High redshift galaxies and AGN with Euclid

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Legacy science with Euclid

- Depth/area combination in the near-ir
- High spatial resolution
- Large number of spectra

Legacy SWGs

- Primeval Universe
- Galaxy and AGN Evolution
- Strong Gravitational Lensing
- Clusters
- Local Universe
- Milky Way and Resolved Stellar Populations
- Supernovae and Transients
- Exoplanets (microlensing)

The scope of the Euclid near-ir imaging

- Wide survey 15,000 deg^2 YJH_{AB}=24 would take 680 years with VISTA or 66 years with SASIR (Synoptic All-Sky Infrared Survey - 2017)
- Deep survey 40 deg^2 YJH_{AB}=26 would take 72 years with VISTA or 7 years with SASIR
- The Euclid surveys are >100 times more ambitious than anything underway and at least >10 times more ambitious than anything else currently conceived

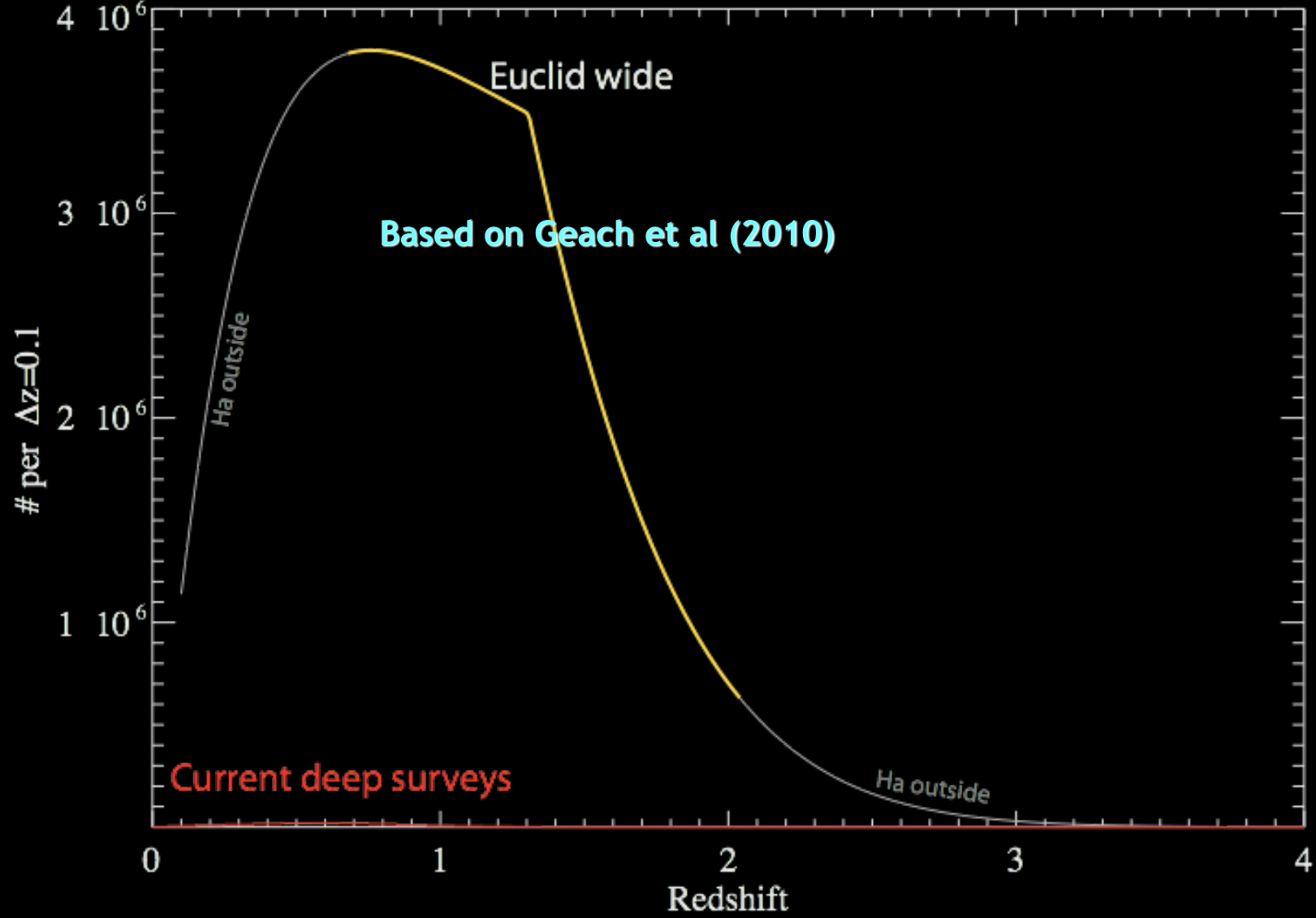
Deep fields locations

- 40 deg^2 YJH 26AB Vis 27.5AB
- Default location SEP, NEP
- Very strong science case for 6deg^2 in Subaru Hypersuprimecam deep fields
  - 3deg^2 in SXDS/UDS 2^h18^m-5^o
  - 3deg^2 in COSMOS 10^h00^m+2^o
- Remainder split between SEP, NEP
  - Advantage of NEP is Hypersuprimecam access for deep z imaging
  - Advantage of SEP is ESO access

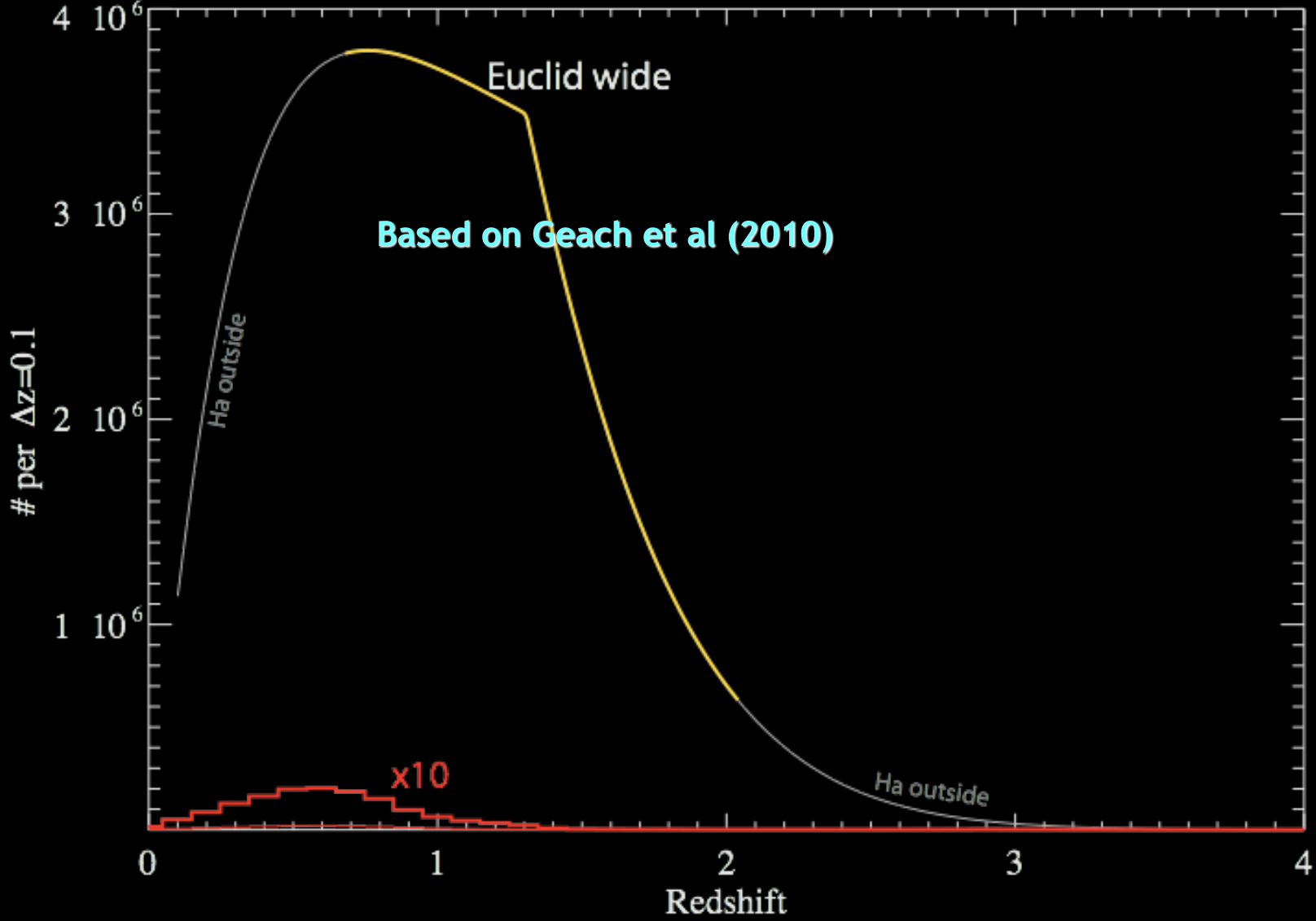
Euclid legacy in numbers

What	Euclid	Before Euclid
Galaxies at 1<z<3 with good mass estimates	~2×10^8	~5×10^6
Massive early-type galaxies (1<z<3) w/spectra	~few x 10^3	~few tens
Hα emitters (0.7<z<2.0)/metal abundance in z~2-3	~$4\times10^7/10^4$	~10^4/~10^2?
Galaxies in massive clusters (~450 at M> 4×10^{14}) at z>1	~2×10^4	~10^3?
Type 2 AGN (0.7<z<2)	~10^4	<10^3
Dwarf galaxies	~10^5	
T_{eff} ~400K Y dwarfs	~few 10^2	<10
Strongly lensed galaxy-scale lenses	~300,000	~10-100
z > 8 QSOs	~30	None

Euclid spectroscopy

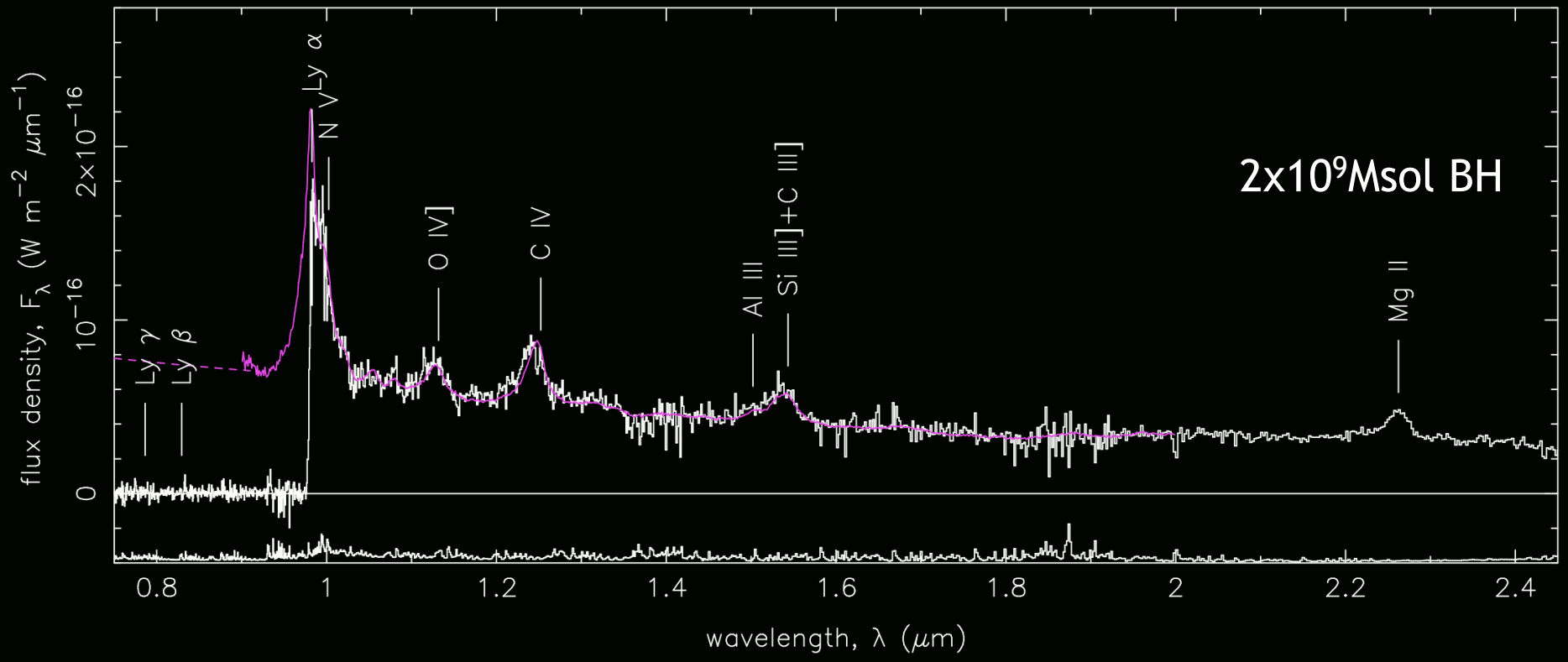


Euclid spectroscopy



High-z quasars with Euclid

z=7.085 quasar Mortlock et al. 2011

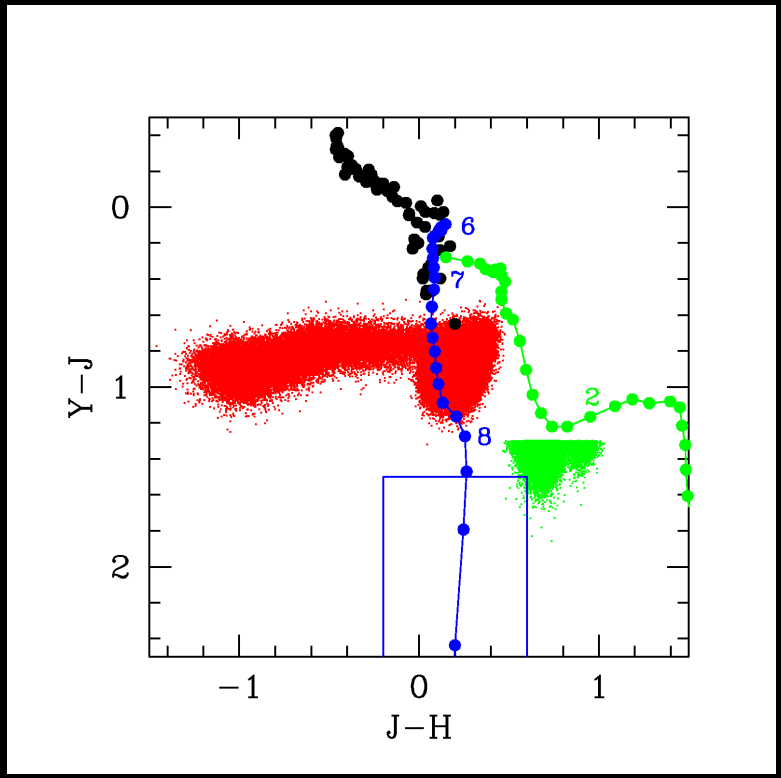


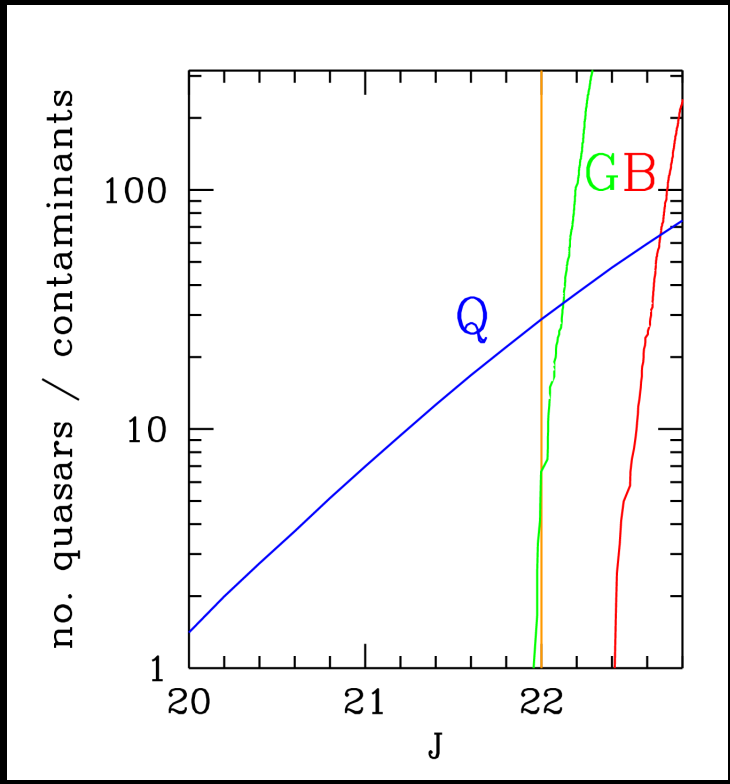
Lya transmission profile resembles damping wing of the IGM with neutral fraction f>0.1. But reionisation predicted to be inhomogeneous process (Mesinger and Furlanetto 2008).

High-redshift quasars
Predictions for future surveys 6.4<z<7.2

Survey	Area	Depth Y (Vega)	Number	complete
UKIDSS	3800	19.6	6	2012
VIKING	1000	20.8	9	2015
PanSTARRS 10 sigma	20000	19.6	33	2015

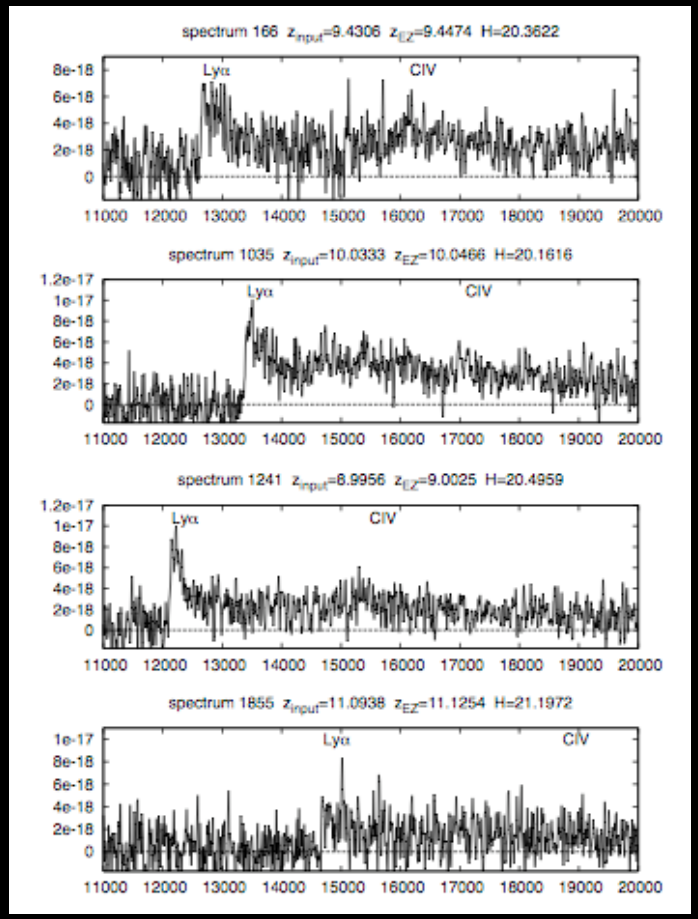
Bright quasars z>8 J<22 from Euclid imaging

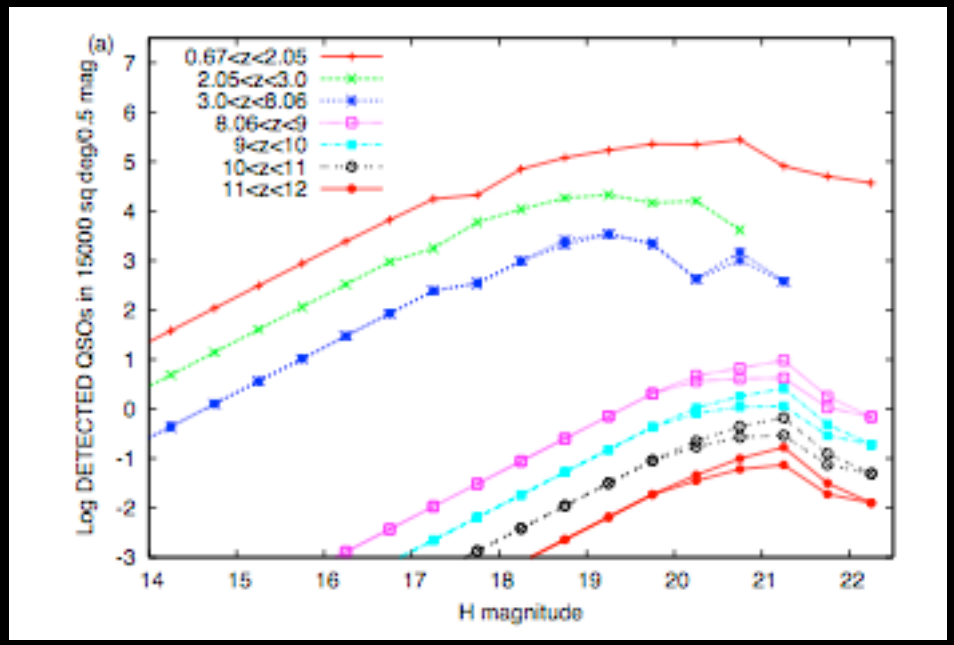




Euclid will find ~30 8.1<z<9 quasars J<22 and 55 quasars J<22.5 (distinguished from galaxies on the basis of morphology)

Bright quasars z>8 J<22 from Euclid spectroscopy

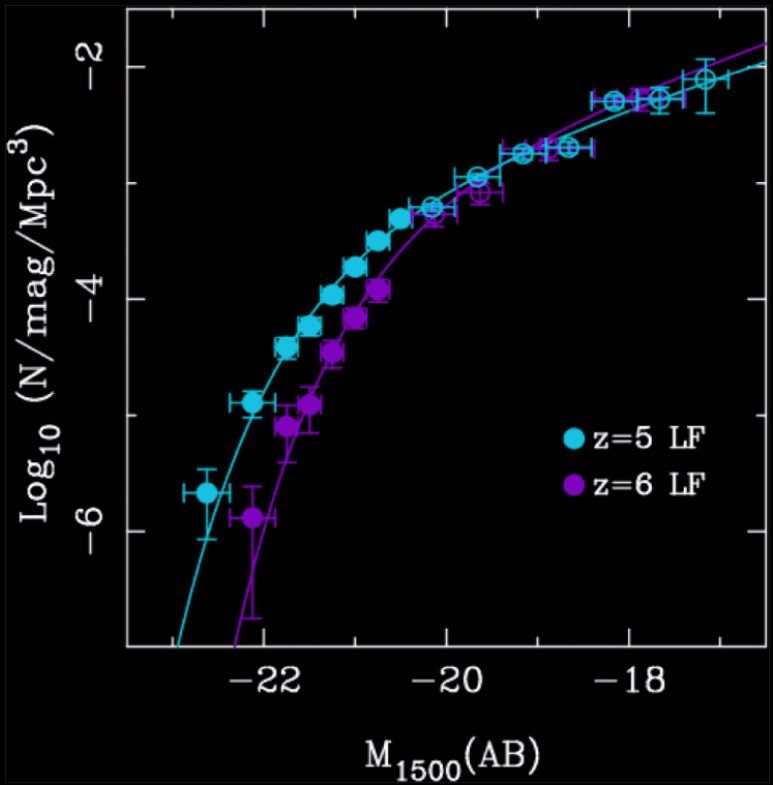




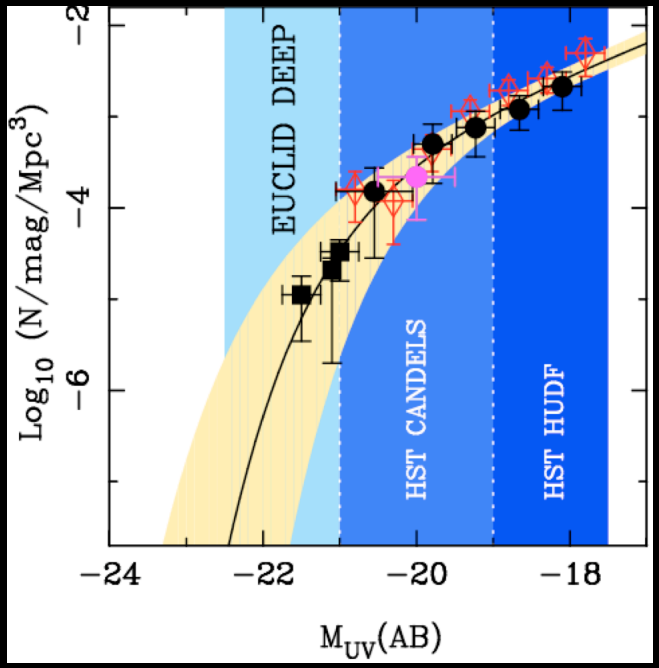
Euclid spectroscopy will find
~ 20-30 quasars at z> 8.1

Cross-check between spectroscopy and imaging candidates should eliminate contaminations and confirm reality of high-z quasars

The galaxy luminosity function 5<z<8

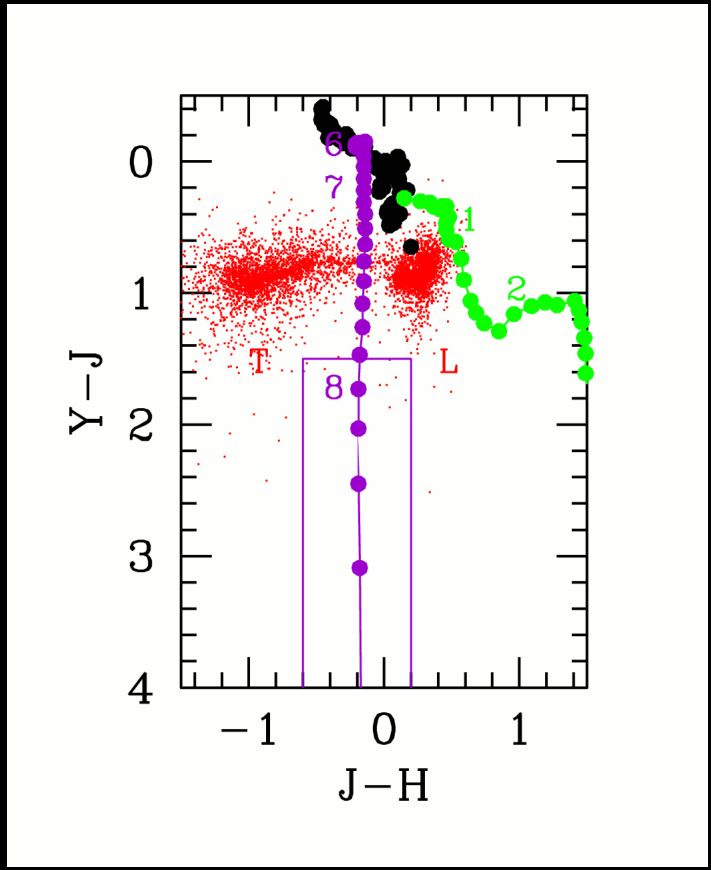


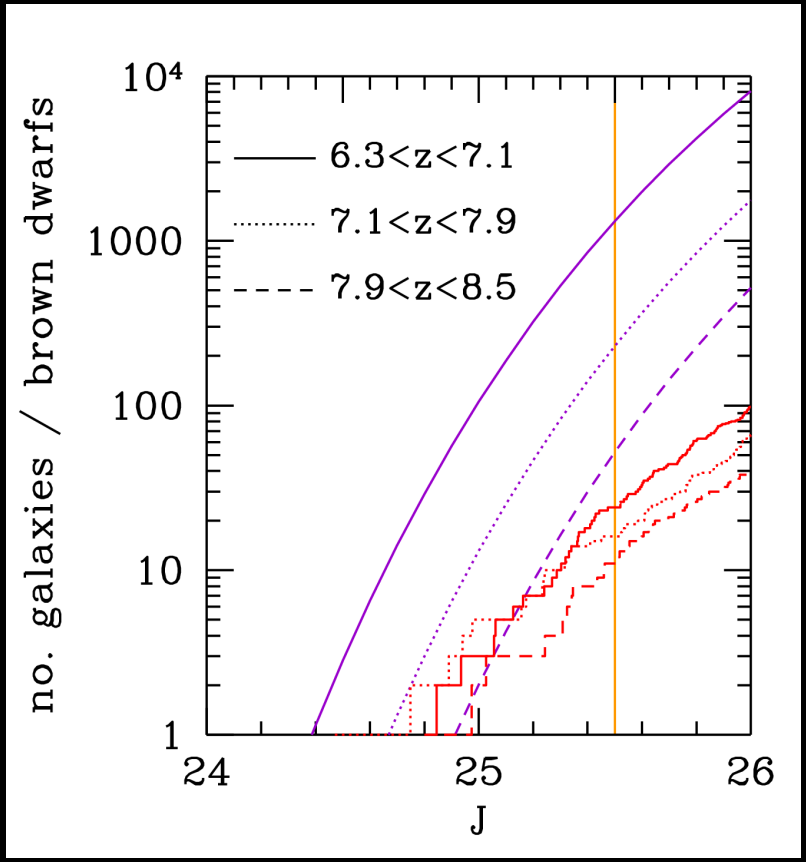
McLure et al. 2009 bright end of the high-redshift galaxy LF, from the UDS K=22.7 over 0.8 deg^2



McLure et al. 2010, Castellano et al 2010, z=7 luminosity function

Euclid deep survey 40deg^2 J_{AB}=26





Euclid will detect 100s of bright J<25.5 z>7 galaxies, with small contamination, compared to a handful known today

High-redshift galaxies with Euclid deep

- The Euclid z>7 galaxies will be “easy” JWST spectroscopic targets

- Bright galaxies J<25.5 allow spectroscopy for LAE/ LBG clustering studies (McQuinn et al 2007)
- Cross-correlation with 21cm – topology of reionisation, bright galaxies are tracers (Lidz et al 2009)
- Stellar population studies: UV slope, HeII 1640 (metallicity, IMF)
- Bright end of LF provides strongest constraints on galaxy formation models

Conclusions

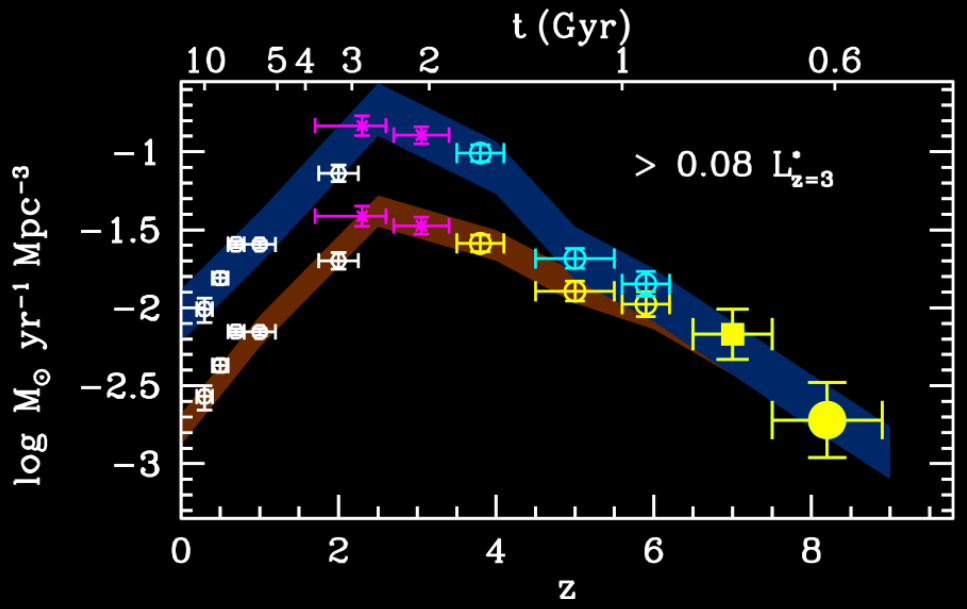
- Euclid will be a very powerful mission for the study of the "bright" high-redshift Universe

- Excellent synergy with other space missions (e.g. JWST) which will cover a different parameter space

- Missing matching facility : X-ray

High-redshift galaxies with Euclid deep: cosmic reionisation

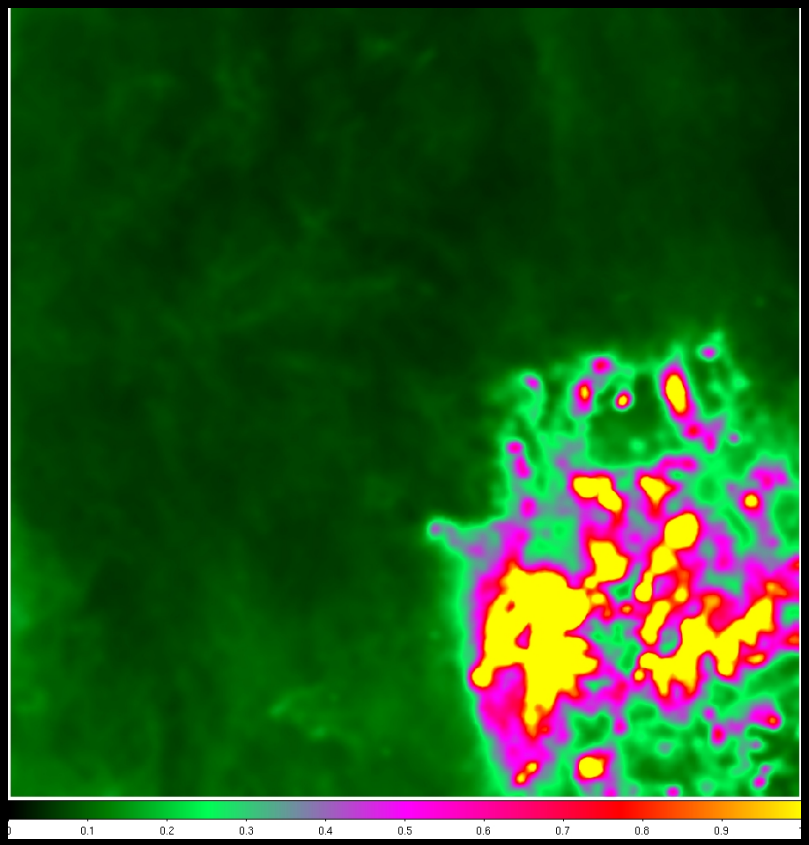
- SFR of detected galaxies at z=8 insufficient to keep universe ionised (Bouwens et al 2010)
- Ways out
  - Steep faint end LF slope
  - Escape fraction
  - IMF
  - Reionisation was later



Deep fields locations

SEP 10x10deg^2

40deg^2 with E(B-V)<0.06 <5^o from SEP



NEP 10x10deg^2

40deg^2 with E(B-V)<0.03 <5^o from NEP