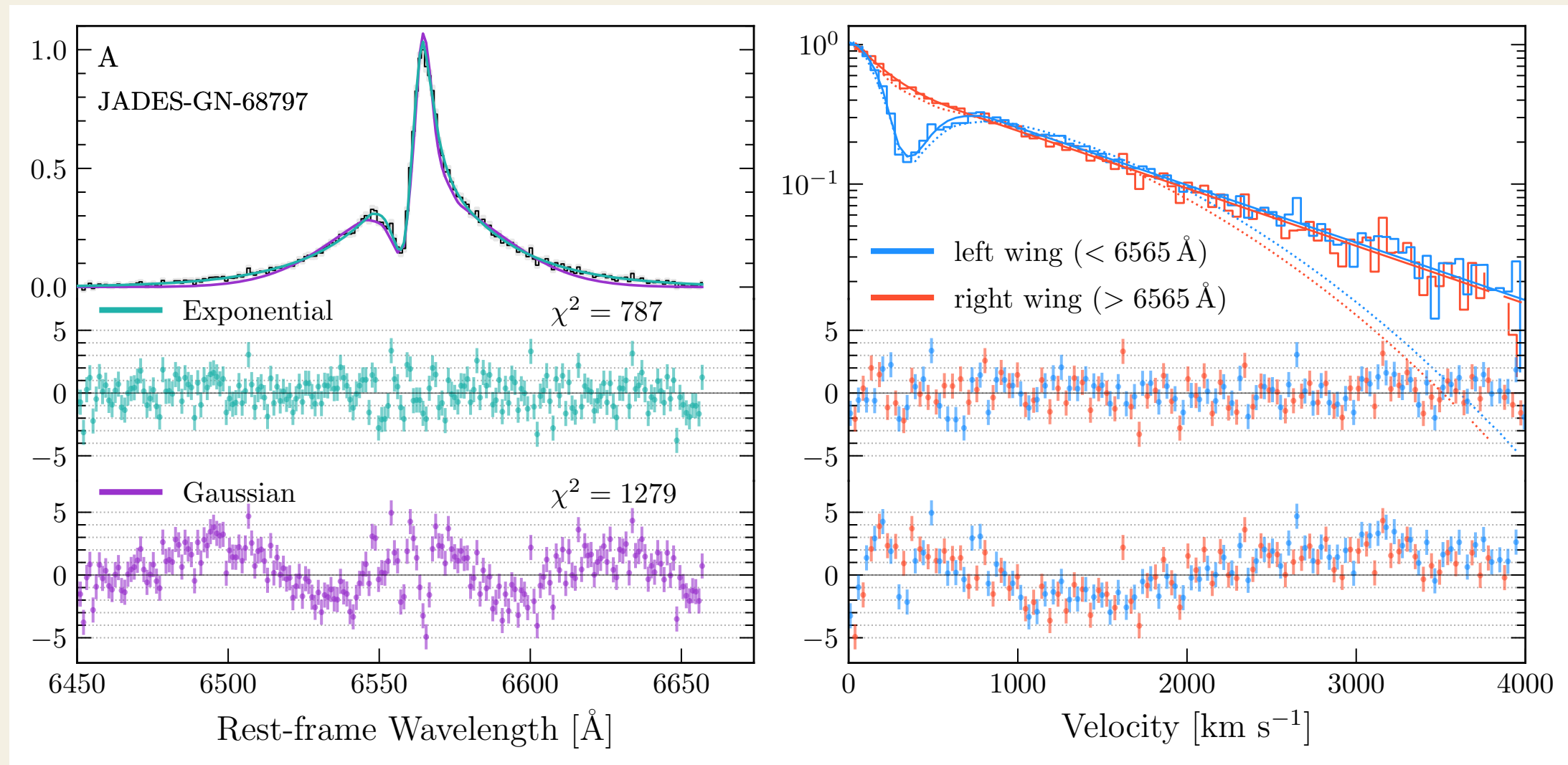
Characteristics:

- Higher number density (than expected from QSO)
- Weaker X-rays **(mostly not detected)*
- Weaker Radio emission **(mostly not detected)*
- Weaker optical variability **(mostly not detected)*
- High-column-density neutral gas (in $n=2$ state) (e.g., Inayoshi & Maiolino 25)

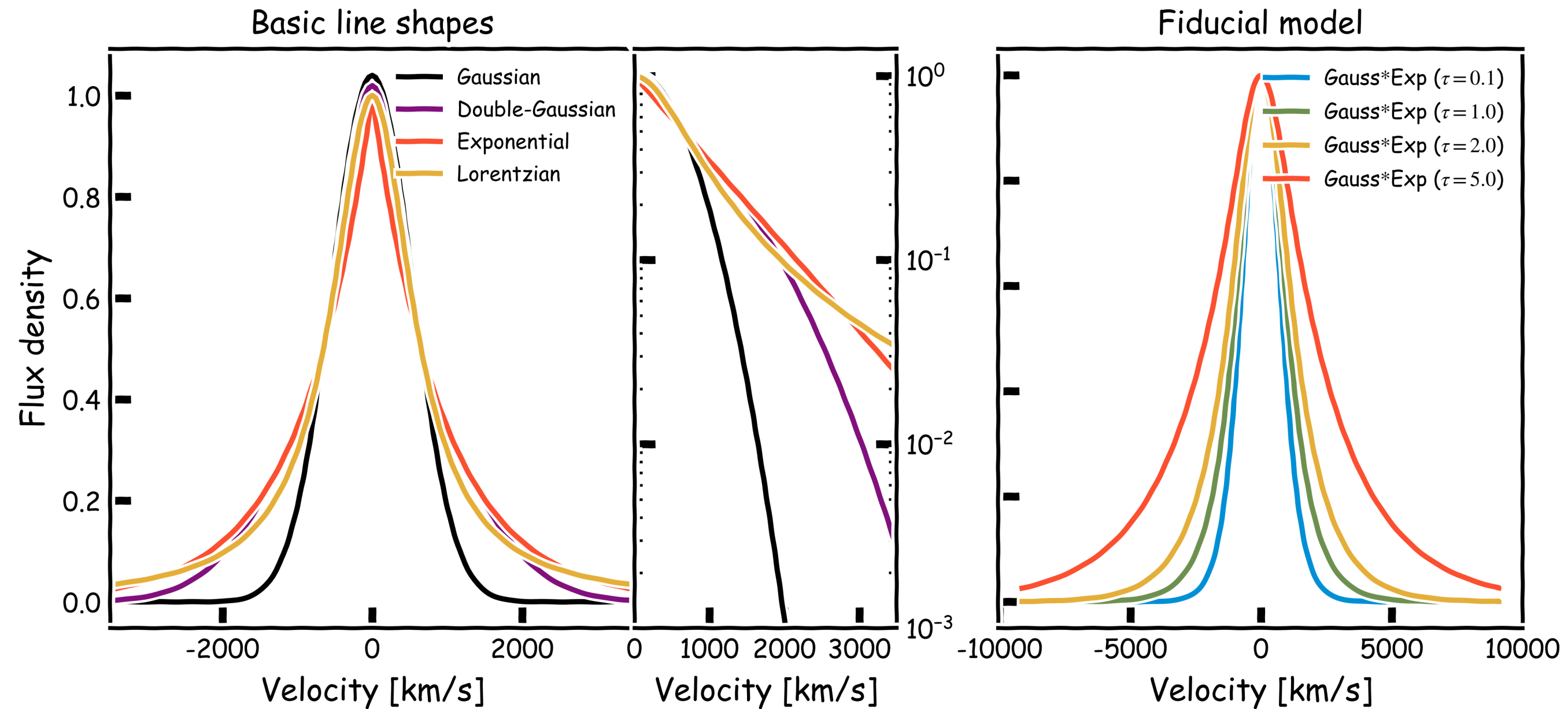


Ji+25

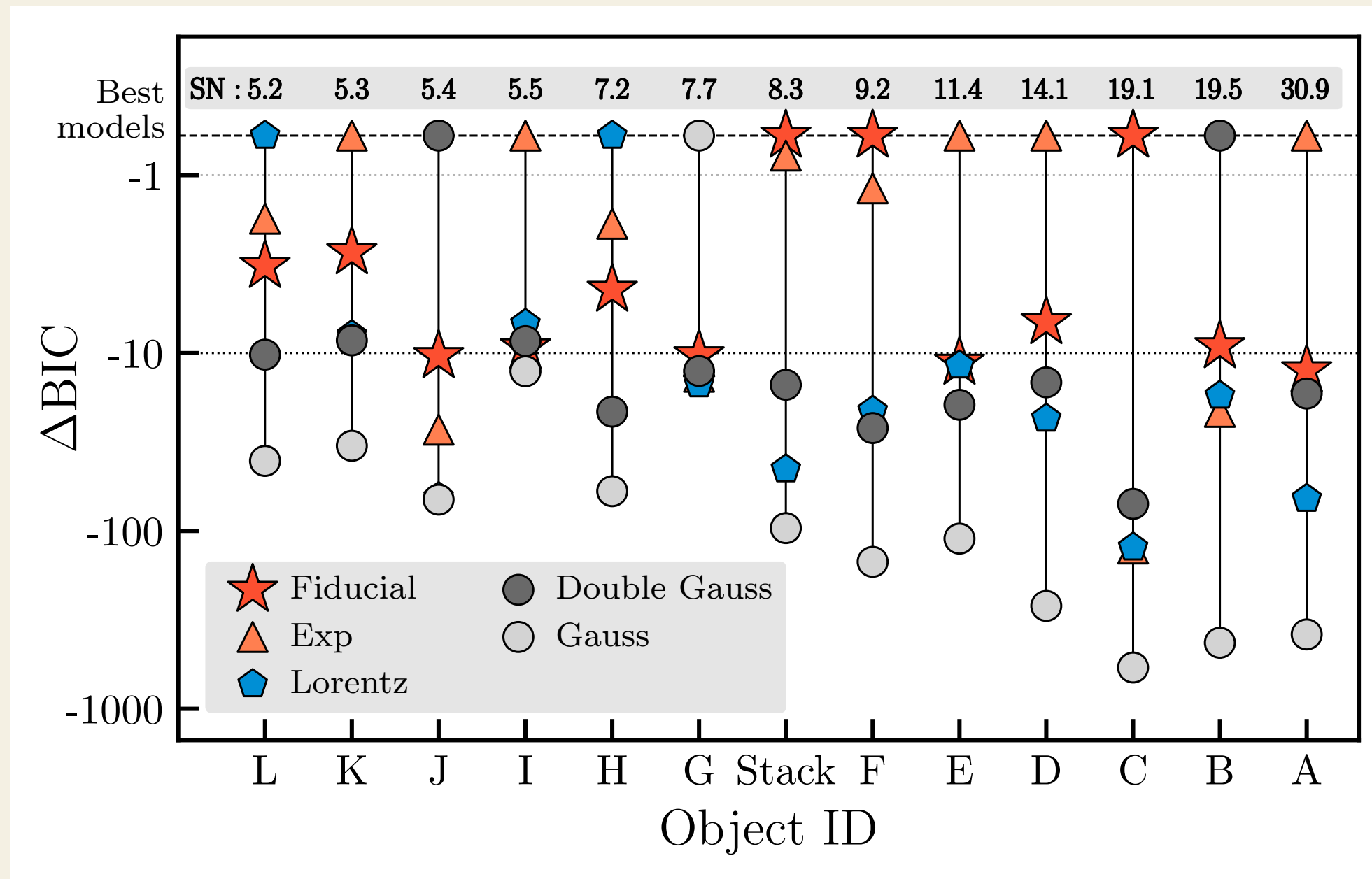
Broad H-alpha lines



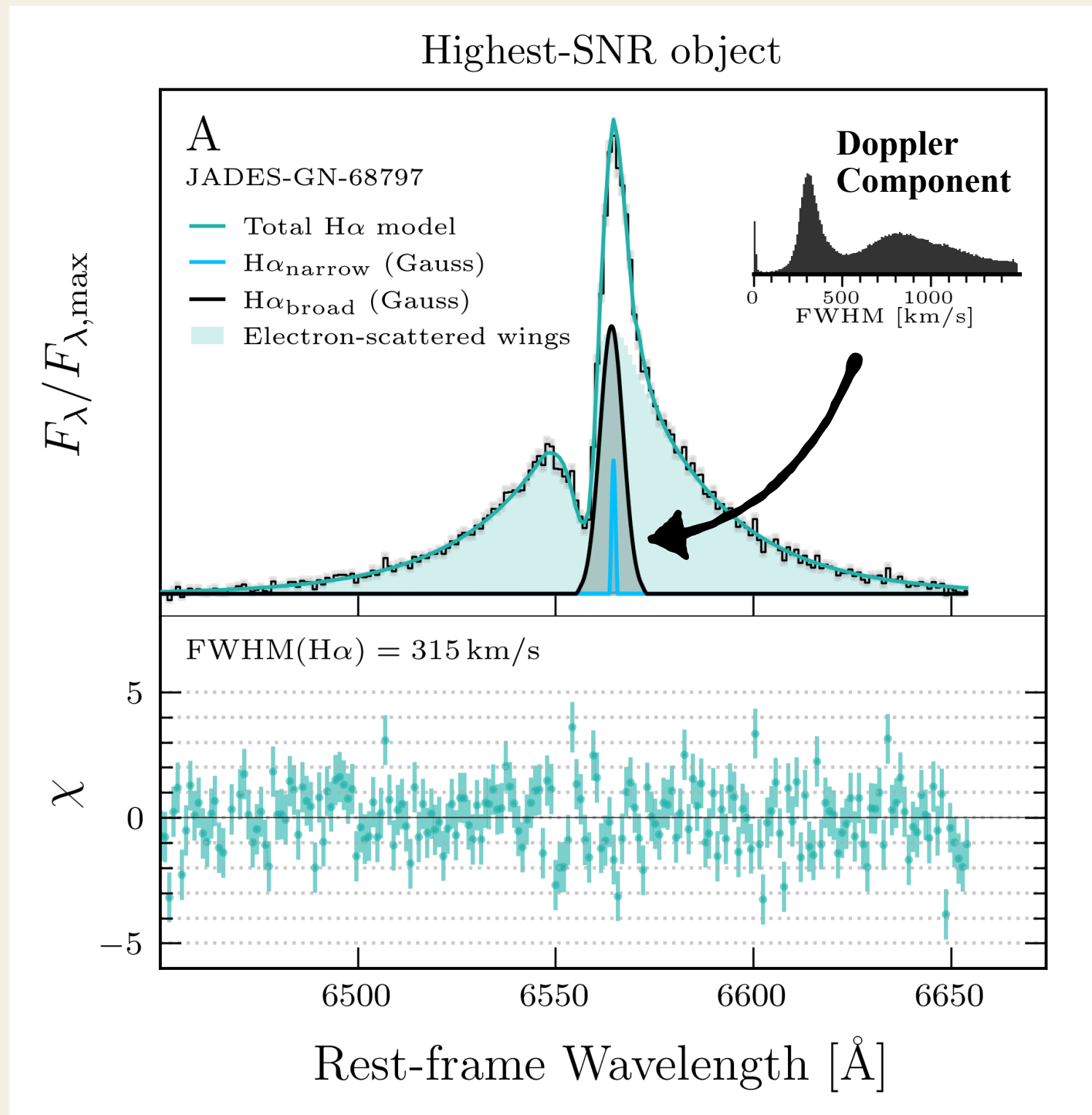
Basic line shapes



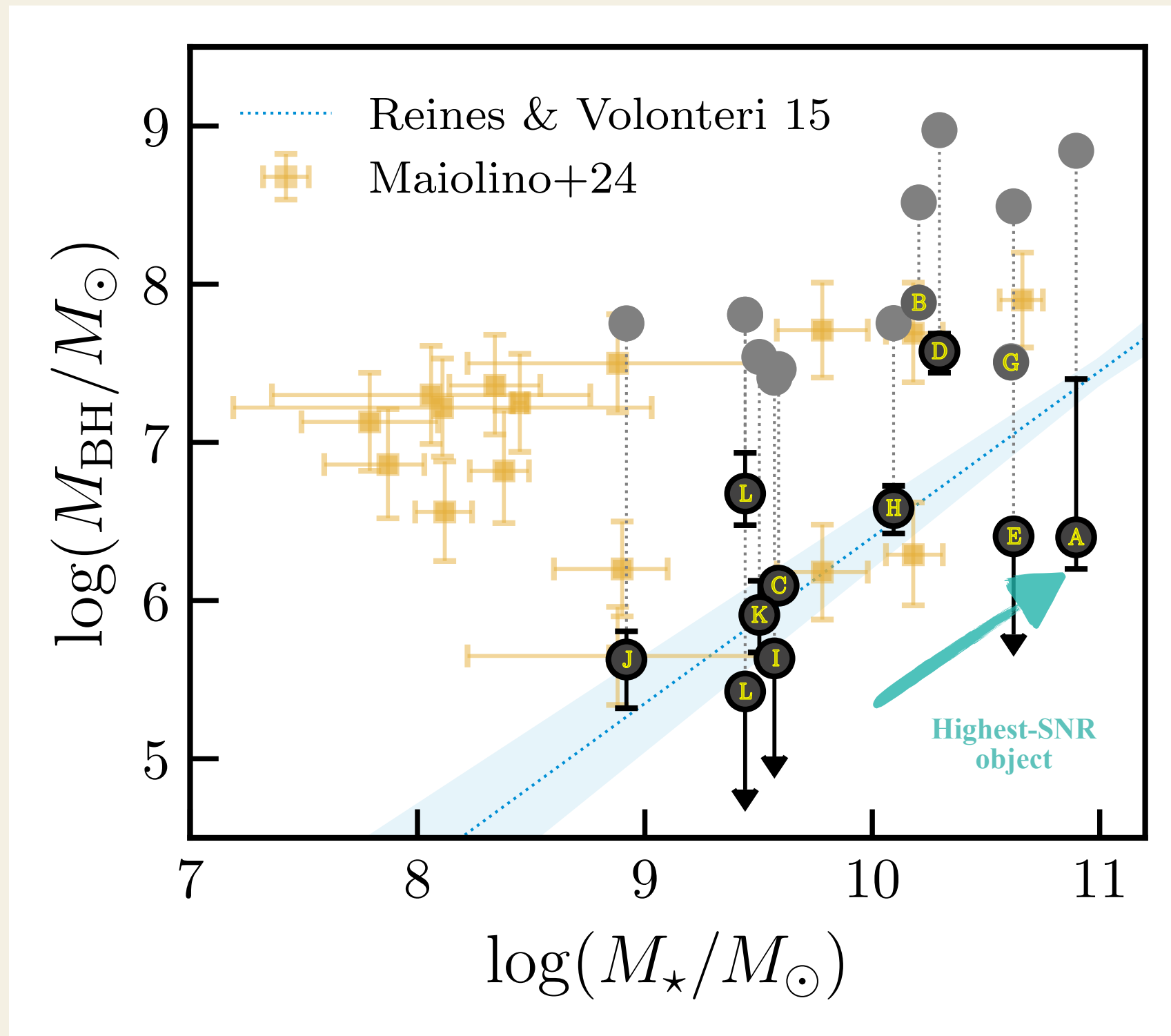
Best-fitting lines shapes



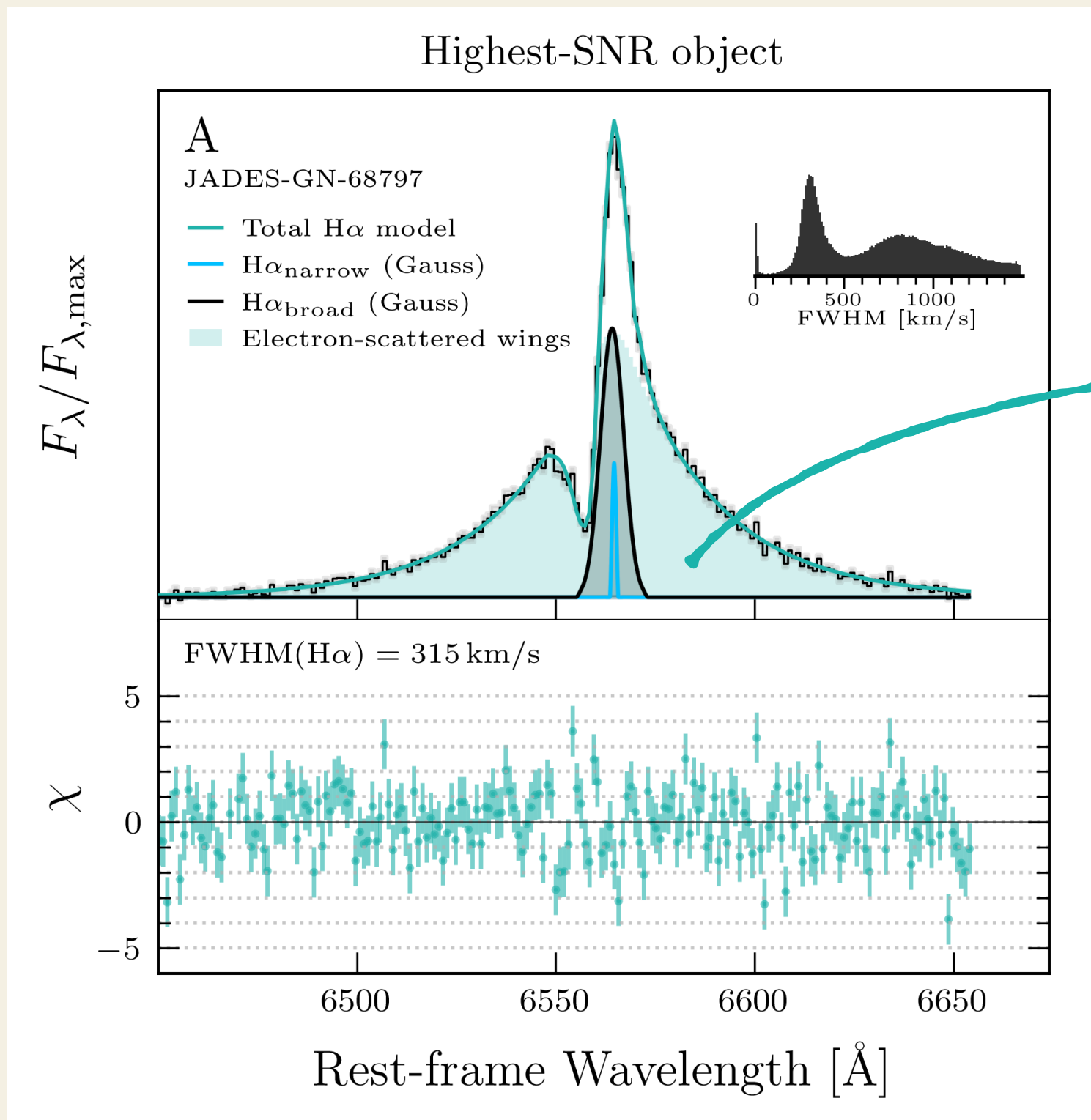
Exponential wings and Gaussian cores



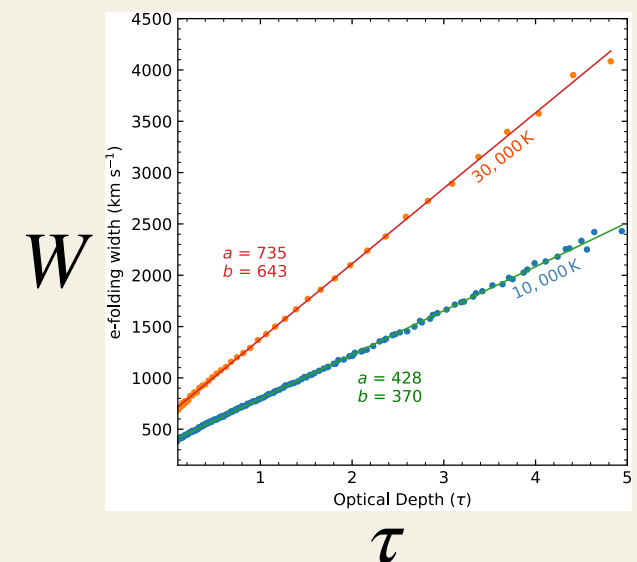
Effect on Black Hole masses



Properties of the scattering medium



$$W = a\tau + b$$

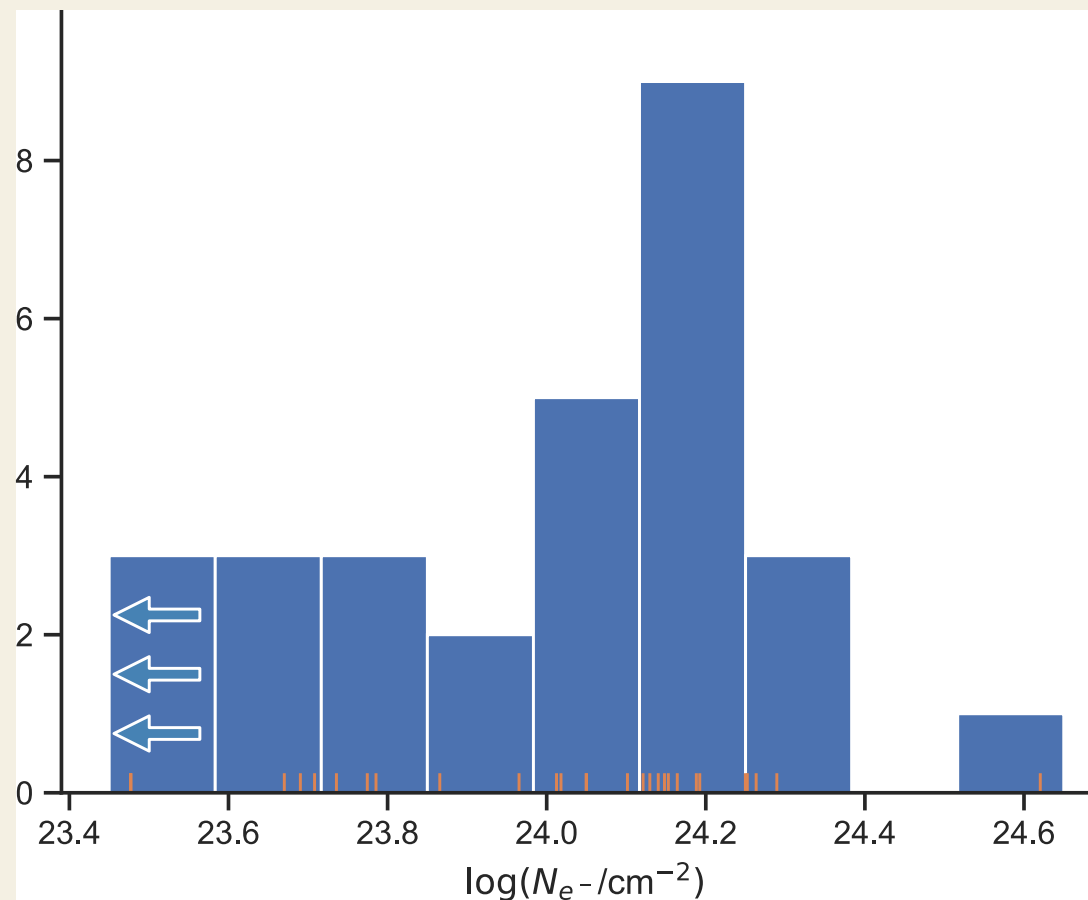


Properties of the scattering medium

ID	Survey-Field-MSAID	Redshift	τ	N_{e^-} (10^{24} cm^{-2})	M_{BH}	$M_{\text{BH Gauss}}$ ———— (log $M_{\odot}$) ————	$M_{\star}$	log $L(\text{H}\alpha)$
A	JADES-GN-68797	5.0405	$1.2^{+0.2}_{-0.1}$	$1.8^{+0.3}_{-0.1}$	$6.4^{+1.0}_{-0.2}$	8.8	< 10.9	$43.70^{+0.02}_{-0.01}$
B	2674-GN-14	5.1826	$2.8^{+0.3}_{-0.3}$	$4.2^{+0.5}_{-0.4}$	$7.9^{+0.1}_{-0.1}$	8.5	< 10.2	$43.36^{+0.01}_{-0.01}$
C	JADES-GN-73488	4.1327	$0.9^{+0.1}_{-0.1}$	$1.3^{+0.2}_{-0.1}$	$6.1^{+0.1}_{-0.1}$	7.5	< 9.6	$42.68^{+0.00}_{-0.00}$
D	RUBIES-EGS-42046	5.2757	$1.5^{+0.3}_{-0.2}$	$2.3^{+0.4}_{-0.2}$	$7.6^{+0.1}_{-0.1}$	9.0	< 10.3	$43.62^{+0.01}_{-0.01}$
E	RUBIES-EGS-49140	6.6847	$1.3^{+0.2}_{-0.1}$	$1.9^{+0.2}_{-0.2}$	< 6.4	8.5	< 10.6	$44.05^{+0.05}_{-0.01}$
F	CEERS-EGS-1244	4.4771	$1.0^{+0.1}_{-0.1}$	$1.5^{+0.2}_{-0.1}$	$5.9^{+0.3}_{-0.6}$	7.9	—	$43.09^{+0.01}_{-0.01}$
G	RUBIES-EGS-58237	3.6505	< 0.8	< 1.2	$7.5^{+0.1}_{-0.1}$	7.5	< 10.6	$42.64^{+0.03}_{-0.05}$
H	4106-EGS-51623	4.9511	$1.0^{+0.1}_{-0.1}$	$1.5^{+0.2}_{-0.2}$	$6.6^{+0.1}_{-0.2}$	7.8	< 10.1	$42.80^{+0.01}_{-0.01}$
I	JADES-GN-53501	3.4294	$0.7^{+0.2}_{-0.1}$	$1.1^{+0.2}_{-0.2}$	< 5.6	7.4	< 9.6	$42.41^{+0.10}_{-0.02}$
J	JADES-GN-38147	5.8694	$0.9^{+0.1}_{-0.1}$	$1.4^{+0.2}_{-0.2}$	$5.6^{+0.2}_{-0.3}$	7.8	< 8.9	$43.02^{+0.01}_{-0.01}$
K	RUBIES-EGS-50052	5.2392	$0.9^{+0.1}_{-0.1}$	$1.3^{+0.2}_{-0.2}$	$5.9^{+0.2}_{-0.2}$	7.5	< 9.5	$42.75^{+0.02}_{-0.03}$
L ^a	RUBIES-EGS-60935	5.2877	$0.9^{+0.2}_{-0.2}$	$1.4^{+0.3}_{-0.2}$	< 5.4 $6.7^{+0.3}_{-0.2}$	7.8	< 9.4	$43.05^{+0.02}_{-0.02}$
S ^b	— Stack (low-SNR)	—	$0.5^{+0.1}_{-0.1}$	$0.7^{+0.1}_{-0.1}$	—	—	< 8.9	—

Rusakov+25

Common presence of ionised gas cocoons



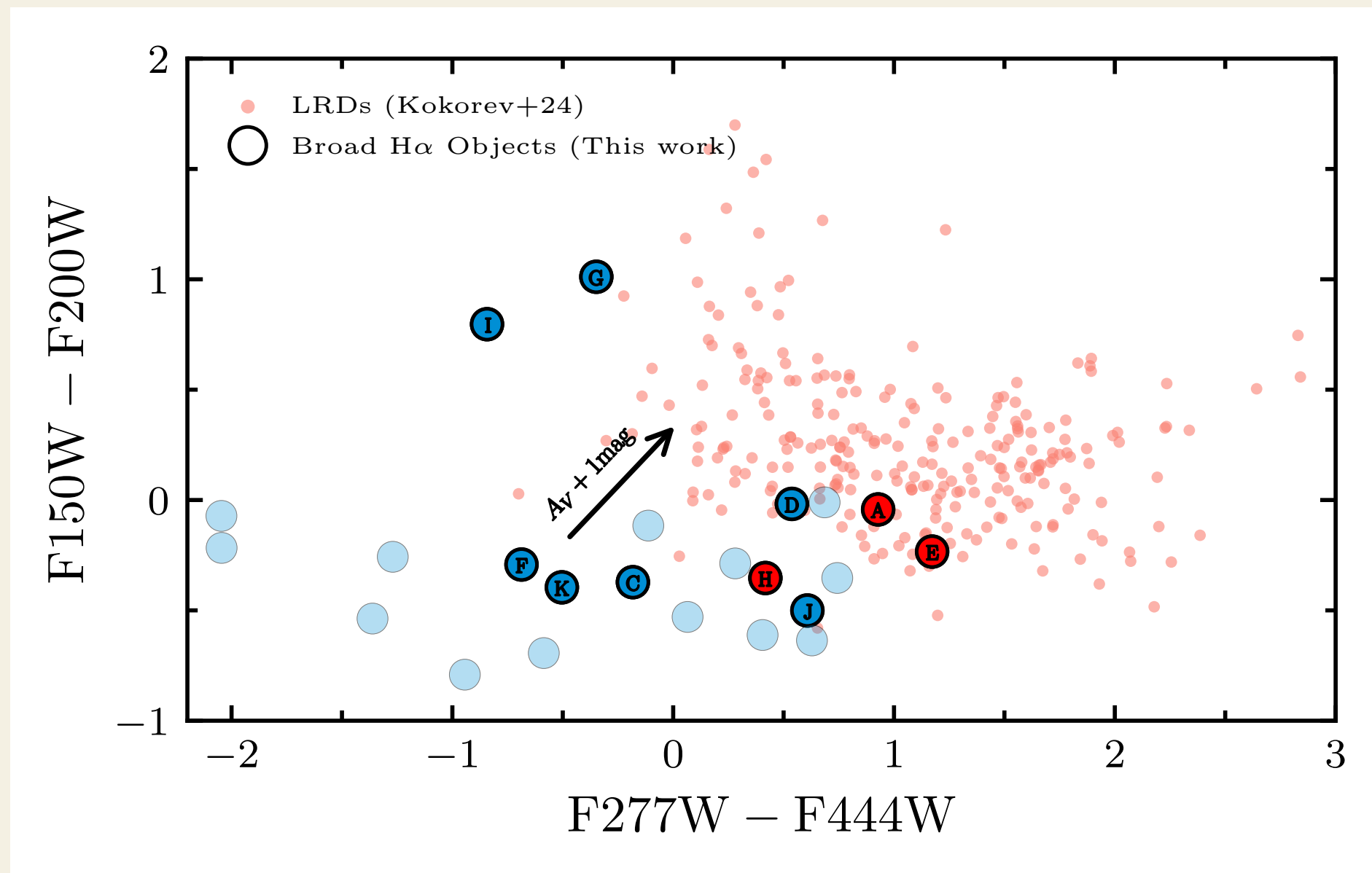
Rusakov+25

Characteristics:

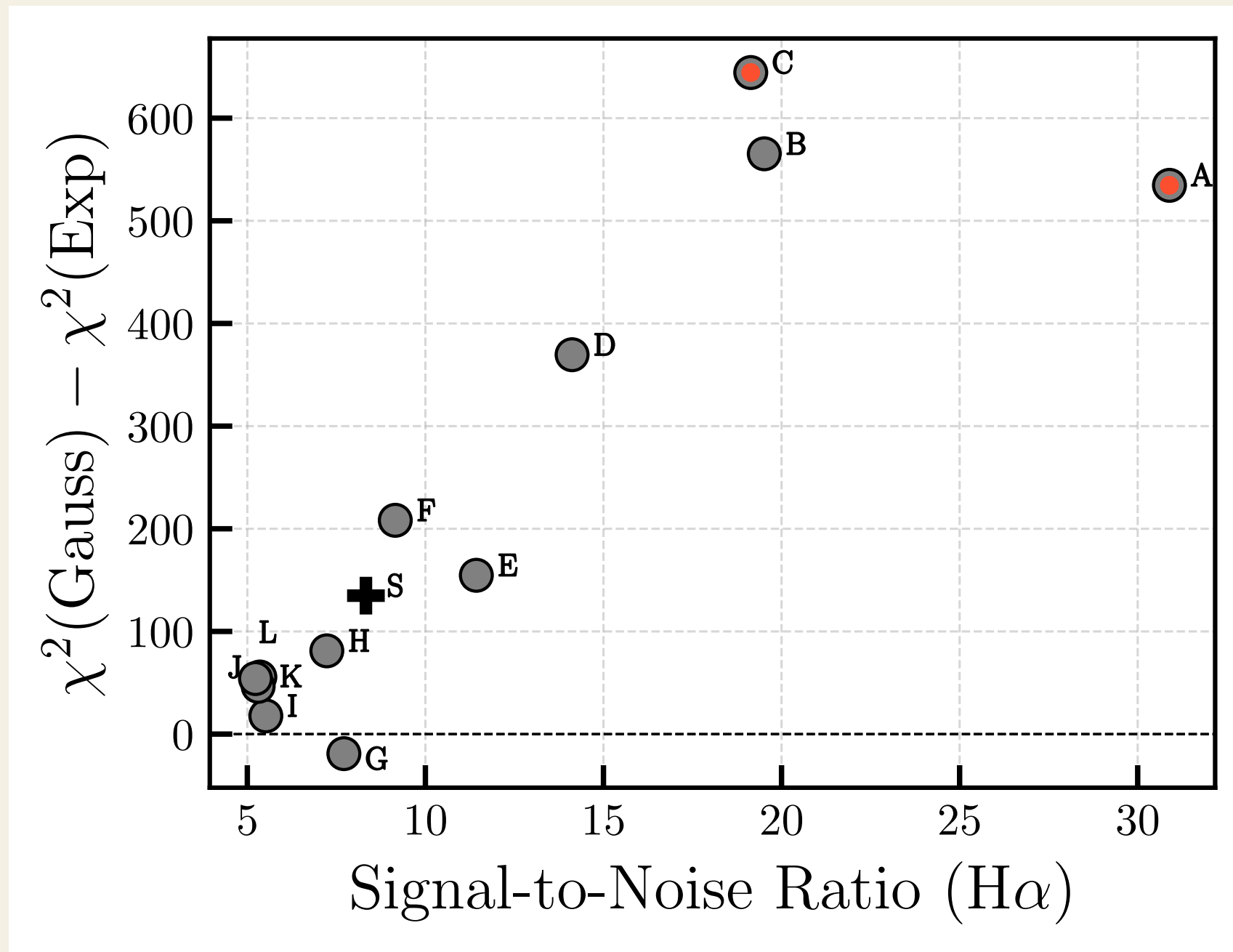
- Higher number density (than expected from QSO)
- Weaker X-rays **(mostly not detected)*
- Weaker Radio emission **(mostly not detected)*
- Weaker optical variability **(mostly not detected)*
- High-column-density neutral gas (in $n=2$ state)
- High-column-density ionised gas (see also Naidu+25, de Graaff+25 for suggested resonant scattering scenario)

Appendix

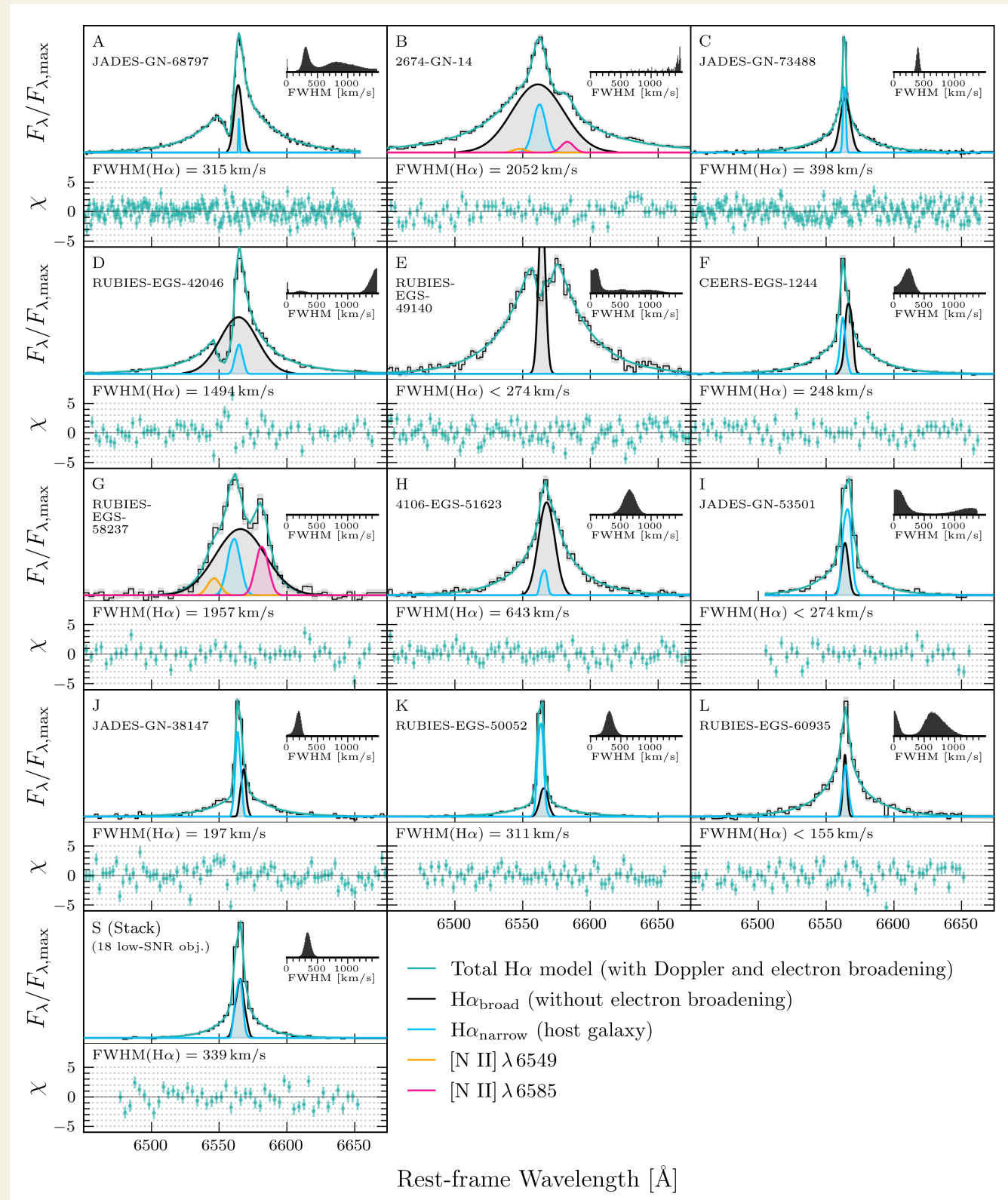
Sample colors



Gaussian & Exponential shapes



Best-fit H-alpha profiles (fiducial model)



Symmetric and exponential wings of H-alpha profiles

