Big and young SMBHs in the early Universe: how can we observe jetted AGN?

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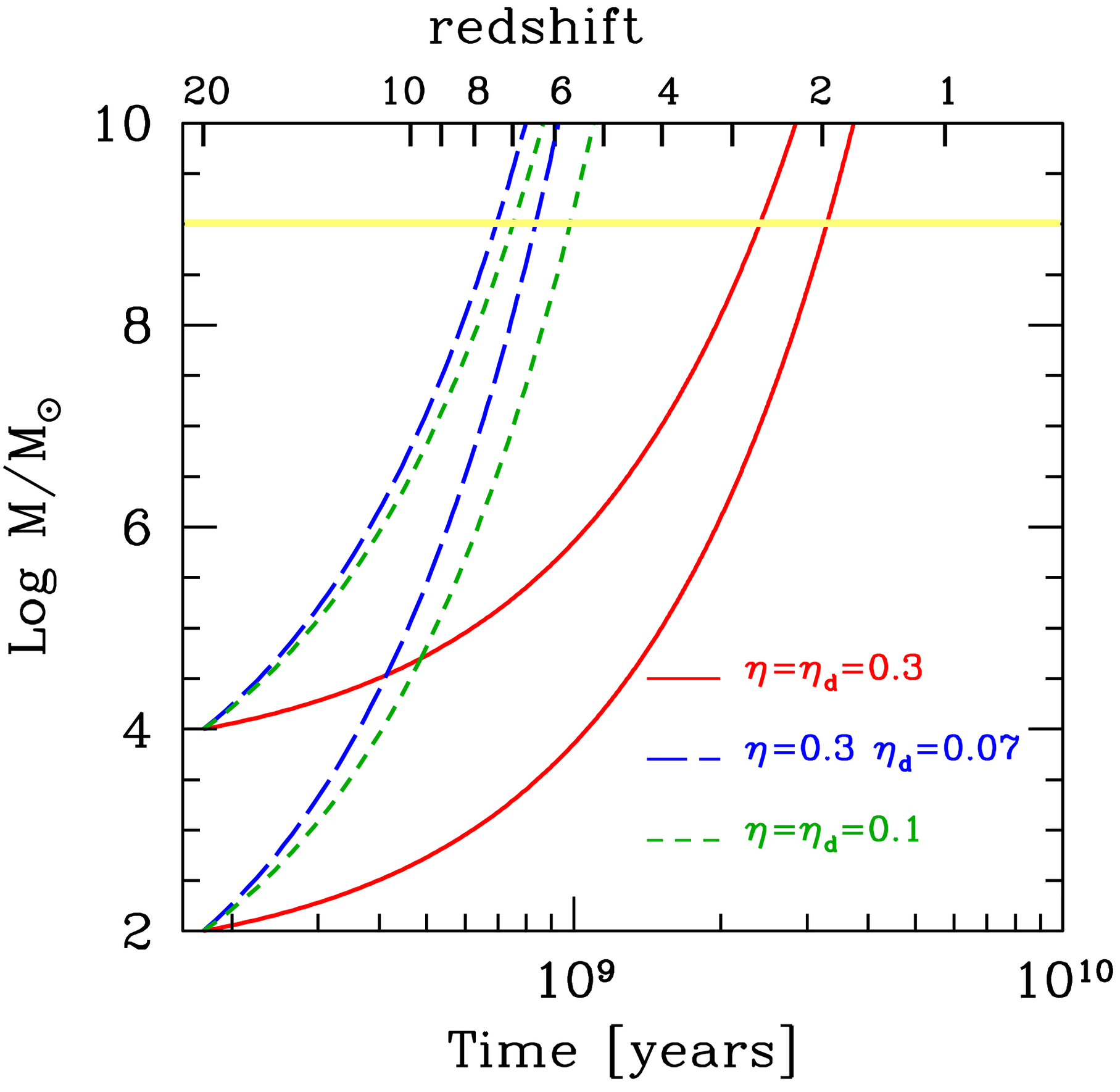
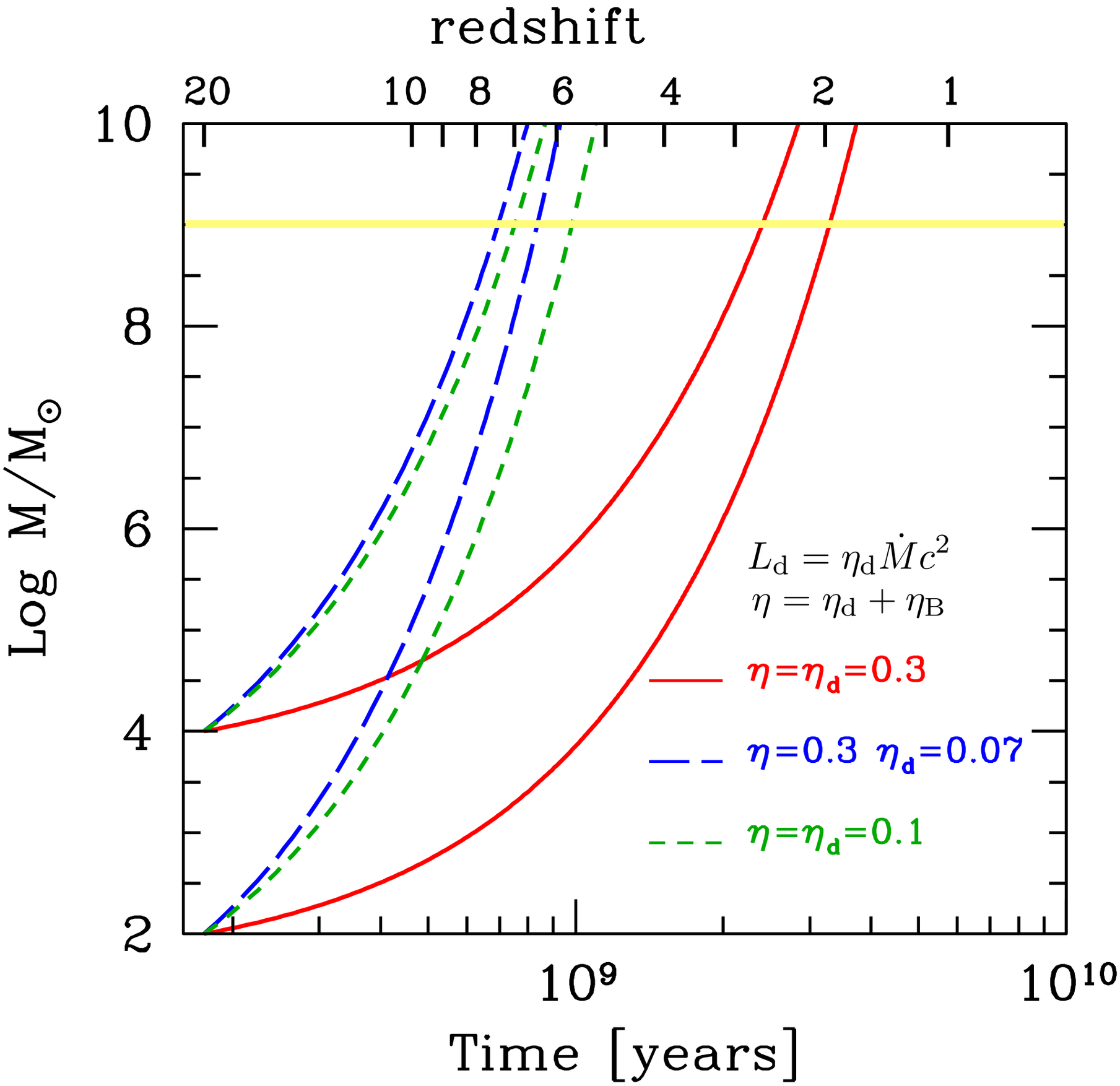
What do we know?

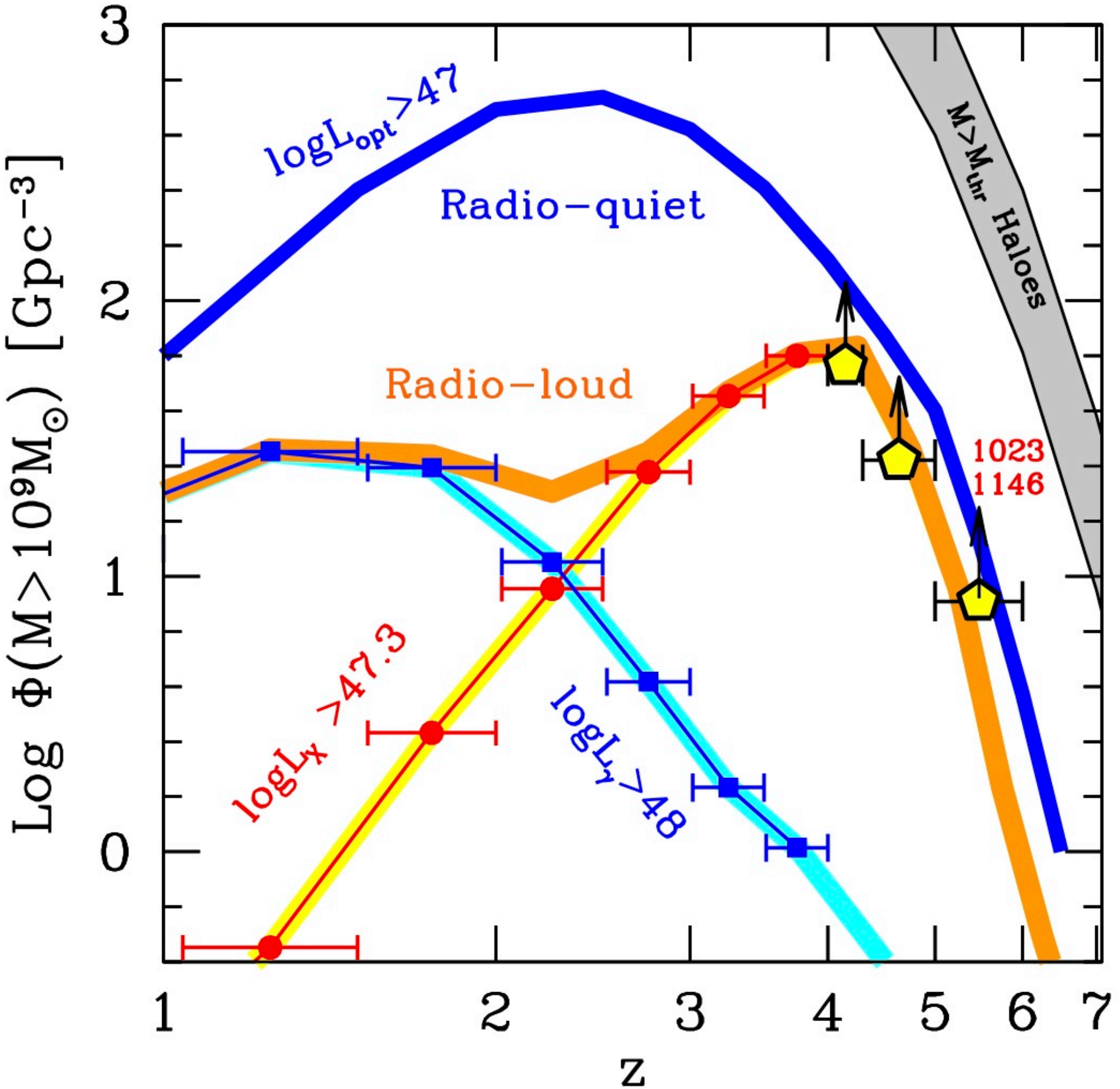
- more and more active supermassive black holes are observed at very high redshift ⟶ back in time!
- the first Gigayear of the Universe is populated with extremely massive black holes

  we only see quasars with more than **10^9** solar masses

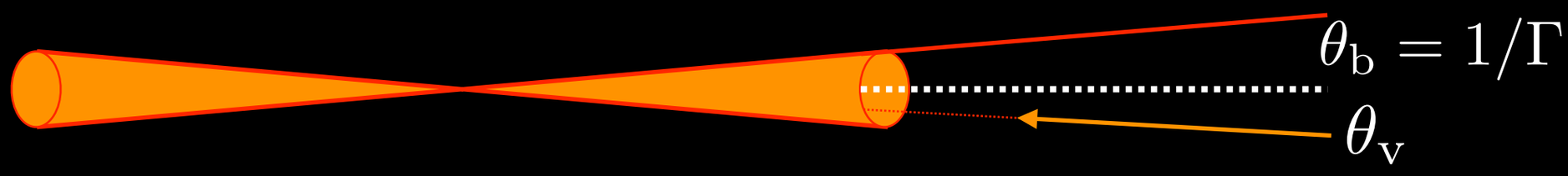
Do these sources have time to grow as we expect up to such large masses?


redshift
20
10
8
6
4
2
1
10
8
6
4
2
Log M/M⊙
$\eta=\eta_d=0.3$
$\eta=0.3\ \eta_d=0.07$
$\eta=\eta_d=0.1$
10^9
10^{10}
Time [years]

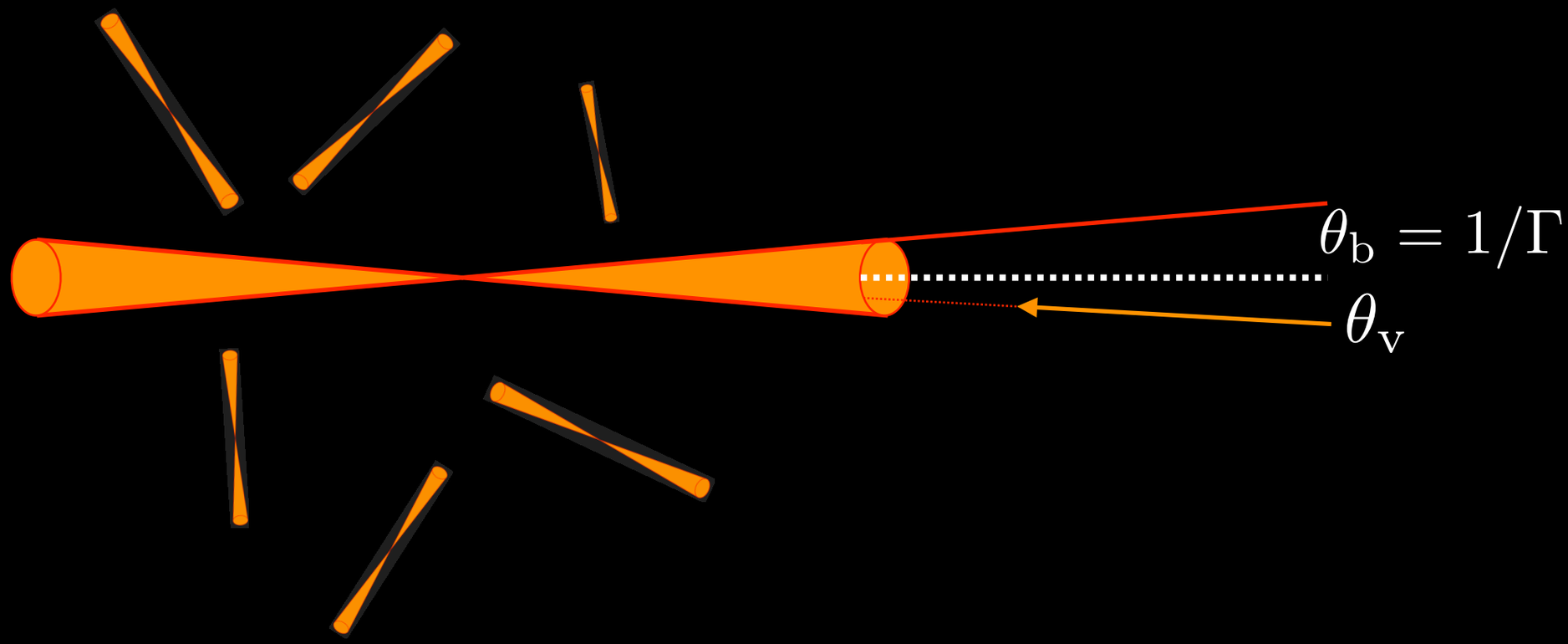

redshift
20
10
8
6
4
2
1
10
8
6
4
2
Log M/M$_\odot$
$L_{\rm d} = \eta_{\rm d} \dot{M} c^2$
$\eta = \eta_{\rm d} + \eta_{\rm B}$
η=$\eta_{\rm d}$=0.3
η=0.3 $\eta_{\rm d}$=0.07
η=$\eta_{\rm d}$=0.1
10^9
10^{10}
Time [years]


Log Φ(M>10⁹M⊙) [Gpc⁻³]
z
logL_opt>47
Radio−quiet
Radio−loud
M>M_thr Haloes
1023
1146
logL_X >47.3
logL_γ>48

Blazars as tracers of high redshift jetted AGN



Blazars as tracers of high redshift jetted AGN



viewing angle:
$\theta_{\rm v} < 1/\Gamma$

→

analogous jetted AGN, randomly oriented:
$2\Gamma^2 \sim 340 - 450$

Blazars as tracers of high redshift jetted AGN

blazars can be found in optical quasar catalogs:

SDSS+FIRST quasar catalog	105783
$z > 4$	1248
radio-detected (>1mJy)	53
radio loudness > 100	31
blazars (up to now!) $M > 10^9 M_\odot$	8

2700 jetted quasars

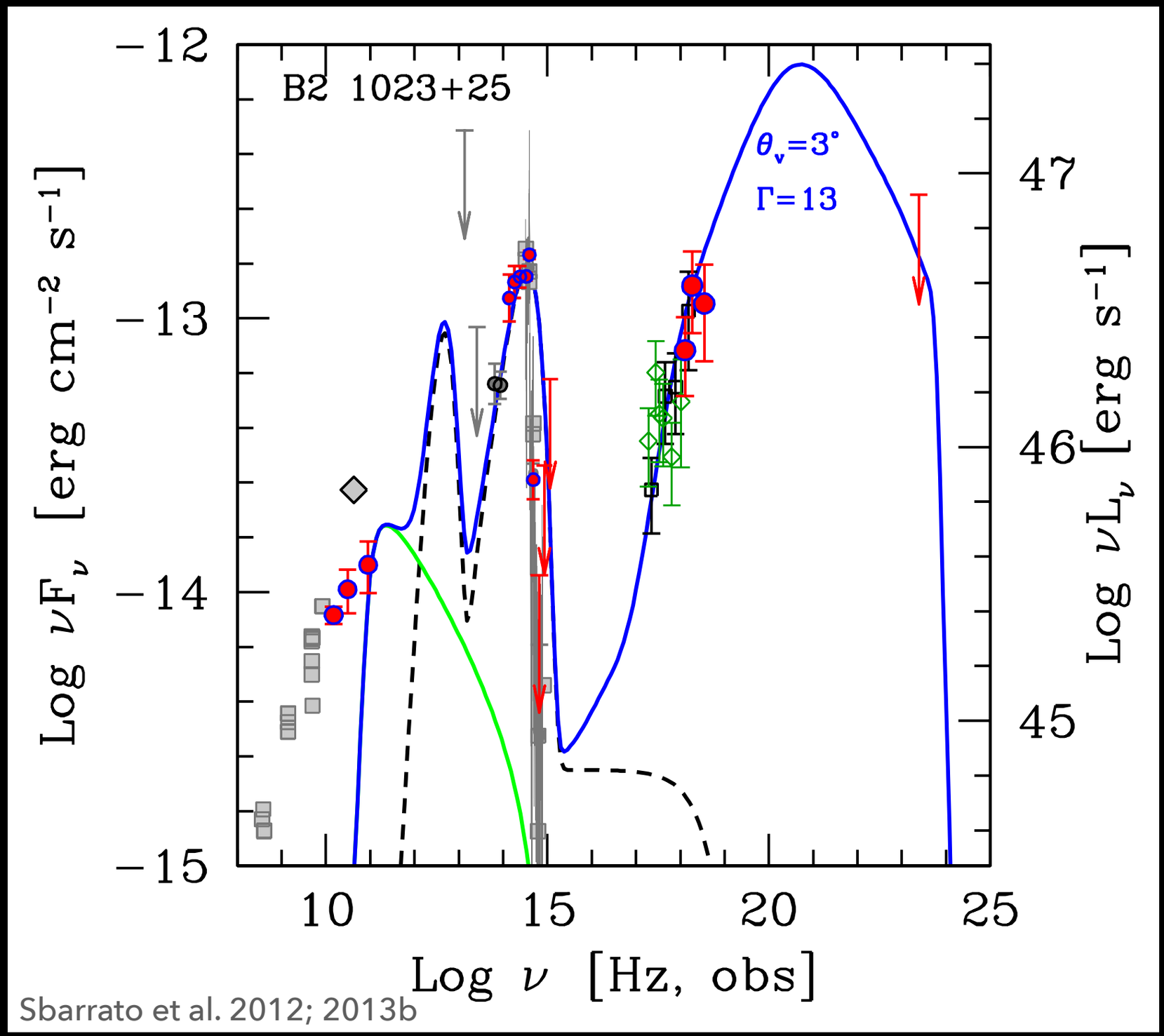
$2\Gamma^2$

140 slightly misaligned

$2\left[\frac{F_{\rm blazar}}{F_{\rm lim}}\right]^{1/p} - 1$

GN,
d:
50

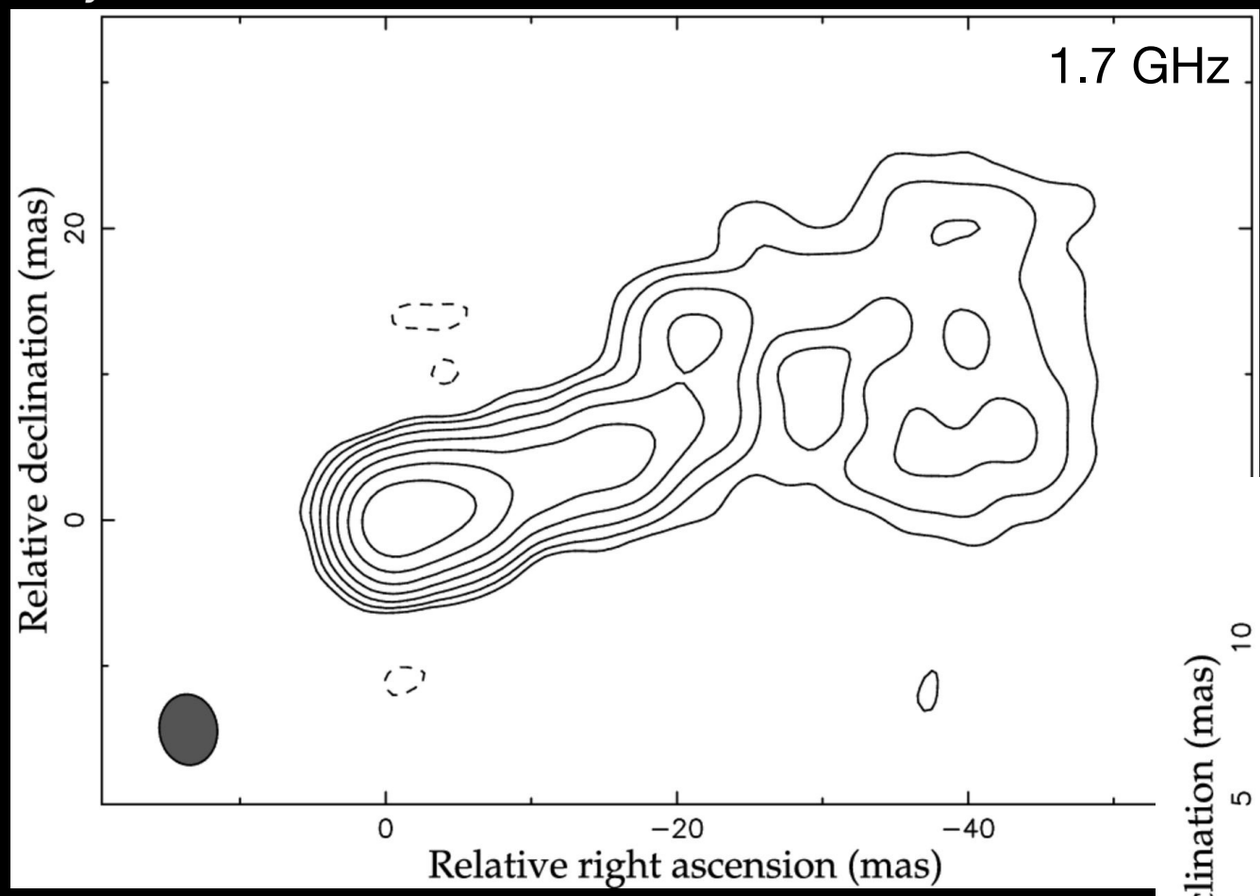
B2 1023+25 z=5.3

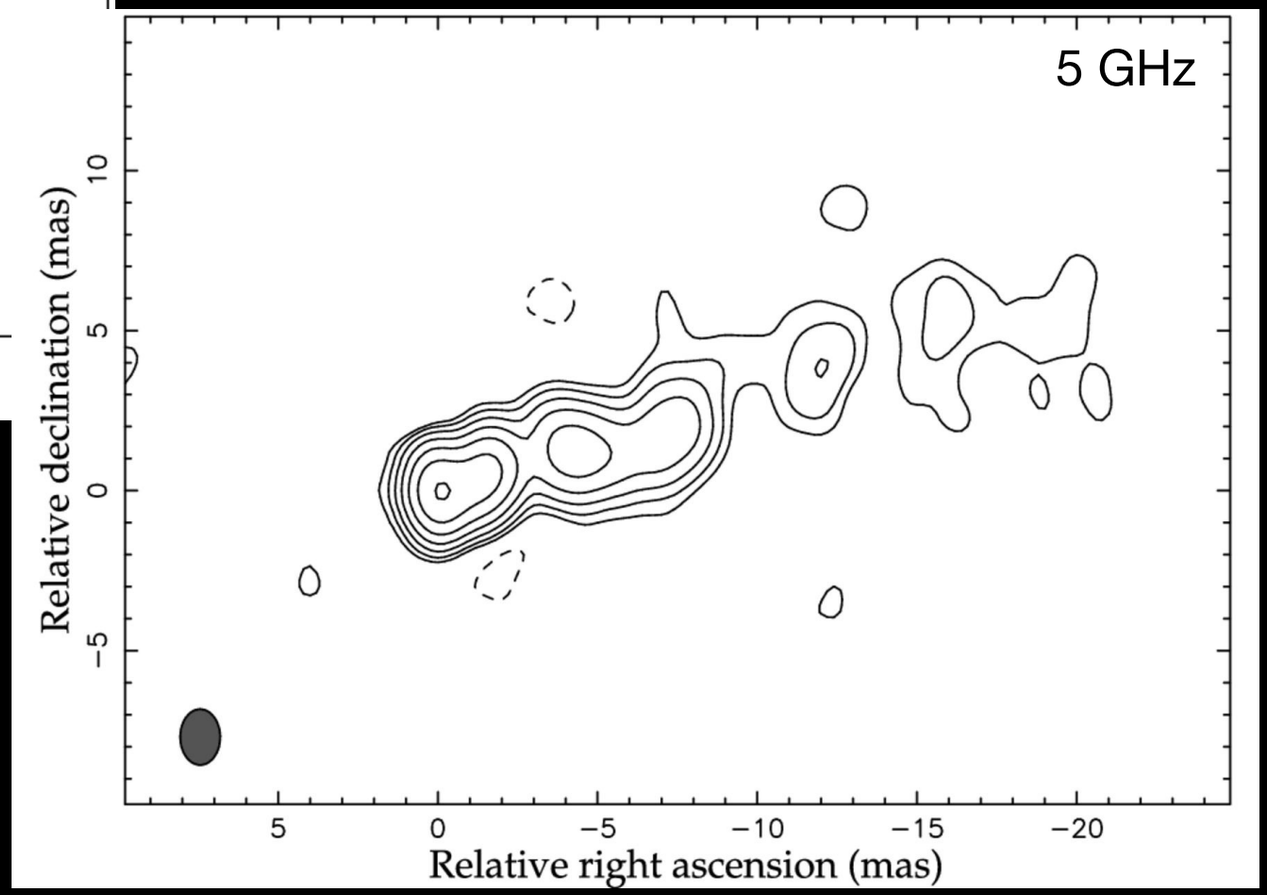


Sbarrato et al. 2012; 2013b

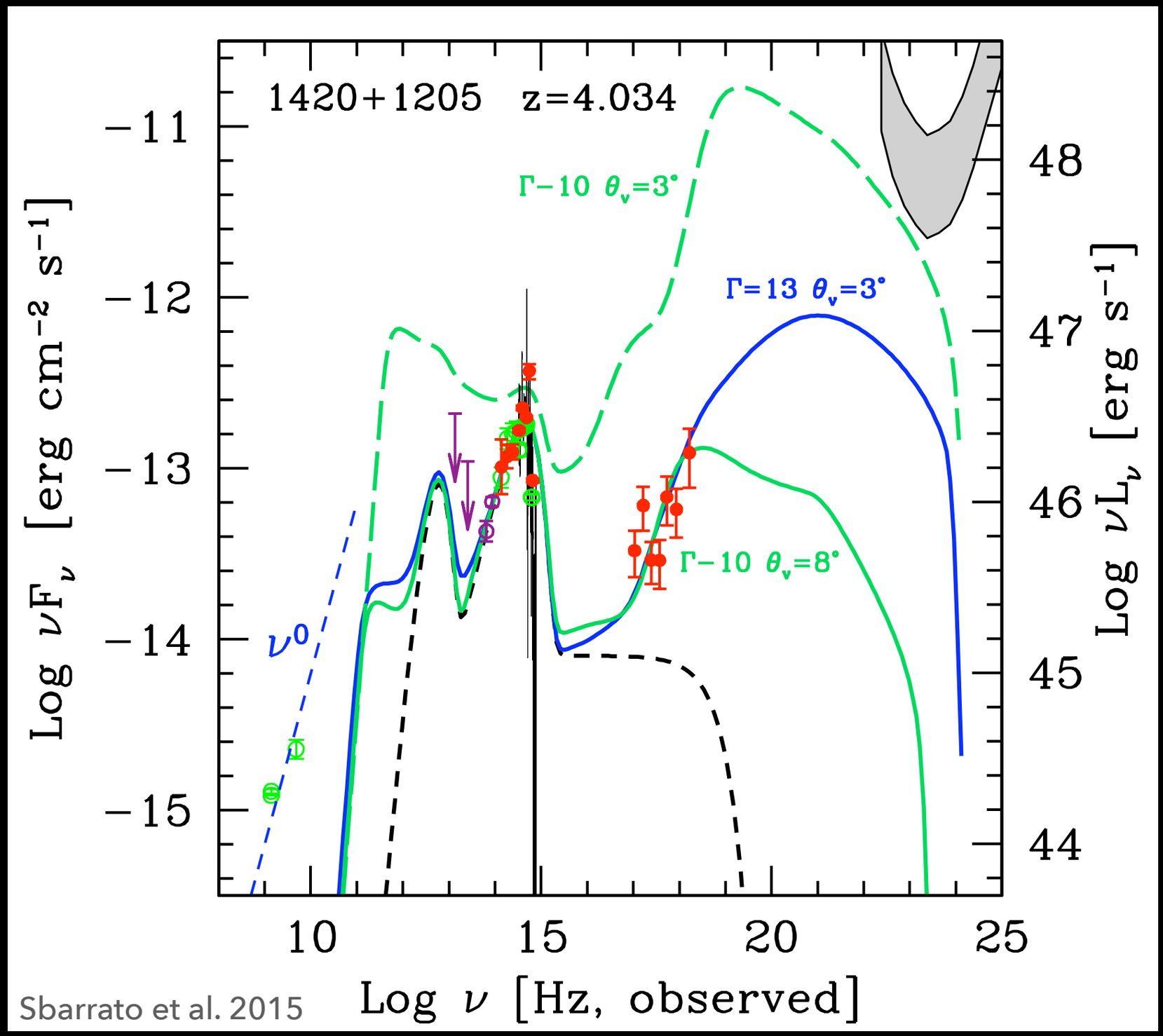
B2 1023+25 z=5.3

Frey et al. 2015





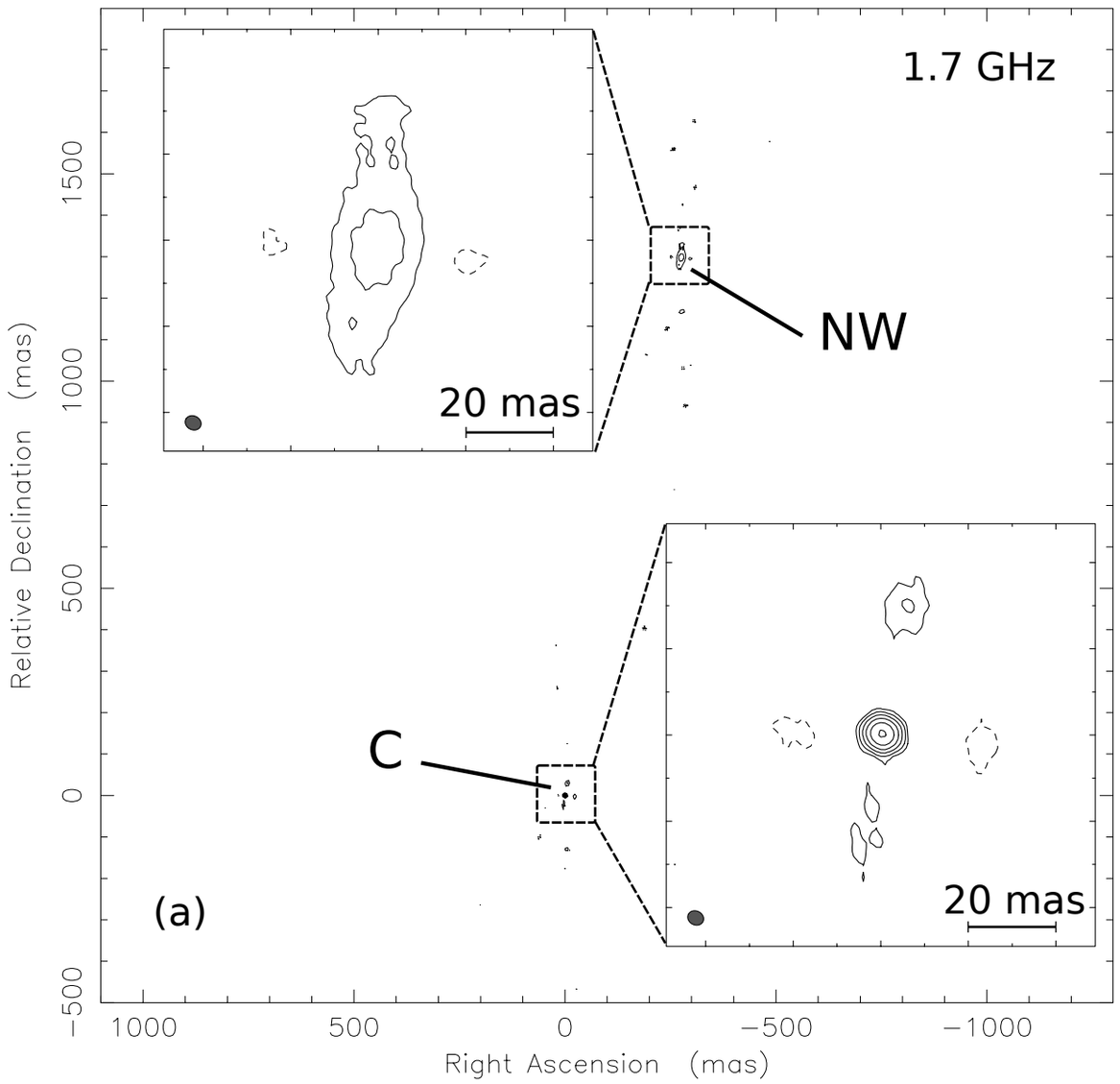
J1420+1205 z=4

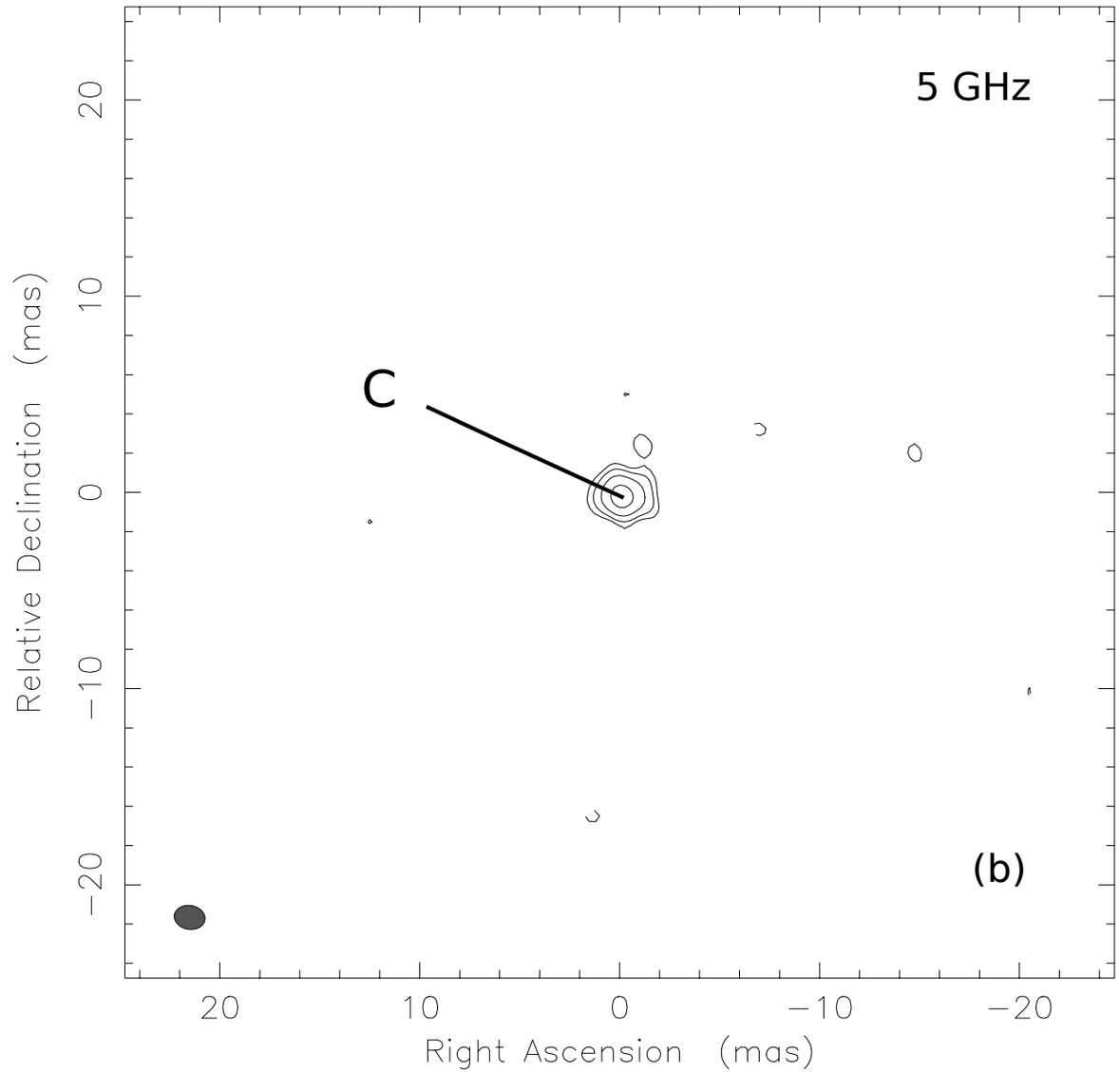


Sbarrato et al. 2015

J1420+1205 z=4

Cao et al. 2015



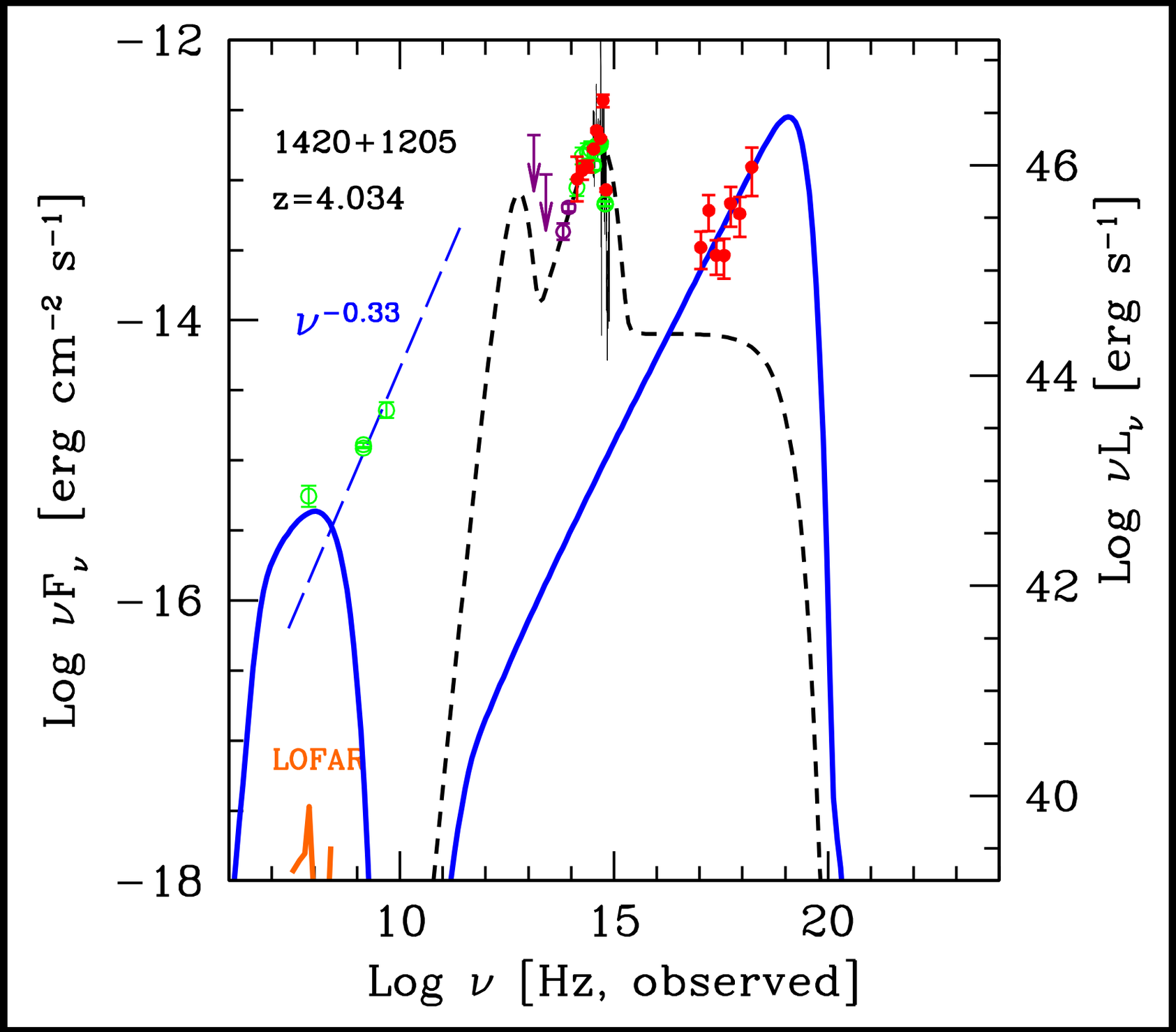


J1420+1205 z=4

What if X-rays were emitted from hotspots or lobes interacting with the CMB?

We tested this possibility:

- **dramatically far from equipartition**
- **injected power (electrons) 2e49 erg/s per each hotspot!!**
- **CMB dominates standard synchrotron of approx a factor 1000…**
  we shouldn't see radio emission at all!



What do we need?

- we need to observe the “inner” part of the jet:
  understand its nature and orientation!
  disentangle between different scenarios, or
  identify a brand new structure/emission!

- lower flux limit and higher resolution, of course!