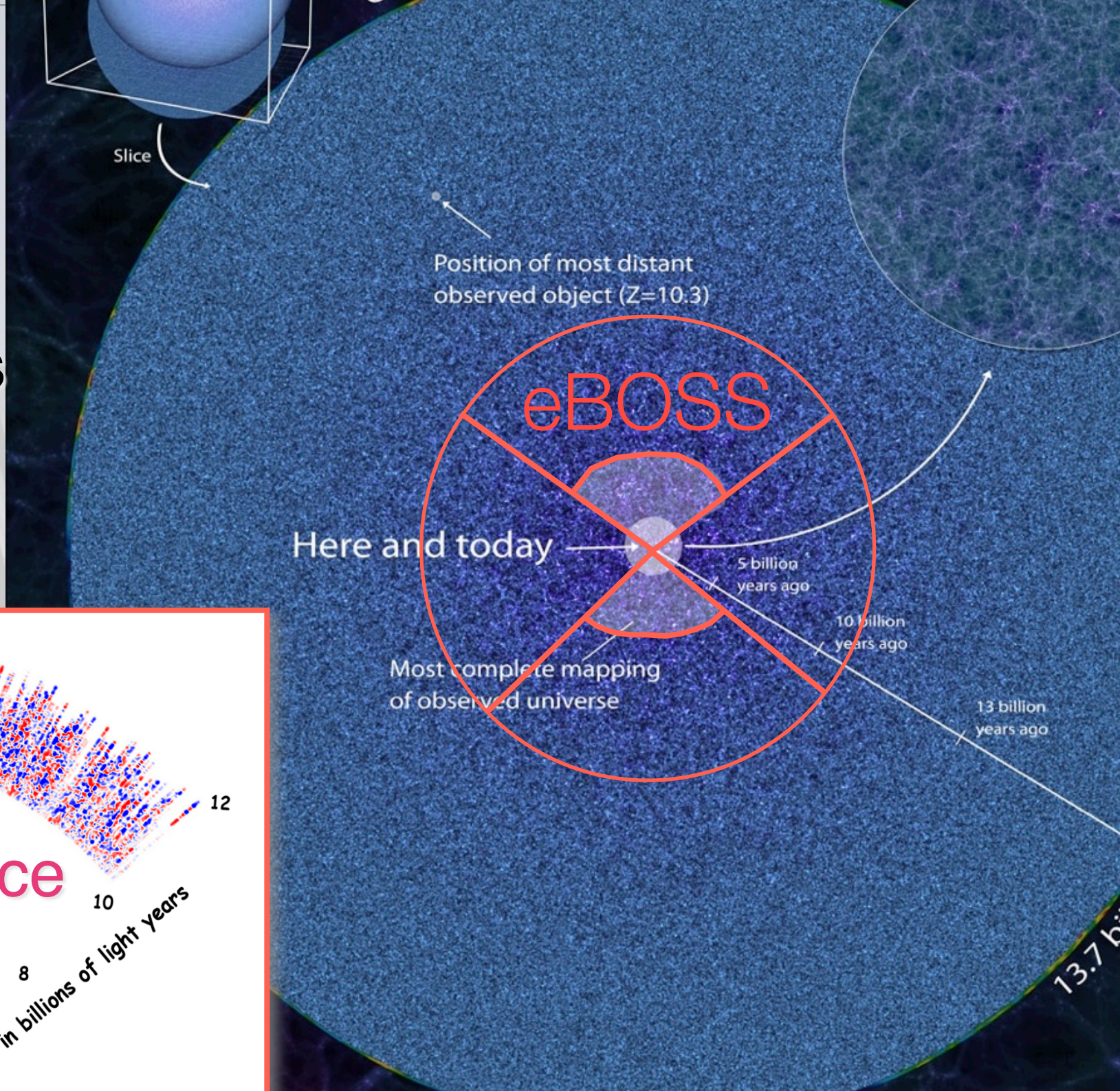
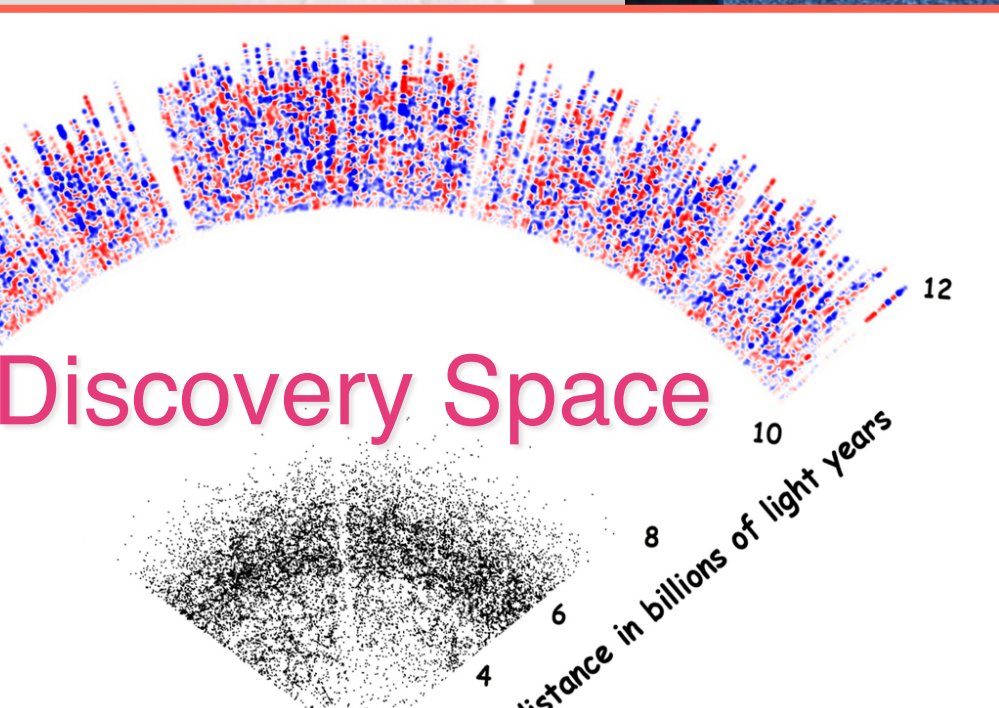


The Extended Baryon Oscillation Spectroscopic Survey

Kyle Dawson
University of Utah



Measuring the Expansion History of the Universe between 7 and 11 billions of light years in Galaxies & Quasars



the new cosmology project within SDSS-IV
use the BOSS spectrograph to observe new redshift interval
basic parameters

$$\Omega = 1,500\text{deg}^2 - 7,500\text{deg}^2$$

~ 650,000 galaxies ($0.6 < z < 1$)

~ 550,000 quasars ($0.9 < z < 2.3$)

~ 100,000 quasars ($z > 2.15$ Ly- α forest)

distance measurements

0.9% at $z=0.8$ (LRGs)

1.8% at $z=0.8$ (ELGs)

2.0% at $z=1.5$ (QSOs)

1.1% at $z=2.5$ (Ly- α forest, inc. BOSS)

survey will start 2014, lasting 6 years

received \$10M from Sloan foundation

and significant funding from partners



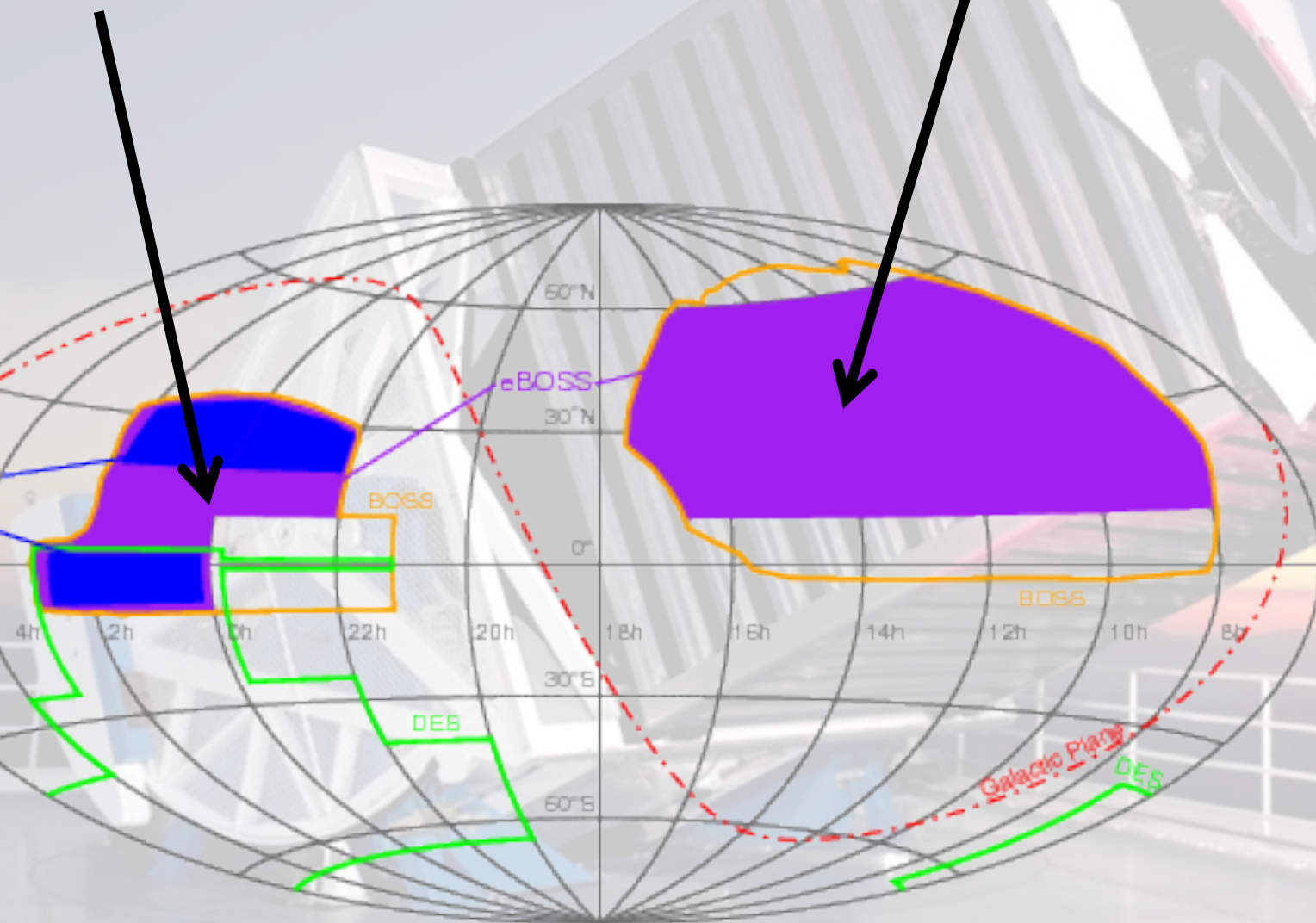
LRGs – WISE+SDSS selected aiming for $z \sim 0.7$ galaxies

ELGs – SCUSS (u-band)+SDSS, South only (+DES over some area)

QSOs – WISE+SDSS selected

Galaxies	Redshifts	Target sky density	Total area	Target success	Number of good redshifts	Distance precision	Effective volume
LRG	$0.6 < z < 0.9$	60deg^{-2}	7500deg^2	95%	430k	0.9%	4.7 Gpc ³
ELG	$0.6 < z < 1.0$	180deg^{-2}	1500deg^2	80%	216k	1.8%	2.3 Gpc ³
QSO	$0.9 < z < 2.3$ all	105deg^{-2}	7500deg^2	70% 90%	550k 700k	2%	6.6 Gpc ³
Ly α QSO	$z > 2.15$	$8+22 \text{deg}^{-2}$	5000deg^2	30%	100k (including revisits)	1.1%	-

-LRG: 2500 sq degrees-----5000 sq degrees
1500 sq degrees



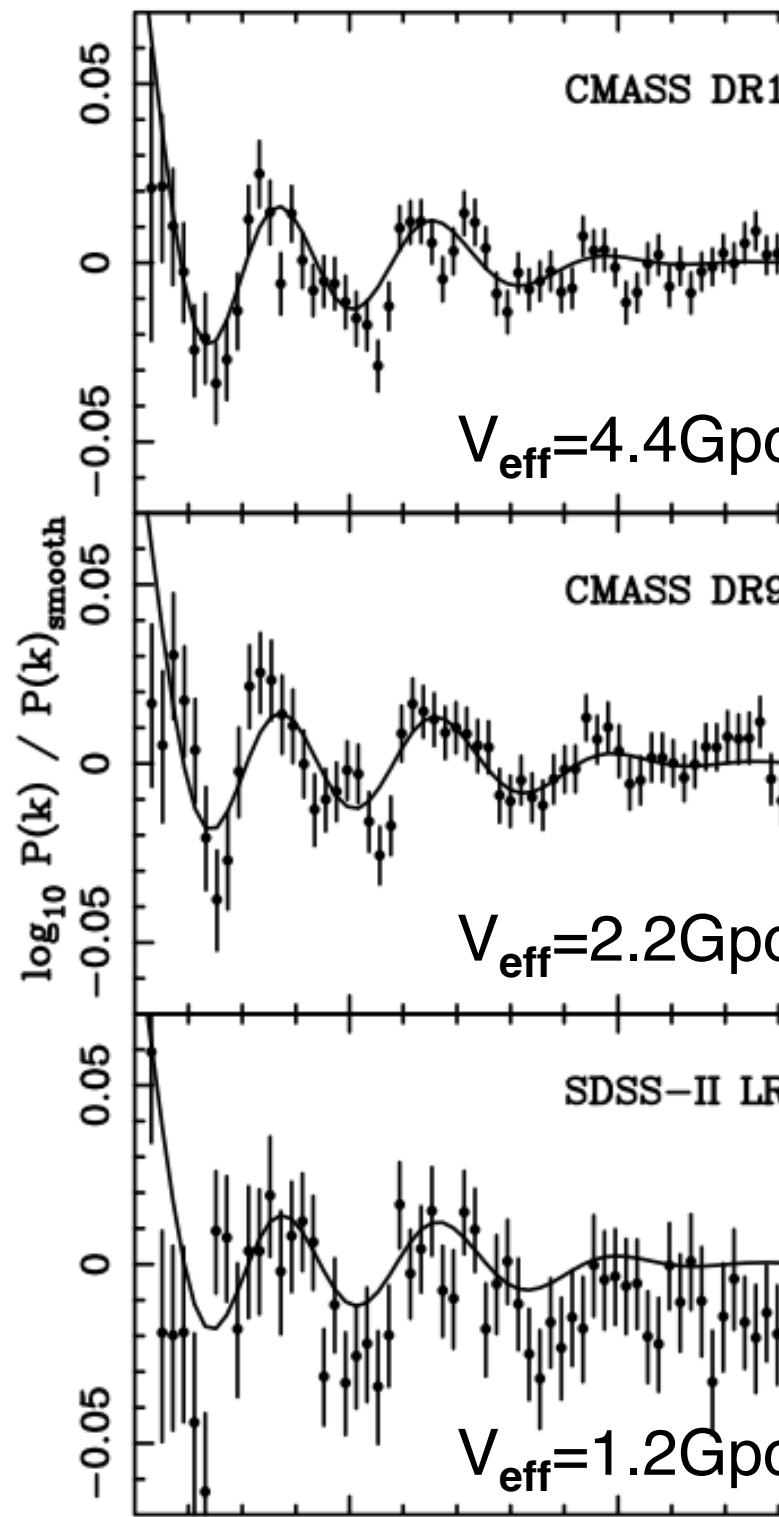
Footprint depends on

- SDSS-IV timeshare between projects
- DES coverage (500deg² overlap)
- SCUSS u-band survey on SGC (using Bo... Kitt-Peak)

Start date: August 20...
but could be earlier!

Duration: 6 years

Galaxies	Effective volume
LRG	4.7 Gpc ³
ELG	2.3 Gpc ³
QSO	6.6 Gpc ³
Lya QSO	-



$\eta(z)$ (Gpc)

- SNIa: UNION2.1 (2012, 580 SNe)
- ◆ BAO : SDSS-LRG (2010)
- △ BAO : WiggleZ (2011)
- BAO : BOSS (2014)

6

4

2

0.5

1

1.5

2

2.5

3

3

Redshift z

QSO

LRG

ELG

Ly α F

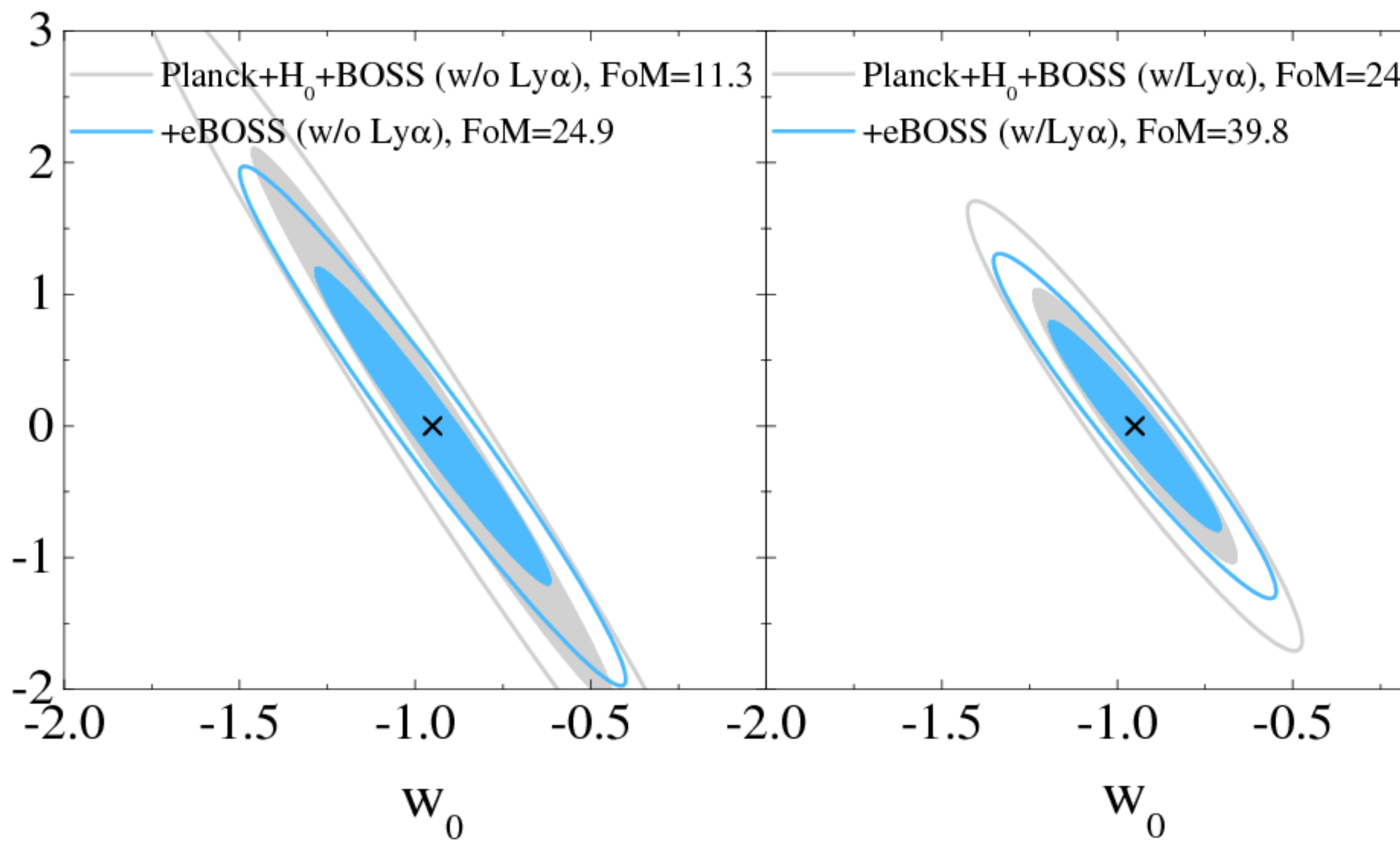
- BAO : eBOSS (2014–2020)
- BAO : HETDEX (2014–2016)
- ◇ BAO : MS-DESI (2018–2022)

σ_{η}/η

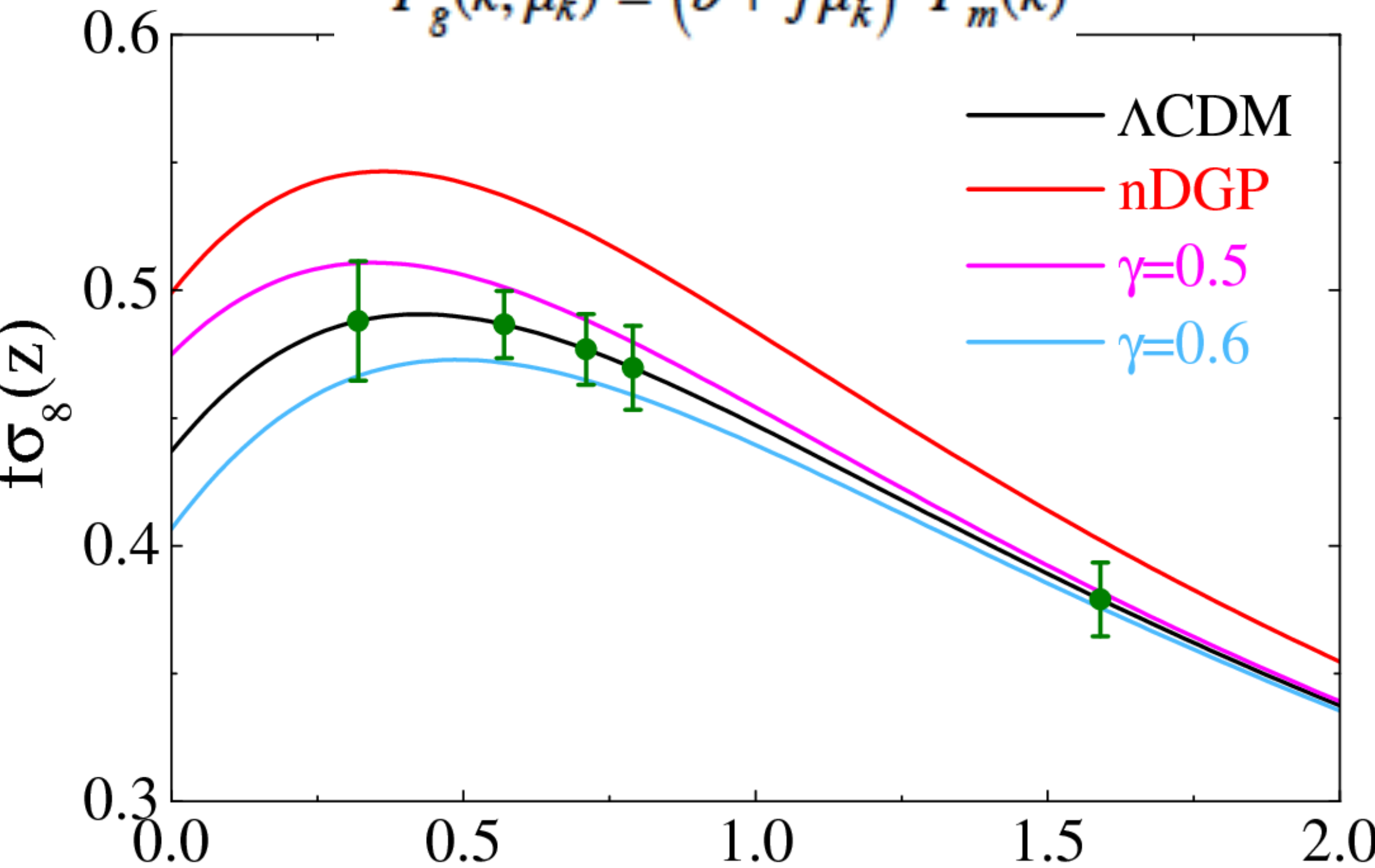
0.1

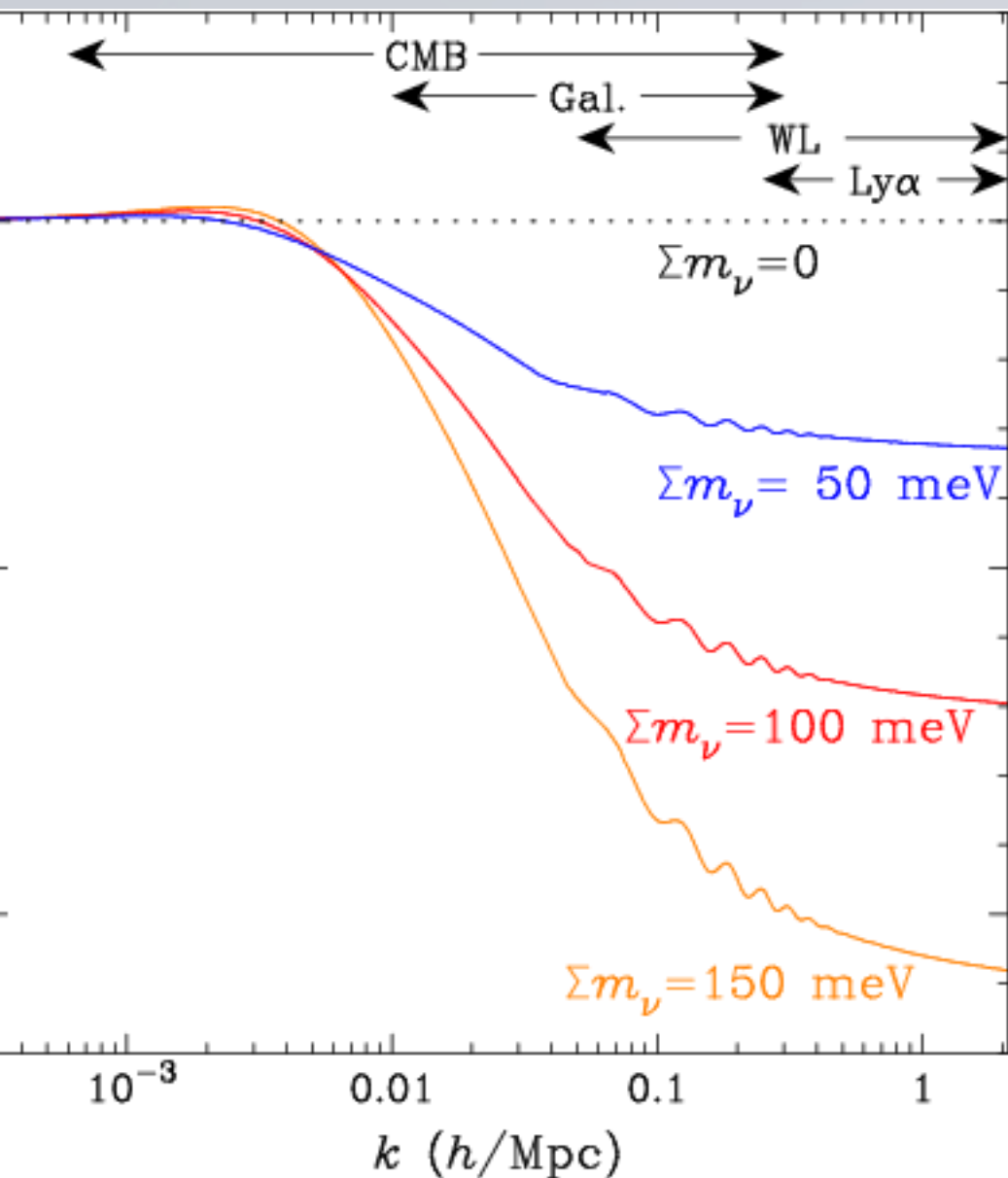
0.05

0.02



$$P_g^s(k, \mu_k) = (b + f\mu_k^2)^2 P_m(k)$$





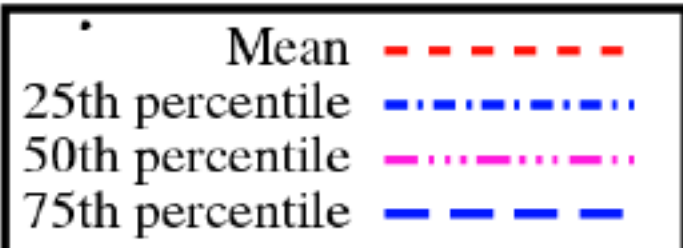
- Planck + eBOSS clustering:
 $\sigma(m_\nu)=52$ & $\sigma(N_{\text{eff}})=0.16$ (conservative)
 $\sigma(m_\nu)=36$ & $\sigma(N_{\text{eff}})=0.13$ (goal)
- Planck + eBOSS clustering:
 $\sigma(f_{\text{nl}})^{\text{local}}=0.12$ (power spectrum only)
- Potential for improvement with
 bispectrum measurements
 $\sigma(f_{\text{nl}})^{\text{local}}=0.12$ (power spectrum only)

suppression of power in matter power spectrum due to summed neutrino mass.
 scales $k < 0.1$ h/Mpc considered conservative.

Equal Area pixels

Surface density per square degrees

$Z < 20.0$



400

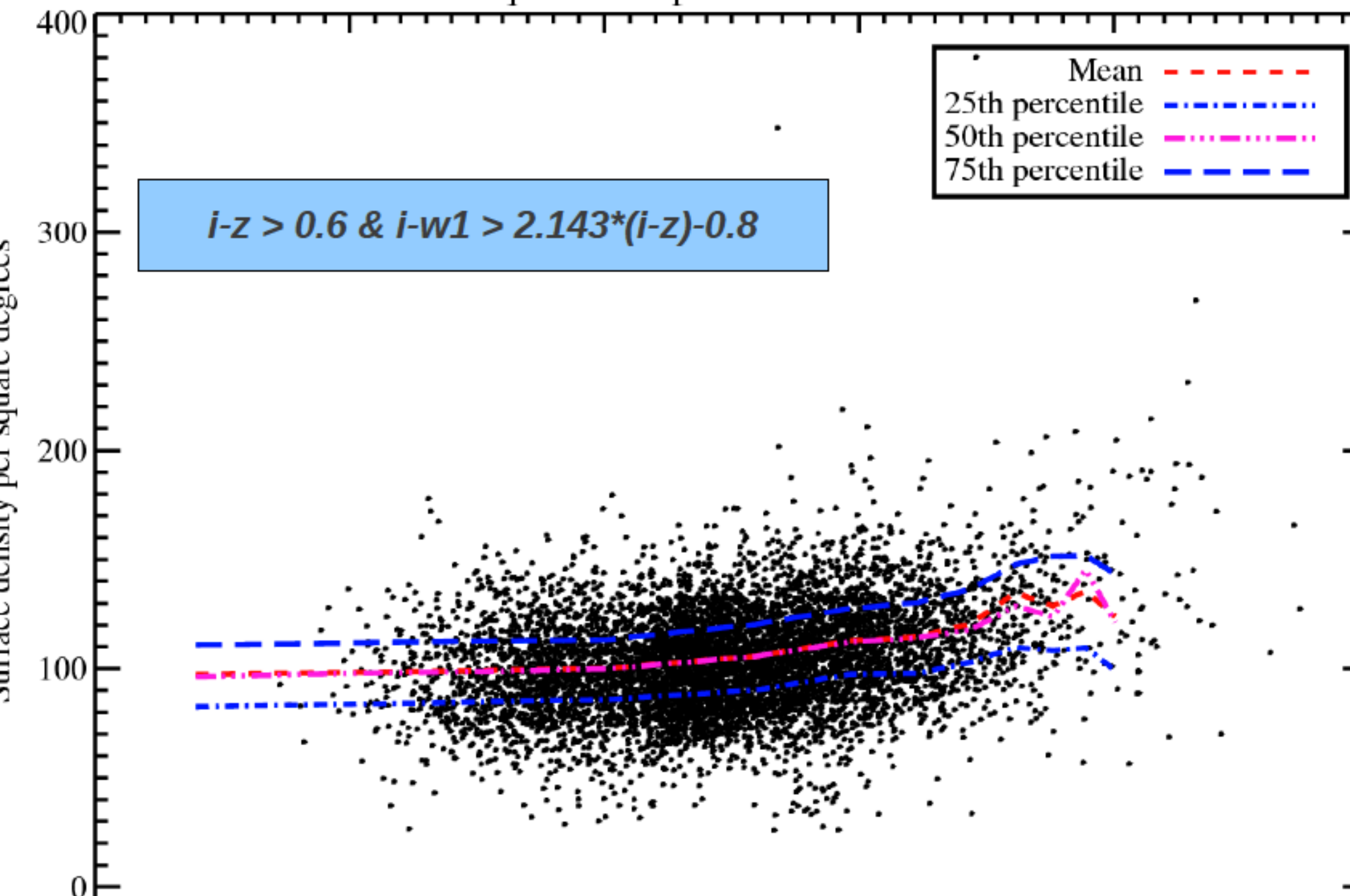
300

200

100

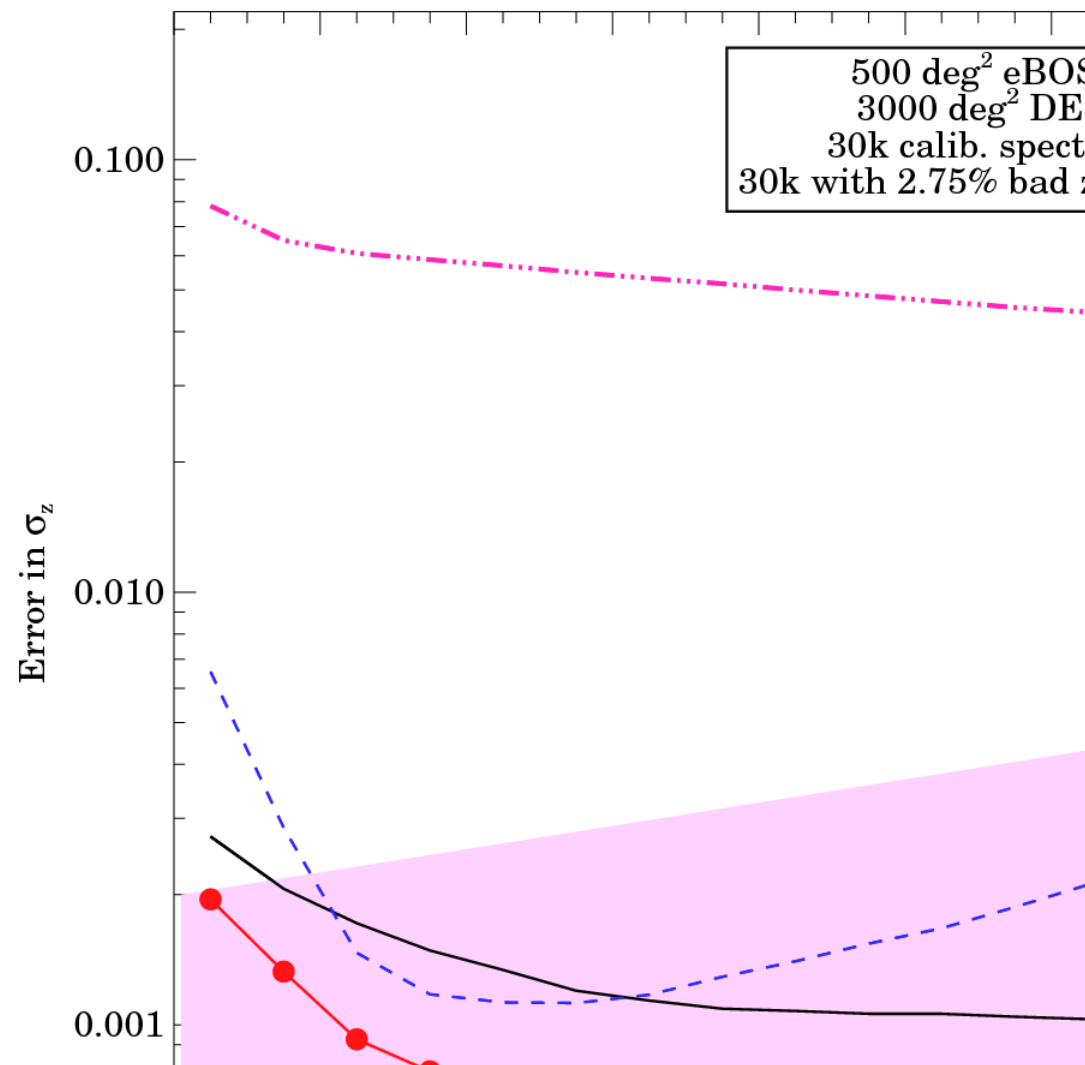
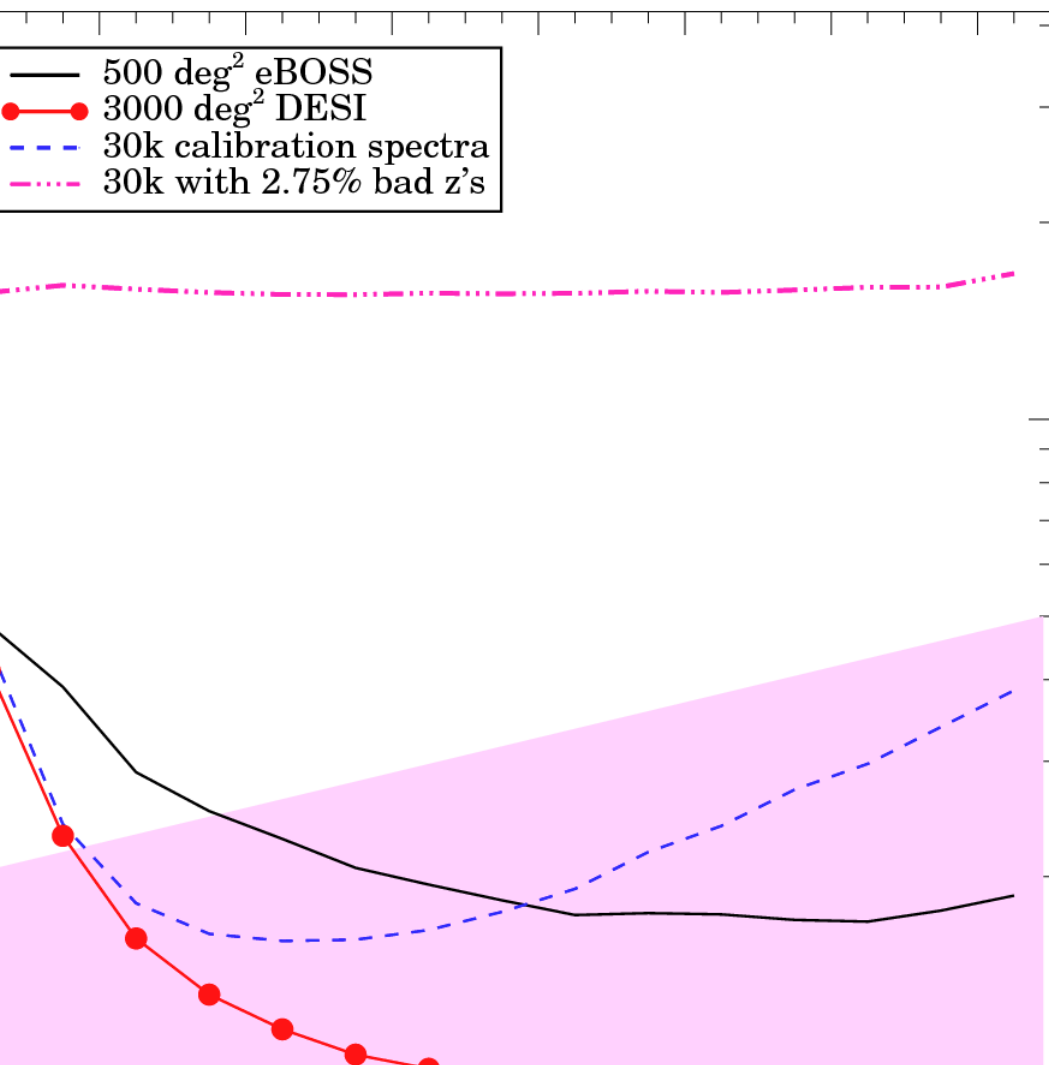
0

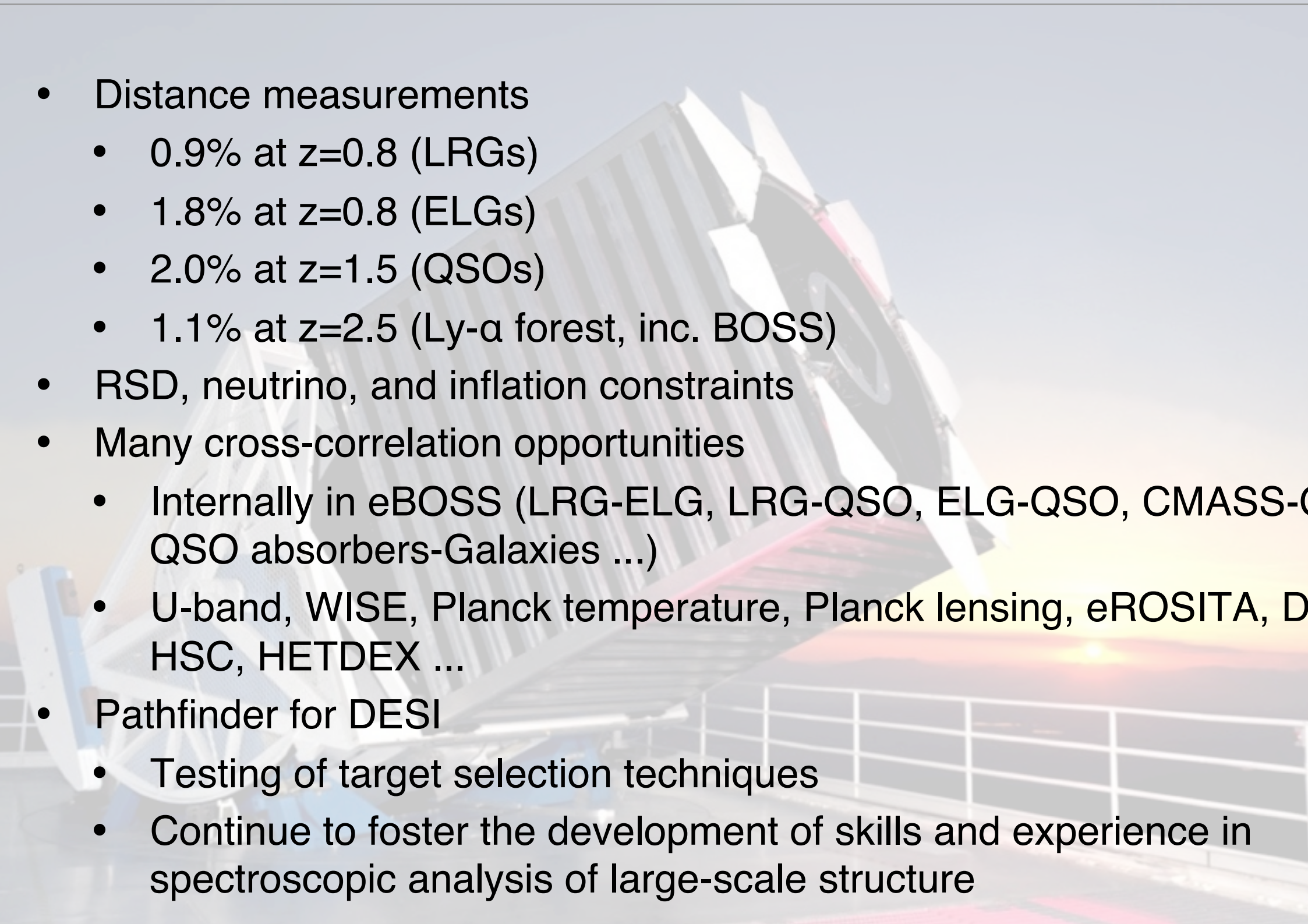
Equal Area pixels– iz color cut



DES – eBOSS overlap

- $\sim 500 \text{ deg}^2$ overlap with eBOSS in Southern sky
- eBOSS will play a critical role allowing high-precision calibration of photo-z through cross-correlation



- 
- Distance measurements
 - 0.9% at $z=0.8$ (LRGs)
 - 1.8% at $z=0.8$ (ELGs)
 - 2.0% at $z=1.5$ (QSOs)
 - 1.1% at $z=2.5$ (Ly- α forest, inc. BOSS)
 - RSD, neutrino, and inflation constraints
 - Many cross-correlation opportunities
 - Internally in eBOSS (LRG-ELG, LRG-QSO, ELG-QSO, CMASS-QSO absorbers-Galaxies ...)
 - U-band, WISE, Planck temperature, Planck lensing, eROSITA, DES, HSC, HETDEX ...
 - Pathfinder for DESI
 - Testing of target selection techniques
 - Continue to foster the development of skills and experience in spectroscopic analysis of large-scale structure