Early QSOs and their SMBHs from KiDS+VIKING

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Bram Venemans, team QSO at MPIA, Kuijken, Mwebaze, Valentijn

Survey Science:

KiDS/VIKING production team, OmegaCEN, Target
McFarland, Helmich, de Jong, Irisarri, Williams, ++
Astro-WISE information system

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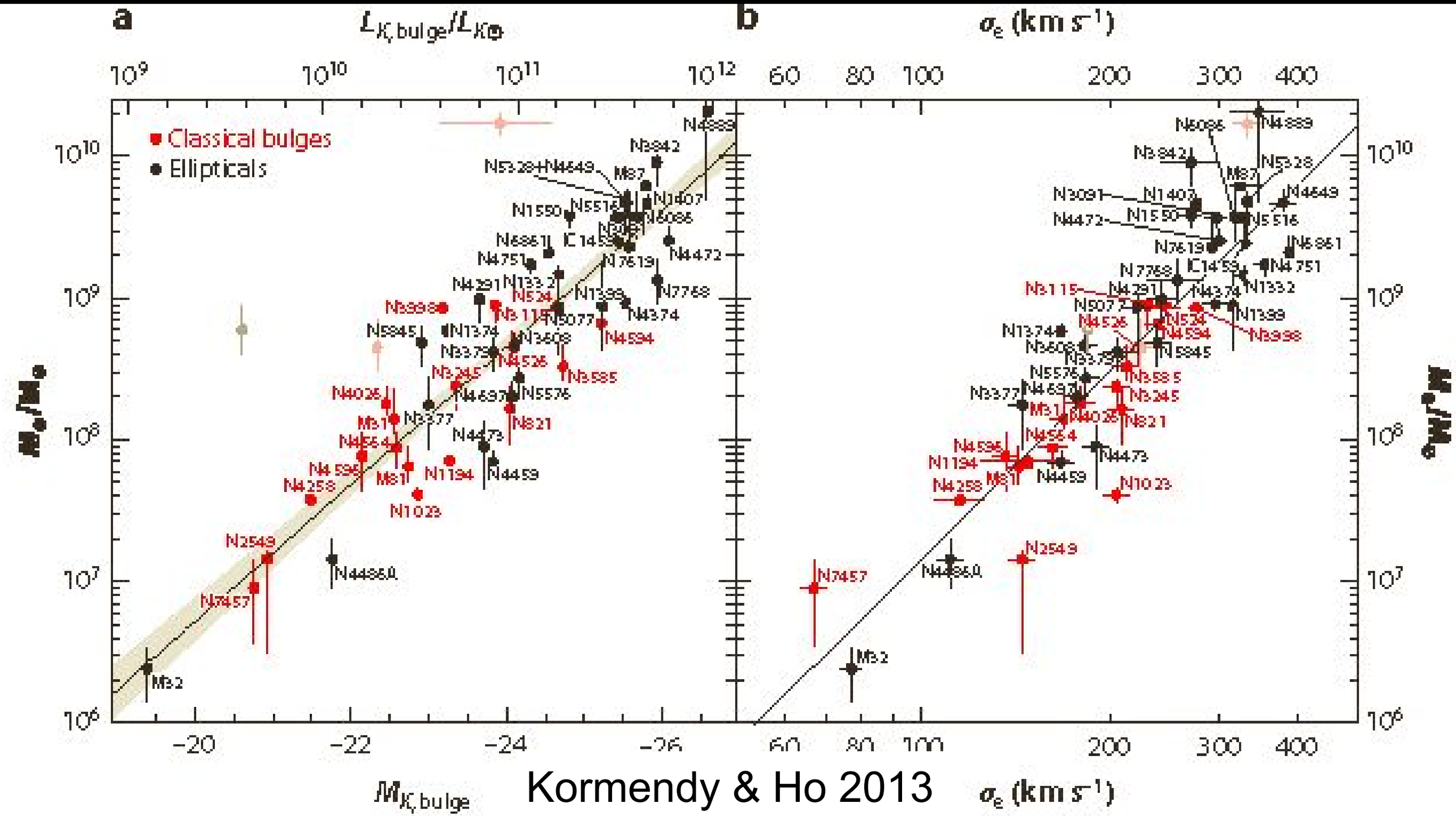
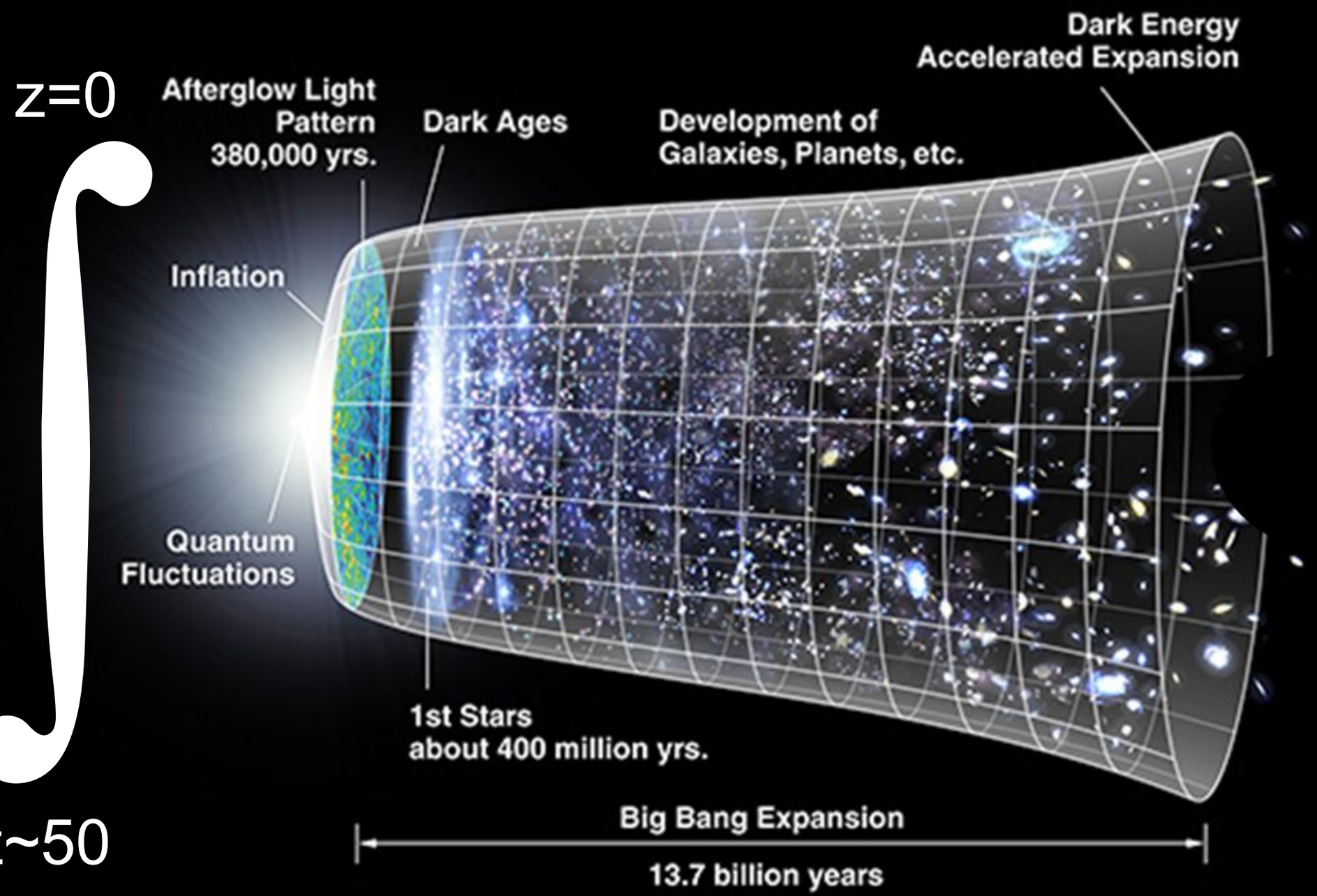
We need to end up with this….



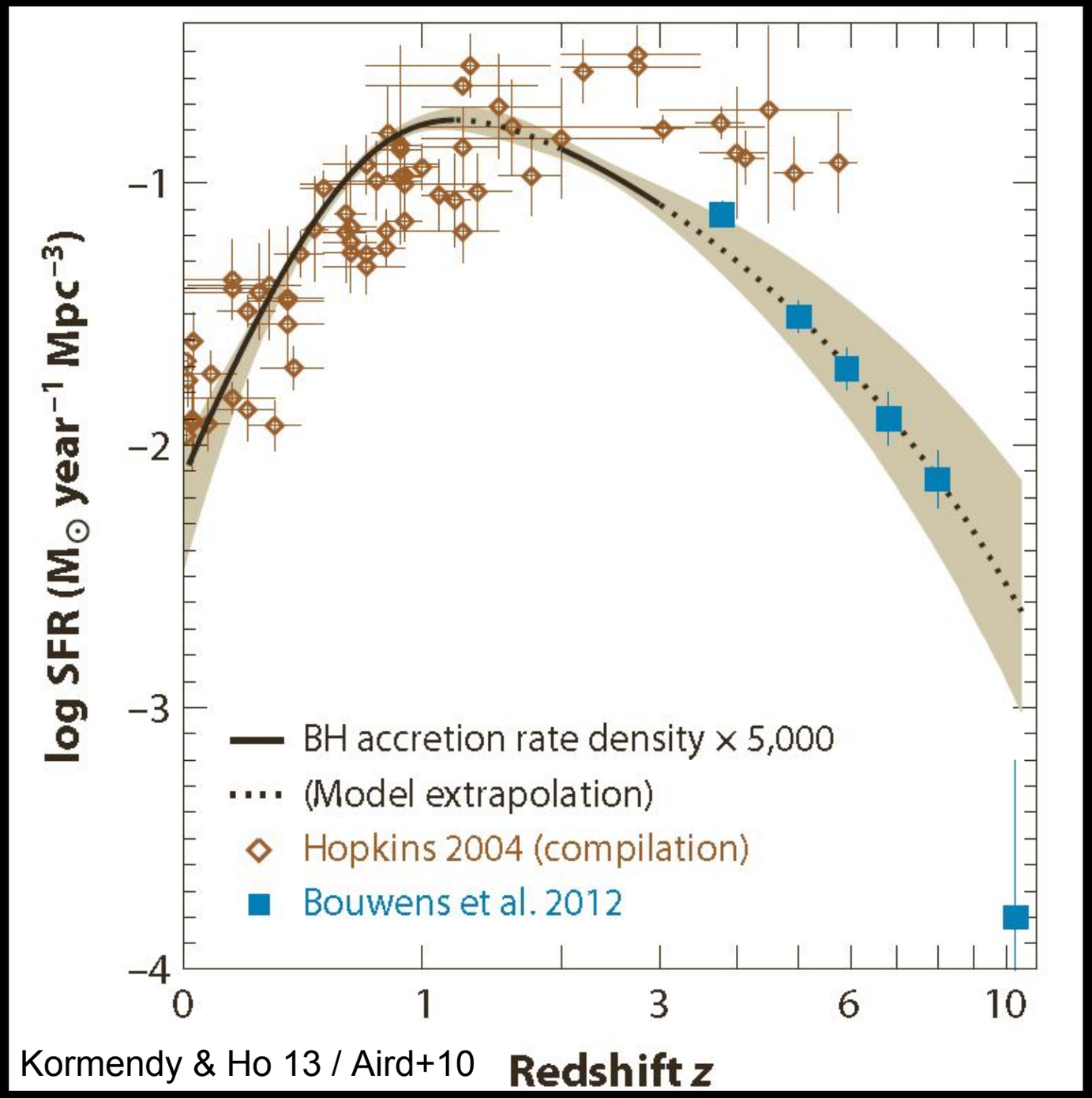
Kormendy & Ho 2013

supermassive blackhole ↔ host symbiosis



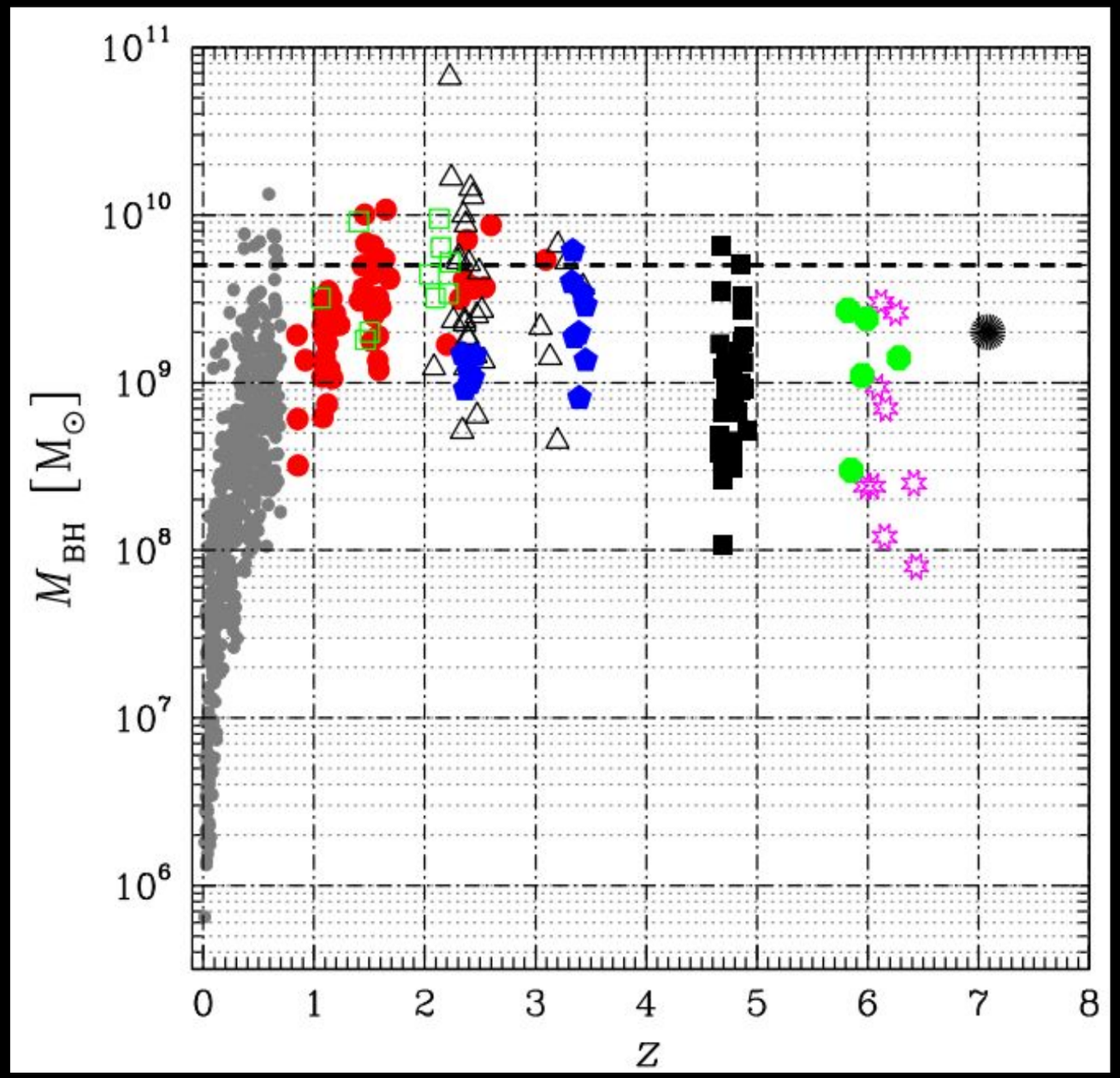
QSOs ideal:
SMBHs
hosts
IGM
feedback

Co-evolution on average



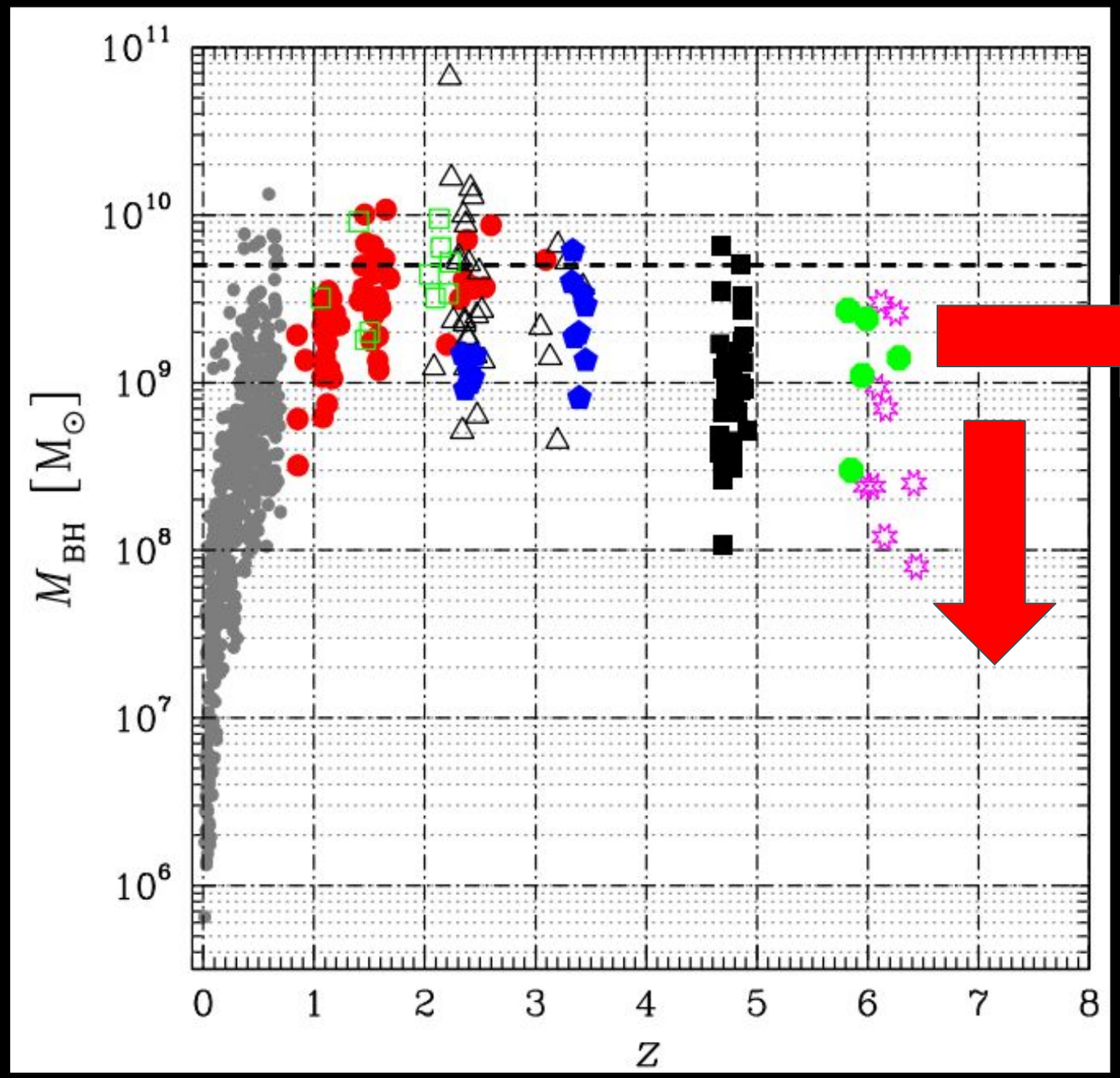
Kormendy & Ho 13 / Aird+10

Varying “evolutionary clockspeeds” (aka downsizing)



Marziani, Sulentic 11

What theorists *and* observers want



Marziani, Sulentic 11

survey telescopes

VIRCAM@VISTA

4m telescope

FoV 0.6 sq.deg, NIR

16 2kx2k, 0.35” pix

VIKING	
passband	AB, 5σ, 2”
Z_V	22.7
Y	22.0
J	21.8
H	21.1
K	21.2

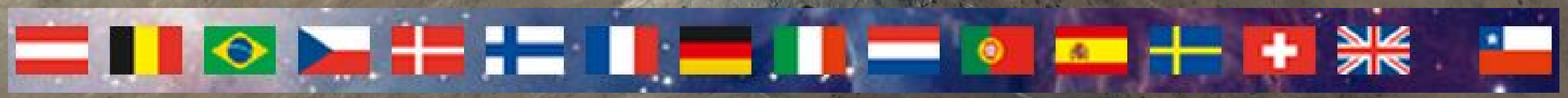
ΩCAM@VST

2.6m telescope

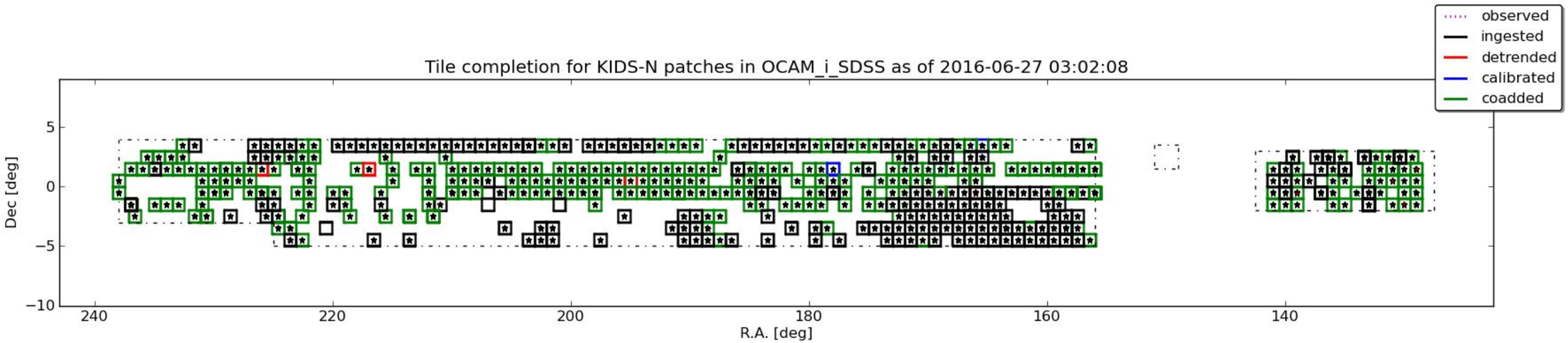
FoV 1 sq.deg, OPT

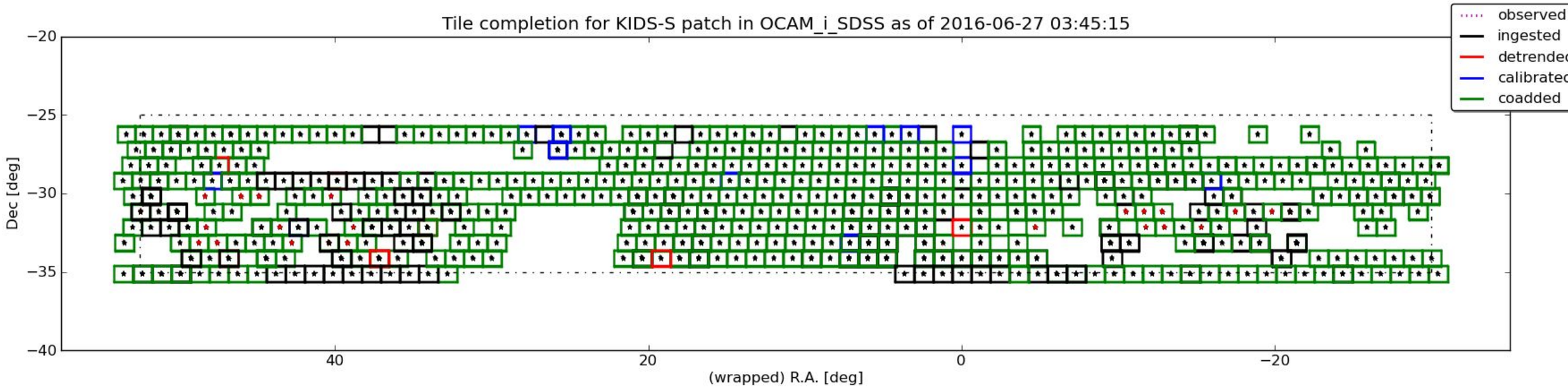
32 2kx4k, 0.21” pix

KiDS	
passband	AB, 5σ, 2”
u	24.2
g	25.2
r	25.0
i	23.8



KiDS+VIKING iZYJHK ~1200sq.deg. today





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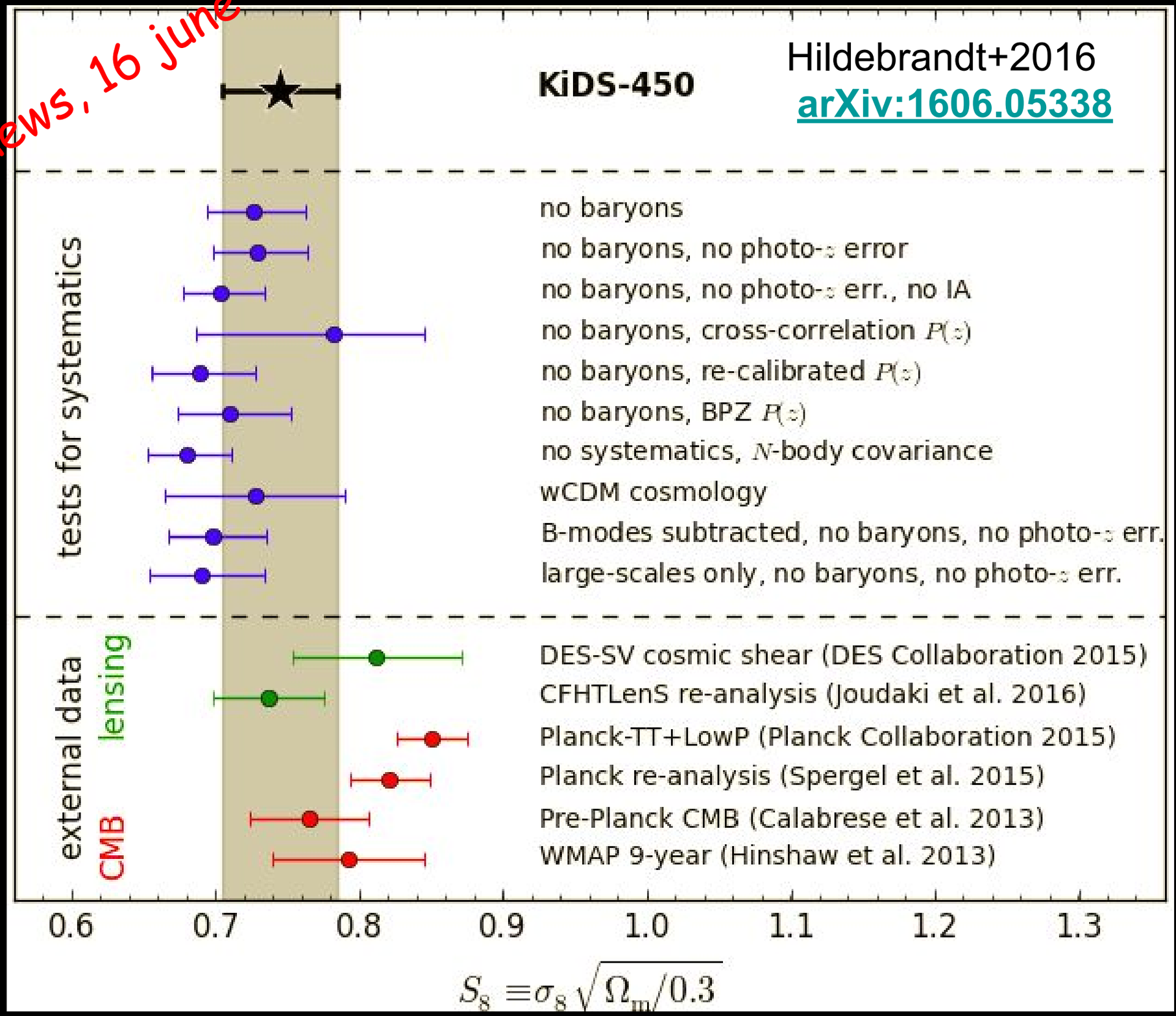
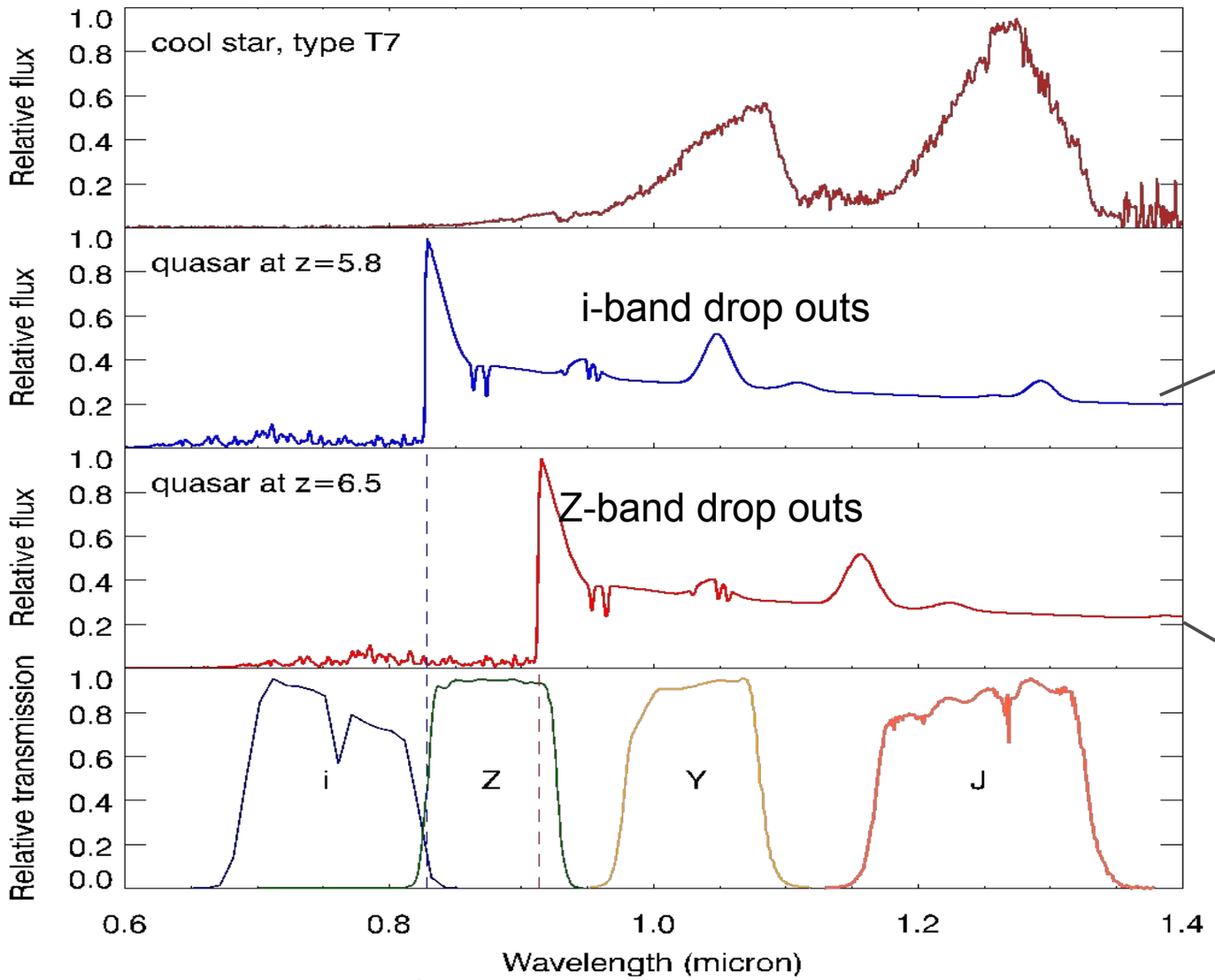
Tension in fundamental cosmology

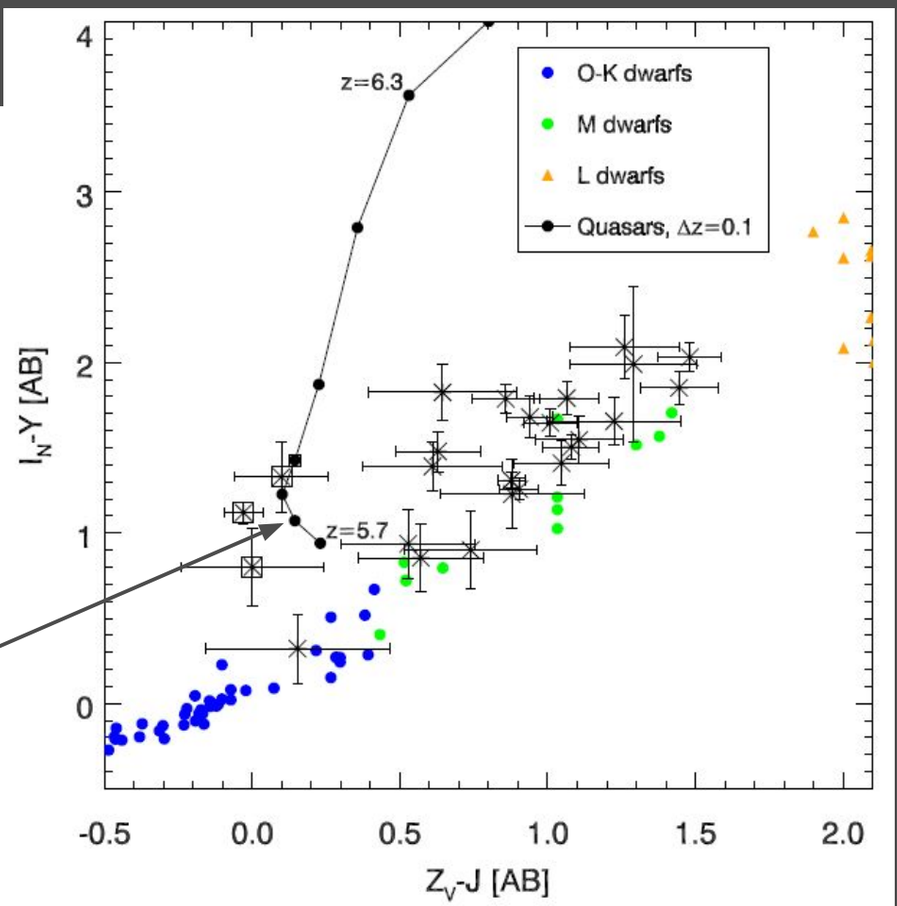
Latest KiDS news, 16 june

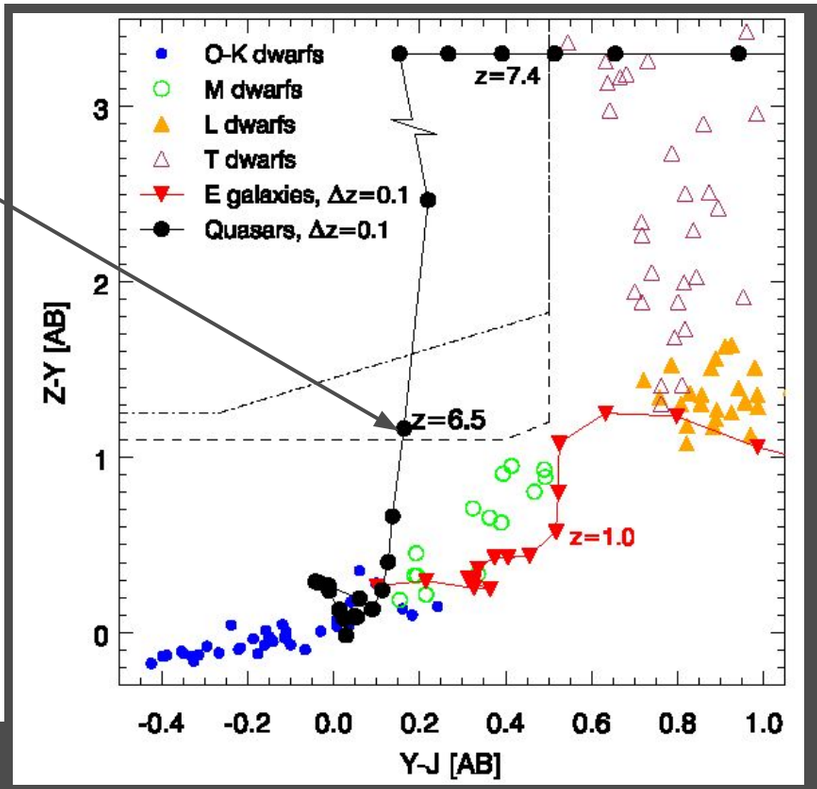


High-z QSO selection and follow-up



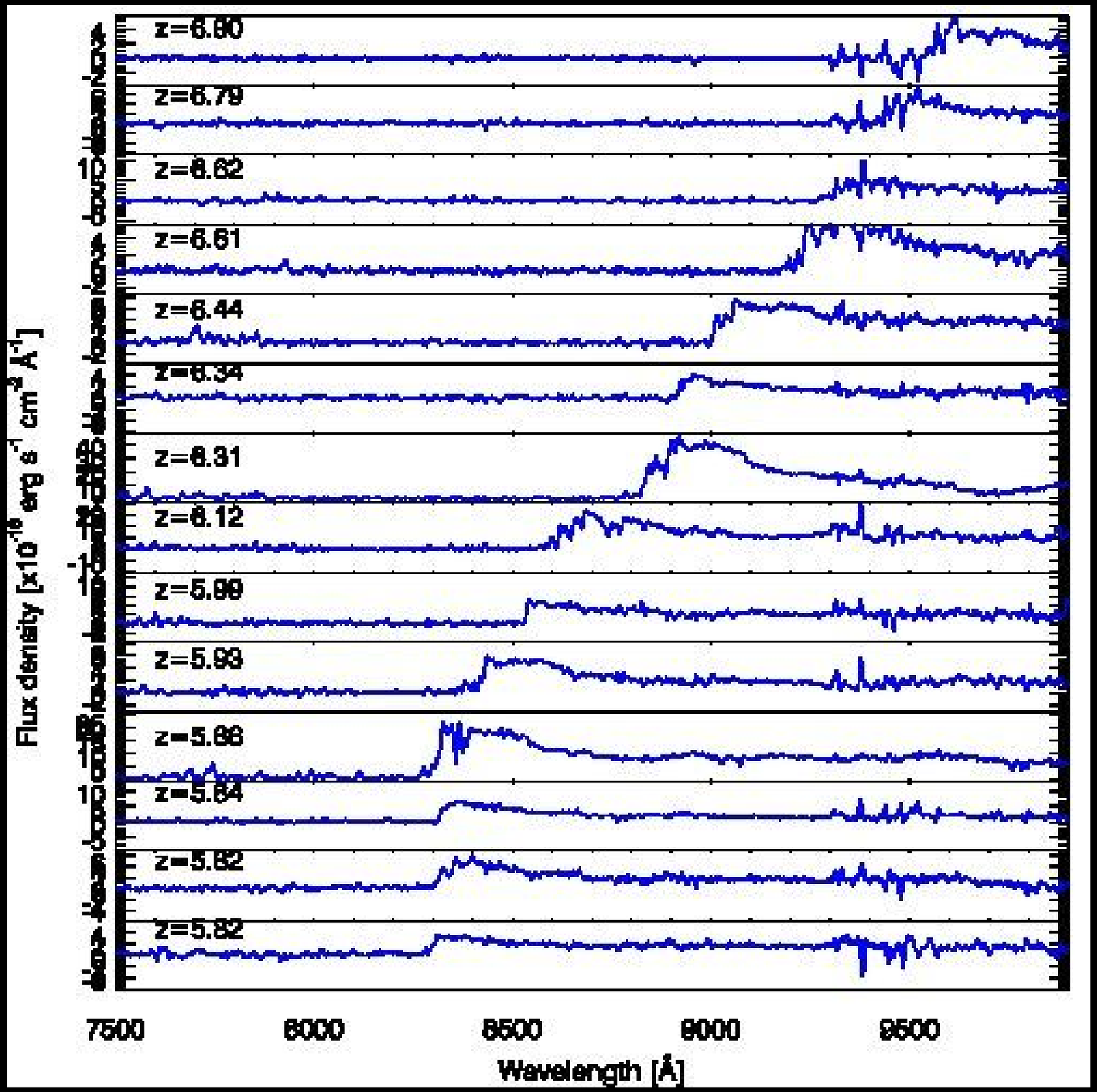
← KiDS | VIKING →





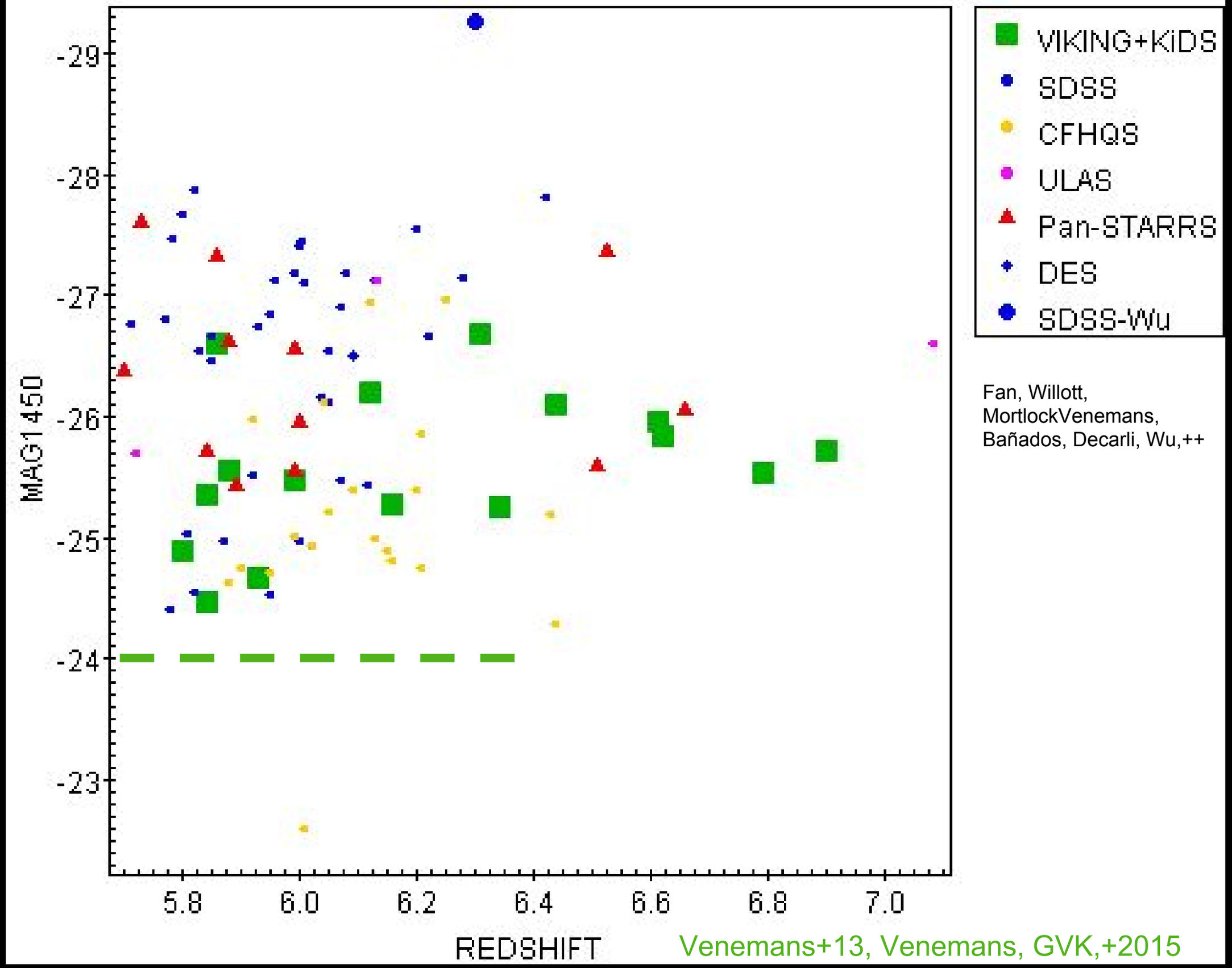
OmegaCEN

VIKING+KiDS QSO harvest 30Jun 2016 :16



+2

OmegaCEN



Fan, Willott, MortlockVenemans, Bañados, Decarli, Wu,++

Venemans+13, Venemans, GVK,+2015

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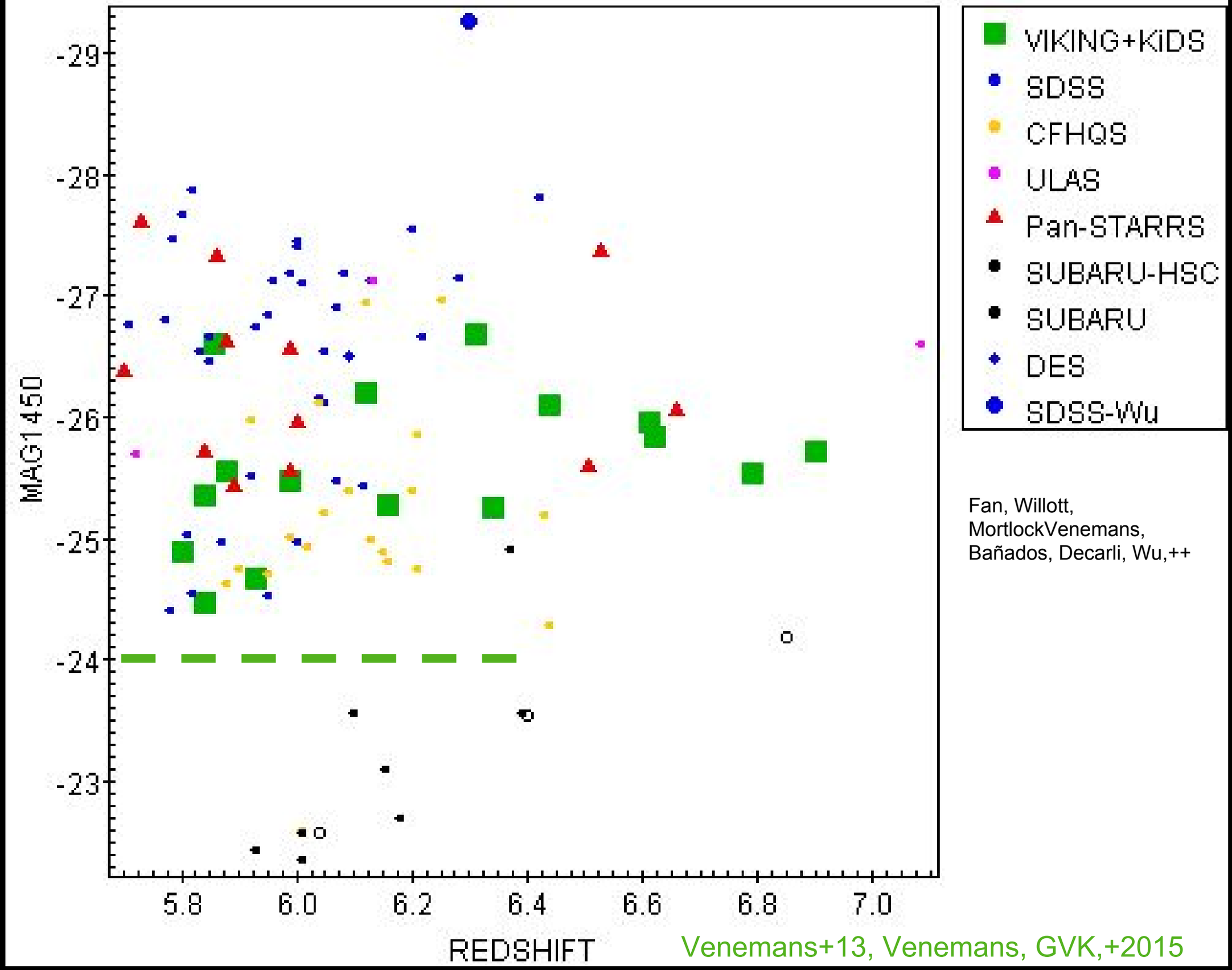
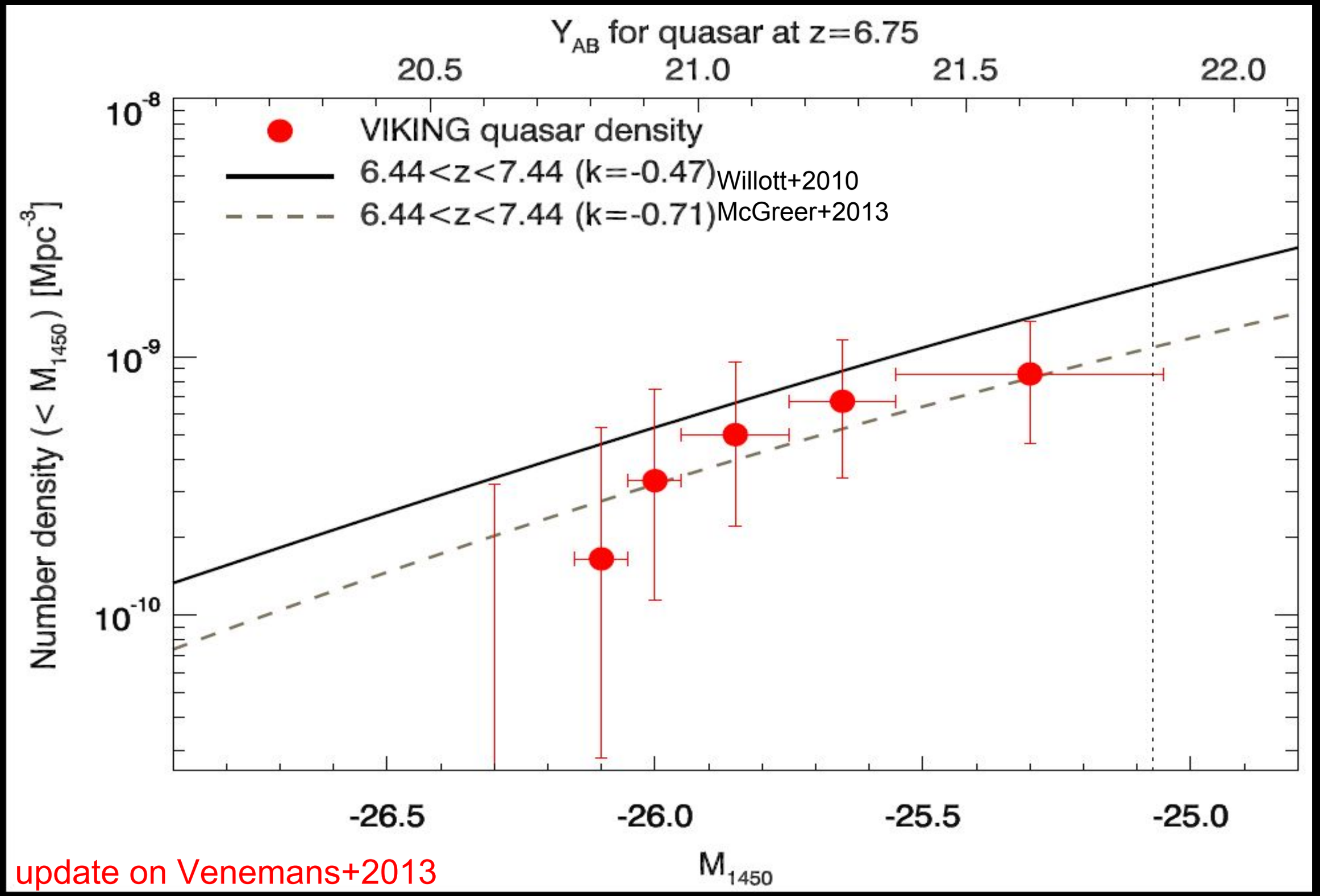
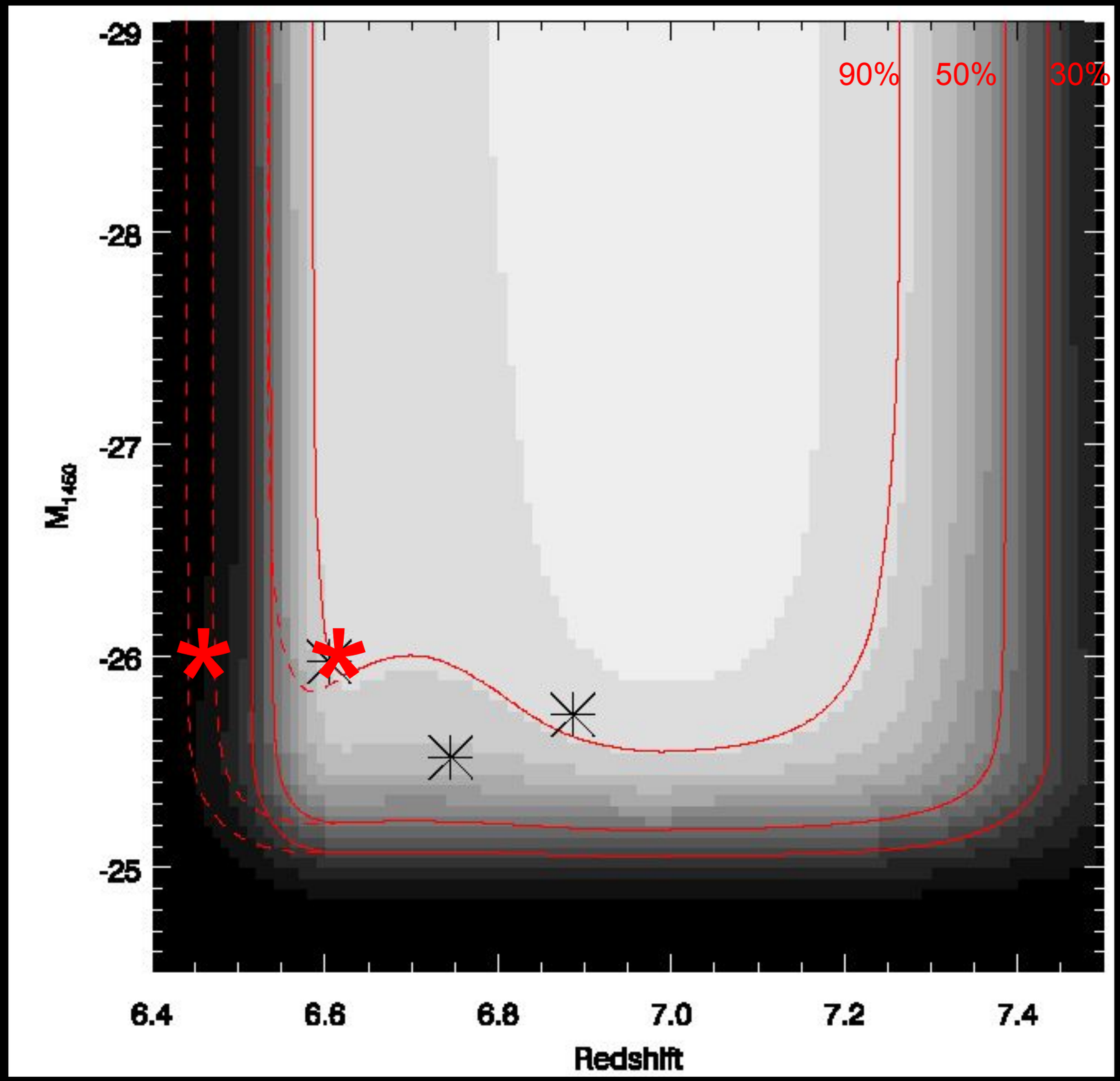

-29
-28
-27
-26
-25
-24
-23
MAG1450
5.8
6.0
6.2
6.4
6.6
6.8
7.0
REDSHIFT
VIKING+KiDS
SDSS
CFHQS
ULAS
Pan-STARRS
SUBARU-HSC
SUBARU
DES
SDSS-Wu
Fan, Willott,
MortlockVenemans,
Bañados, Decarli, Wu,++
Venemans+13, Venemans, GVK,+2015

QLF at z~7, favoring steeper decline



update on Venemans+2013

Completeness



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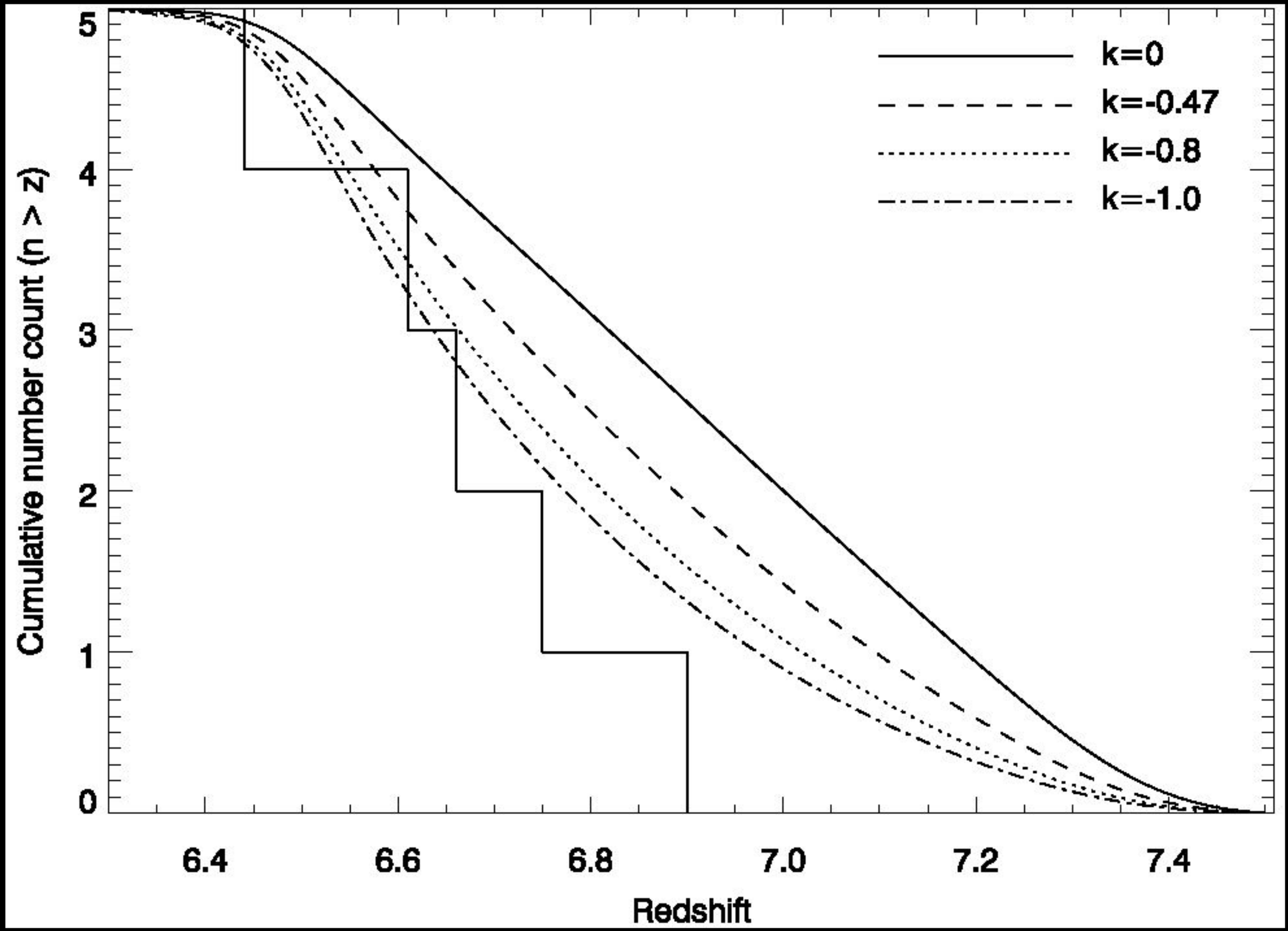
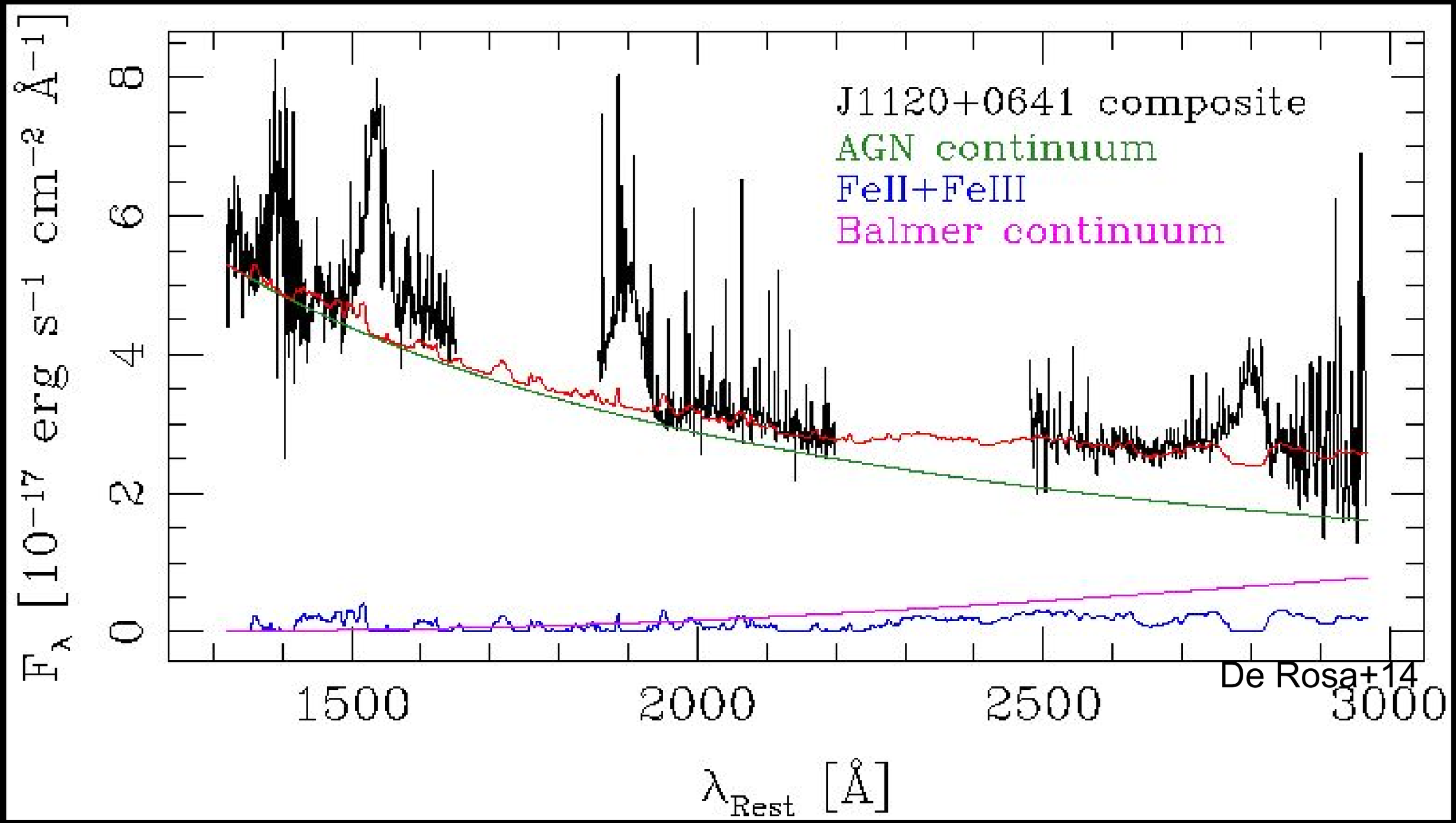
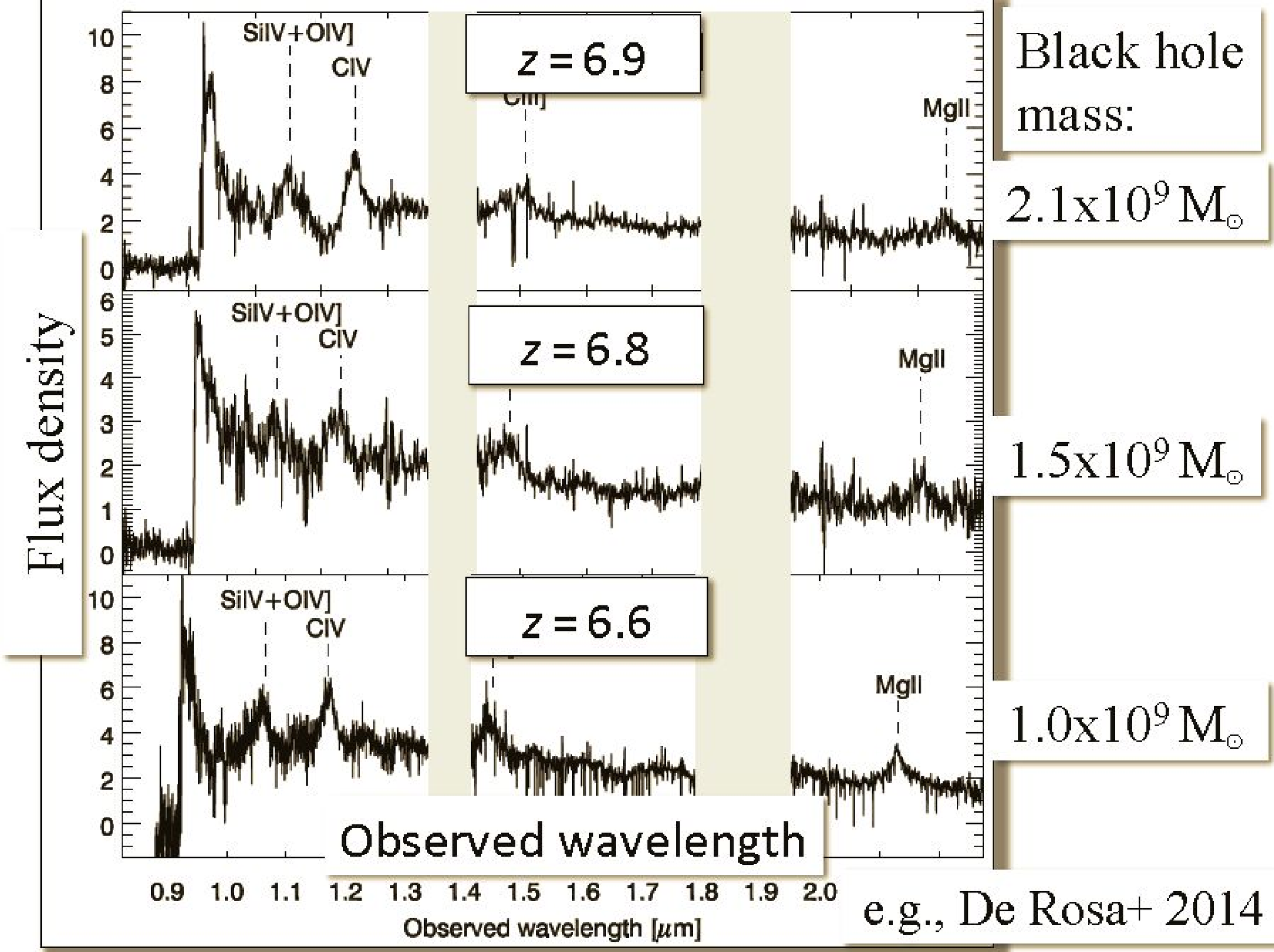


SMBH masses: careful spectral modelling





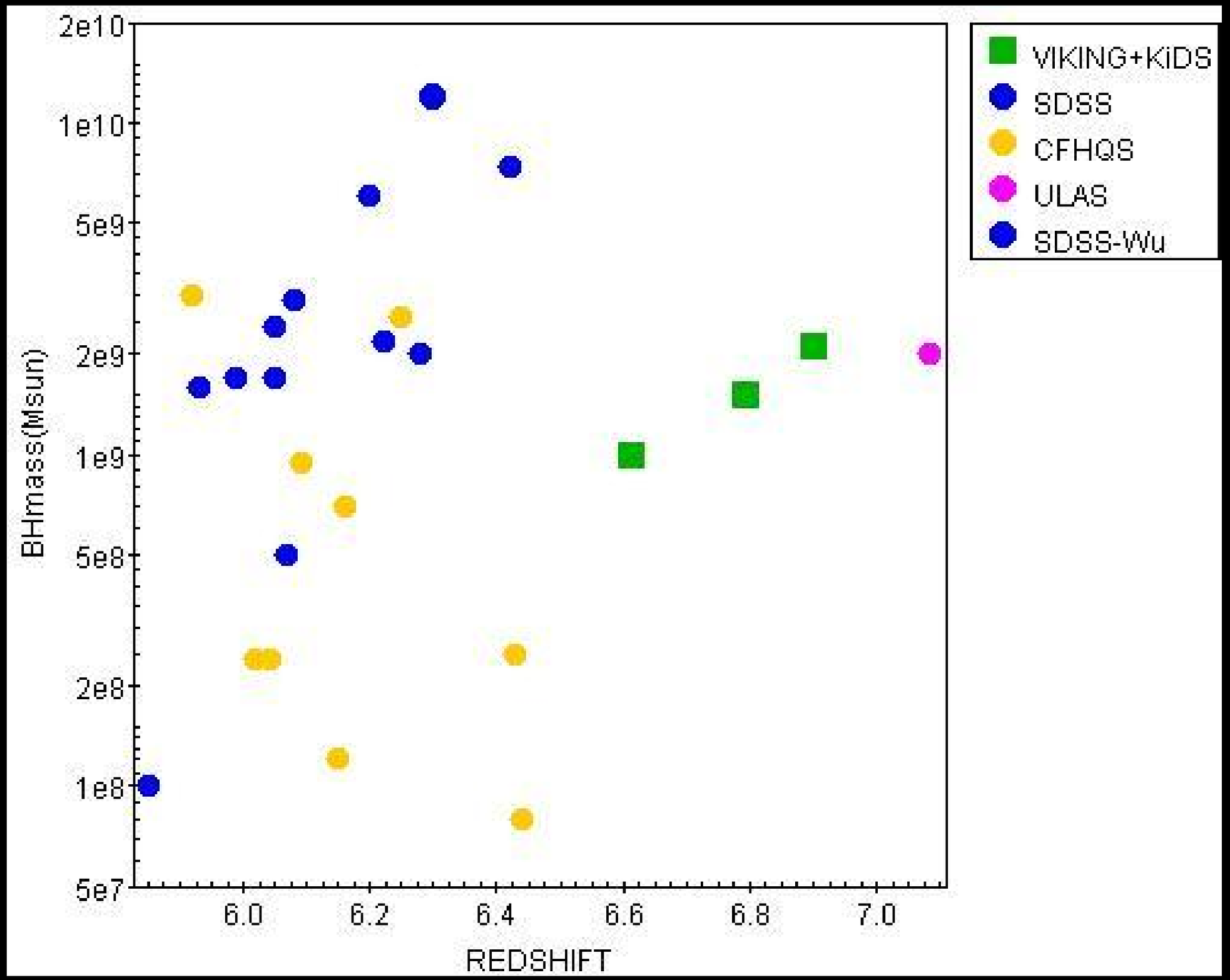
Black hole mass:

$2.1 \times 10^9 M_\odot$

$1.5 \times 10^9 M_\odot$

$1.0 \times 10^9 M_\odot$

e.g., De Rosa+ 2014



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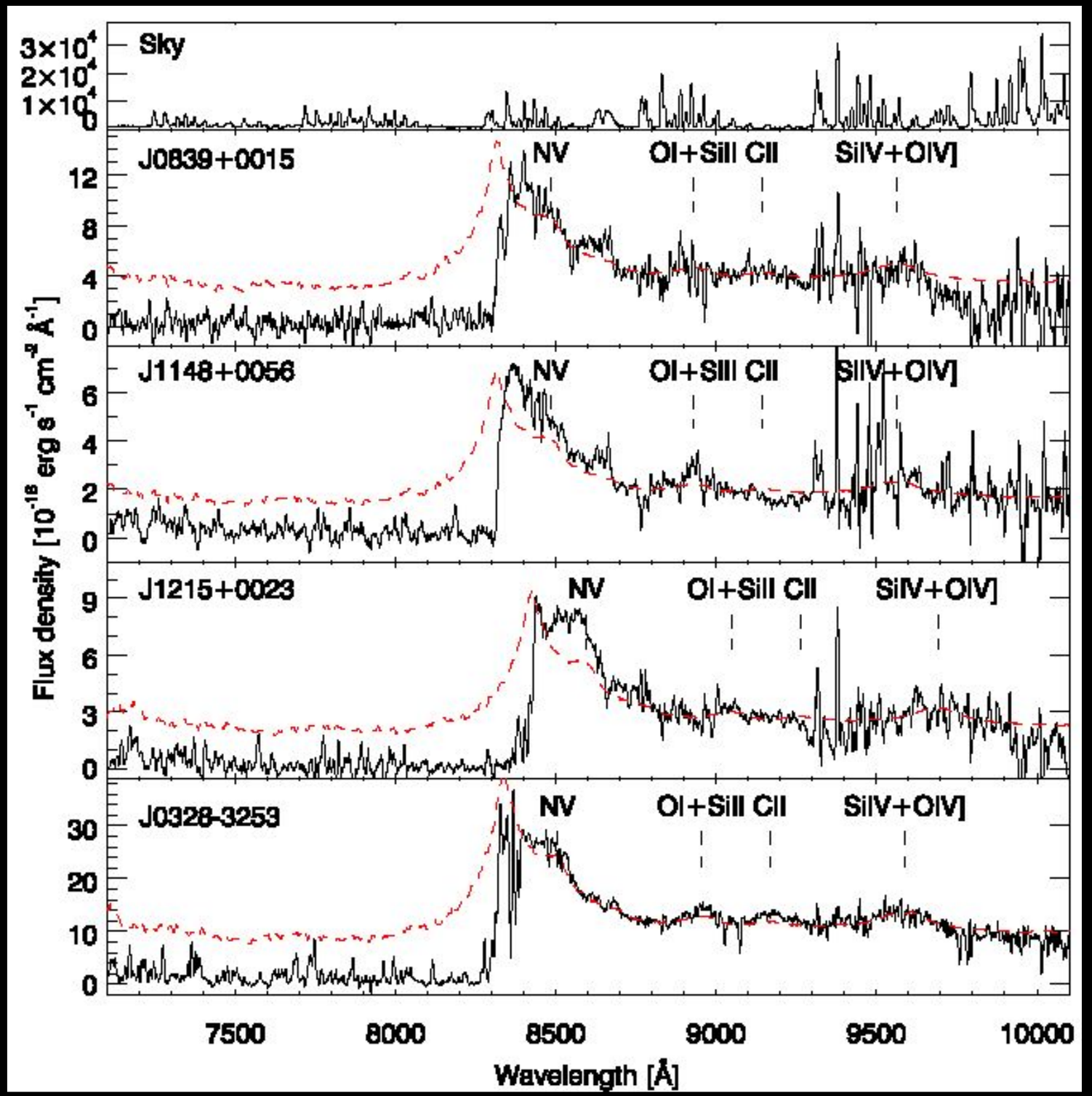
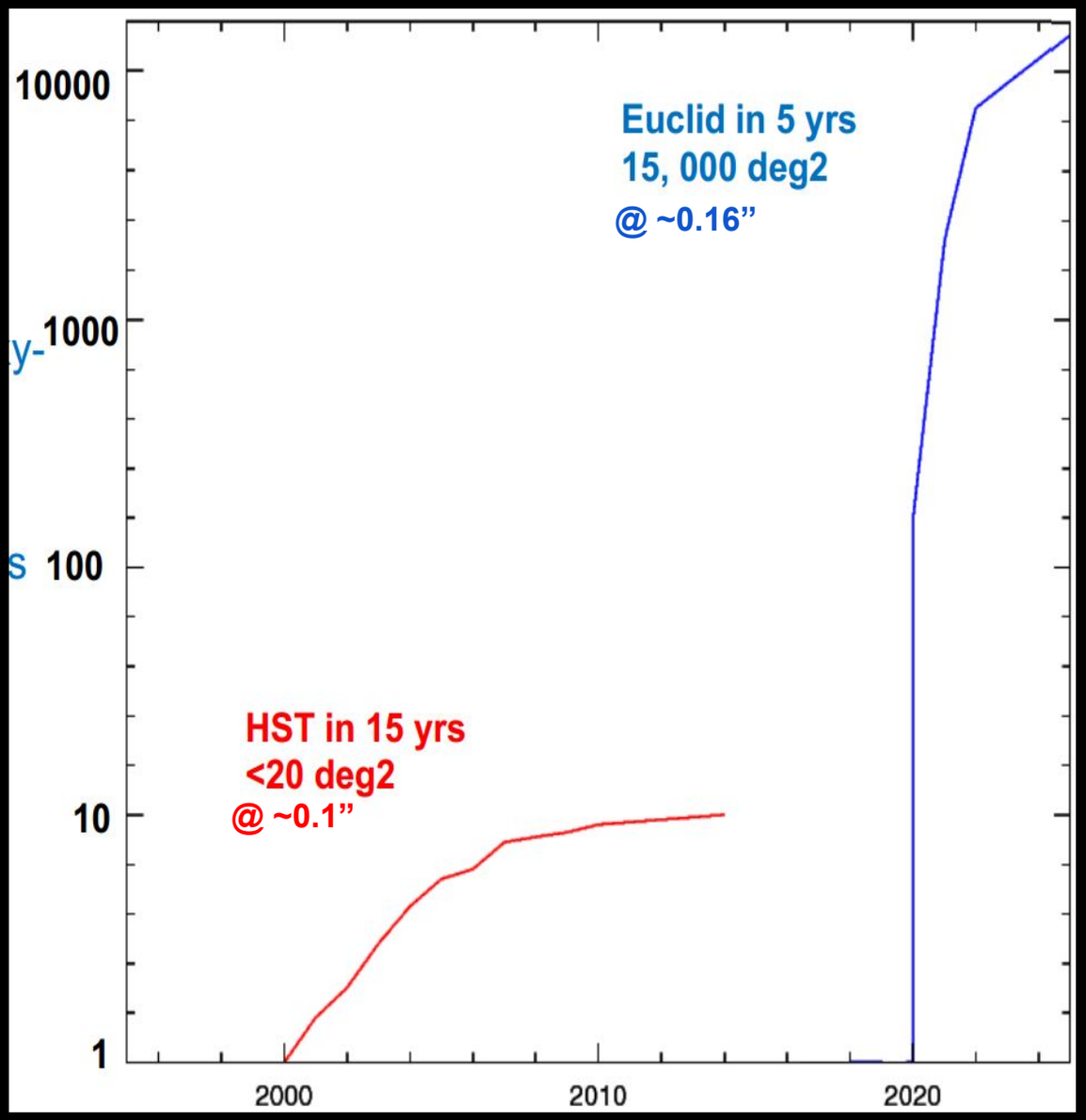
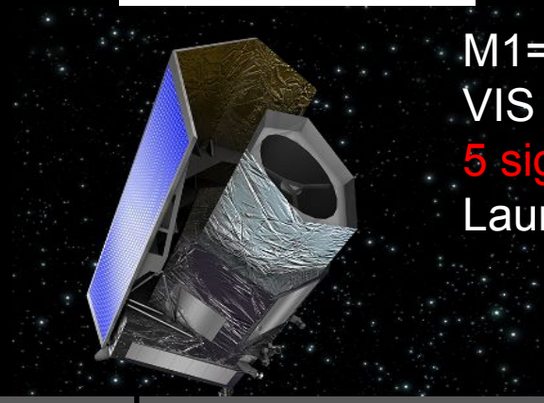
Mostly weak Lyα QSOs at z~6



Venemans, GVK+2015

KiDS → Euclid
1 → 10





M1=1.2m
VIS / Y,J,H, NIR-spectra
5 sigma (AB) ~25 / 24.5
Launch 2020

What	KiDS+VIKING	Euclid
FoM Dark Energy		~1500
Galaxies at 1<z<3 with good mass estimates	~10^7	~$2x10^8$
Massive galaxies (1<z<3) w/spectra	--	~few x 10^3
Hα emitters/metal abundance in z~2-3	--	~$4x10^7/10^4$
Galaxies in massive clusters at z>1	~10^3?	~$2x10^4$
Type 2 AGN (0.7<z<2)	<10^3 ?	~10^4
Dwarf galaxies	?	~10^5
T_{eff} ~400K Y dwarfs	few	~few 10^2
Strongly lensed galaxy-scale lenses	**~2000**	**~300,000**
z > 6.5 QSOs	**~10**	**>30**

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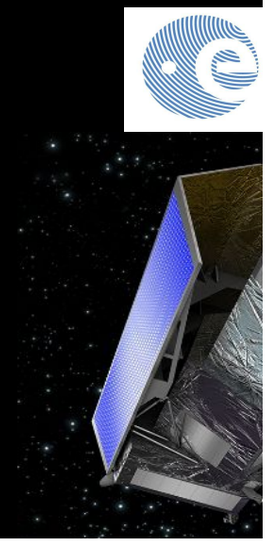
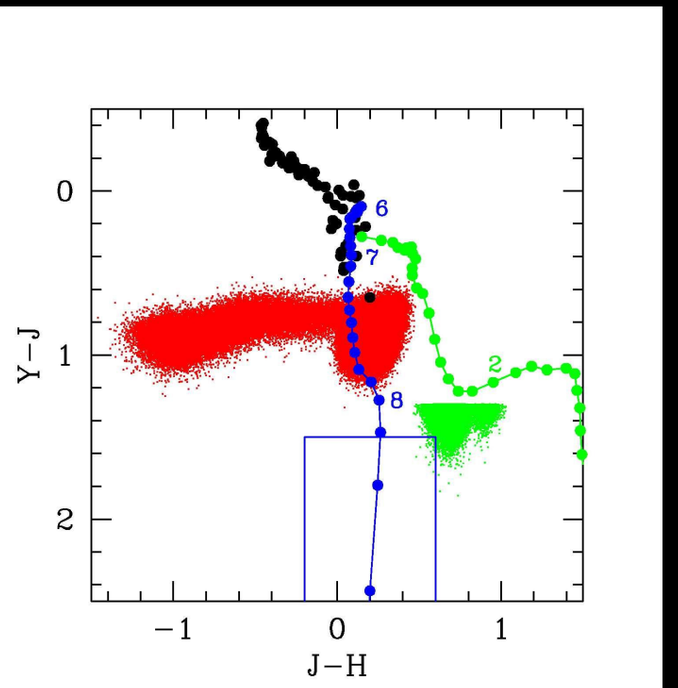
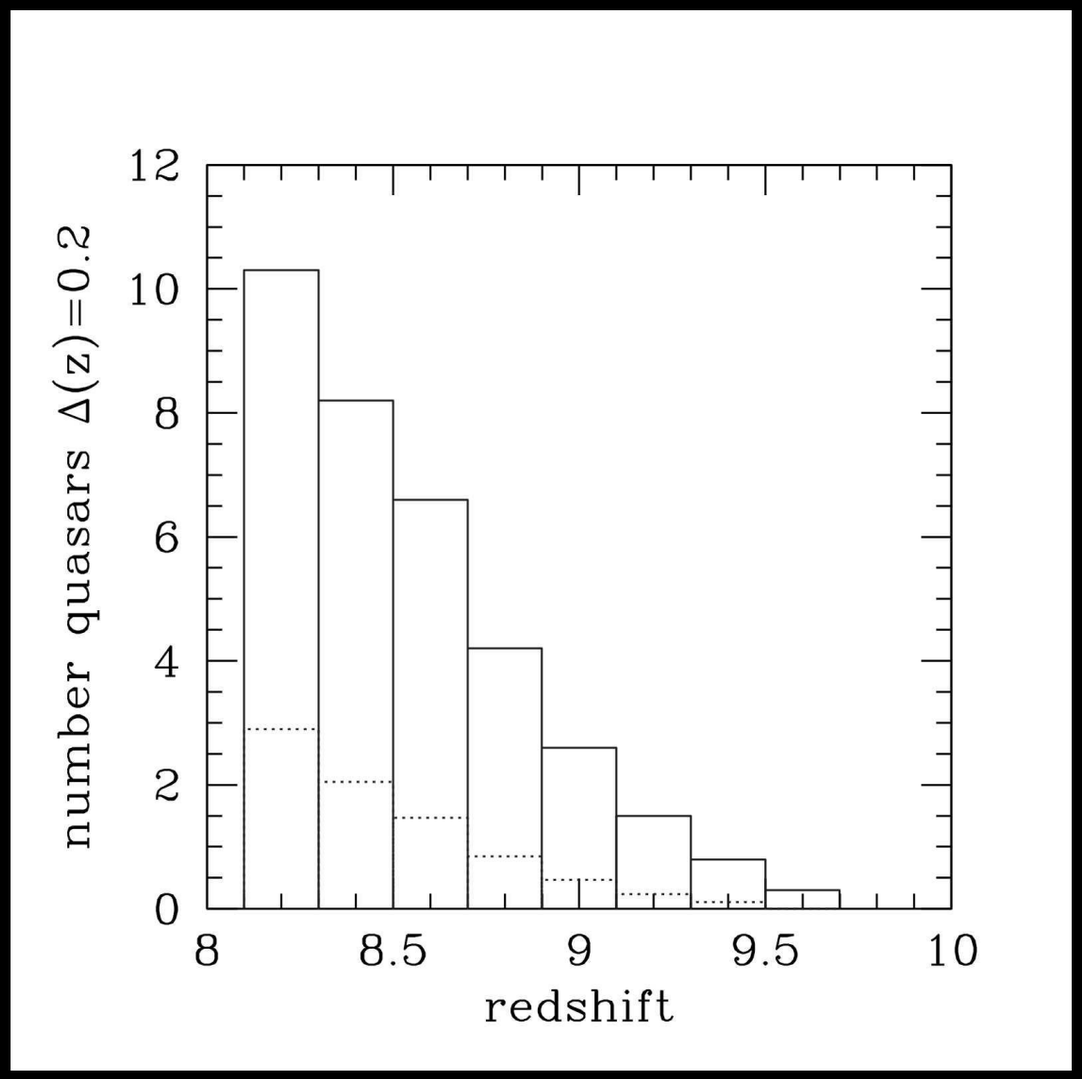
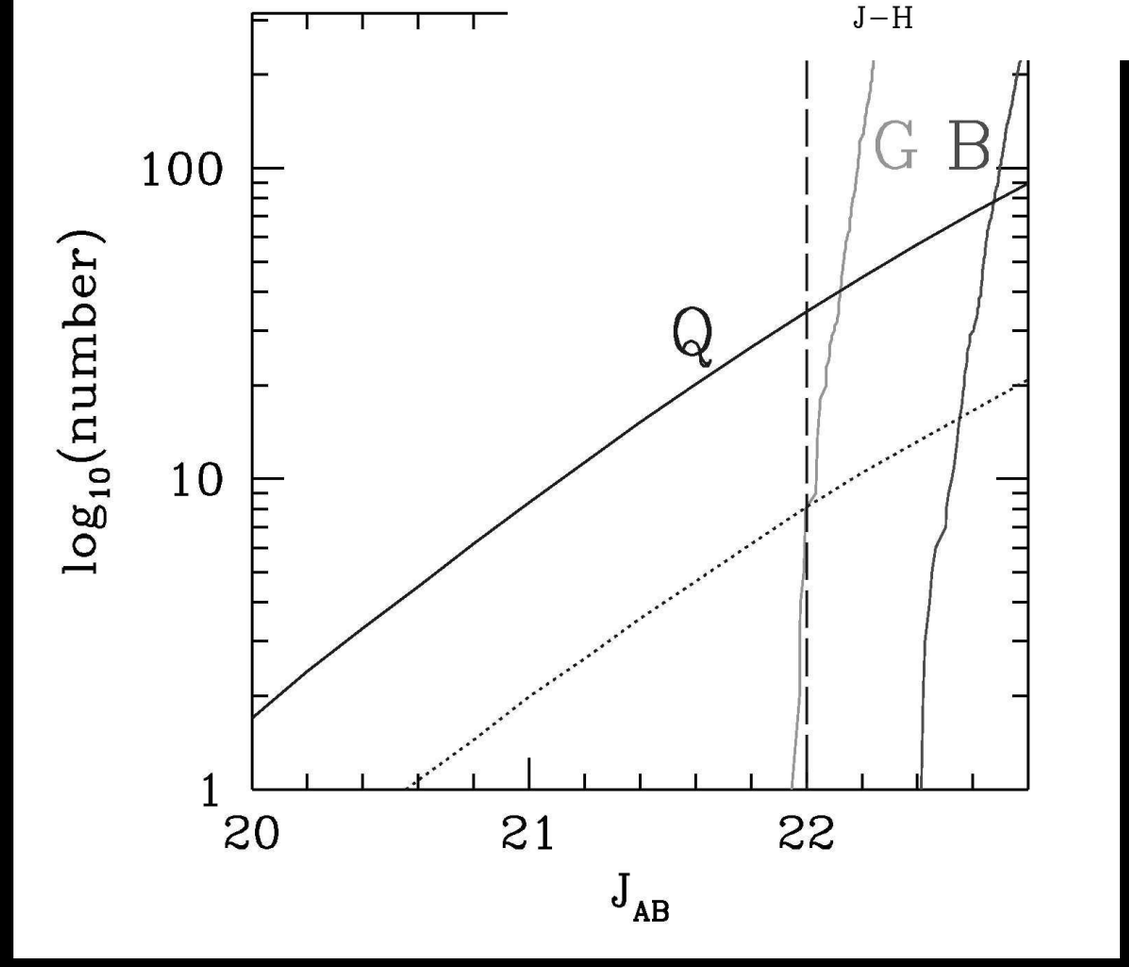
KiDS

KiDS → Euclid
1 → 10









Courtesy Steve Warren and QSO Science Working Group

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Conclusions

VIKING + KiDS, a homogeneously selected sample,

- probes up to z ~ 7.4
- and downto M_{1450} = -24

Redshifts	#QSO	Brightnesses
5.80 ≤ z ≤ 6.34	11	-26.7 ≤ M_{1450} ≤ -24.5
6.44 ≤ z ≤ 6.90	5	-26.1 ≤ M_{1450} ≤ -25.4
TOTAL	16	~75% harvested

- found only weak Lyα QSOs at z~6
- hint of drop in QSO density z>6.5
- observed ρ ~ 0.4 Gpc^{-3} for SMBH=10^9 M_{sun} at z>6.5
- The QSO future looks bright with Euclid: 2020
  - many LLQSO, many z>8 expected