Full-sky / X-ray – optical / Future

An eROSITA mock catalog of Active Galactic Nuclei and their large-scale structure

The low redshift survey at calar alto

March 2019, Astro-plate-III Bamberg

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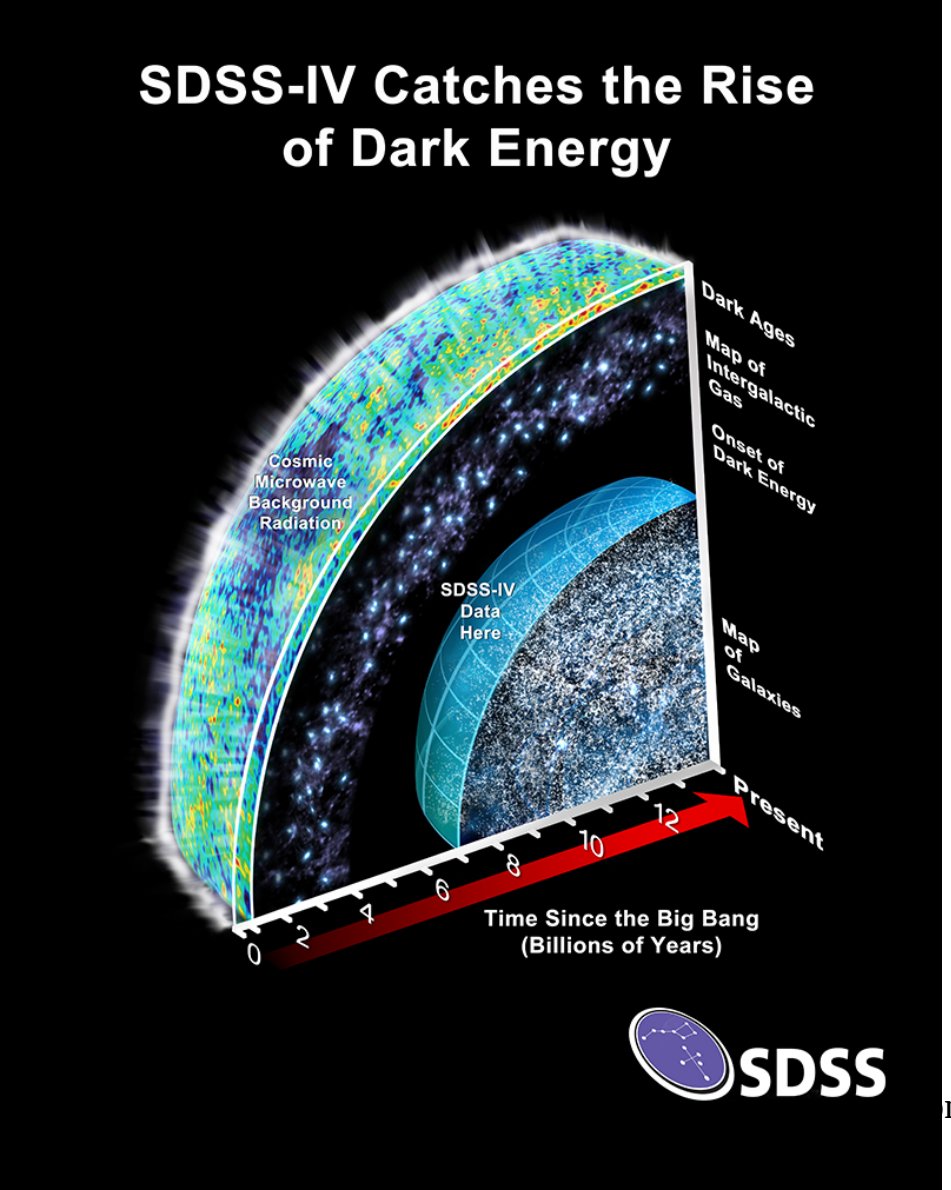
MAX-PLANCK-GESELLSCHAFT

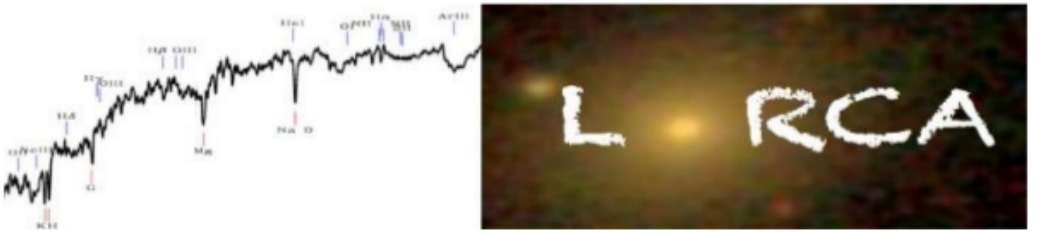


Cosmological puzzles

- Dark matter
- Dark energy

Galaxy evolution puzzles

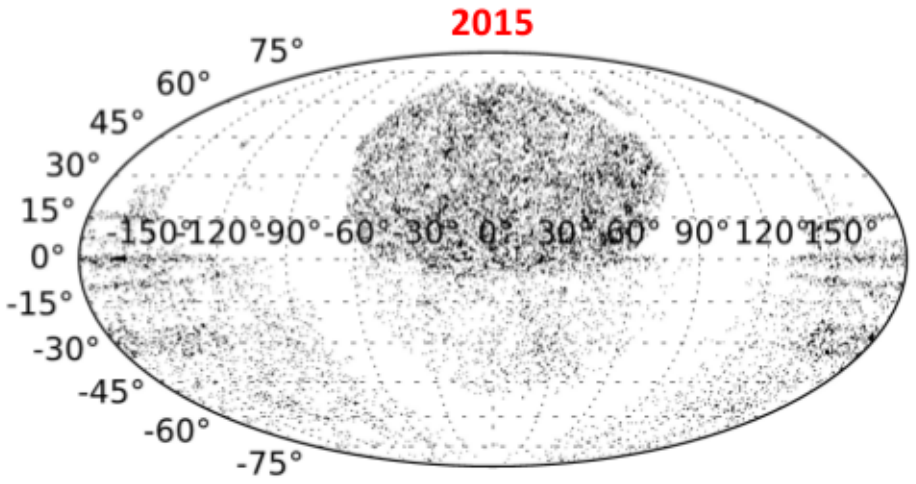
- role of AGN
- formation of clusters

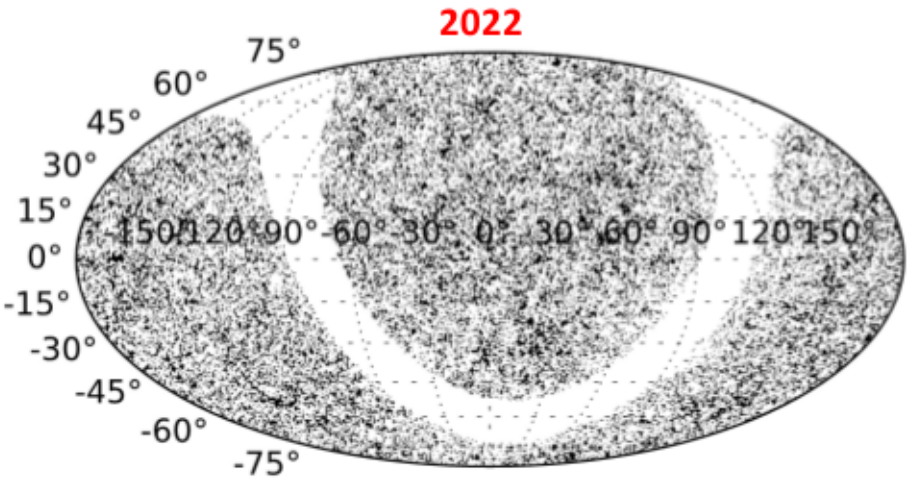


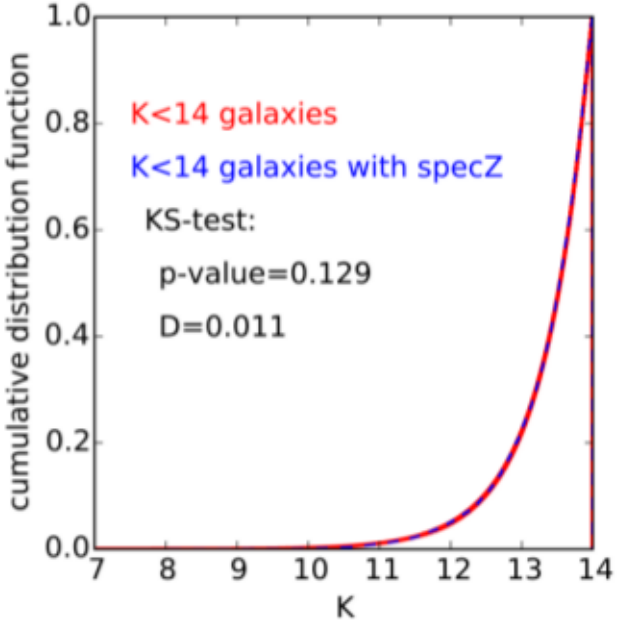
Low Redshift survey at Calar Alto (LoRCA)

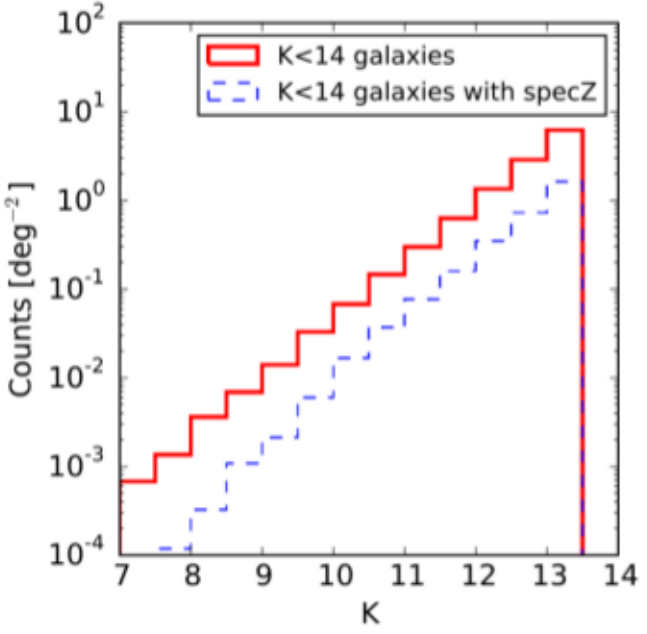
Mapping completely the low redshift Universe.

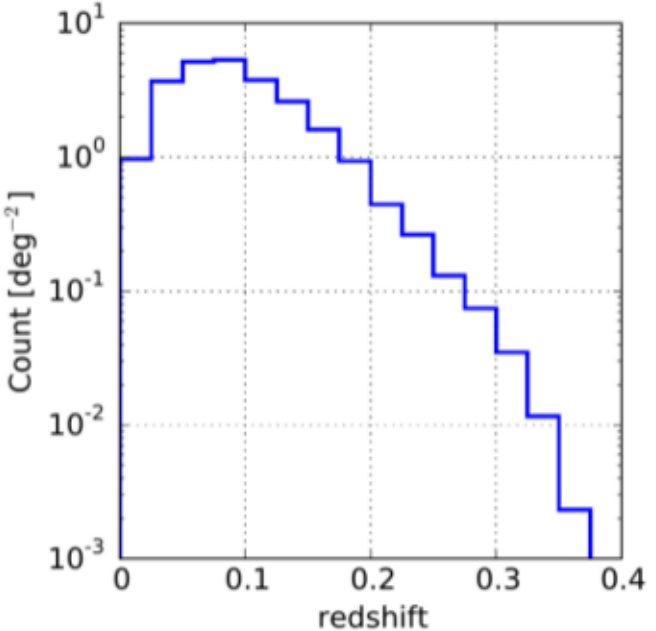
Comparat et al. 2015 MNRAS. arXiv 1510.00147


2015
75°
60°
45°
30°
15°
0°
-15°
-30°
-45°
-60°
-75°
-150°-120°-90°-60°-30° 0° 30° 60° 90°120°150°


2022
75°
60°
45°
30°
15°
0°
-15°
-30°
-45°
-60°
-75°
-150°-120°-90°-60°-30° 0° 30° 60° 90°120°150°


cumulative distribution function
K<14 galaxies
K<14 galaxies with specZ
KS-test:
p-value=0.129
D=0.011
K


Counts [deg^{-2}]
K<14 galaxies
K<14 galaxies with specZ
K

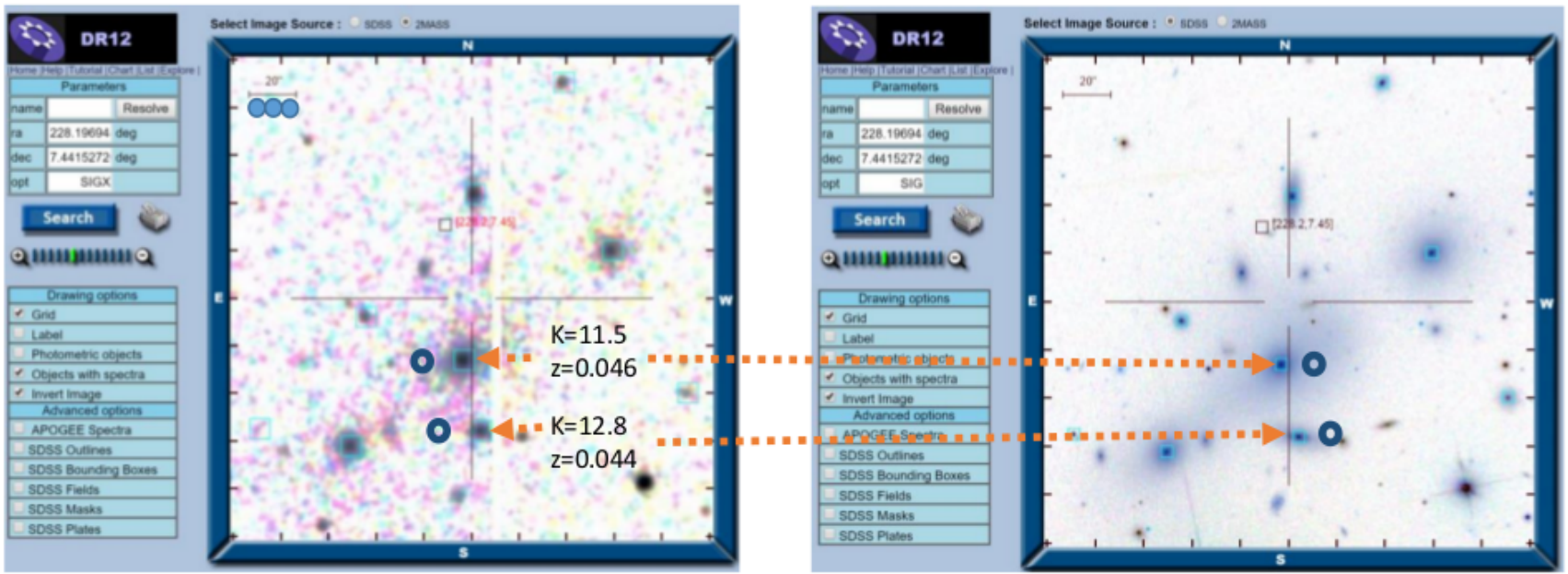

Count [deg^{-2}]
redshift

Photometry and targets

? Use digitized archival astro-plates to enhance/improve target selection ?

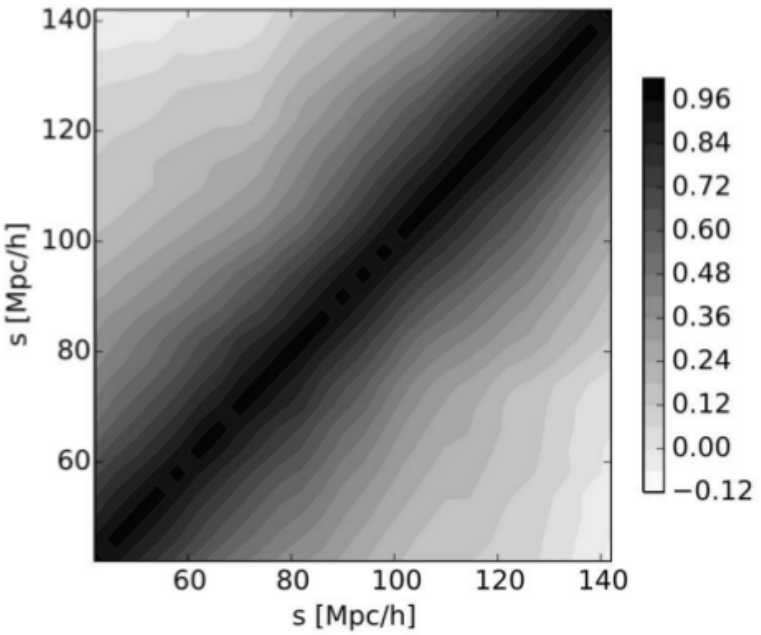
2MASS

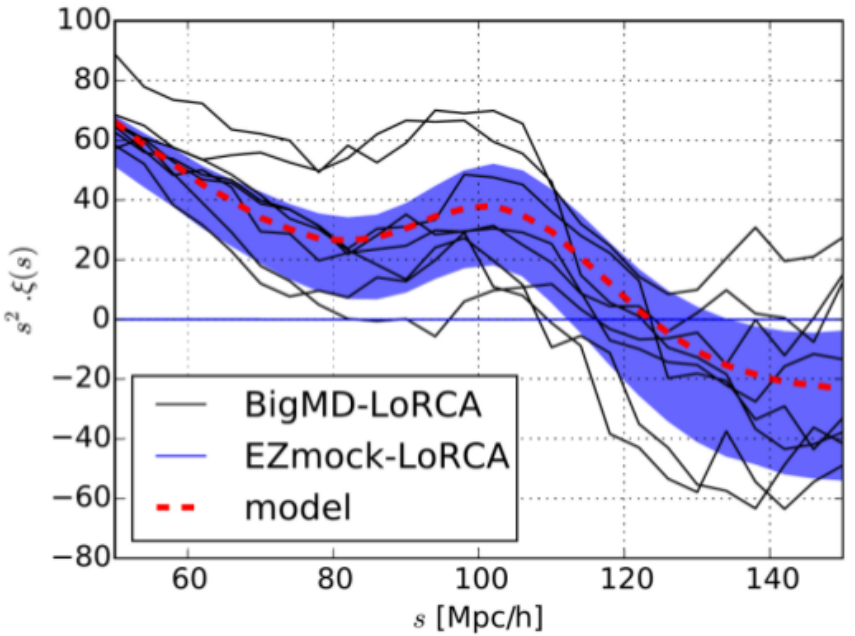
SDSS



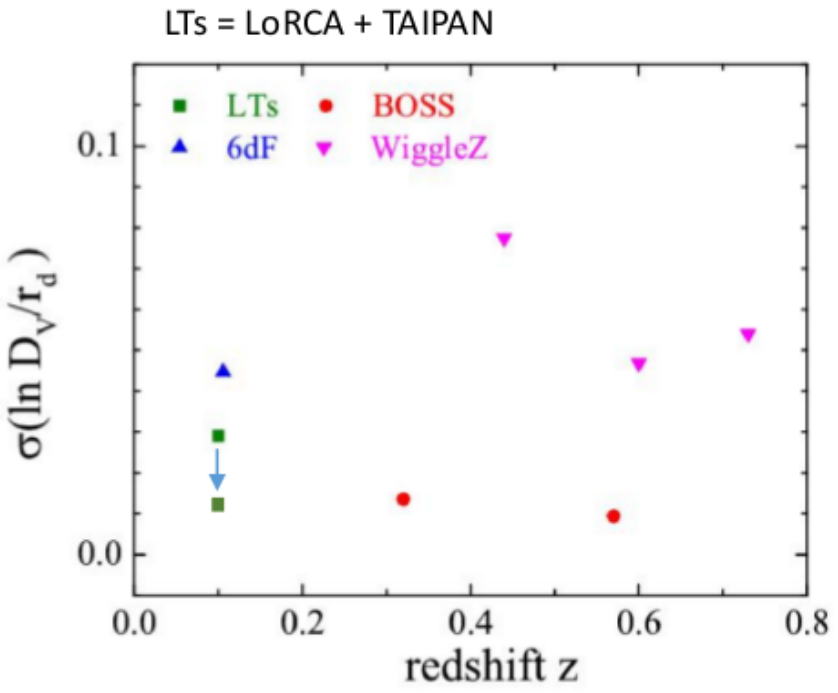
BAO prediction

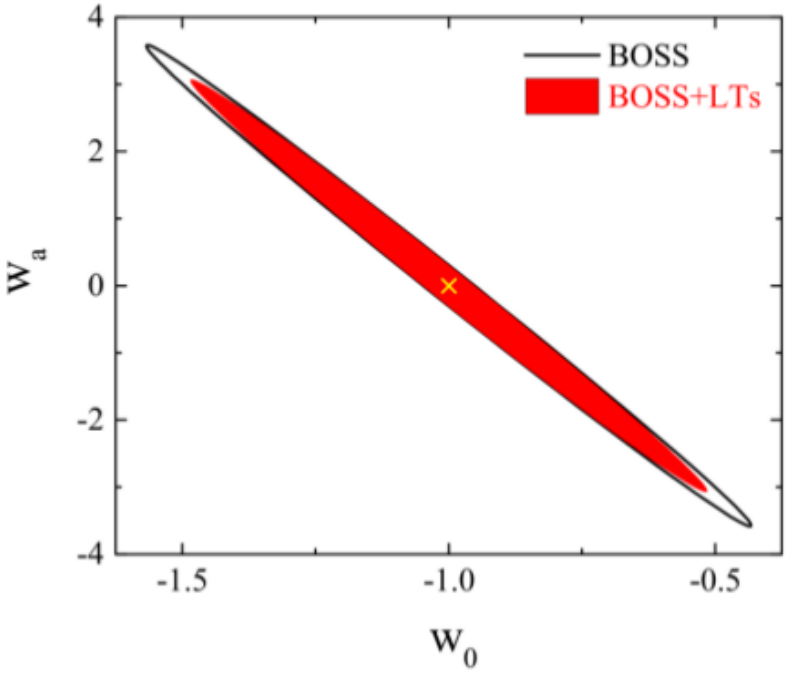
We generated 1,024 EZmocks light cones to compute the 2-pt function covariance matrix





Predicted measurement

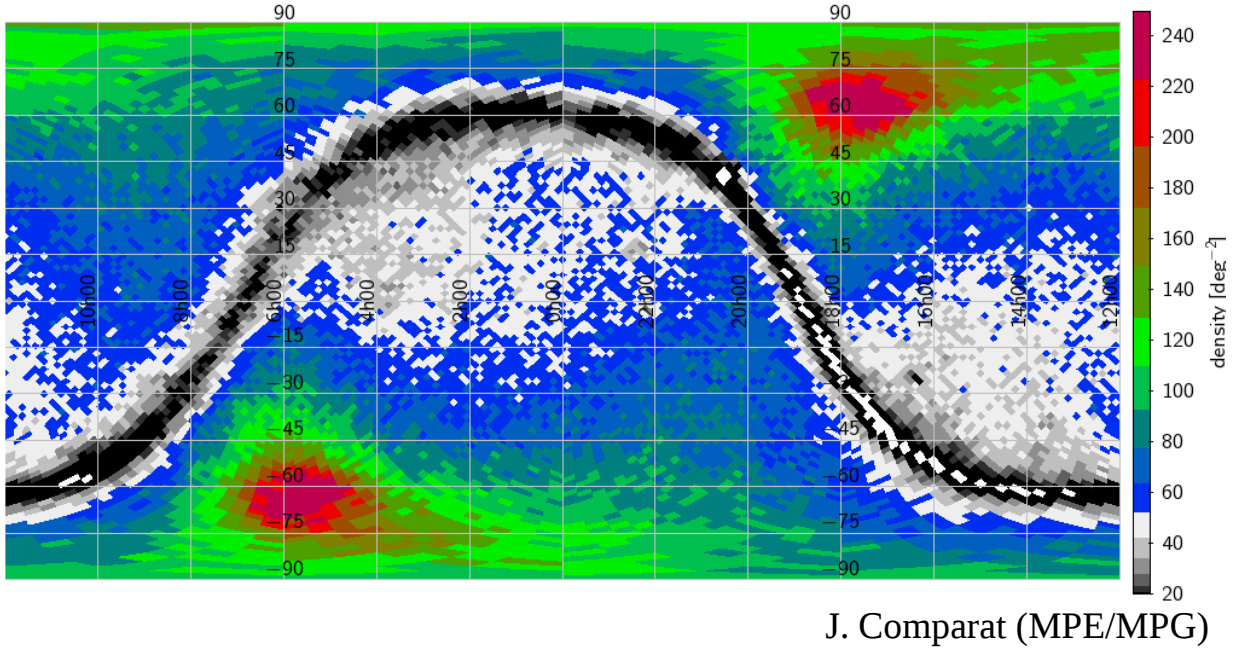


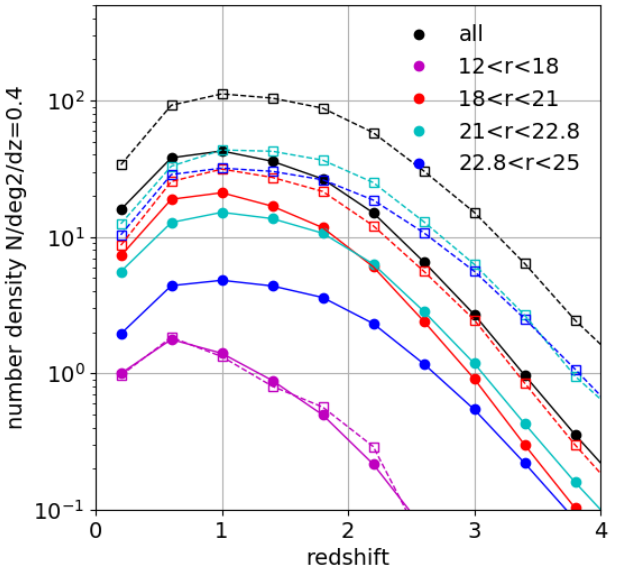


An eROSITA mock catalog of Active Galactic Nuclei and their large-scale structure

Submitted to MNRAS. ArXiv: 1901.10866

J. Comparat,[1⋆] A. Merloni[1], M. Salvato[1], K. Nandra[1], T. Boller[1], A. Georgakakis[2], A. Finoguenov[3], T. Dwelly[1], J. Buchner[4,5,6], A. Del Moro[1], N. Clerc[7], Y. Wang[8], G. Zhao[8,9,10], F. Prada[11], G. Yepes[12], M. Brusa[13,14], M. Krumpe[15]





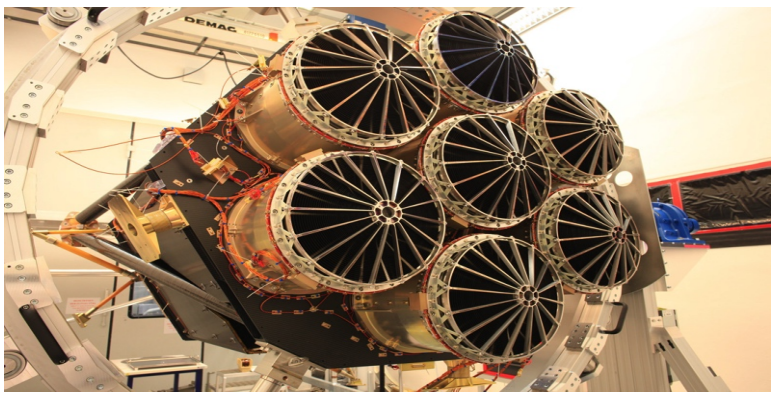
J. Comparat (MPE/MPG)

A full-sky multi-wavelength mock catalog

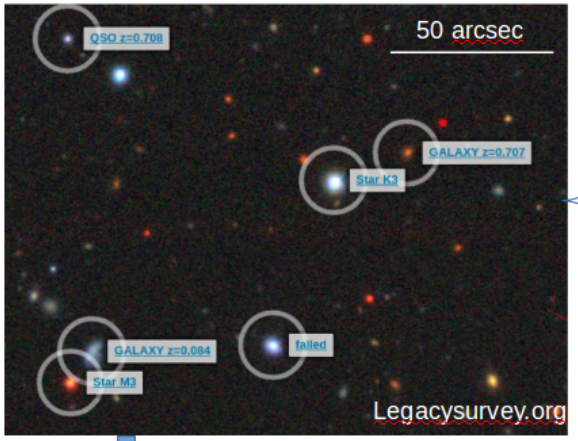
EROSITA in a nutshell

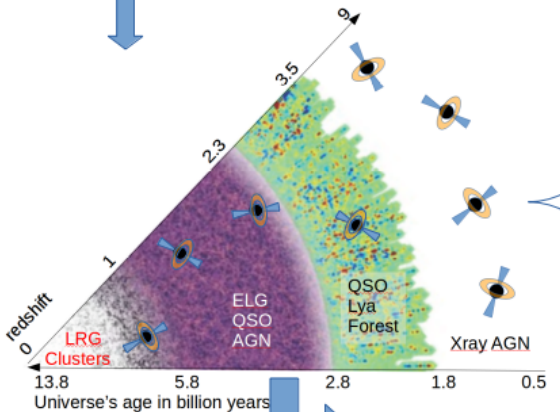
- **eROSITA: Next Generation all-sky X-ray survey**
  - 0.5-2 keV: 30× deeper than ROSAT
  - 2-10 keV: 100× deeper than HEAO-1; 10× XMM Slew
- Image quality comparable to XMM-Newton, better spectral resolution
- detect 100,000 clusters (LSS, cosmology)
- 3Million AGN, including obscured objects
- Built by consortium led by MPE

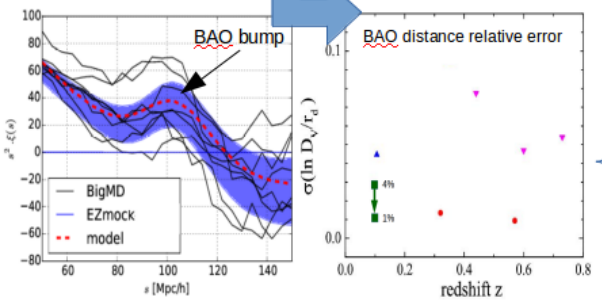
Slide from A. Merloni



End to end simulations for cosmology







2D

3D

Cosmology

Data flow | Simulation flow | E2E model

Photometry | Virtual skies | Galaxies in halos + Photo simulator

Target selection

Spectroscopy | Simulated spectroscopy | High fidelity spectral Energy distribution

Redshift measurement | Spec simulator

3D map | Mock light cones | Full sky light cones

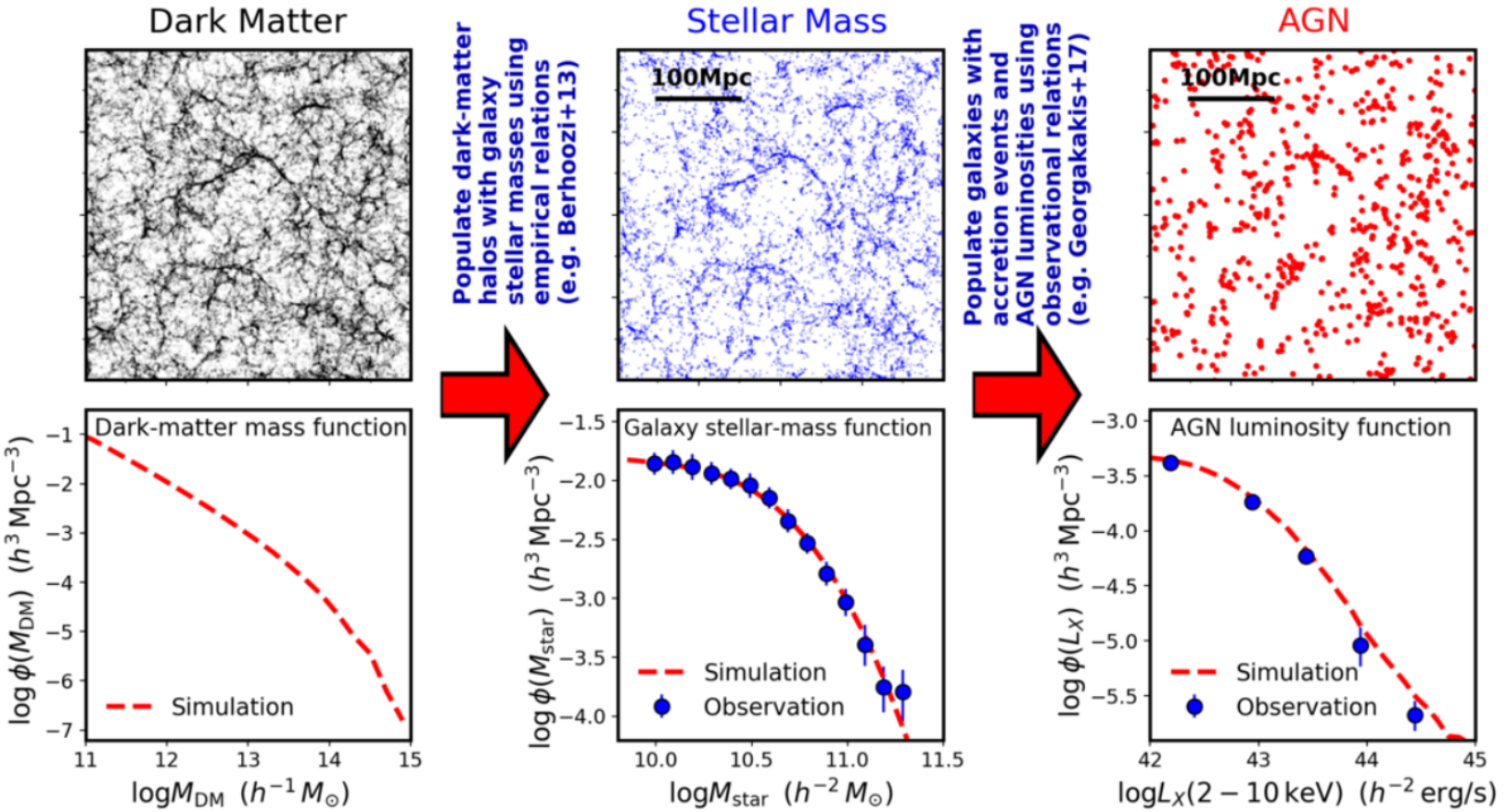
Fourier transform

BAO measurement | Error | Cosmology pipeline

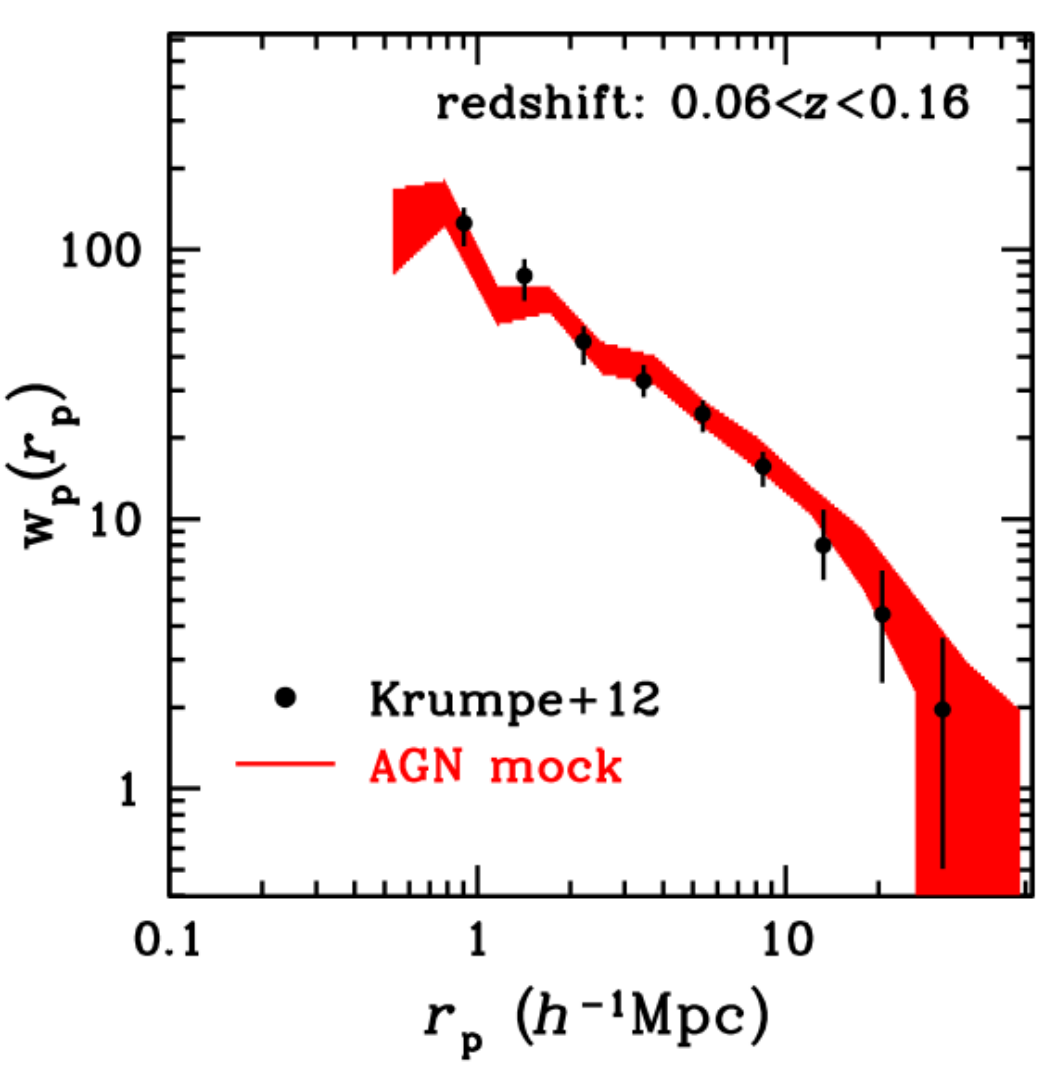
Exploring the halo occupation of AGN using dark-matter cosmological simulations

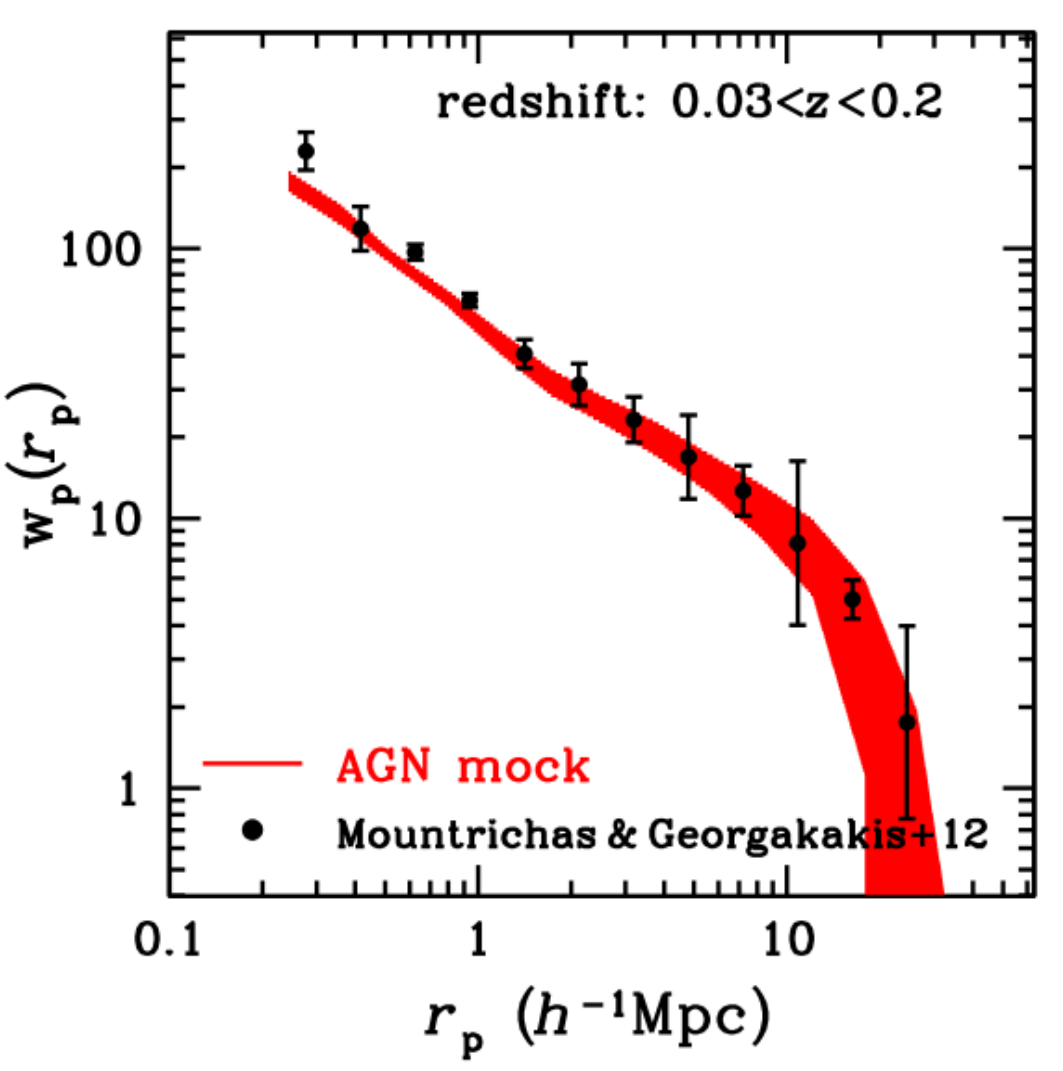
MNRAS 2018. ArXiv: 1812.04025

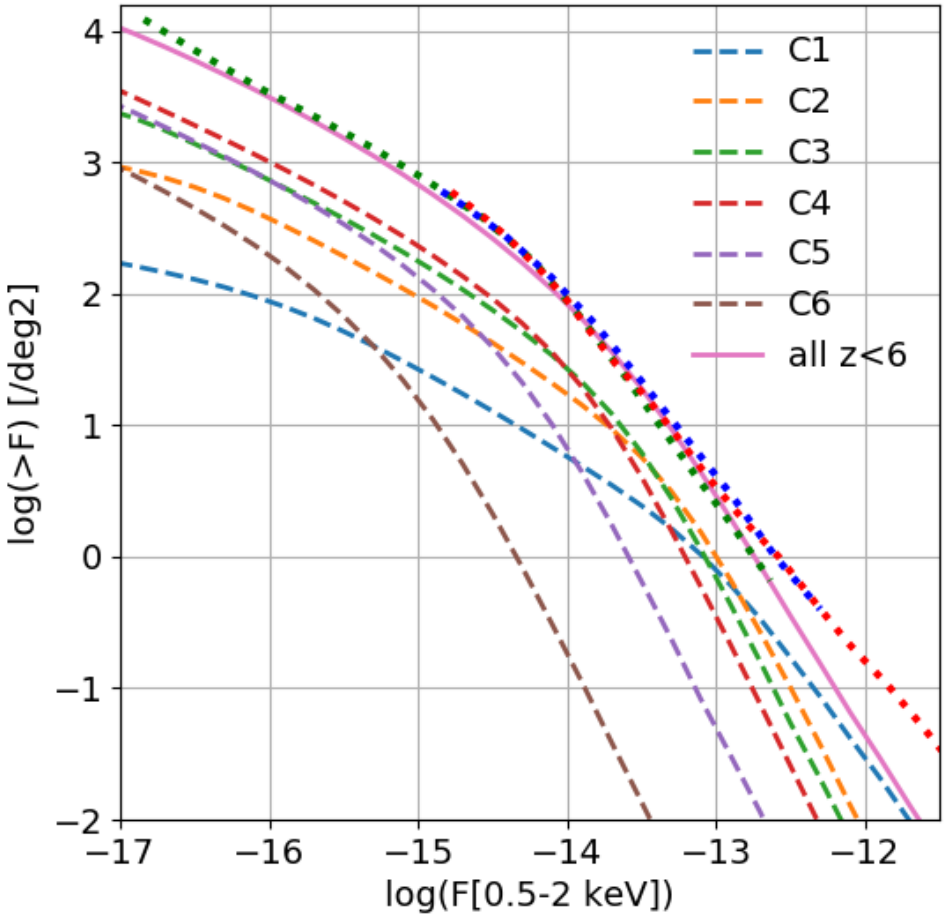
A. Georgakakis,[1⋆], J. Comparat[2], A. Merloni[2], L. Ciesla[3], J. Aird[4], A. Finoguenov[2,5]

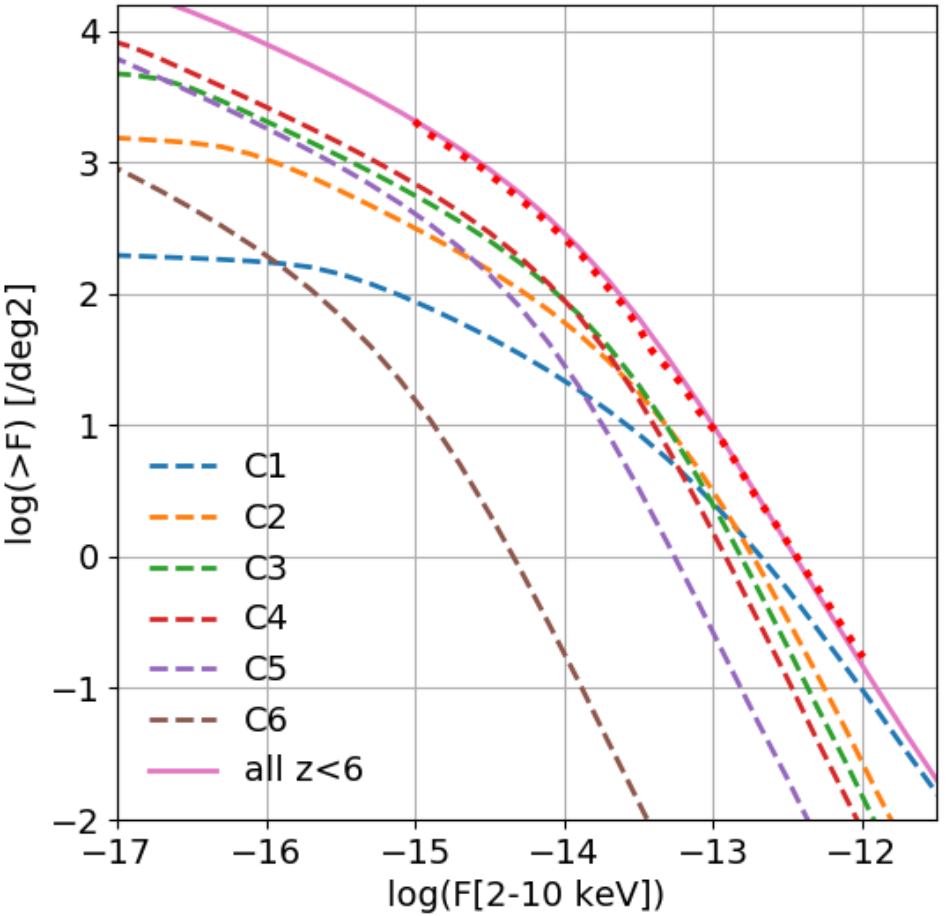


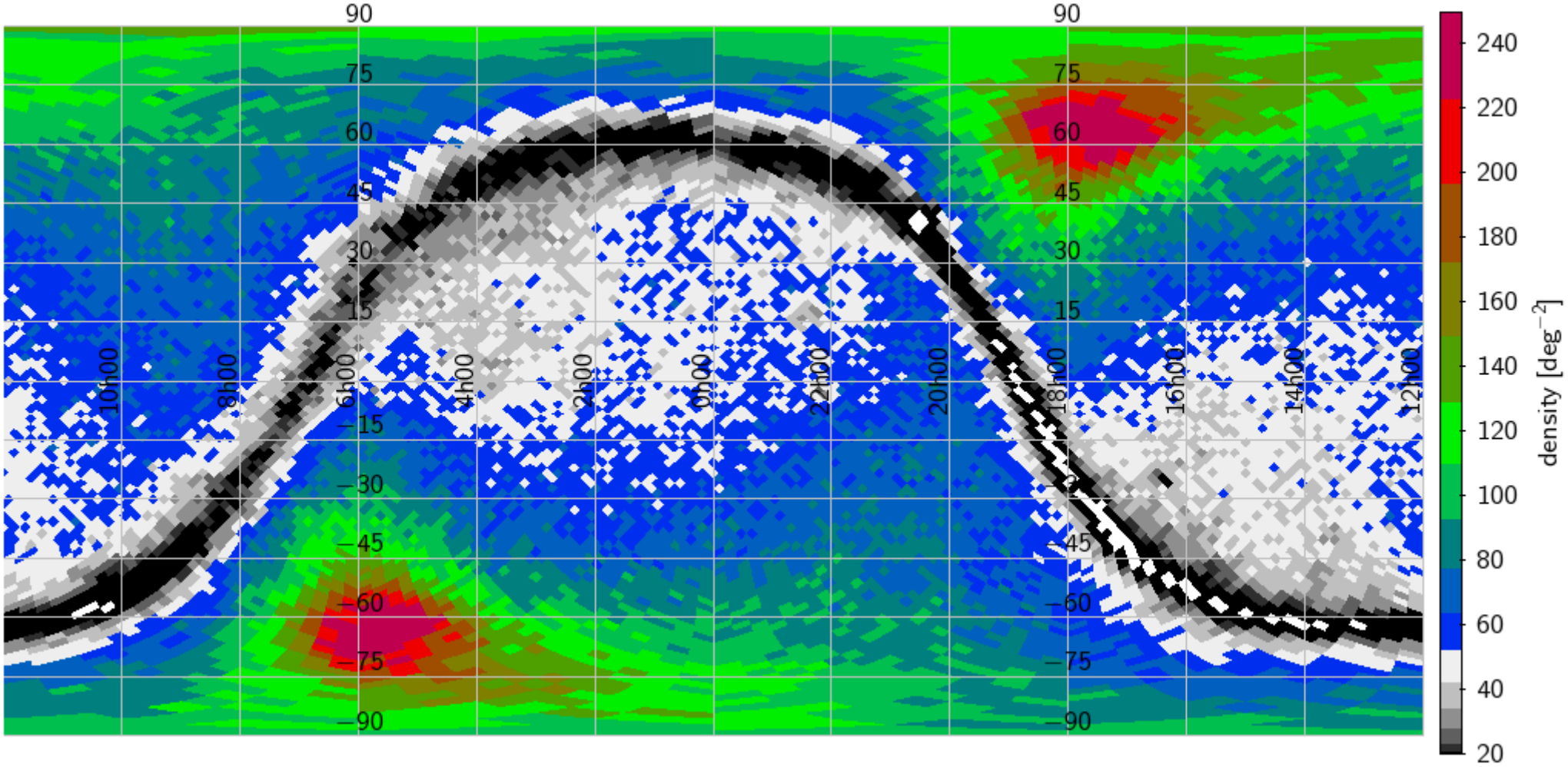
A proof-of-concept mock catalog


redshift: 0.06<z<0.16
100
10
1
$w_p(r_p)$
Krumpe+12
AGN mock
0.1
1
10
r_p (h^{-1}Mpc)

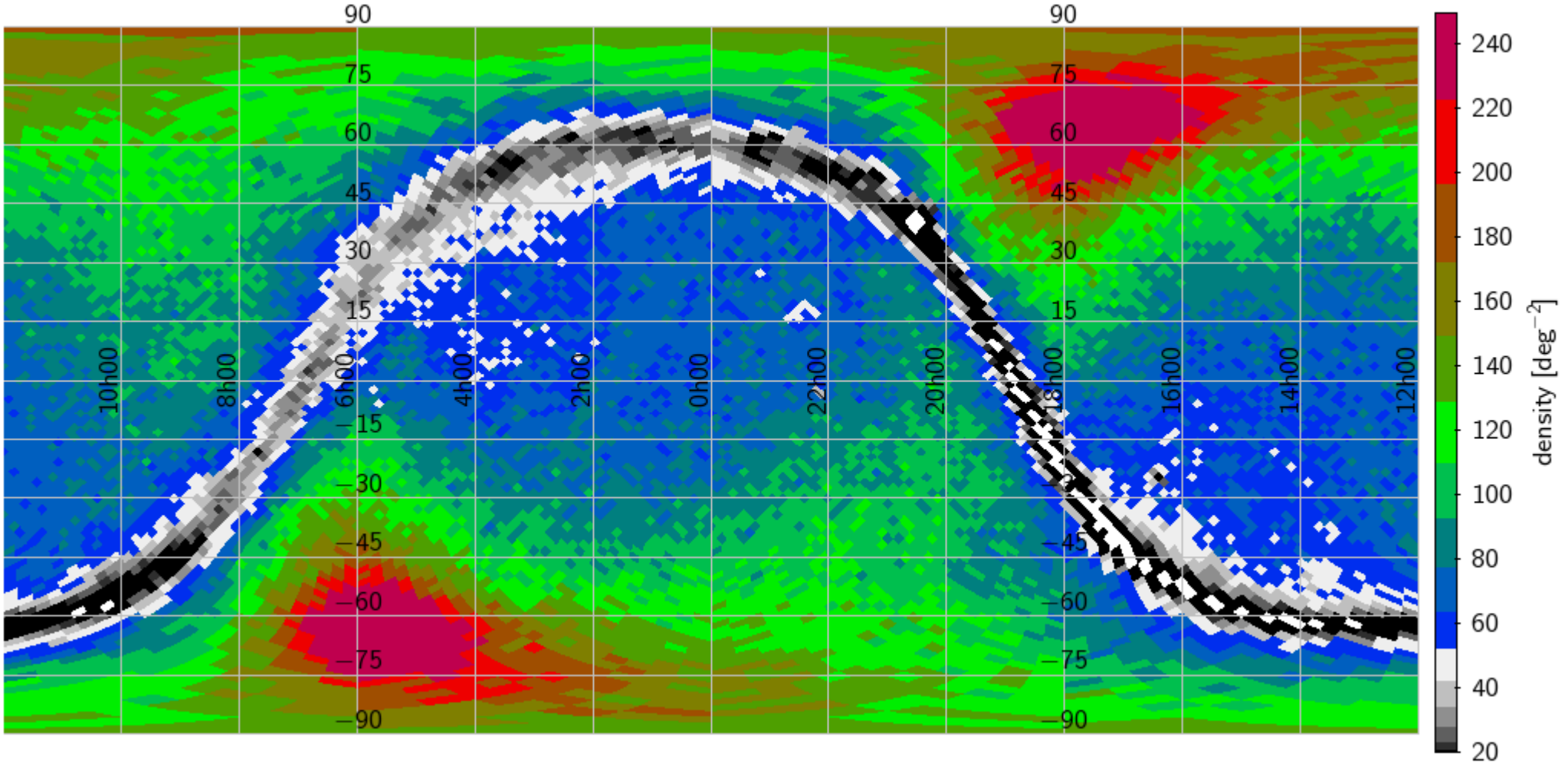

redshift: 0.03<z<0.2
100
10
1
$w_p(r_p)$
AGN mock
Mountrichas & Georgakakis+12
0.1
1
10
r_p (h^{-1}Mpc)


C1
C2
C3
C4
C5
C6
all z<6
log(>F) [/deg2]
log(F[0.5-2 keV])
4
3
2
1
0
−1
−2
−17
−16
−15
−14
−13
−12


C1
C2
C3
C4
C5
C6
all z<6
log(>F) [/deg2]
log(F[2-10 keV])
4
3
2
1
0
−1
−2
−17
−16
−15
−14
−13
−12


90
75
60
45
30
15
0
−15
−30
−45
−60
−75
−90
10h00
8h00
6h00
4h00
2h00
0h00
22h00
20h00
18h00
16h00
14h00
12h00
240
220
200
180
160
140
120
100
80
60
40
20
density [deg^{-2}]

eRASS8


90
75
60
45
30
15
−15
−30
−45
−60
−75
−90
10h00
8h00
6h00
4h00
2h00
0h00
22h00
20h00
18h00
16h00
14h00
12h00
density [deg^{-2}]
240
220
200
180
160
140
120
100
80
60
40
20

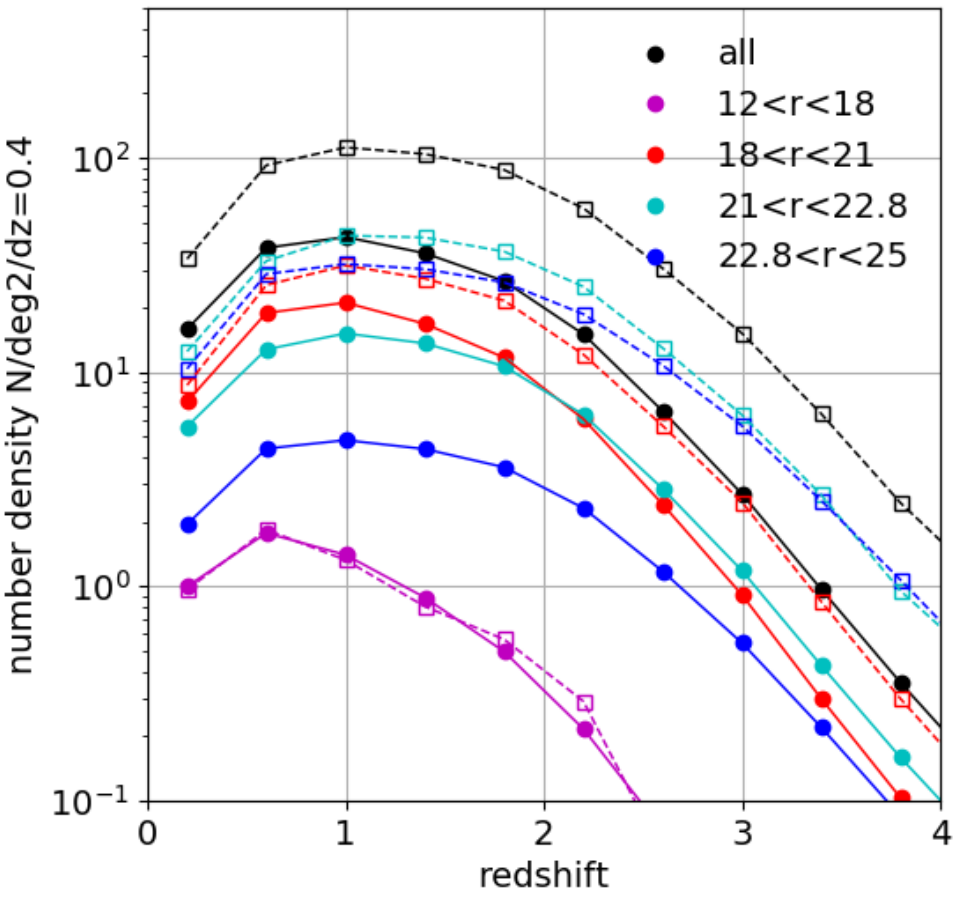
SNR3

Redshift distribution

eRASS8: 2.6e6 AGN (Merloni 12, Kolozdig 2013,14: ~3e6 AGNs)

eRASS3: 1.3e6

SNR3: 3.6e6

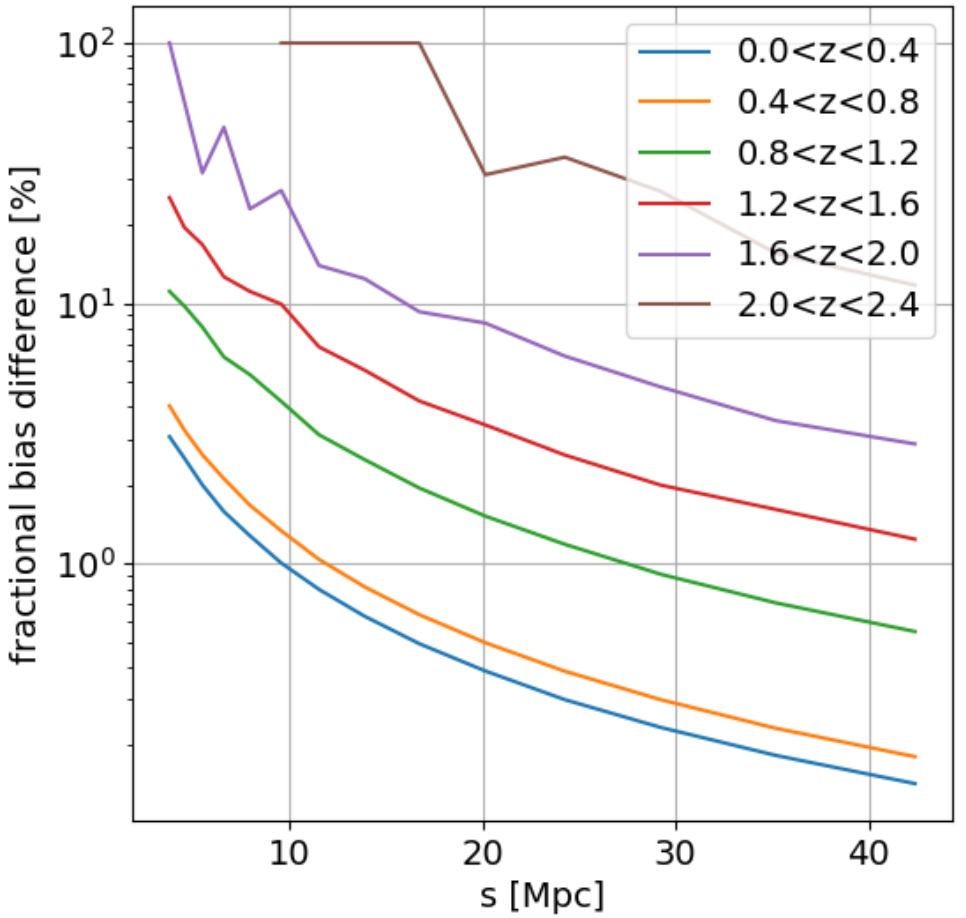


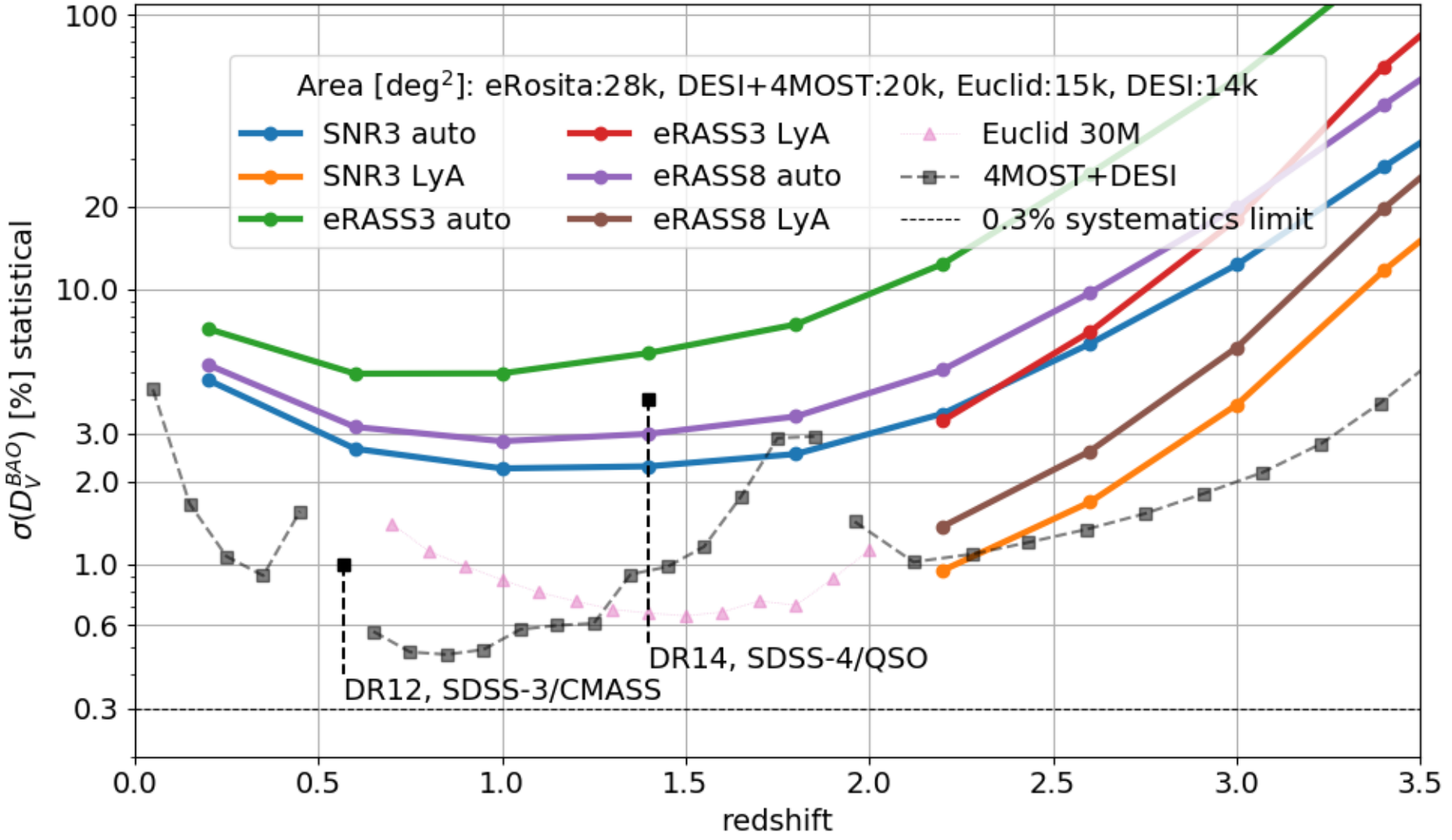
Clustering amplitude

Discrepancy between the clustering of obscured vs. un-obscured AGNs ?

Current uncertainties on the bias >10-20% level

eROSITA: Redshift 0-1: sub-percent level sensitivity to the bias.




Area [deg^2]: eRosita:28k, DESI+4MOST:20k, Euclid:15k, DESI:14k
SNR3 auto
SNR3 LyA
eRASS3 auto
eRASS3 LyA
eRASS8 auto
eRASS8 LyA
Euclid 30M
4MOST+DESI
0.3% systematics limit
DR12, SDSS-3/CMASS
DR14, SDSS-4/QSO
$\sigma(D_V^{BAO})$ [%] statistical
redshift
100
20
10.0
3.0
2.0
1.0
0.6
0.3
0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5

Full-sky / X-ray – optical / Future

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The low redshift survey at calar alto

! Multi-wavelength synergy with astro-plates !

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