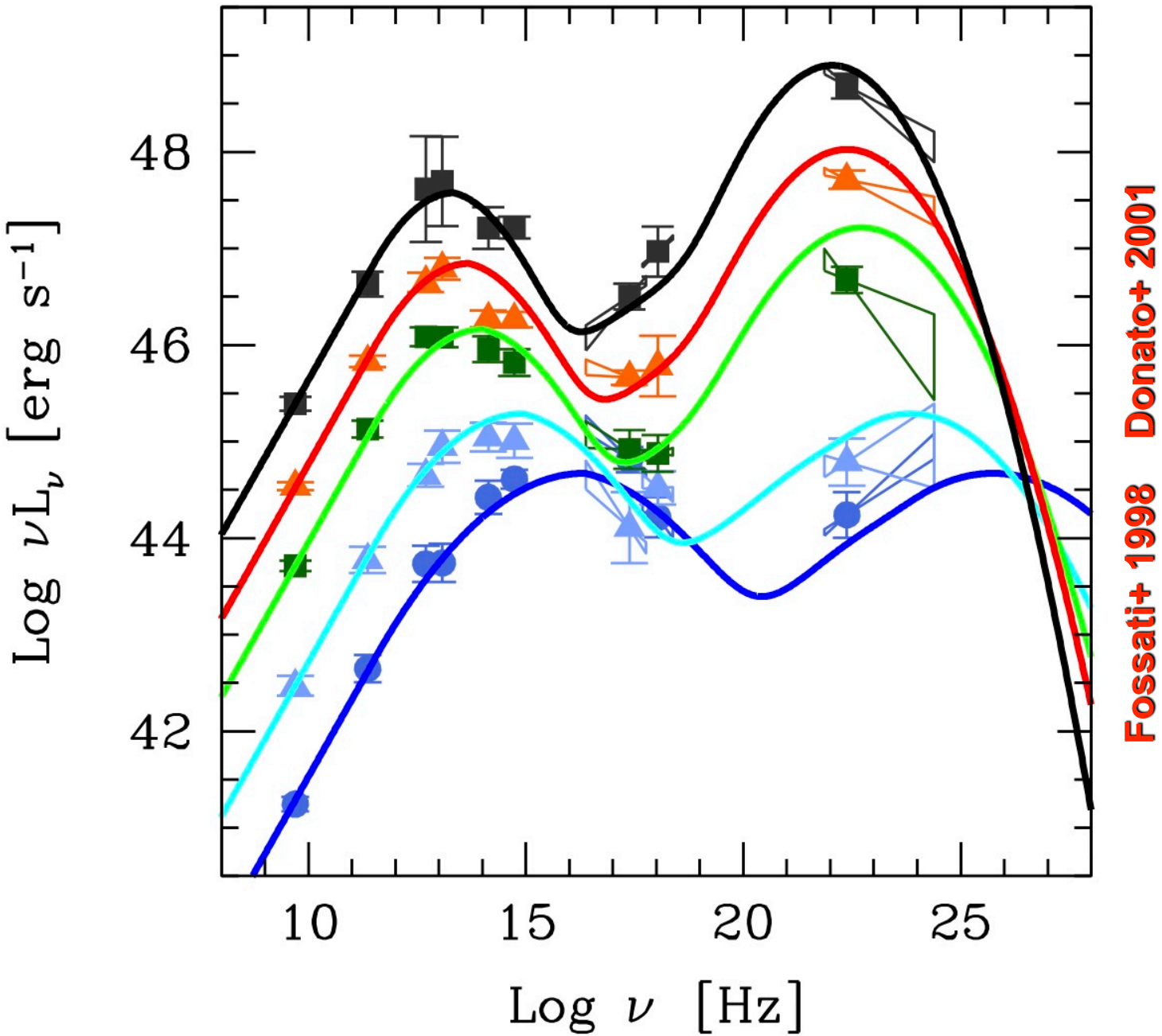
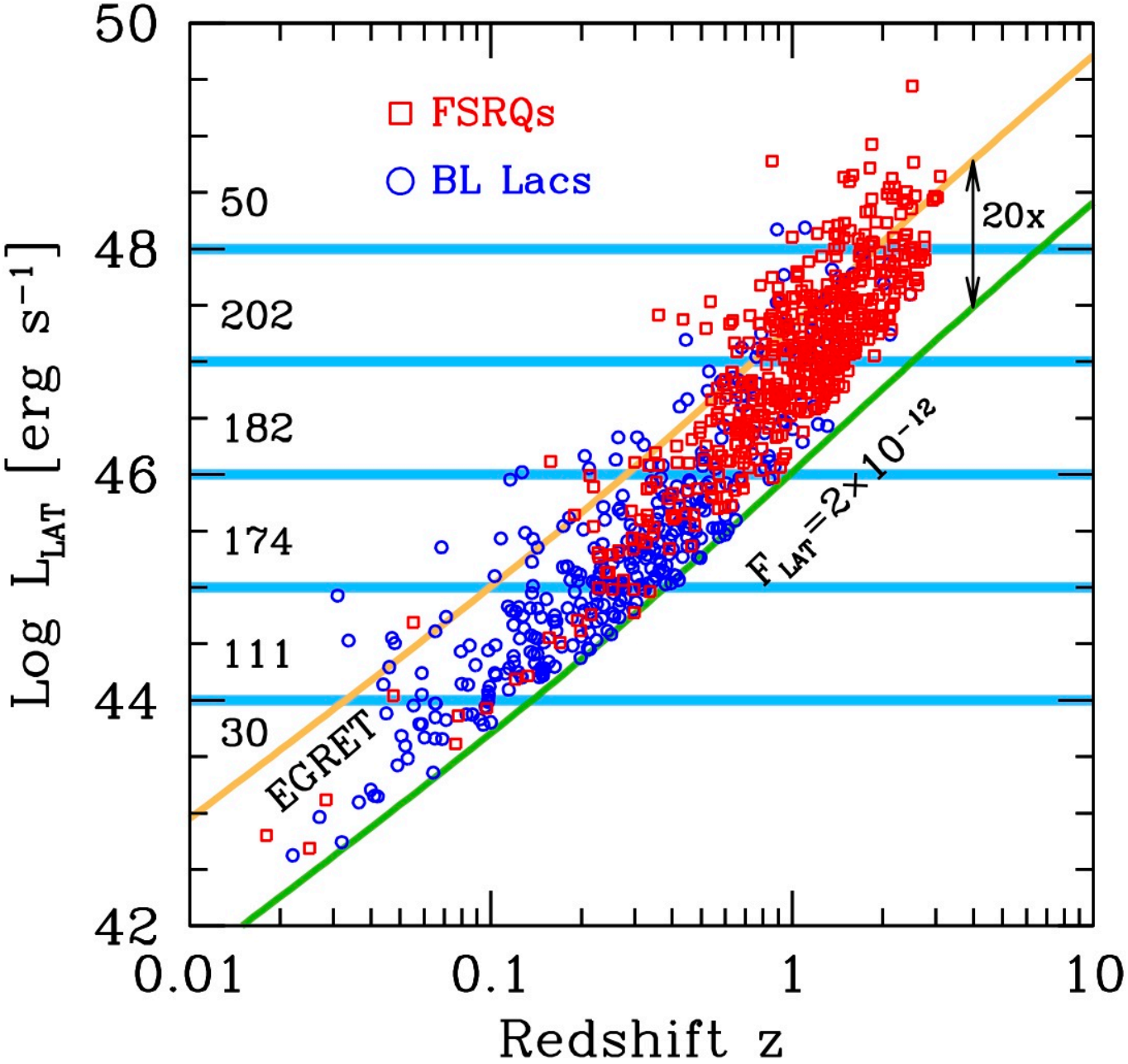
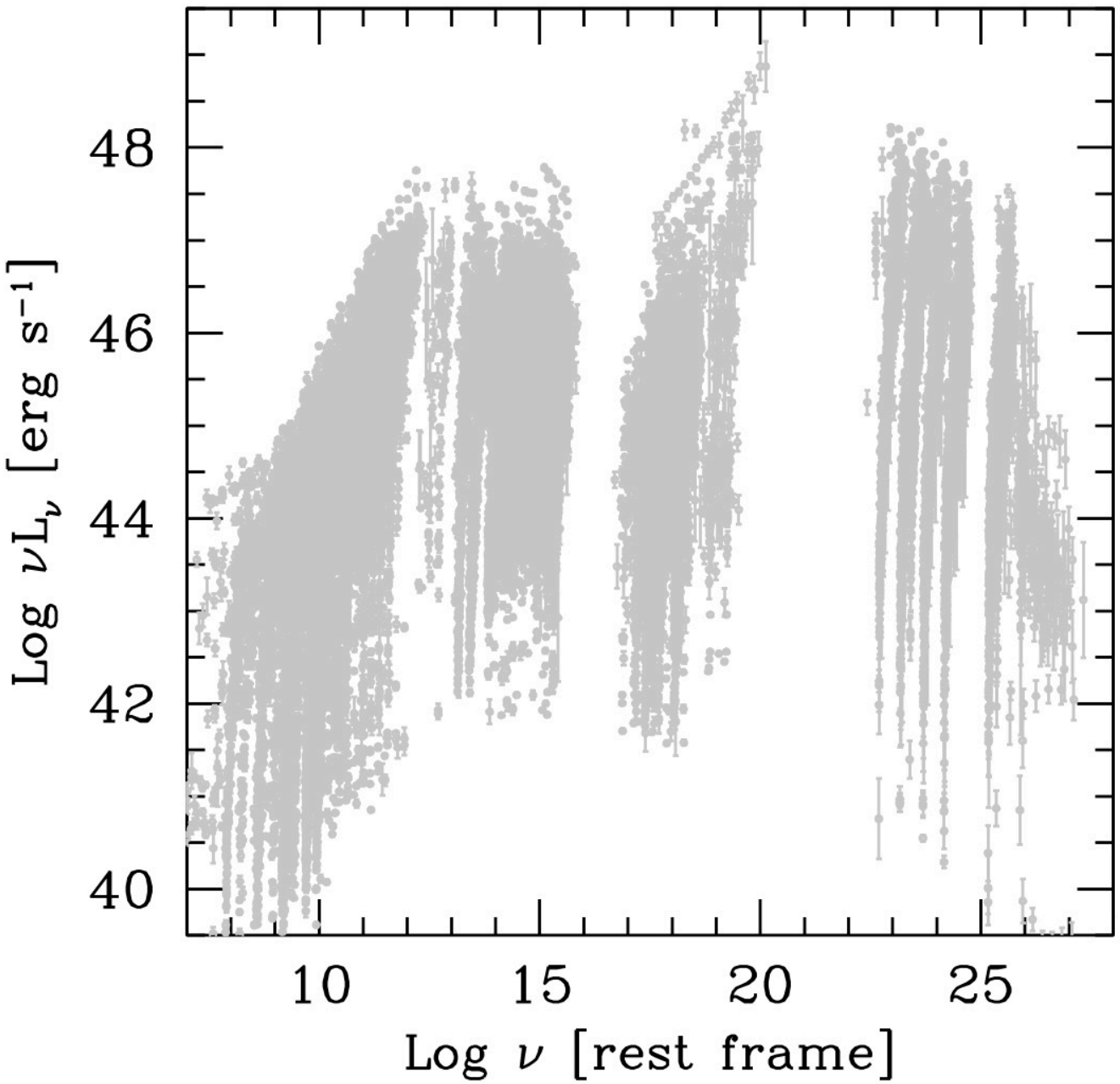
e-ASTROGAM for blazars

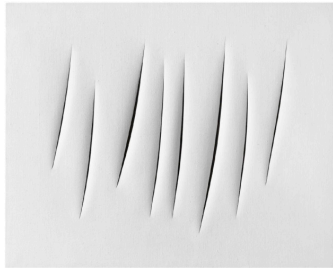
Gabriele Ghisellini
INAF - Osservatorio di Brera

The blazar sequence 1.0: 126 blazars, only 33 detected in γ

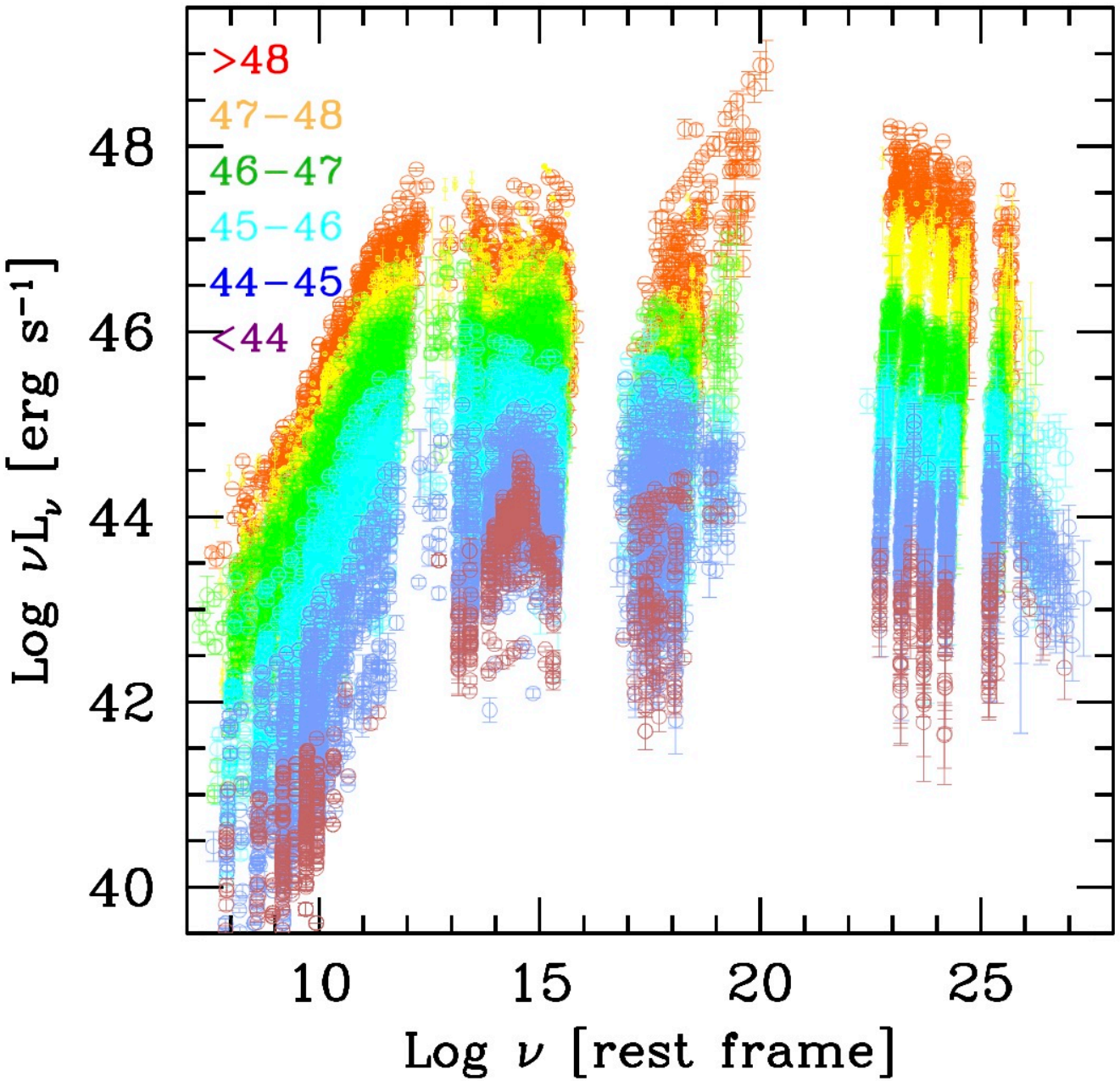



FSRQs
BL Lacs
50
202
182
174
111
30
20x
EGRET
$F_{LAT}=2\times10^{-12}$
Log L_{LAT} [erg s^{-1}]
Redshift z
50
48
46
44
42
0.01
0.1
1
10

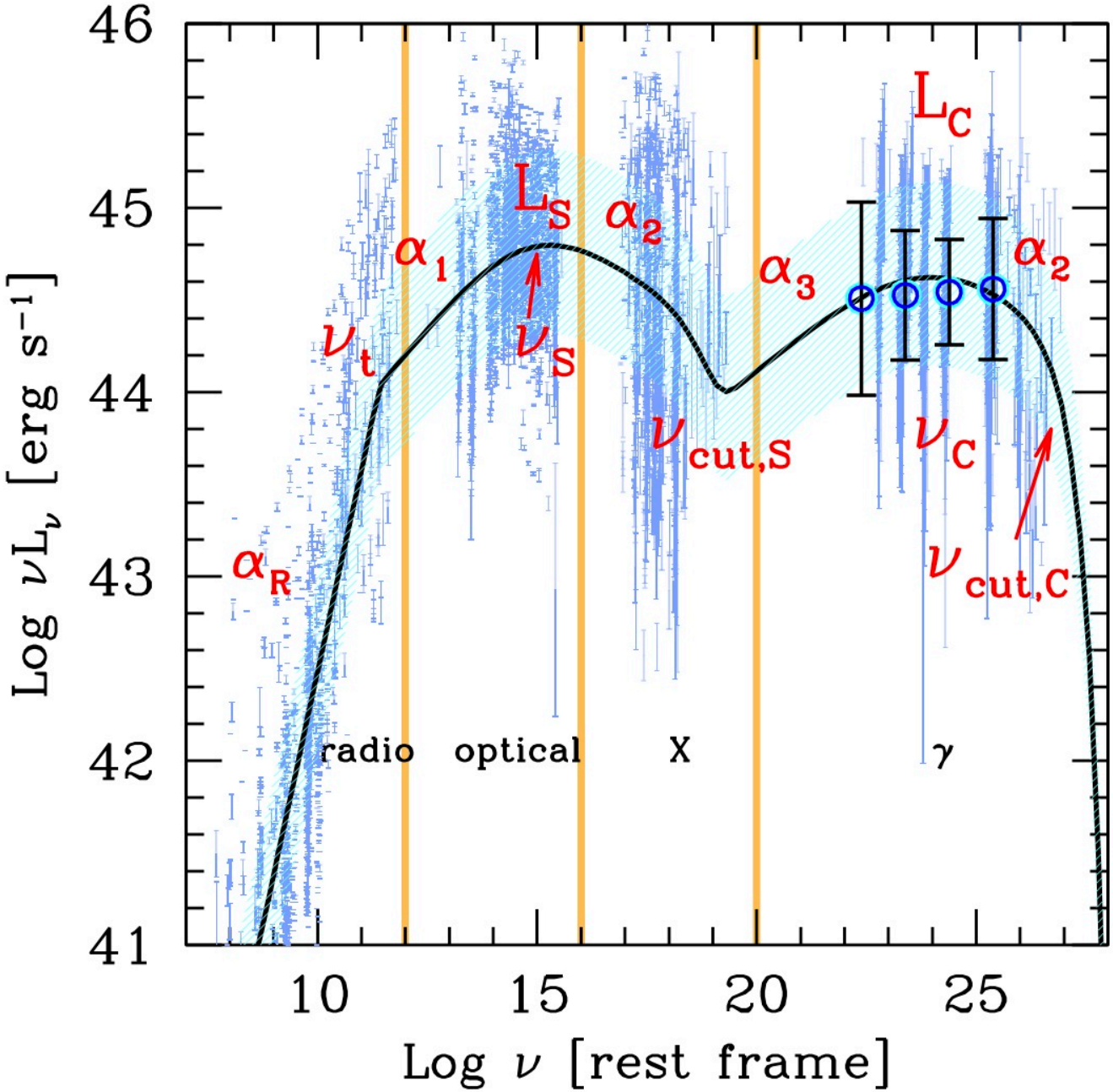


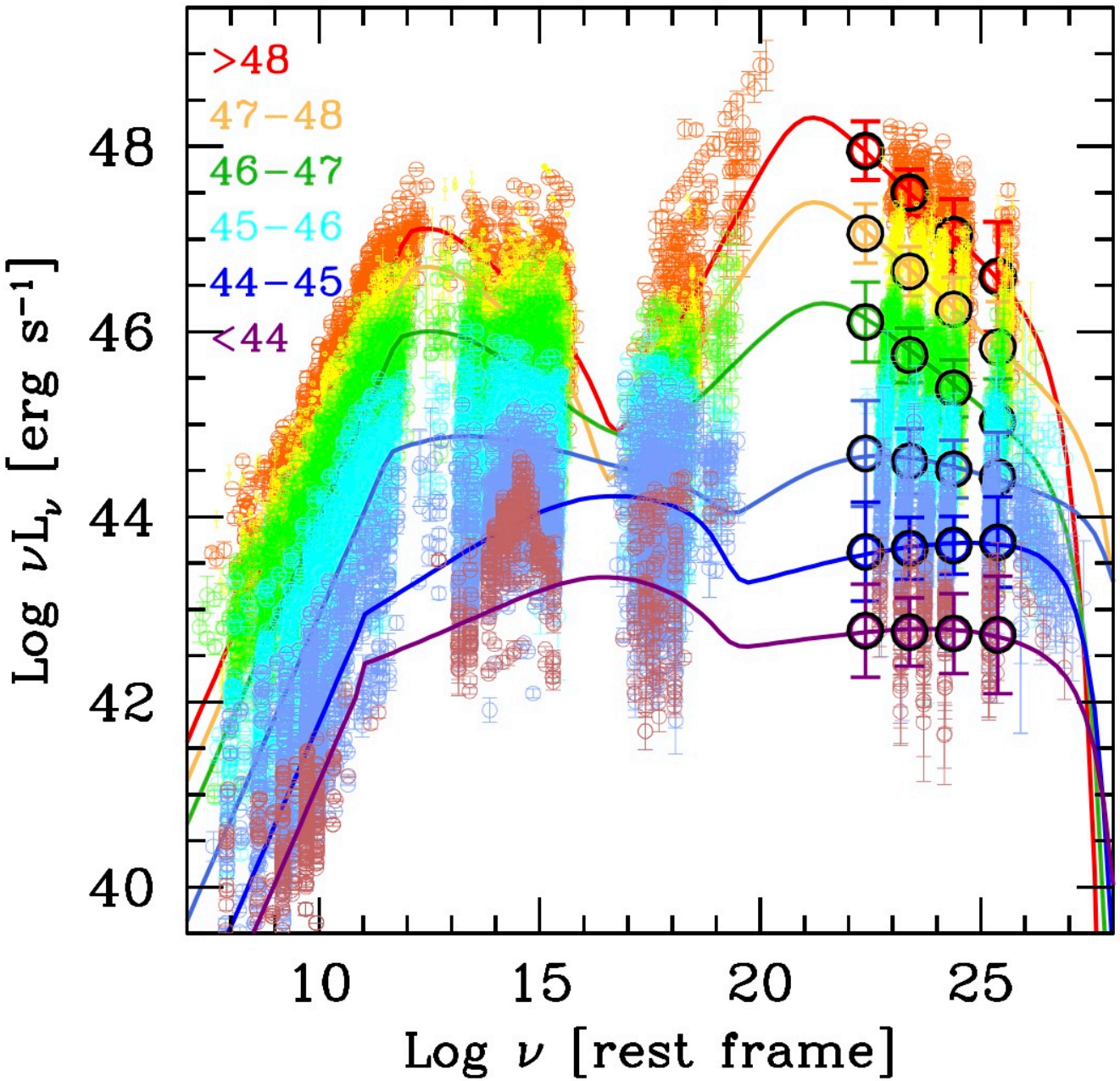


Fontana

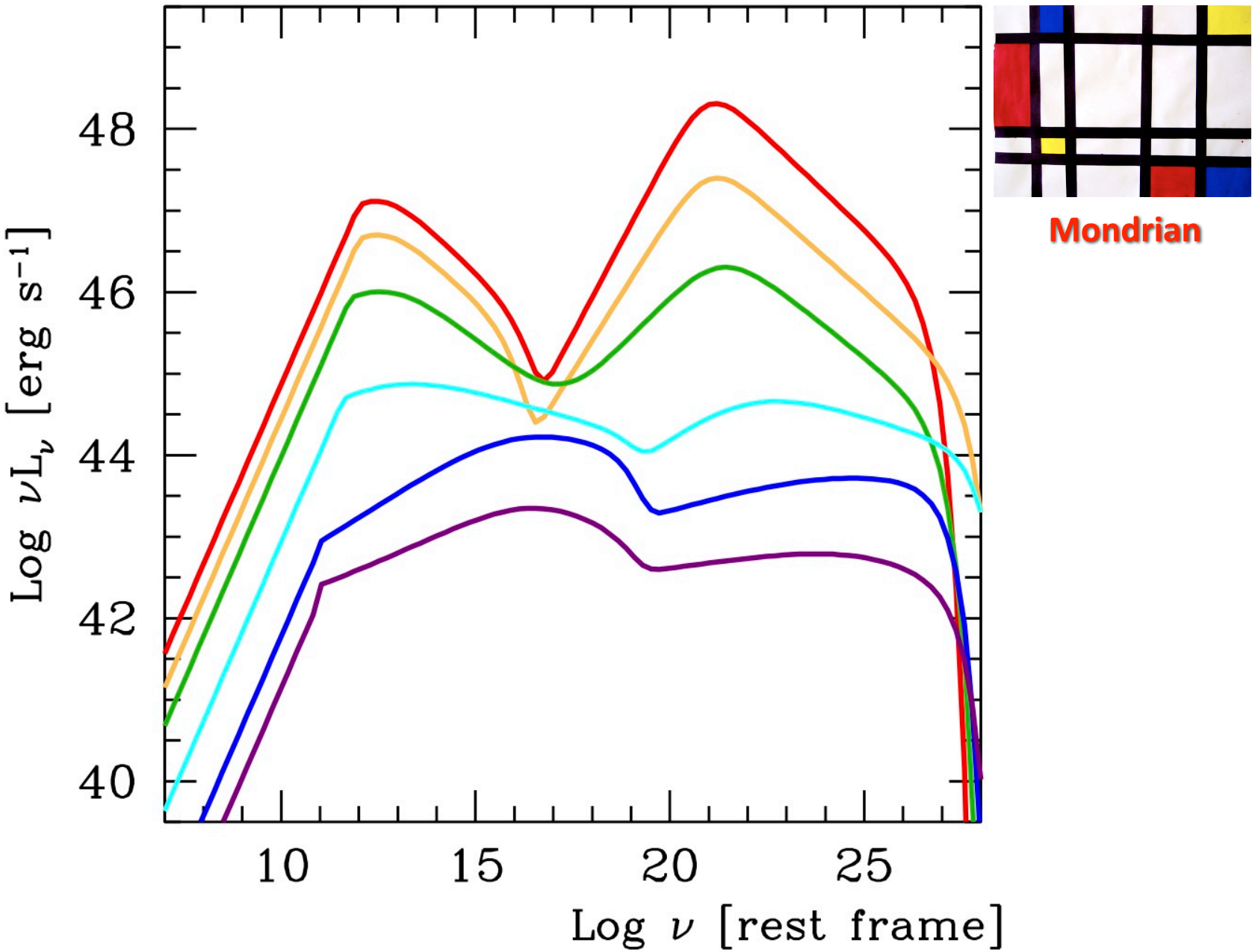

>48
47−48
46−47
45−46
44−45
<44
48
46
44
42
40
10
15
20
25
Log νL_ν [erg s^{-1}]
Log ν [rest frame]

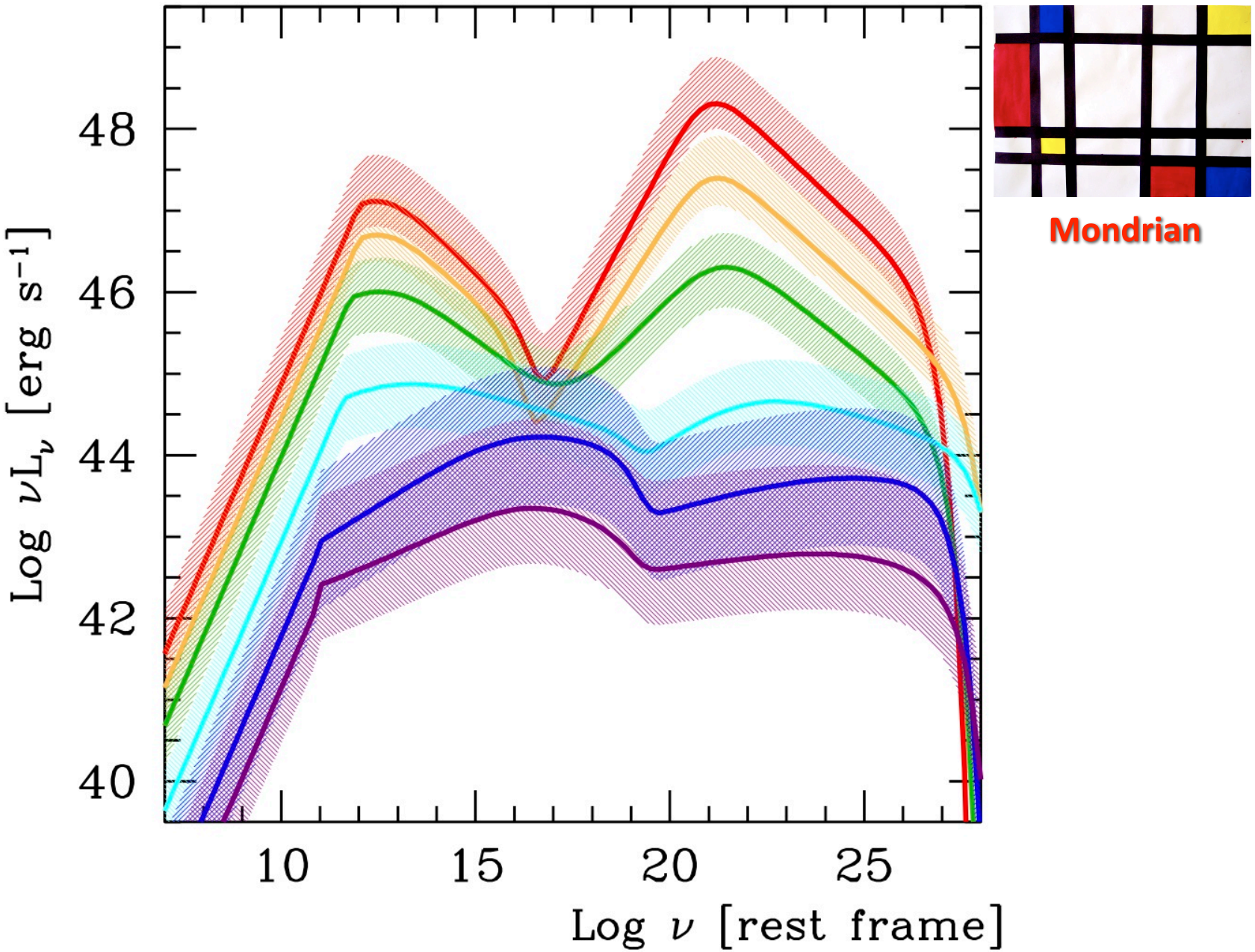
Kandinsky


46
45
44
43
42
41
10
15
20
25
Log νL_ν [erg s^{-1}]
Log ν [rest frame]
α_R
ν_t
α_1
L_S
ν_S
α_2
$\nu_{cut,S}$
α_3
L_C
ν_C
α_2
$\nu_{cut,C}$
radio
optical
X
γ

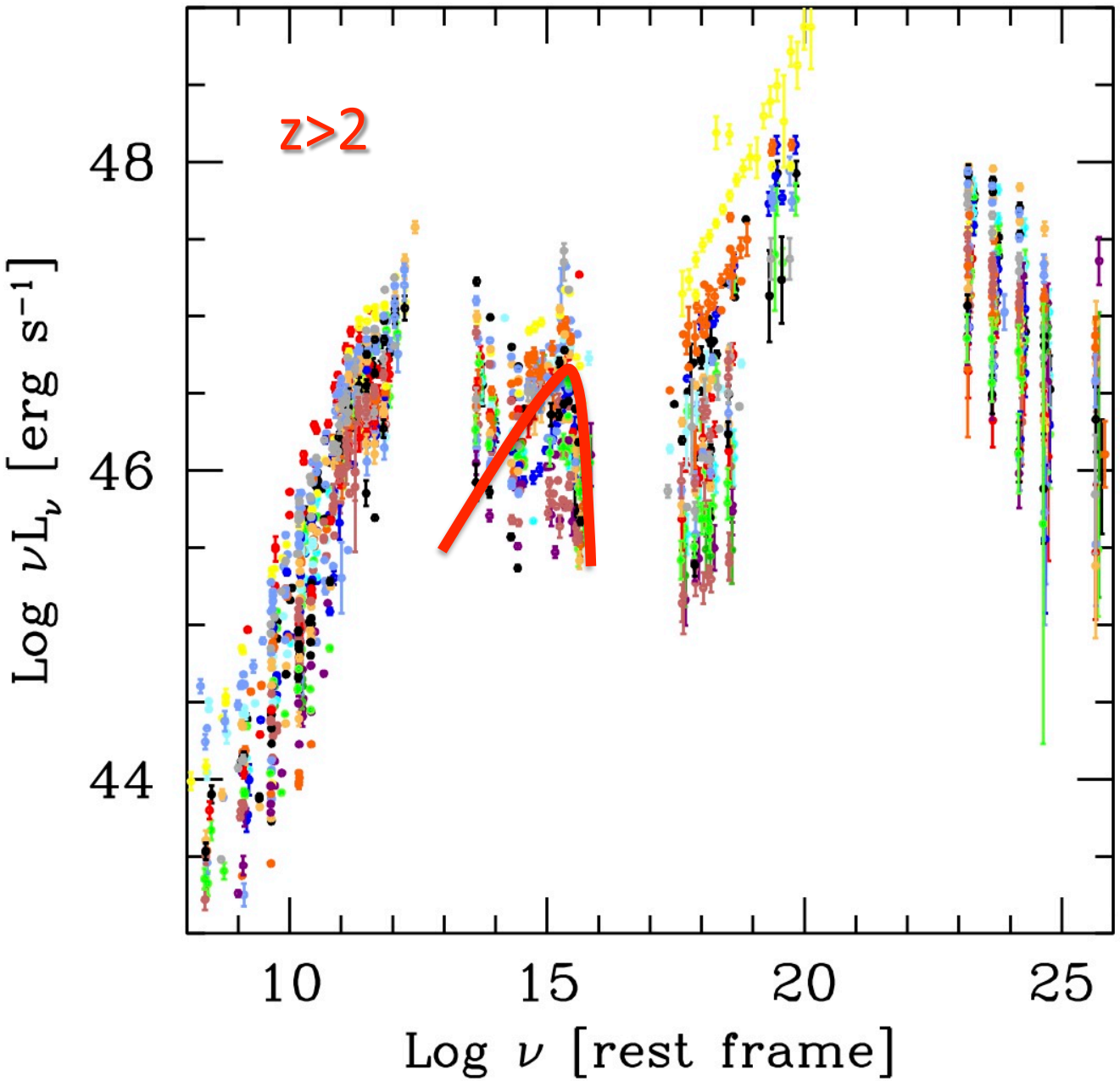

>48
47−48
46−47
45−46
44−45
<44
48
46
44
42
40
10
15
20
25
Log νL_ν [erg s^{-1}]
Log ν [rest frame]

Kandinsky

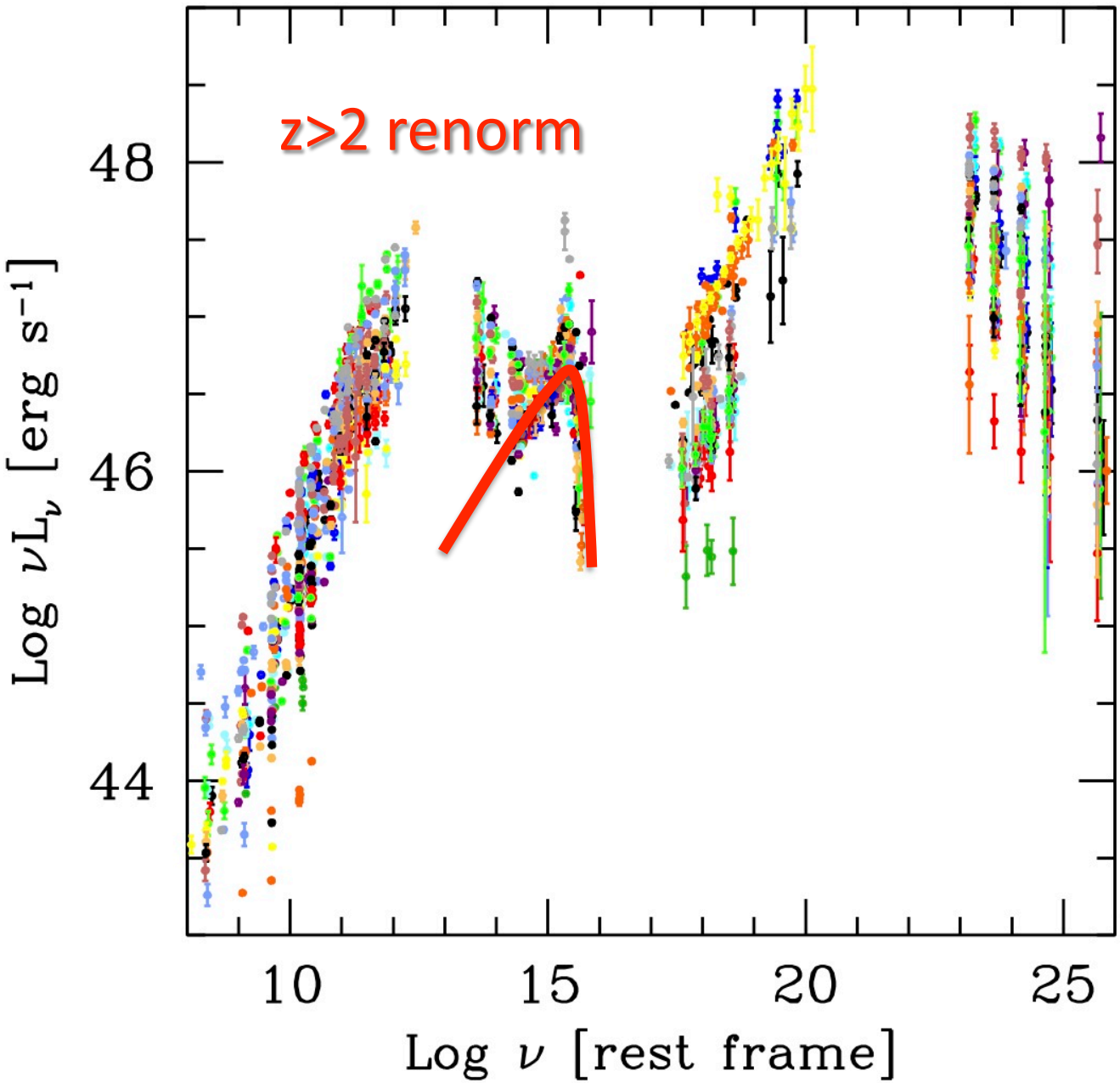

48
46
44
42
40
10
15
20
25
Log νL_ν [erg s^{-1}]
Log ν [rest frame]
Mondrian

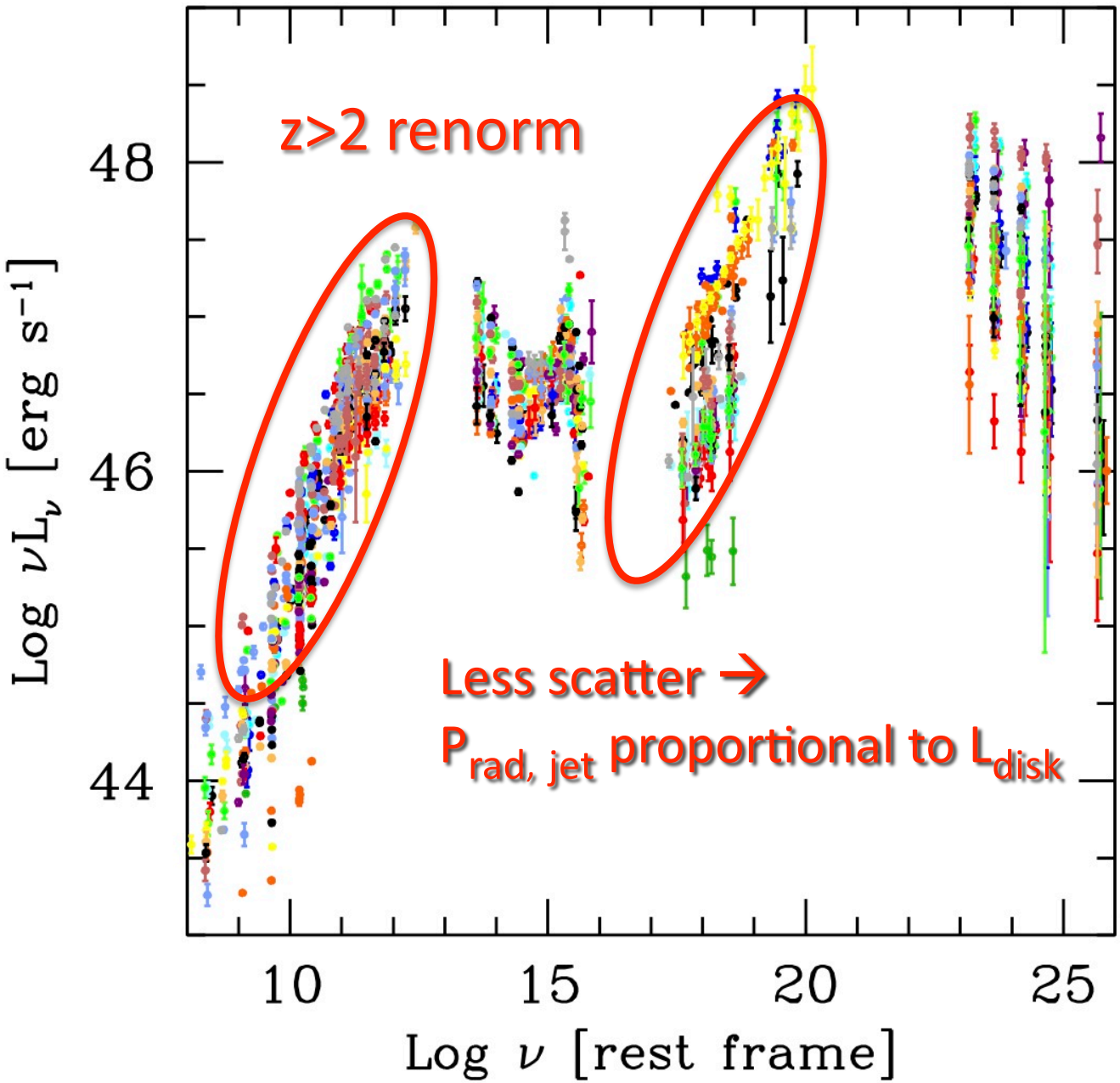

48
46
44
42
40
Log νL_ν [erg s^{-1}]
10
15
20
25
Log ν [rest frame]
Mondrian

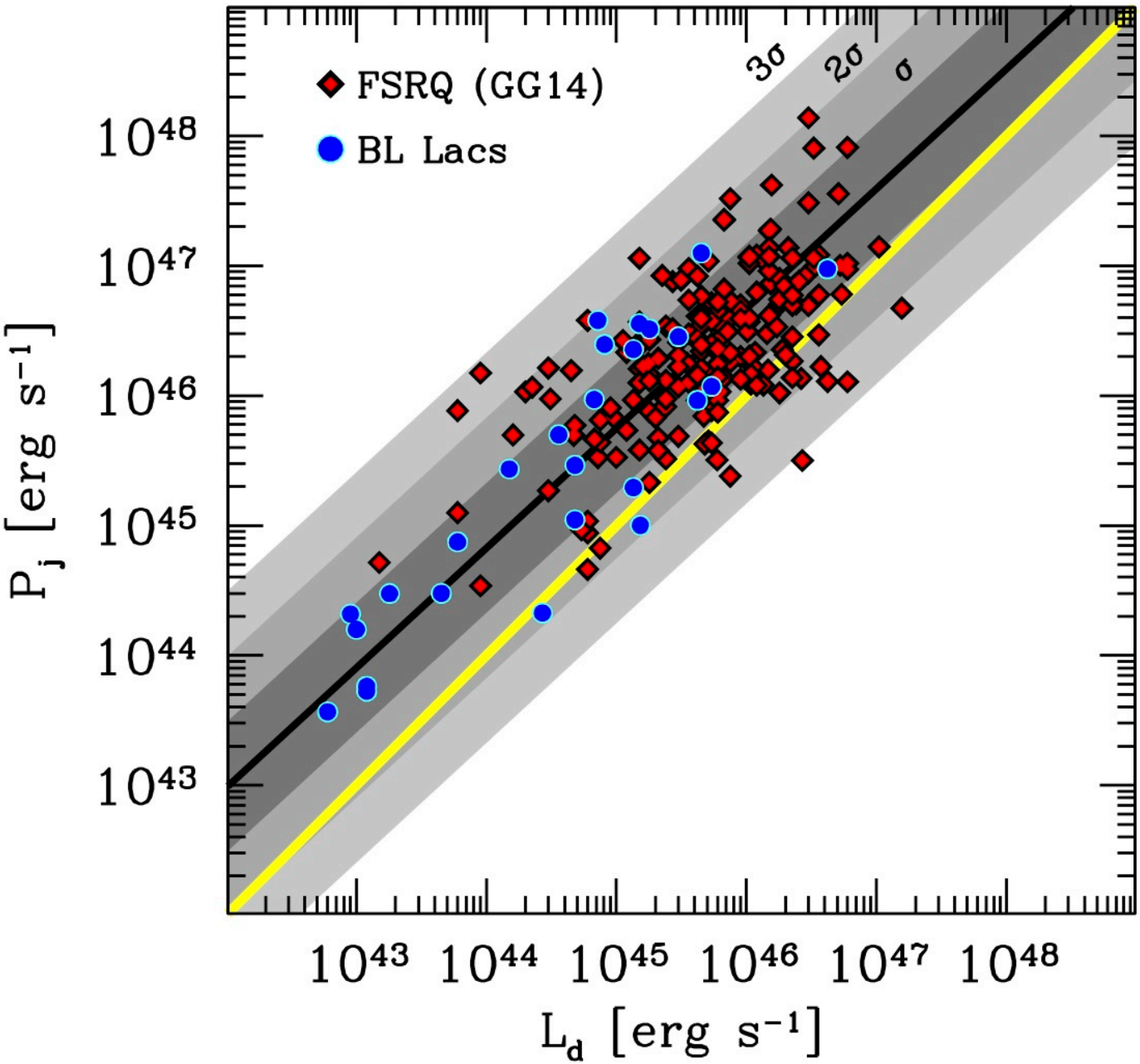
High z: the disk emerges



Pollock

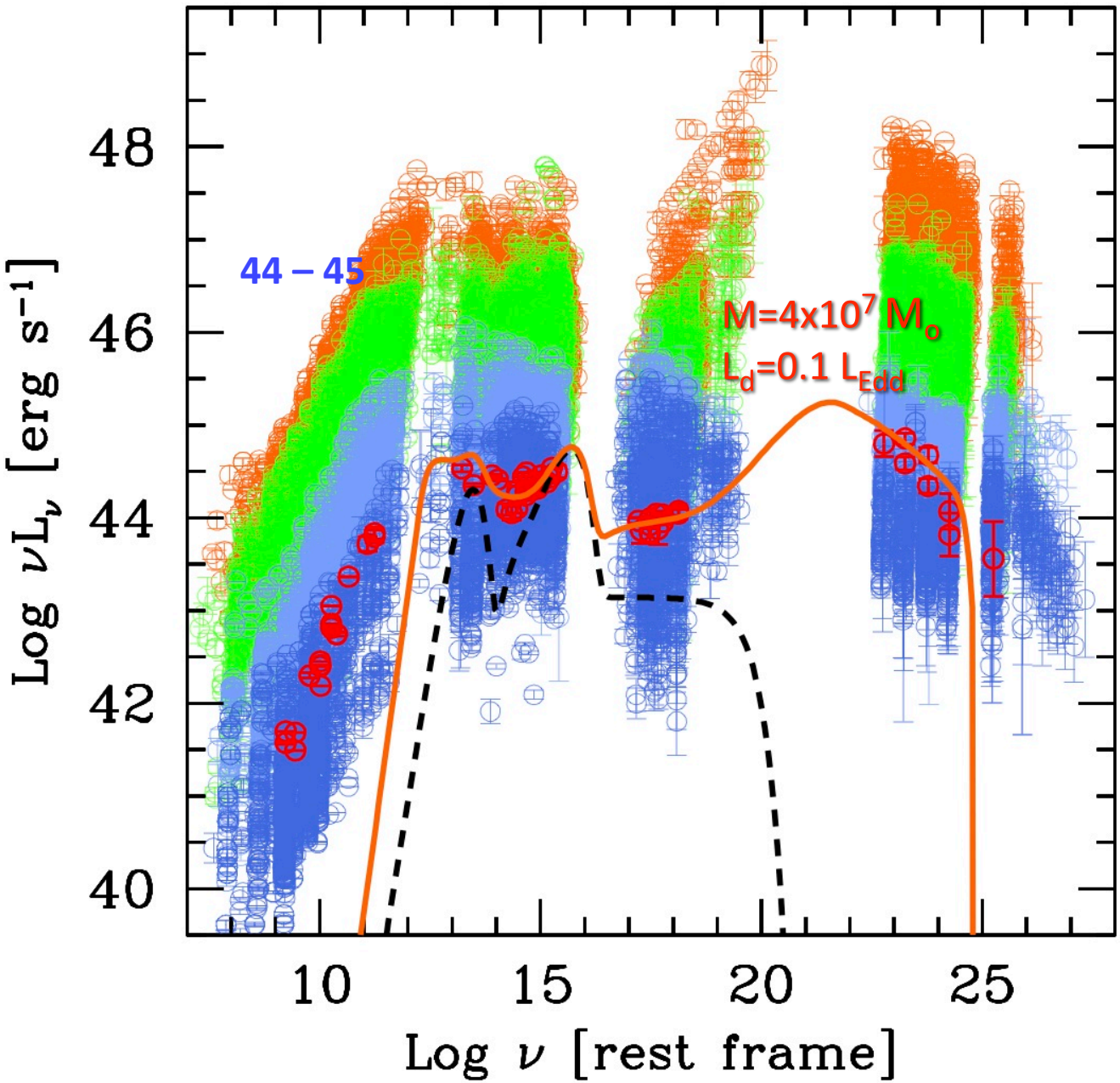

z>2 renorm
48
46
44
10
15
20
25
Log νL_ν [erg s^-1]
Log ν [rest frame]

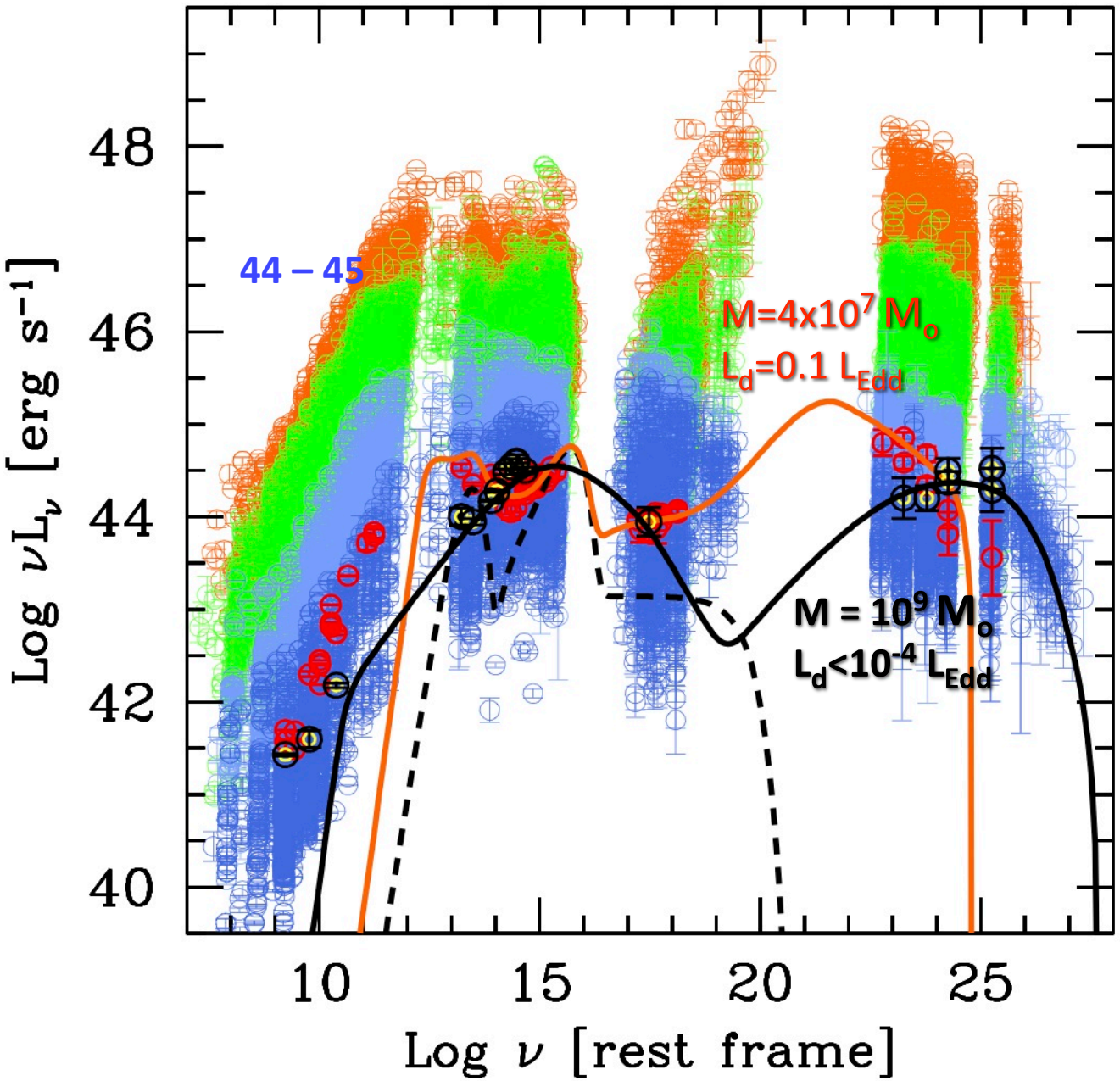

z>2 renorm
Less scatter →
$P_{rad, jet}$ proportional to L_{disk}
48
46
44
10
15
20
25
Log νL_ν [erg s^{-1}]
Log ν [rest frame]



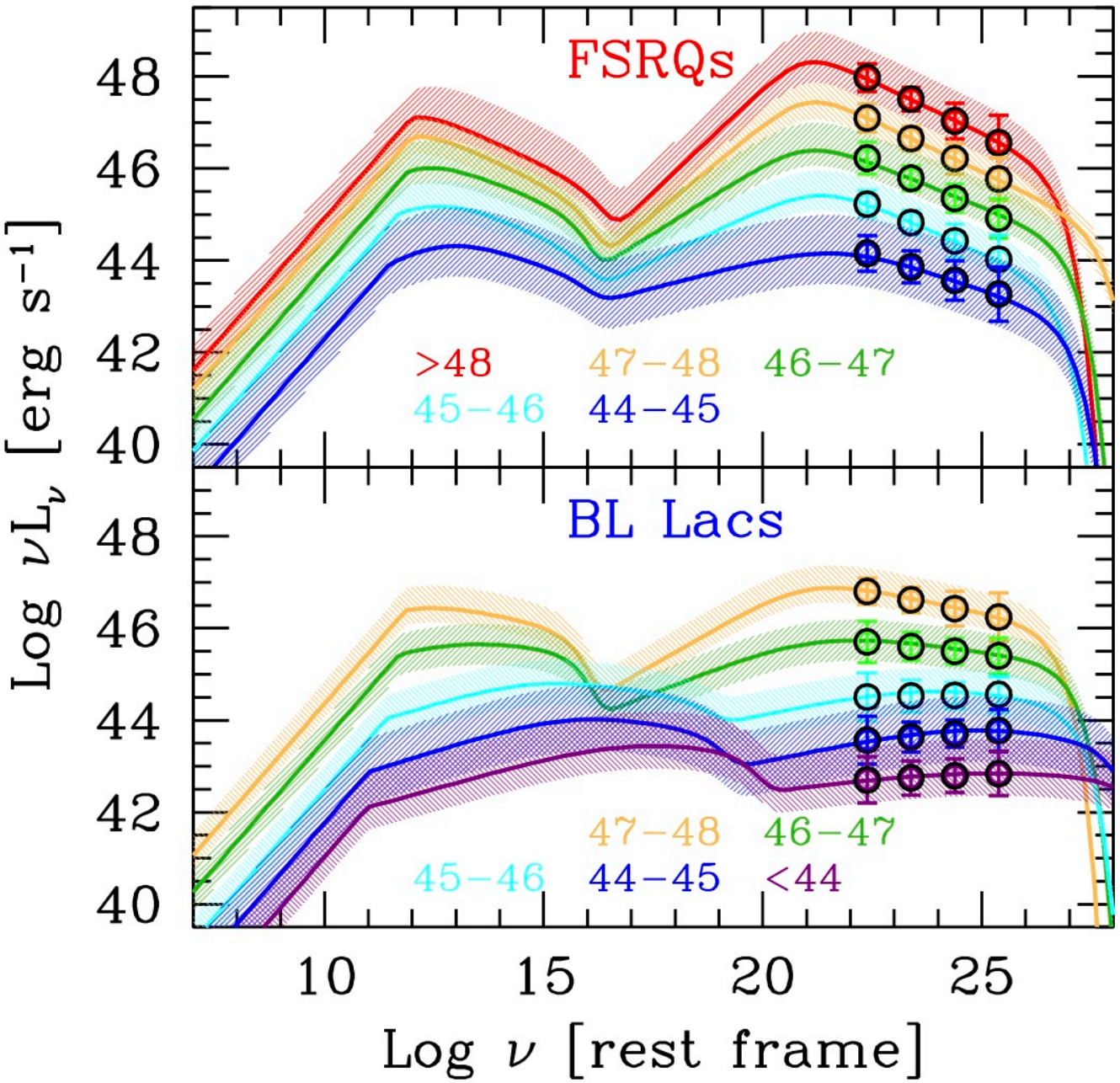
GG+ Nature, 2014

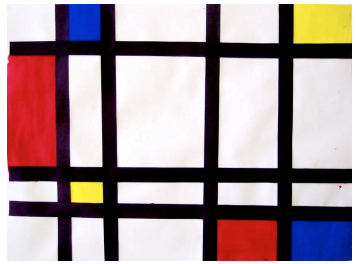
Intermediate luminosities: a mess


44 – 45
M=4x10^7 M_o
L_d=0.1 L_Edd
Log νL_ν [erg s^-1]
Log ν [rest frame]
48
46
44
42
40
10
15
20
25

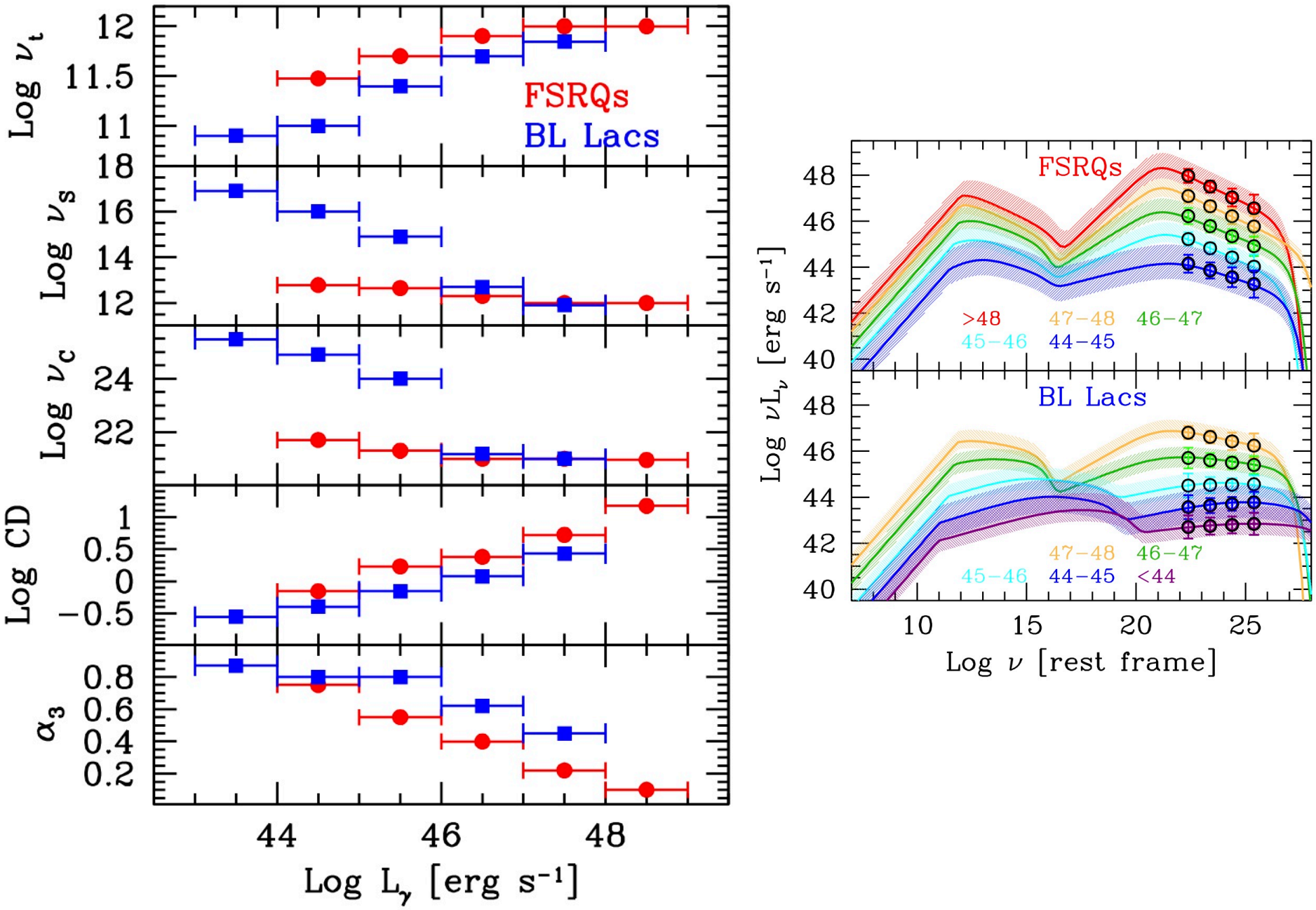

44 – 45
M=4x10^7 M_o
L_d=0.1 L_Edd
M = 10^9 M_o
L_d<10^-4 L_Edd
Log νL_ν [erg s^-1]
Log ν [rest frame]
48
46
44
42
40
10
15
20
25

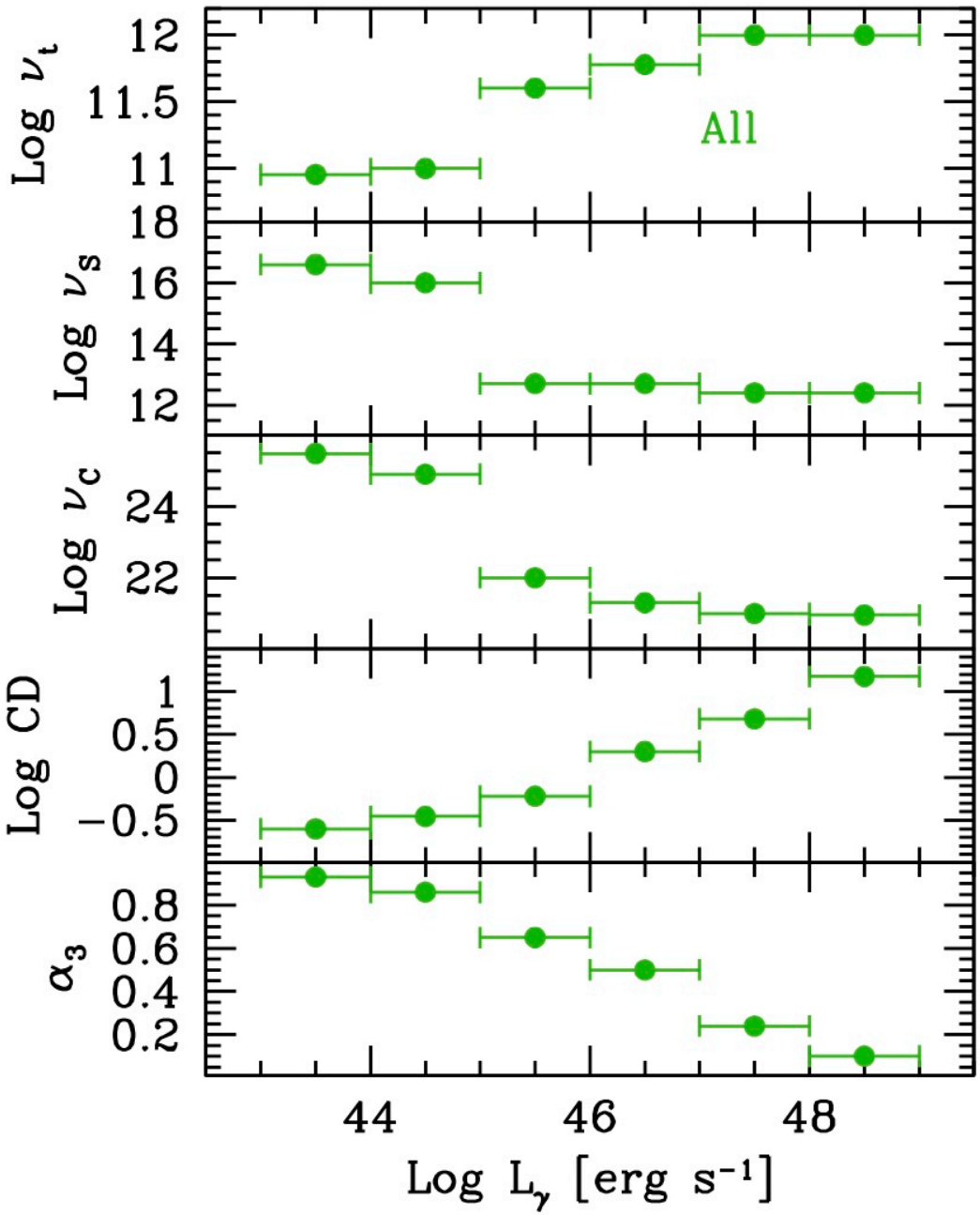
Picasso

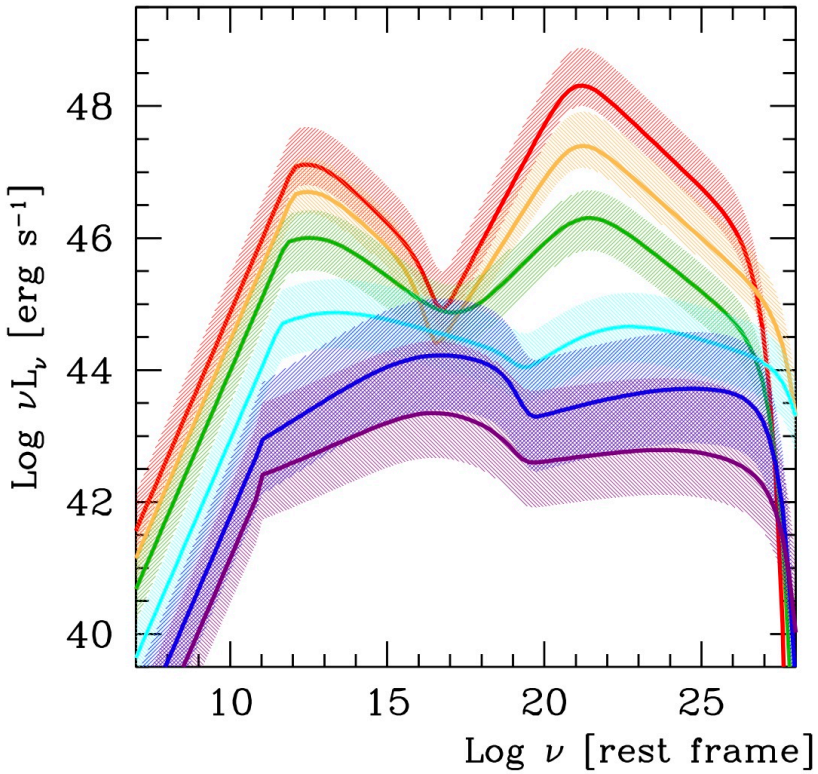

FSRQs
>48
47−48
46−47
45−46
44−45
BL Lacs
47−48
46−47
45−46
44−45
<44
Log νL_ν [erg s^-1]
Log ν [rest frame]
40
42
44
46
48
10
15
20
25

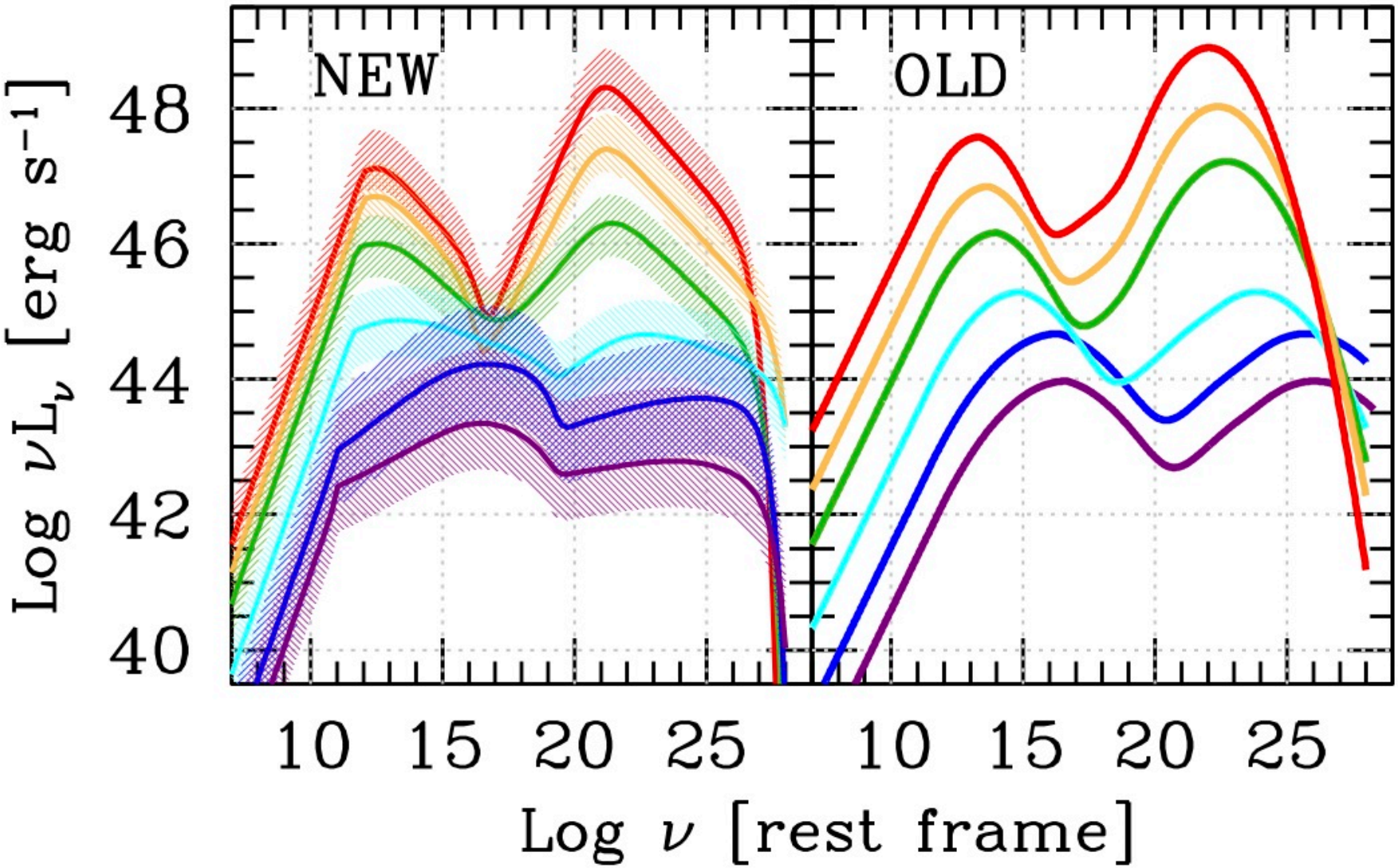


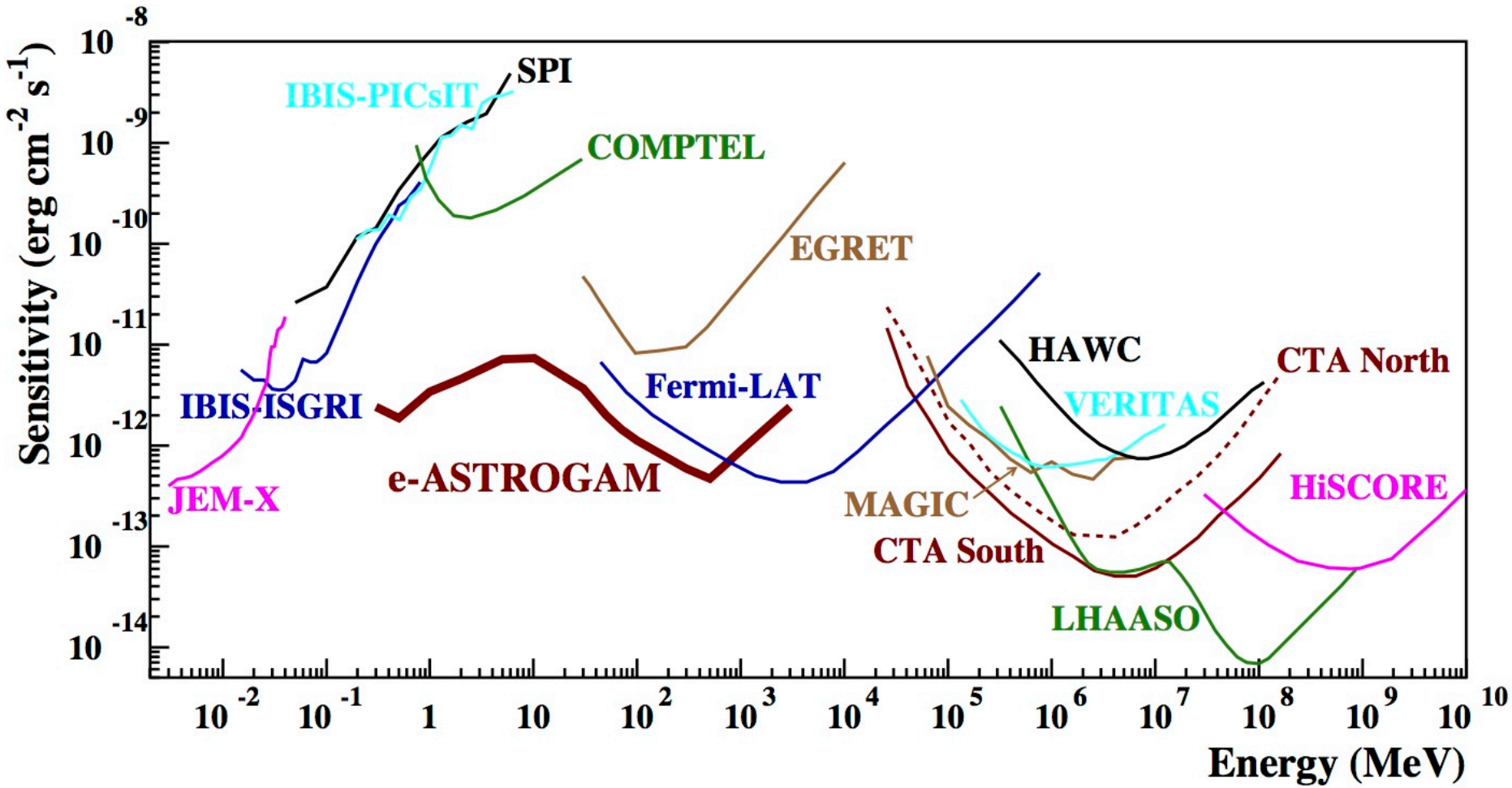
Mondrian

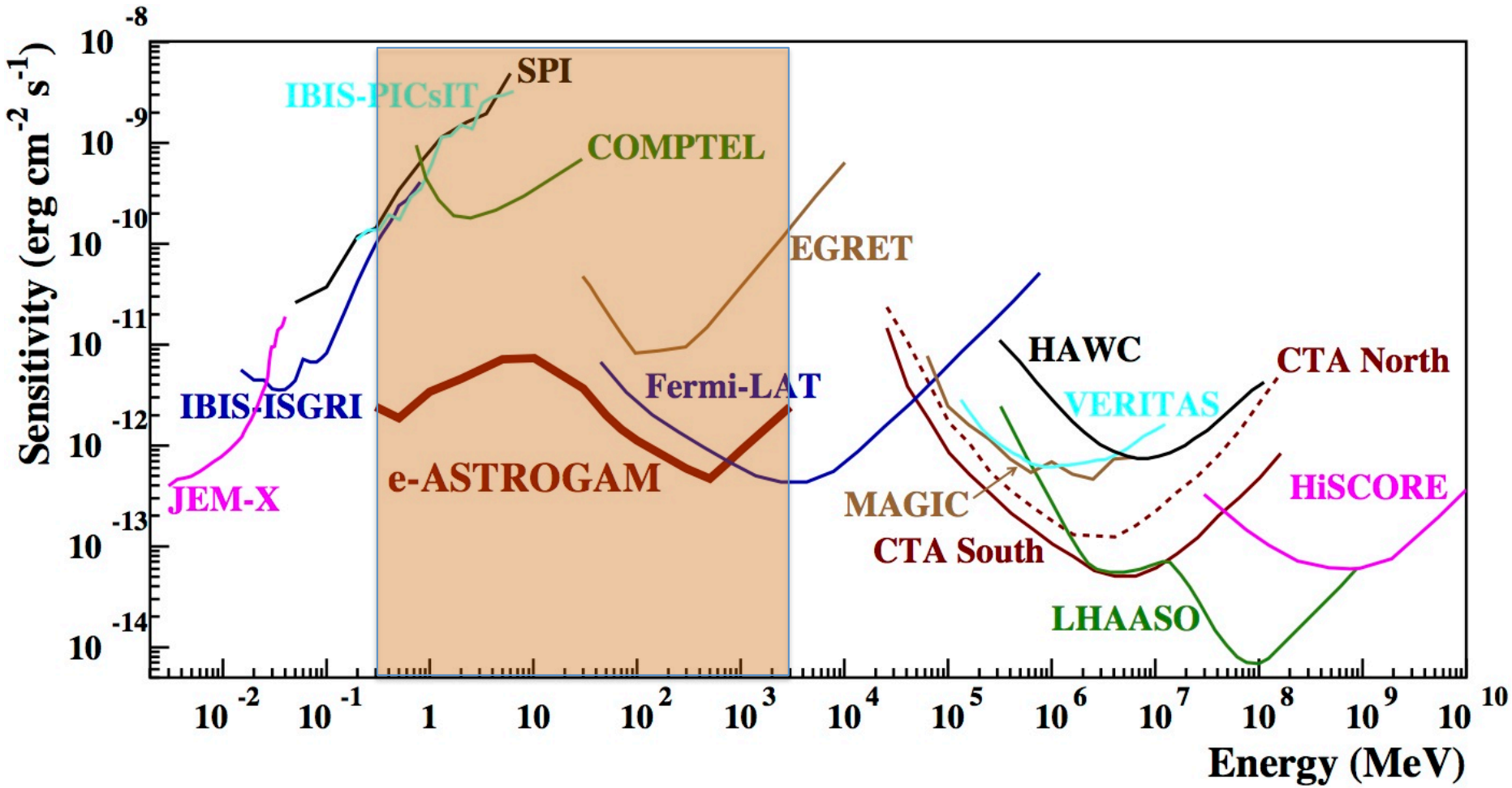

FSRQs
BL Lacs
Log ν_t
Log ν_s
Log ν_c
Log CD
α_3
Log L_γ [erg s^{-1}]
>48
47−48
46−47
45−46
44−45
<44
Log νL_ν [erg s^{-1}]
Log ν [rest frame]


Log ν_t
12
11.5
11
All
Log ν_s
18
16
14
12
Log ν_c
24
22
Log CD
1
0.5
0
−0.5
α_3
0.8
0.6
0.4
0.2
44
46
48
Log L_γ [erg s^{-1}]

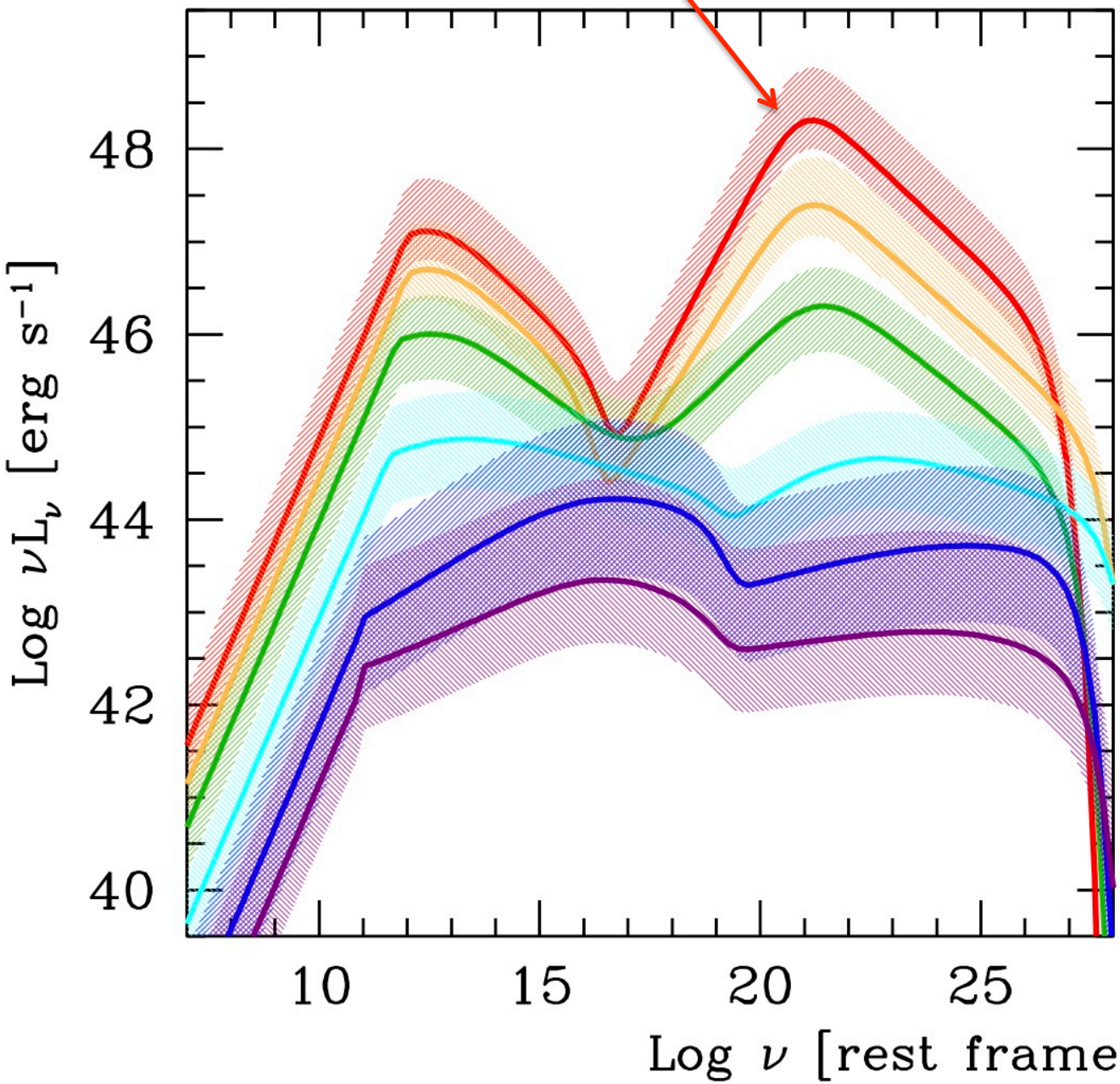

48
46
44
42
40
Log νL_ν [erg s^{-1}]
10
15
20
25
Log ν [rest frame]

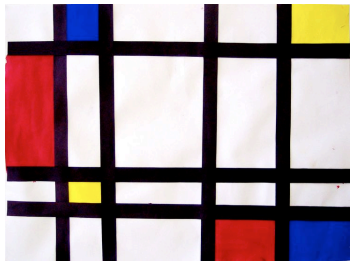

NEW
OLD
48
46
44
42
40
Log νL_ν [erg s^{-1}]
10 15 20 25
10 15 20 25
Log ν [rest frame]


Sensitivity (erg cm^{-2} s^{-1})
Energy (MeV)
SPI
IBIS-PICsIT
COMPTEL
EGRET
Fermi-LAT
IBIS-ISGRI
JEM-X
e-ASTROGAM
HAWC
CTA North
VERITAS
MAGIC
CTA South
HiSCORE
LHAASO


Sensitivity (erg cm^{-2} s^{-1})
Energy (MeV)
SPI
IBIS-PICsIT
COMPTEL
EGRET
HAWC
CTA North
VERITAS
Fermi-LAT
IBIS-ISGRI
e-ASTROGAM
JEM-X
MAGIC
HiSCORE
CTA South
LHAASO

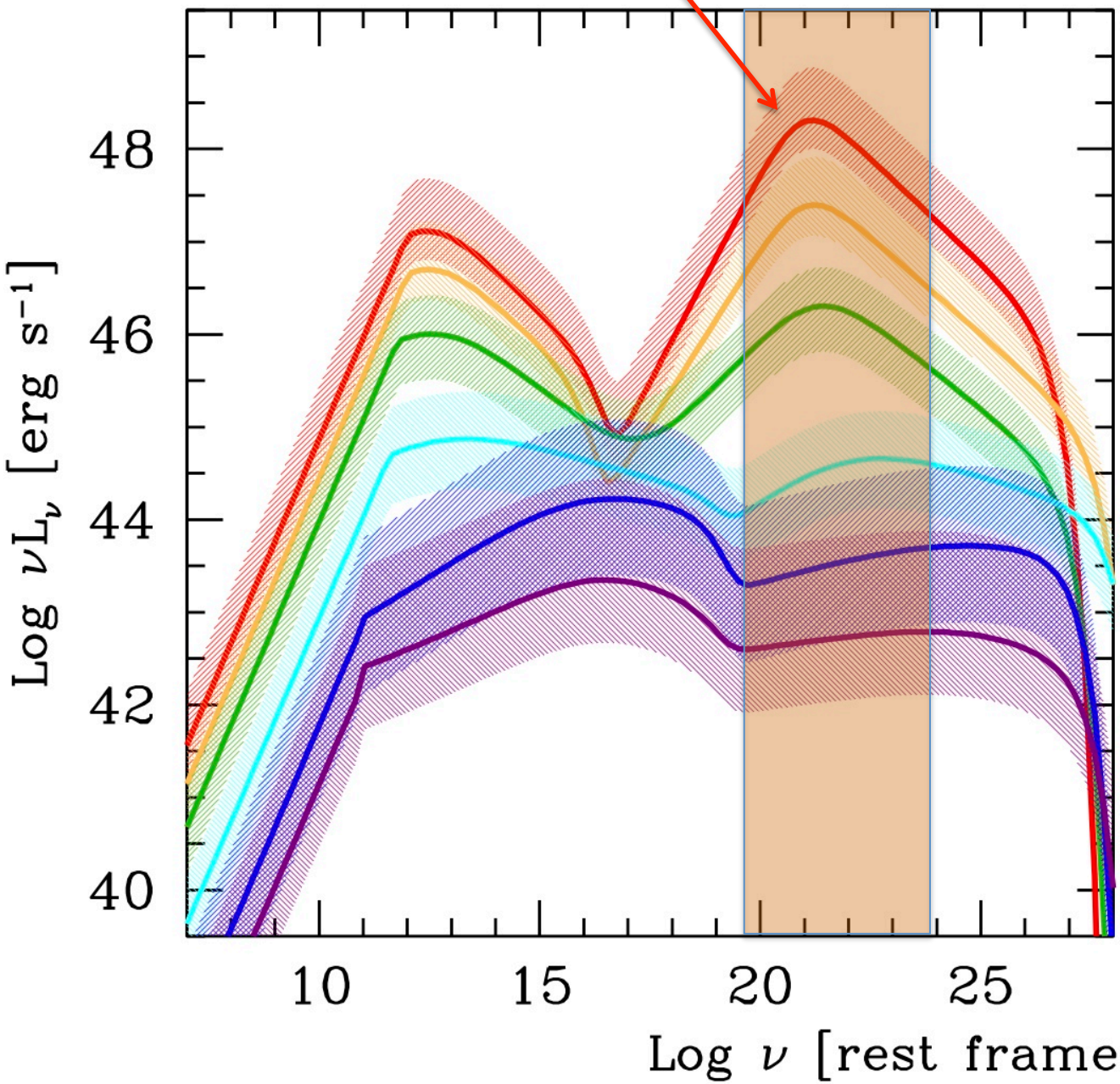
The most luminous persistent sources of the Universe…

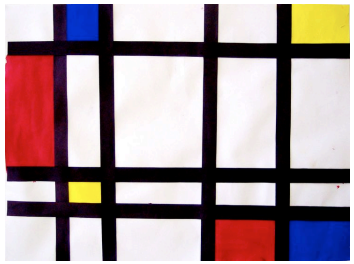




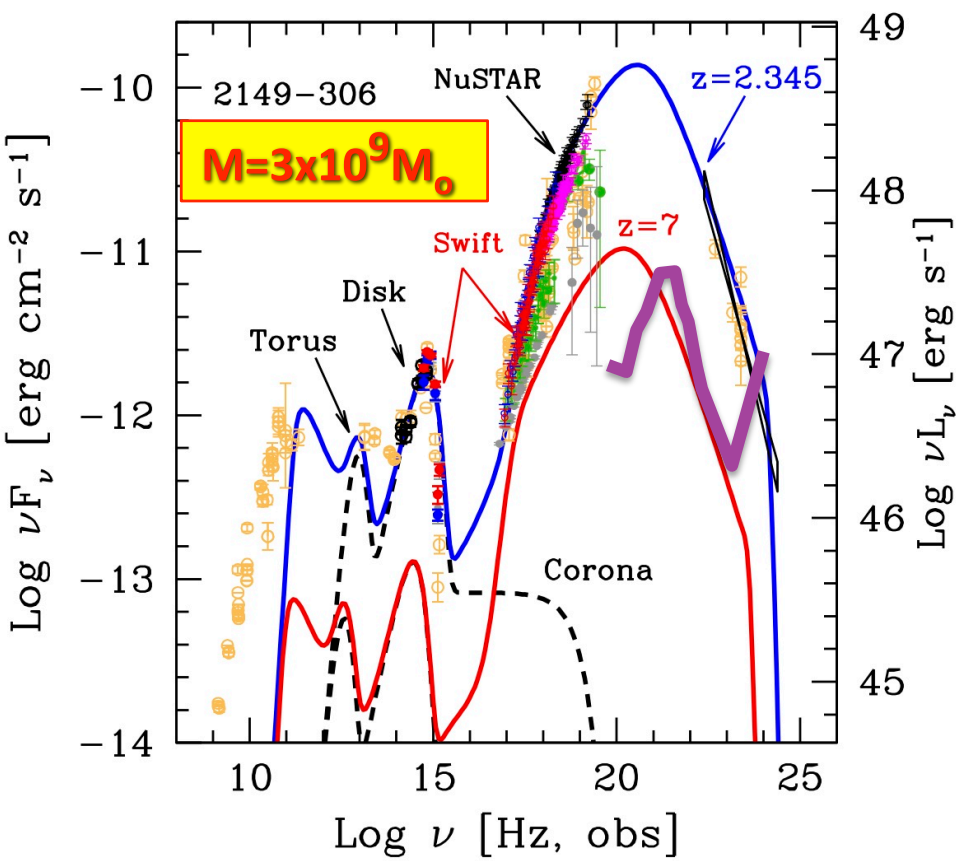
Mondrian

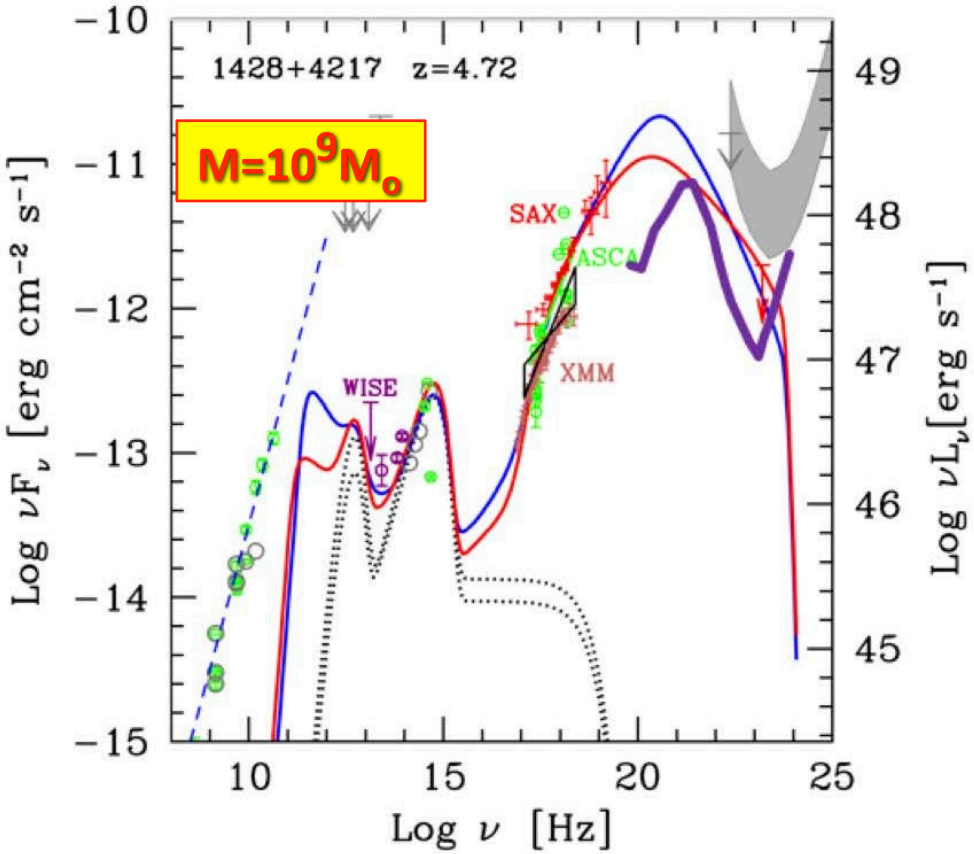
The most luminous persistent sources of the Universe…

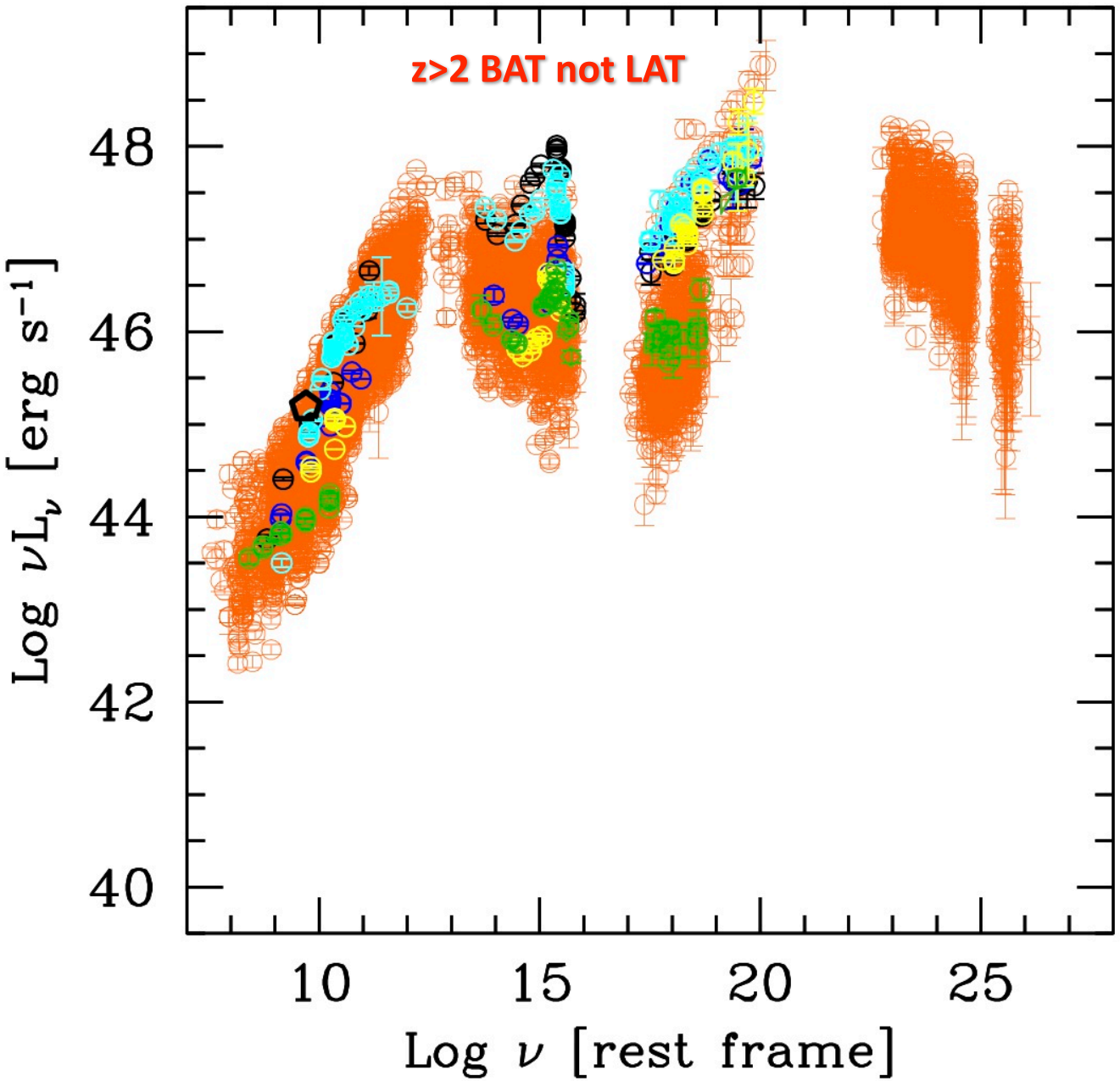


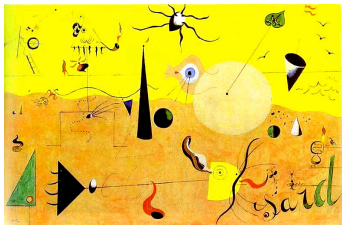


Mondrian

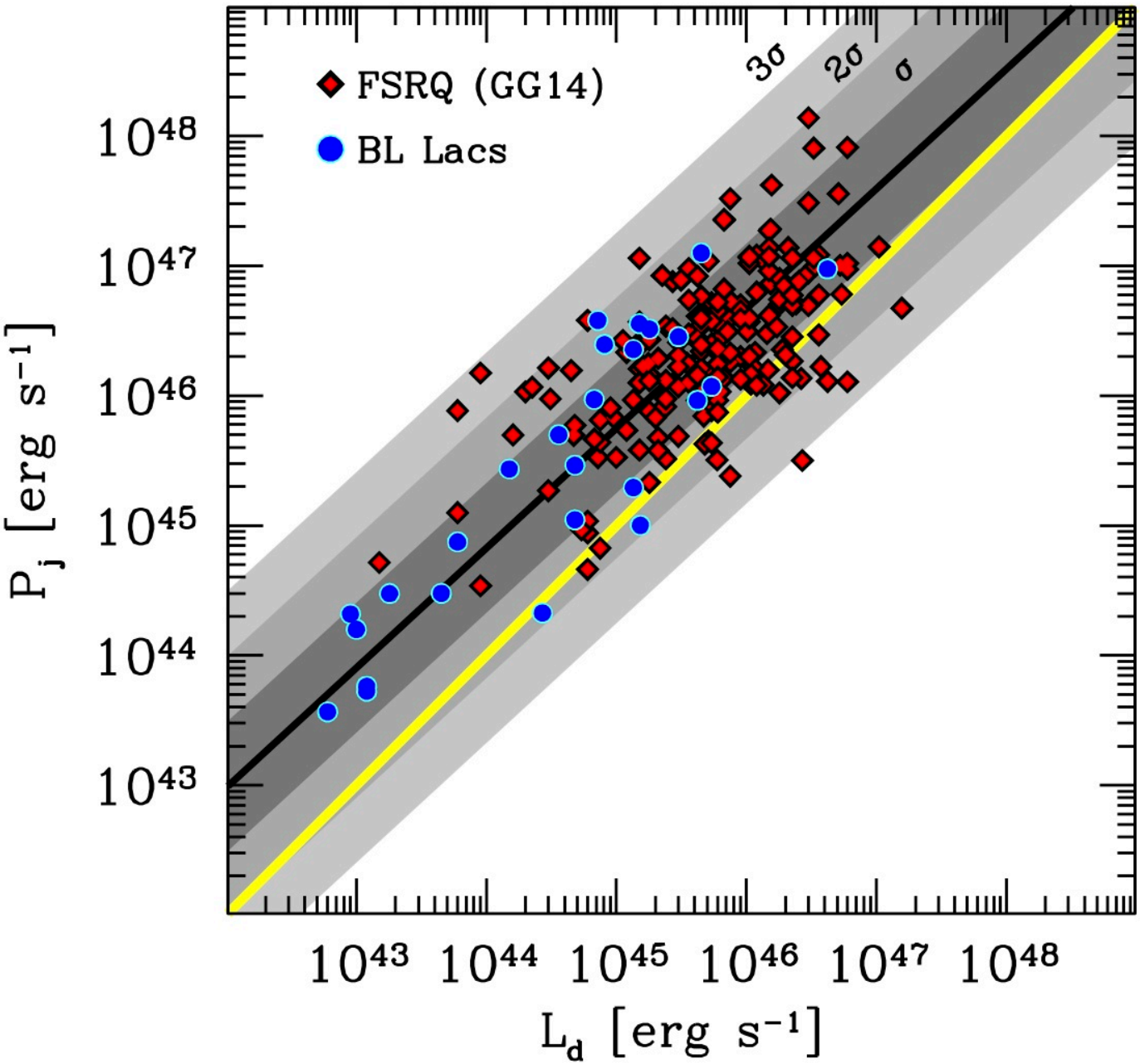

2149−306
M=3x10^9M_o
NuSTAR
z=2.345
Swift
z=7
Disk
Torus
Corona
Log νF_ν [erg cm^-2 s^-1]
Log νL_ν [erg s^-1]
Log ν [Hz, obs]


1428+4217 z=4.72
M=10^9M_o
SAX
ASCA
XMM
WISE
Log νF_ν [erg cm^-2 s^-1]
Log νL_ν [erg s^-1]
Log ν [Hz]

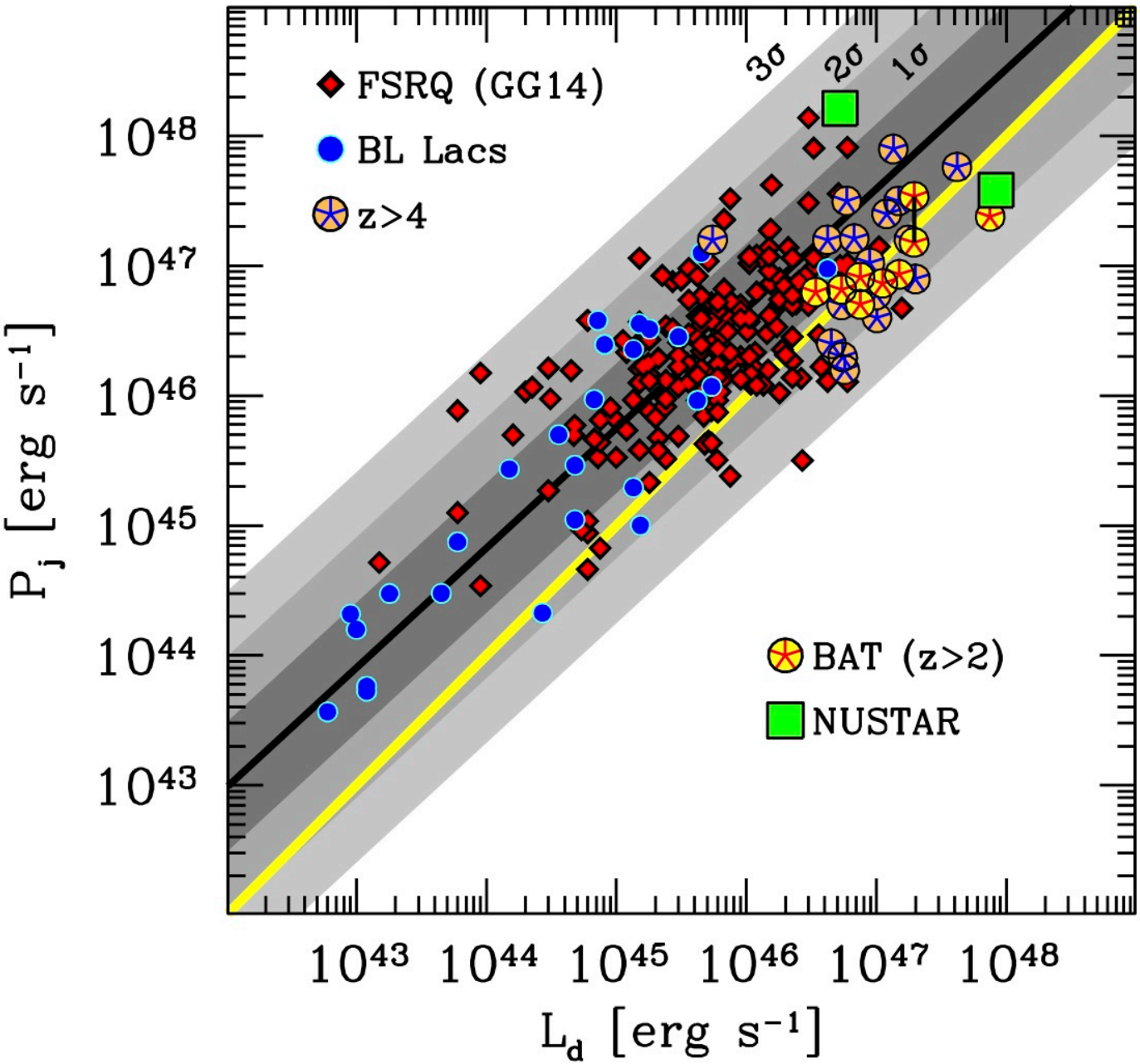

z>2 BAT not LAT
48
46
44
42
40
10
15
20
25
Log νL_ν [erg s^{-1}]
Log ν [rest frame]



Miro'



GG+ Nature, 2014



Sbarrato+ 2016

Seeking the most distant blazars with the heaviest *and active* black holes

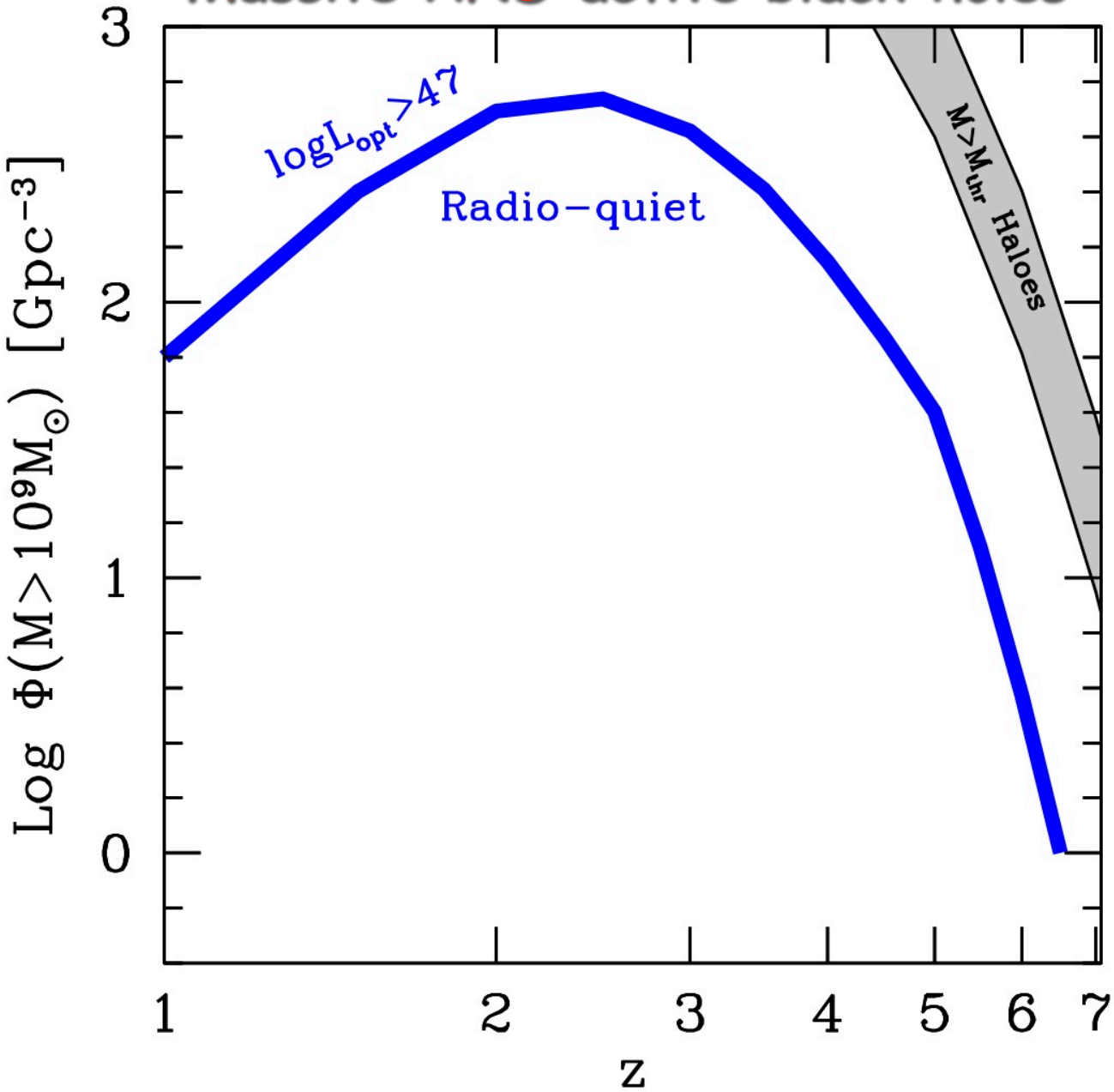
Rewarding: ~ 100 radio-quiet quasars known with $z>6$, and 1 at $z\sim7$, with $M\sim10^9 M_{sun}$

Even only one blazars at $z=6$ with $M>10^9 M_{sun}$....

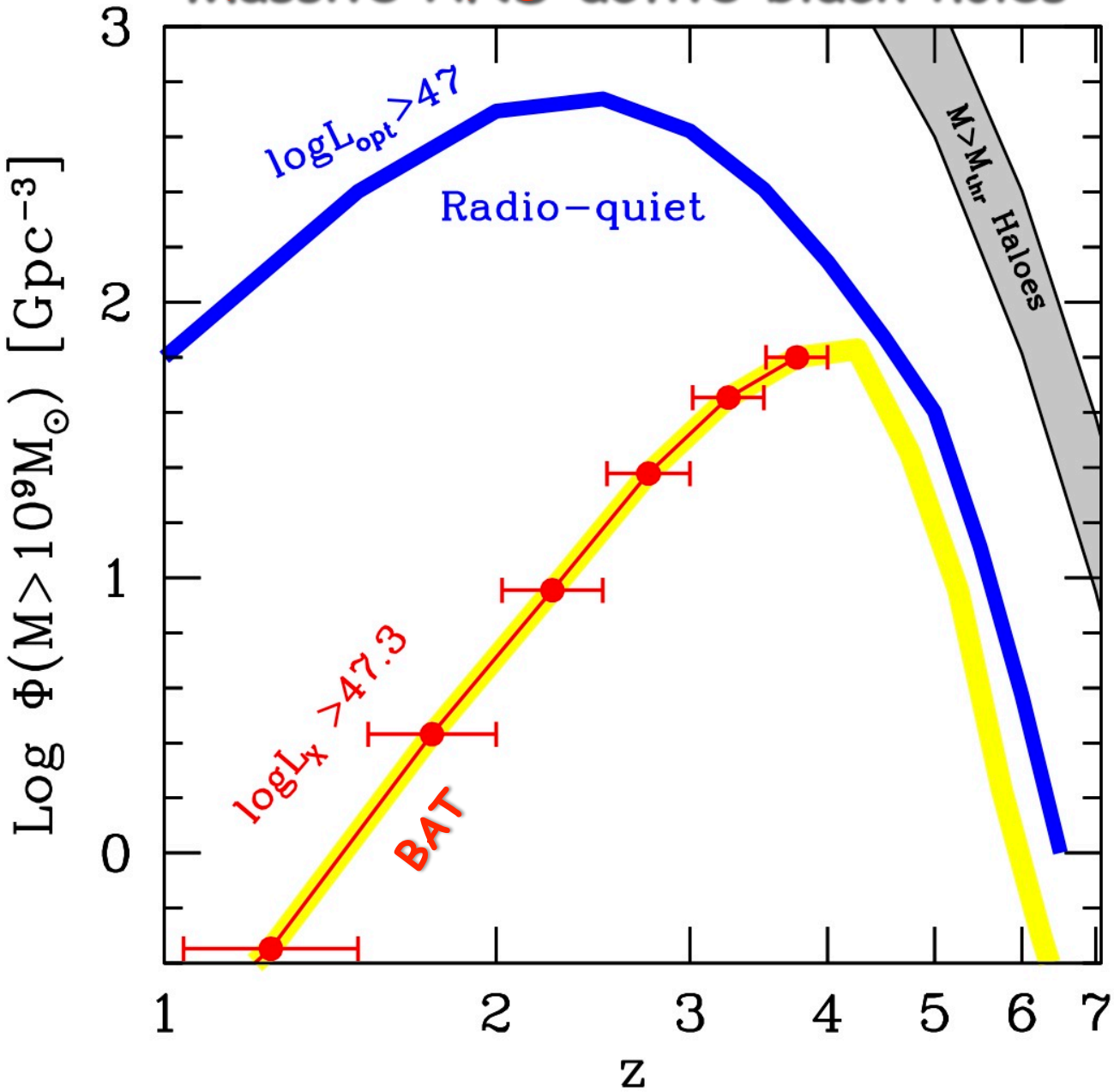
$$1 = 2\Gamma^2$$

~300-500

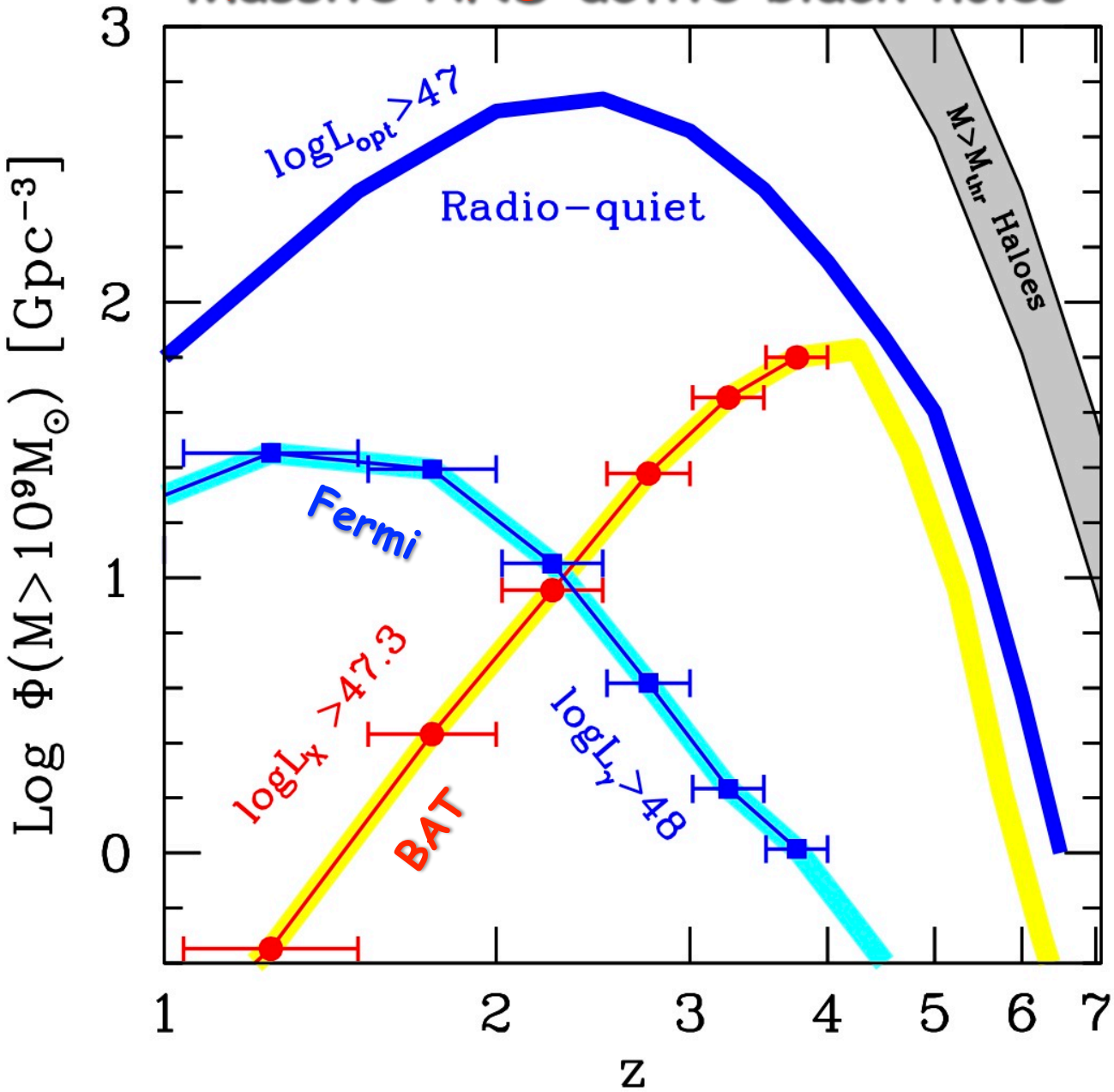
Massive AND active black holes



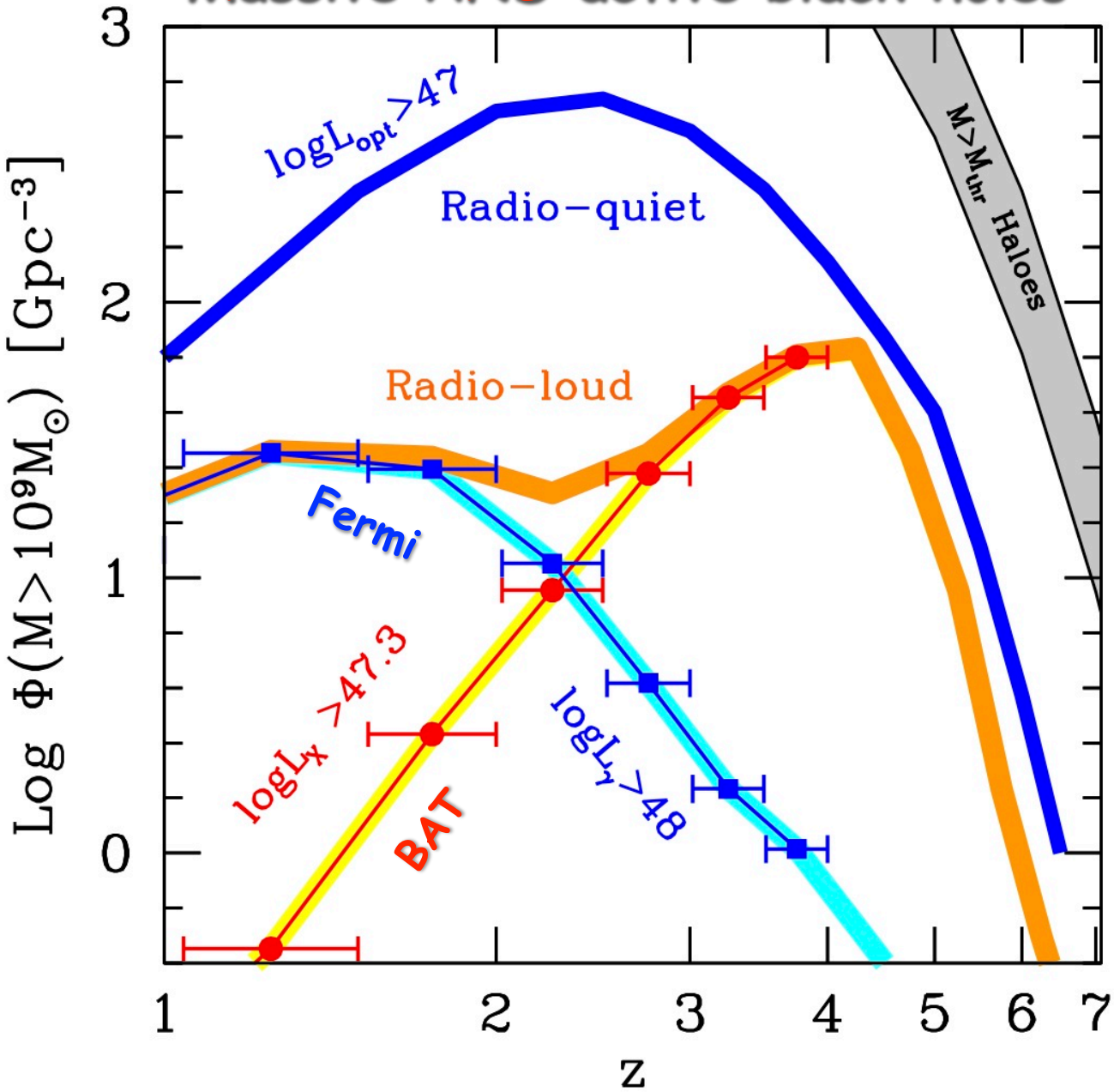
Massive AND active black holes



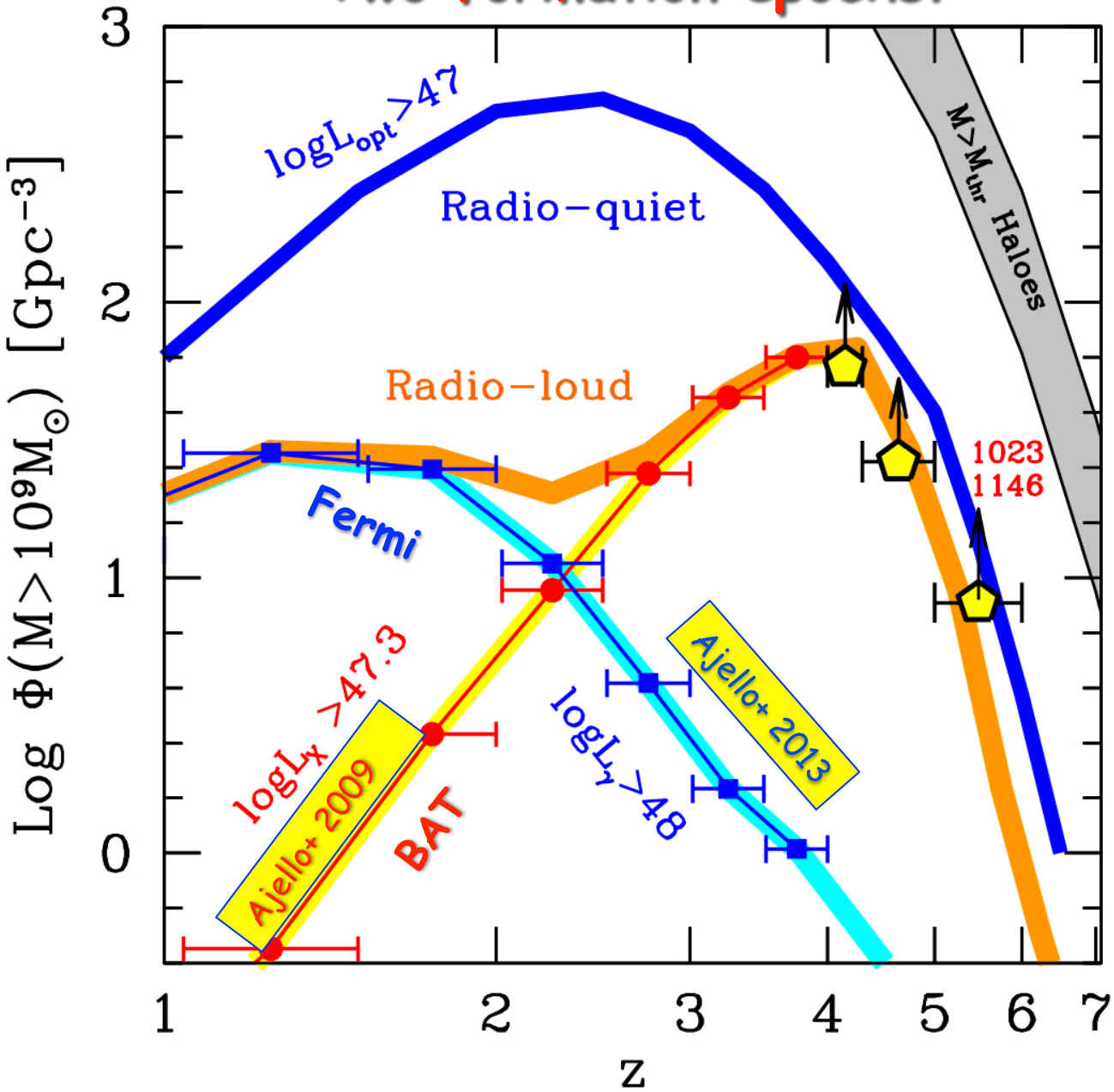
Massive AND active black holes



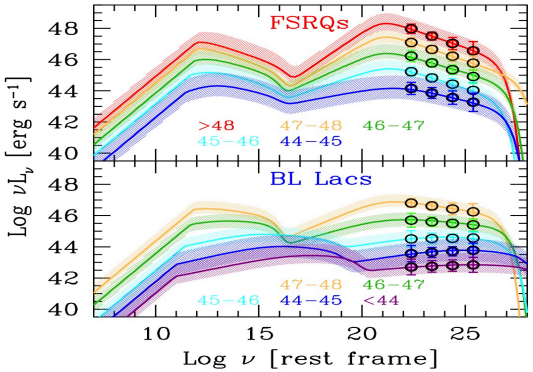
Massive AND active black holes

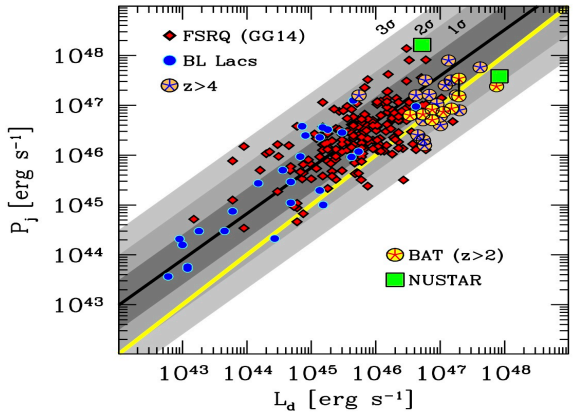


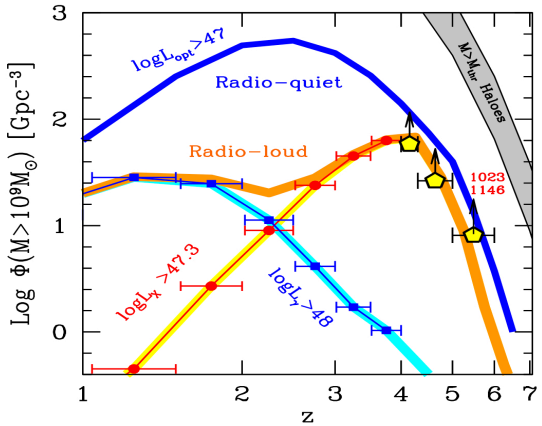
Two formation epochs?



Conclusions







- Blazar sequence 2.0:
  BL Lacs → Changing SED
  FSRQs change Compton Dominance

- the most efficient engine of the Universe
  $P_{jet} \sim \dot{M}c^2$, larger than L_d

- Heavy and early BH:
  $M>10^9 M_\odot$ @ z~4 in jetted AGNs. Does the jet help to accrete faster?