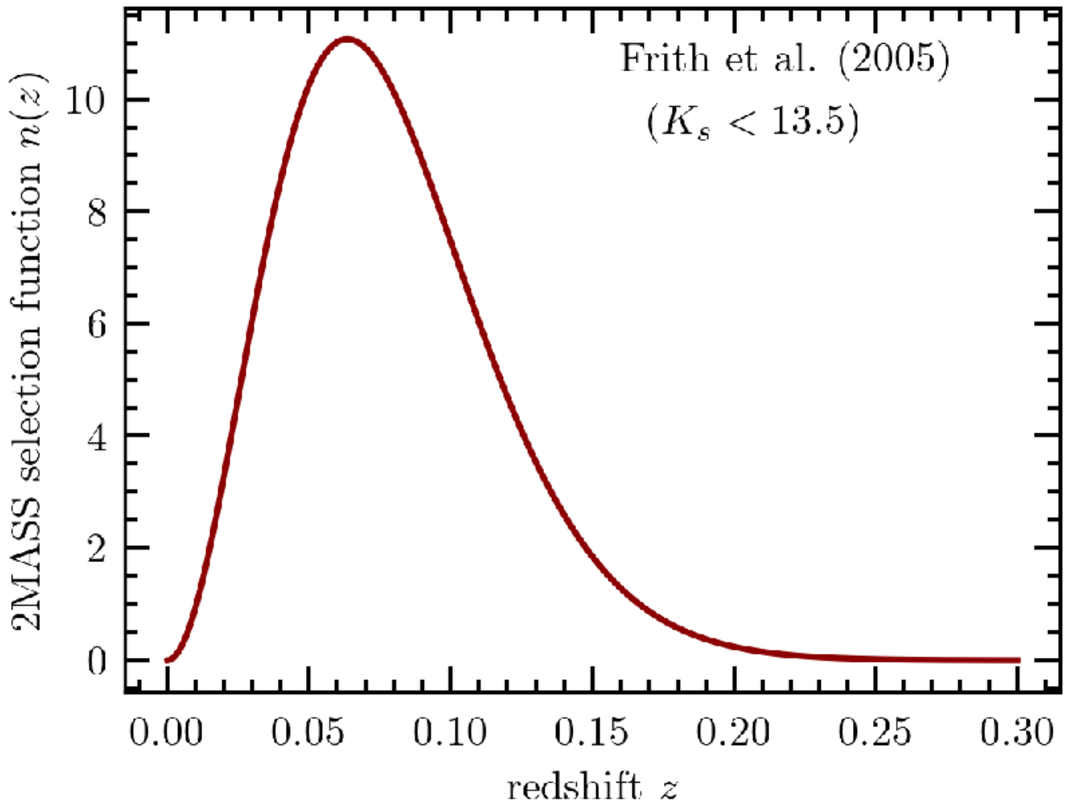
Cosmology with A-SPEC

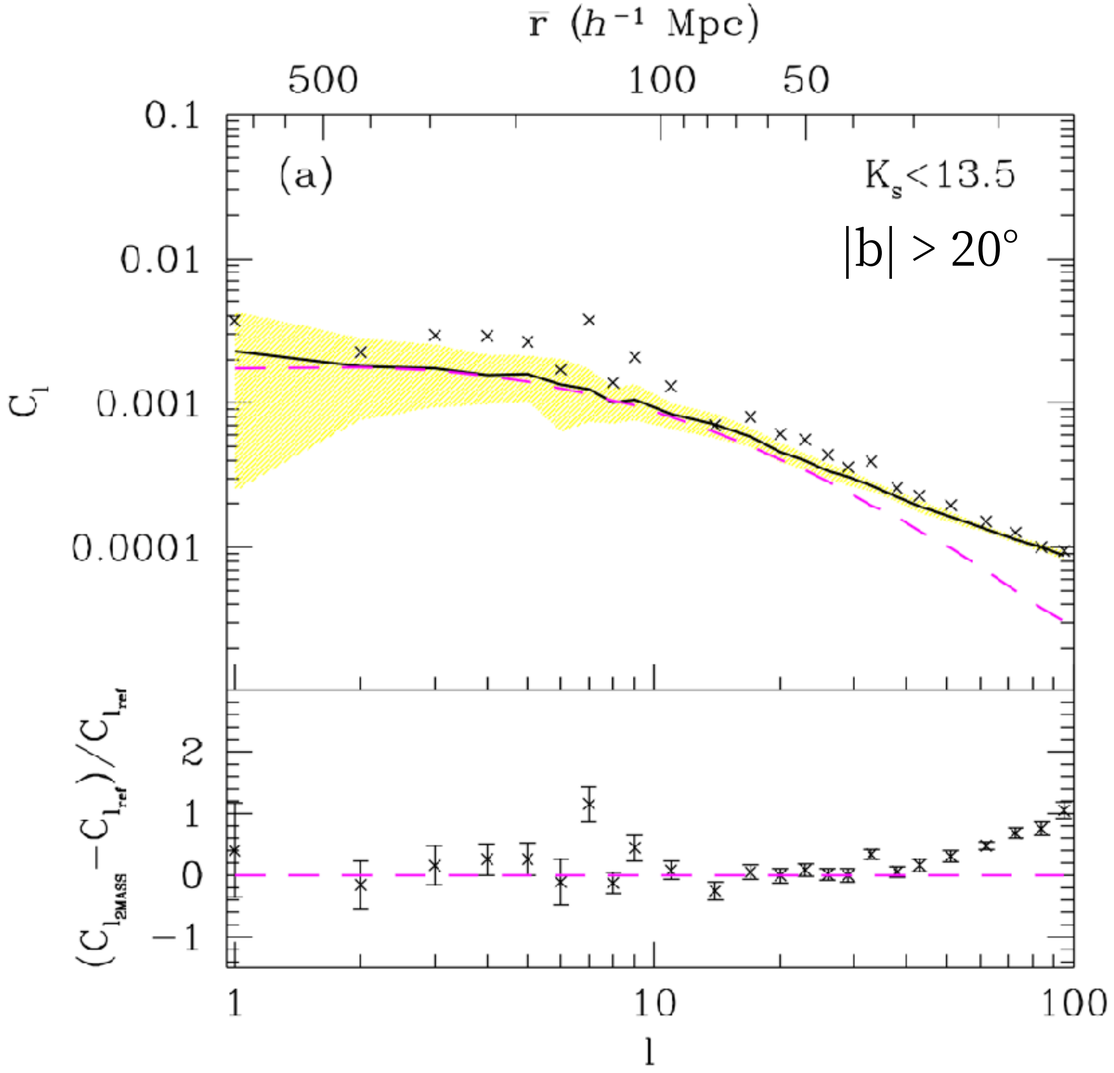
Donghui Jeong (정동희)
Penn State/KIAS

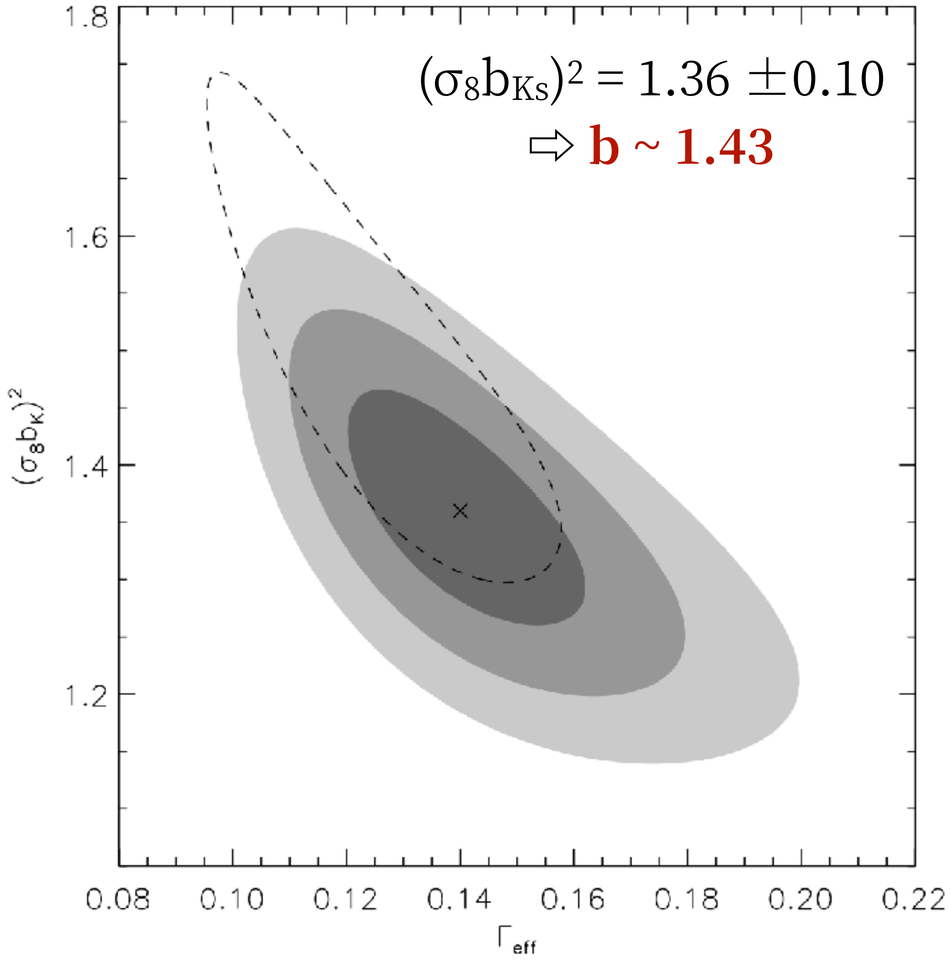
Some numbers for A-SPEC cosmology

- 2MASS, flux-limited Ks < 13.75
- f_{sky} = 90%, outside galactic plane
- Total galaxies: 776k,
  target = **450k galaxies** w/o redshift
  - Volume: 0.992 Gpc^3 to z = 0.15
    2.26 Gpc^3 to z = 0.2

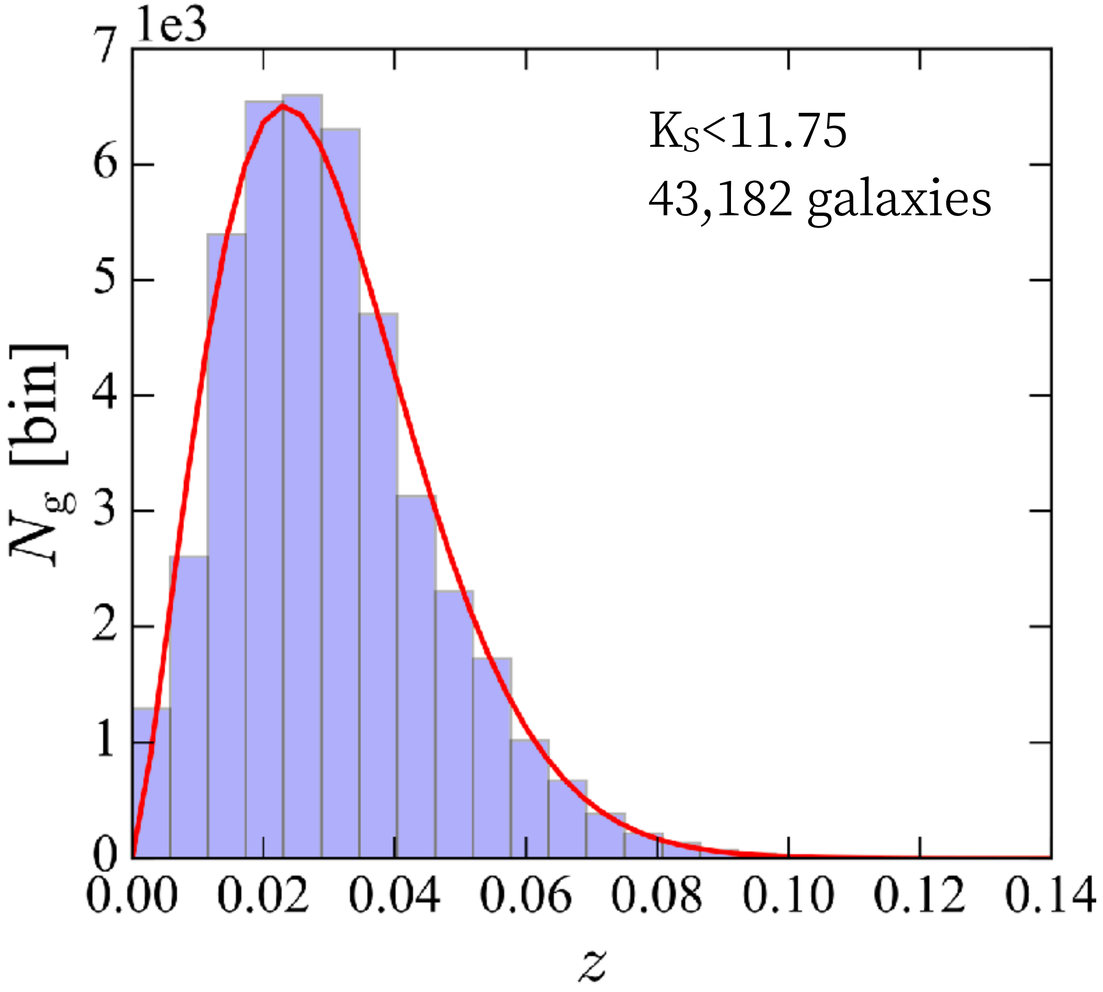


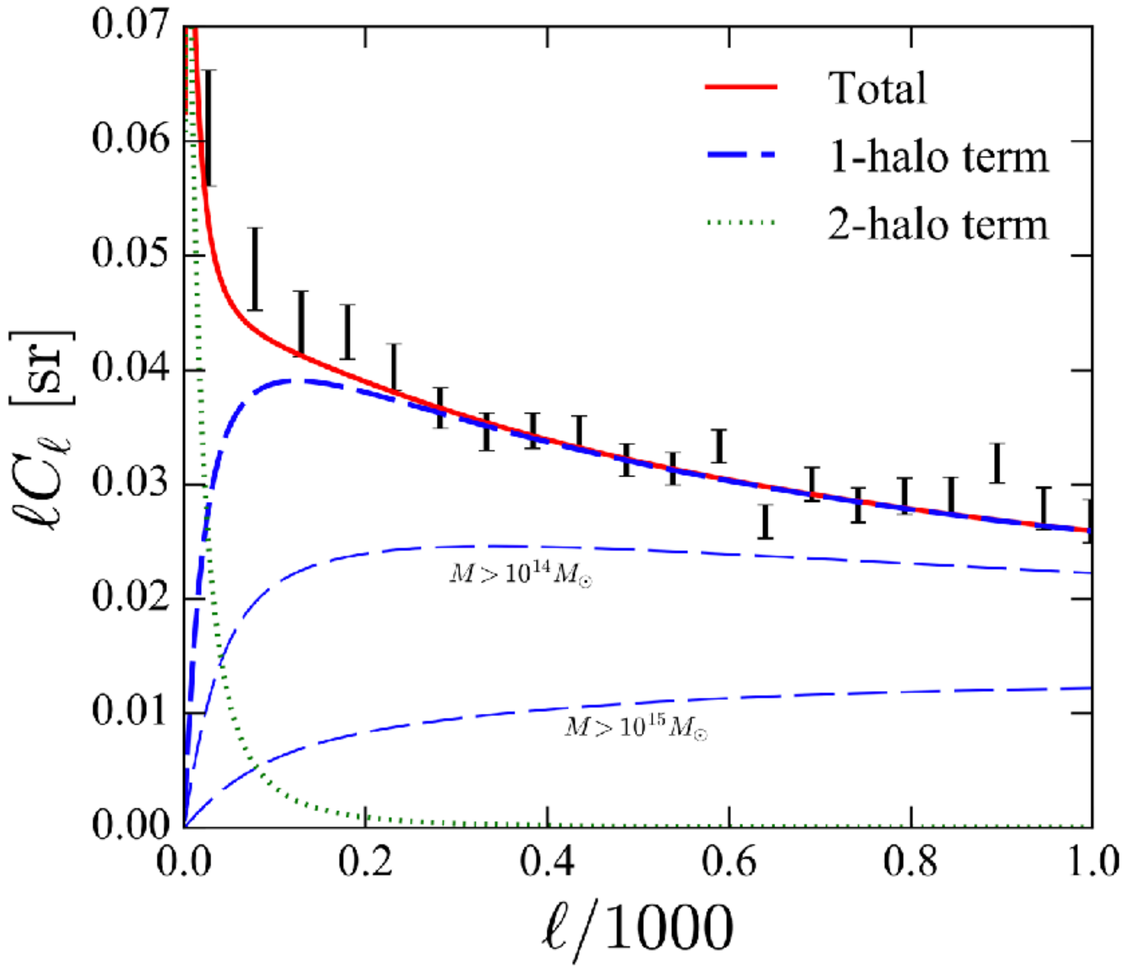
Previous study I. Frith et al. (2005)



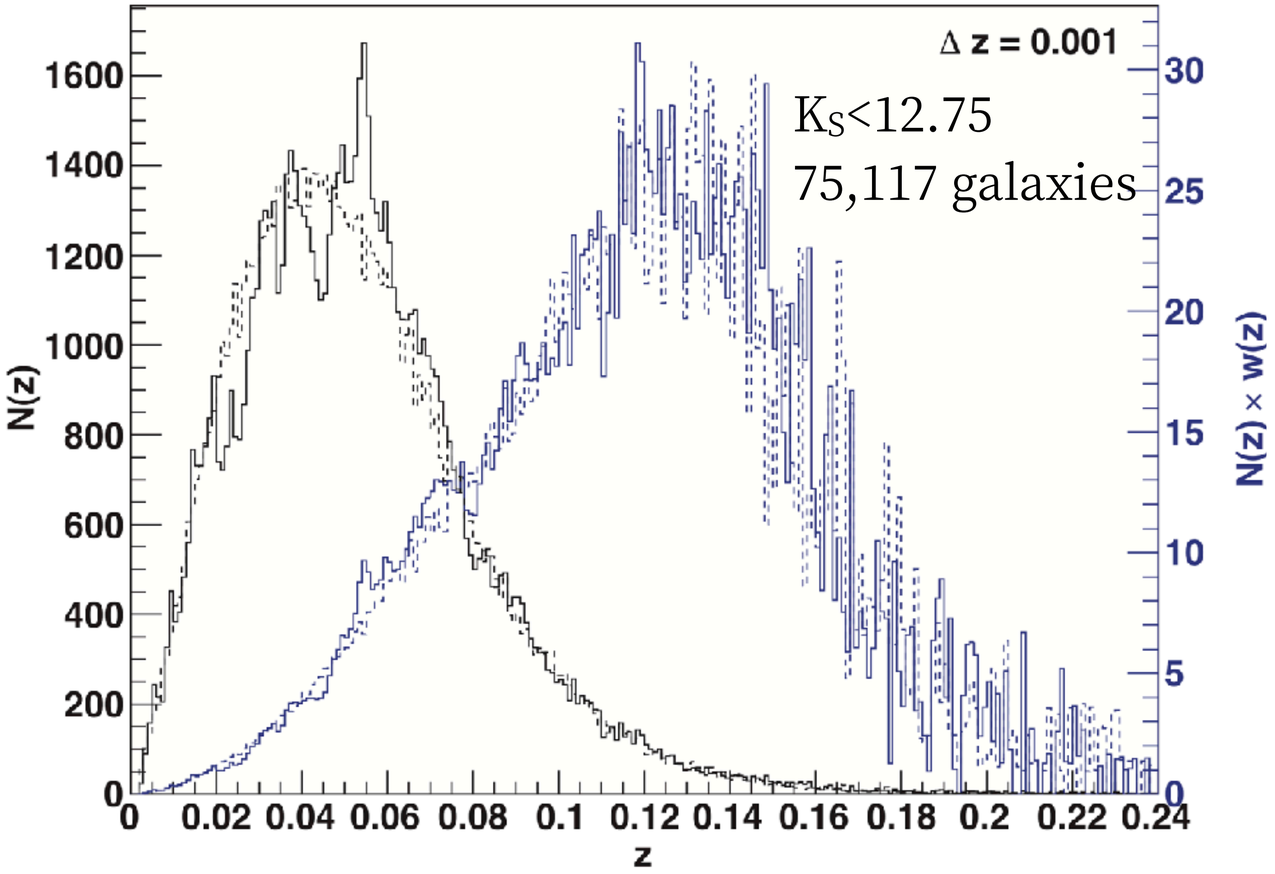


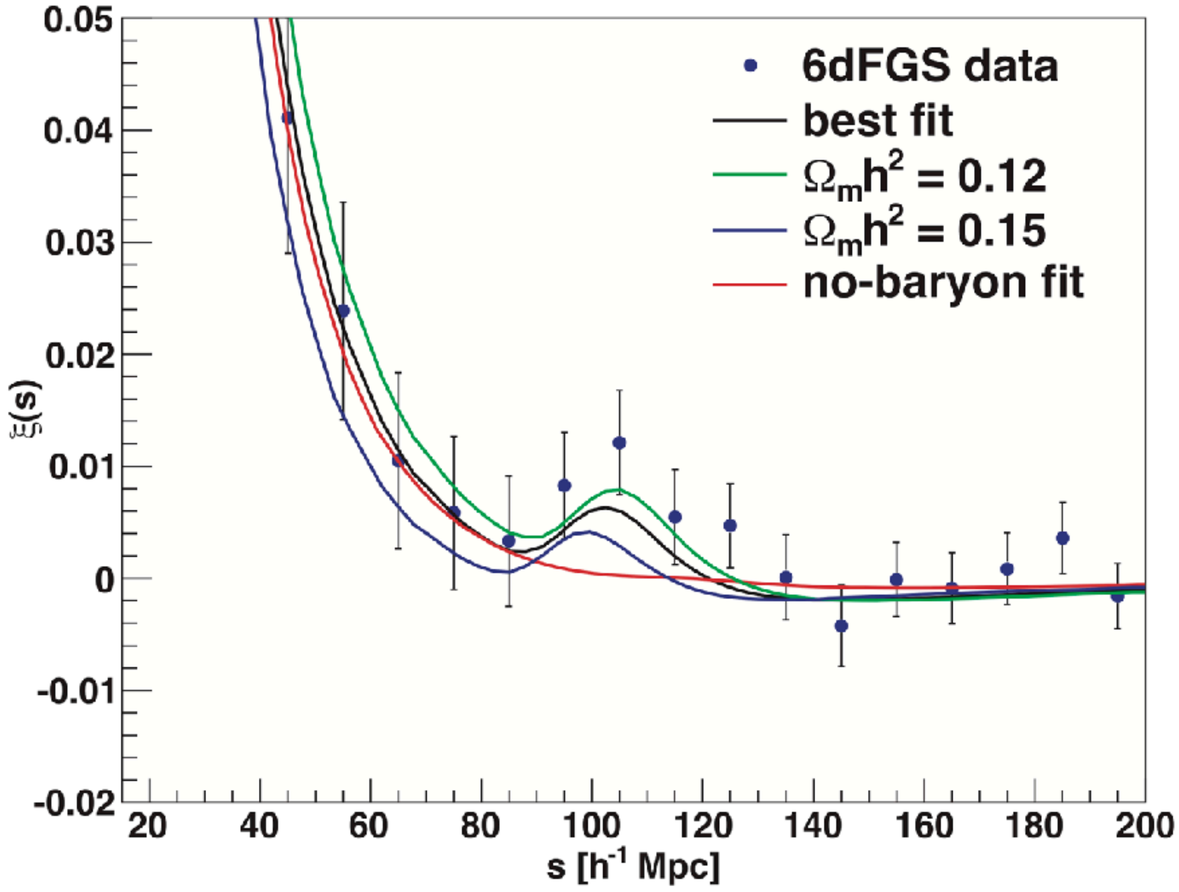
Previous study II. Ando et al. (2012)





Previous study III. 6dFGS Beutler et al. (2011)





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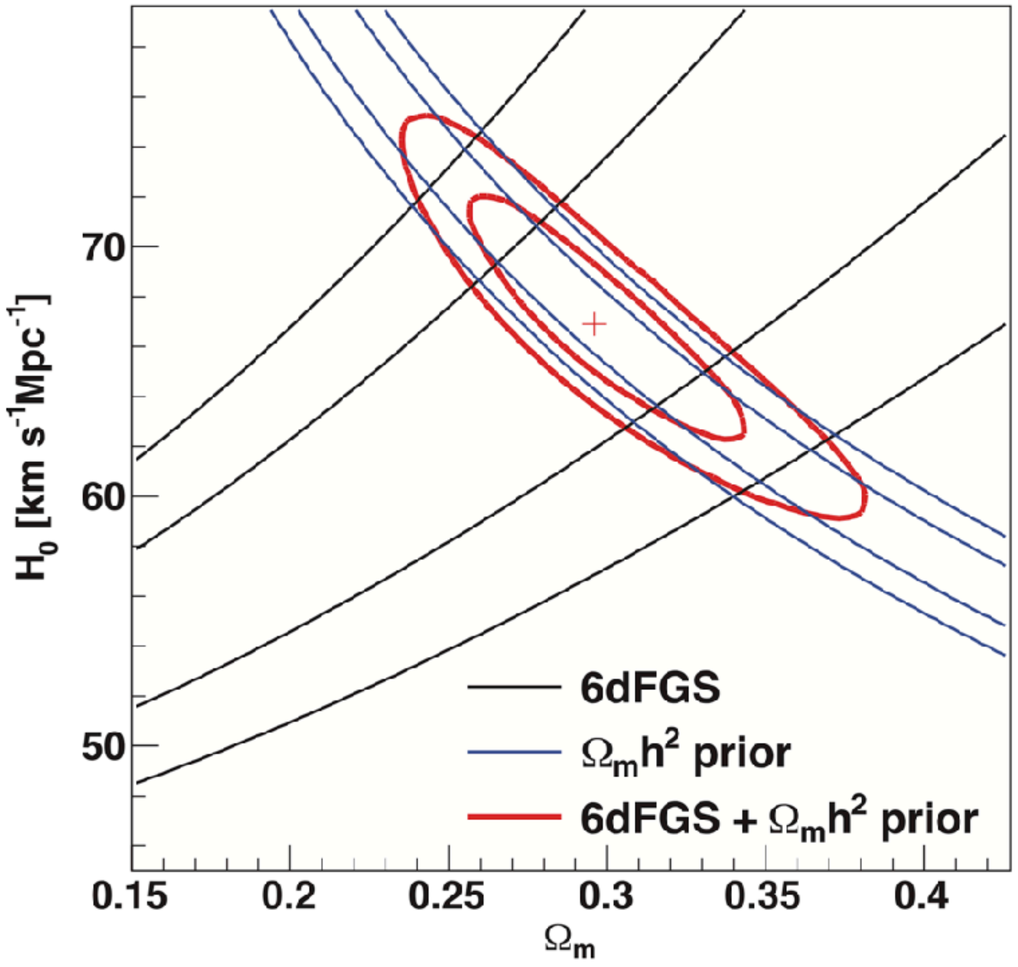
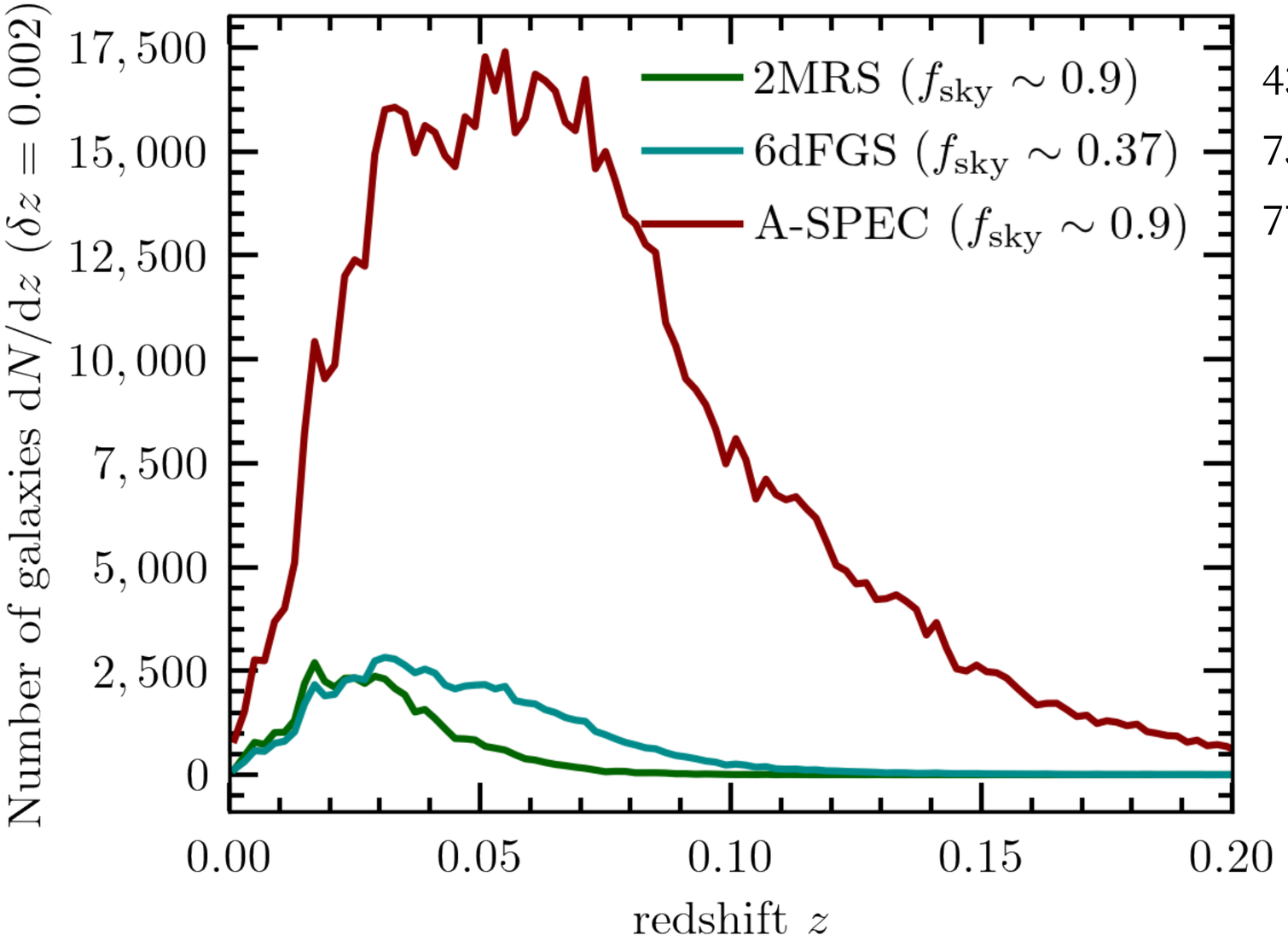


$H_0 = 67 \pm 3.2$

$\Omega_\Lambda = 0.704 \pm 0.028$

Three surveys in comparison (dN/dz)

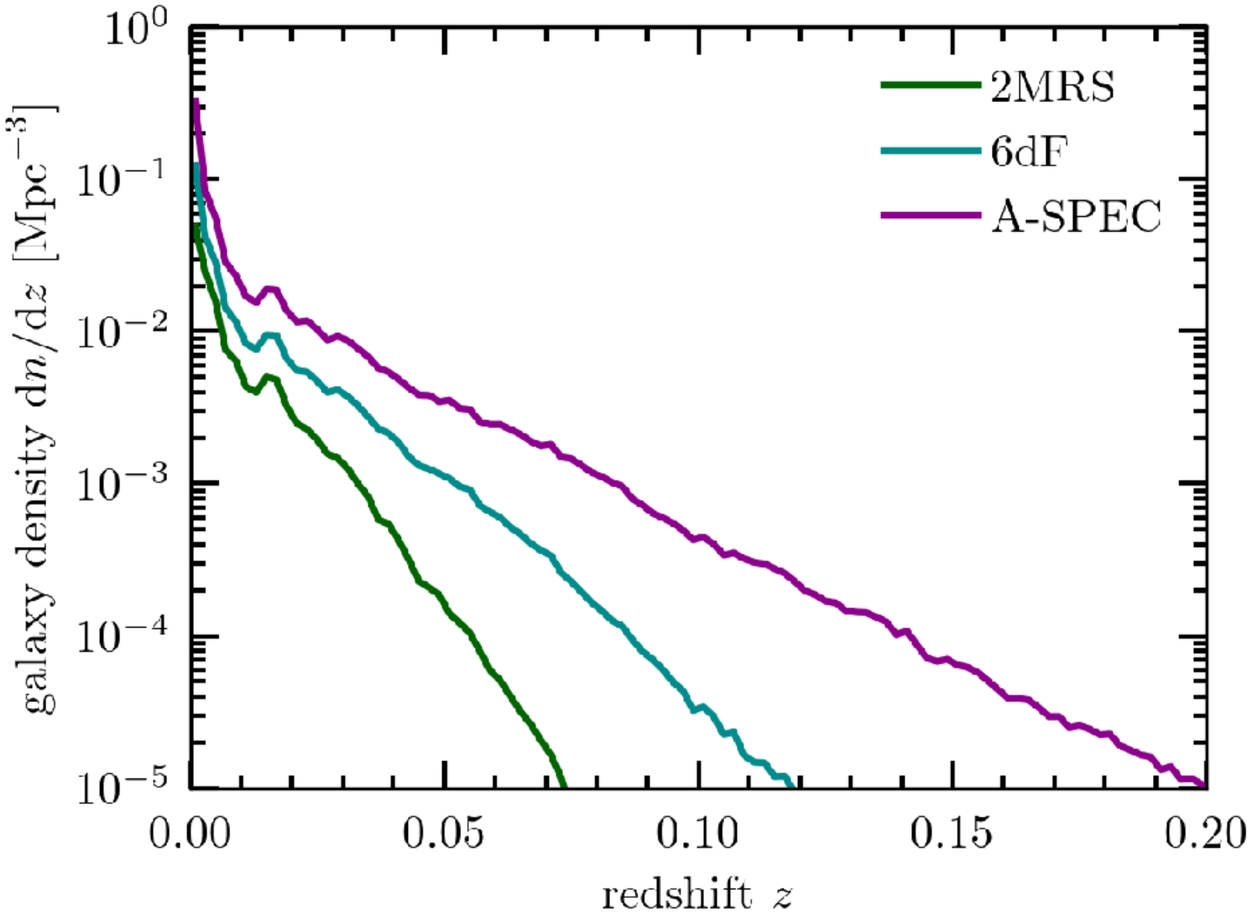


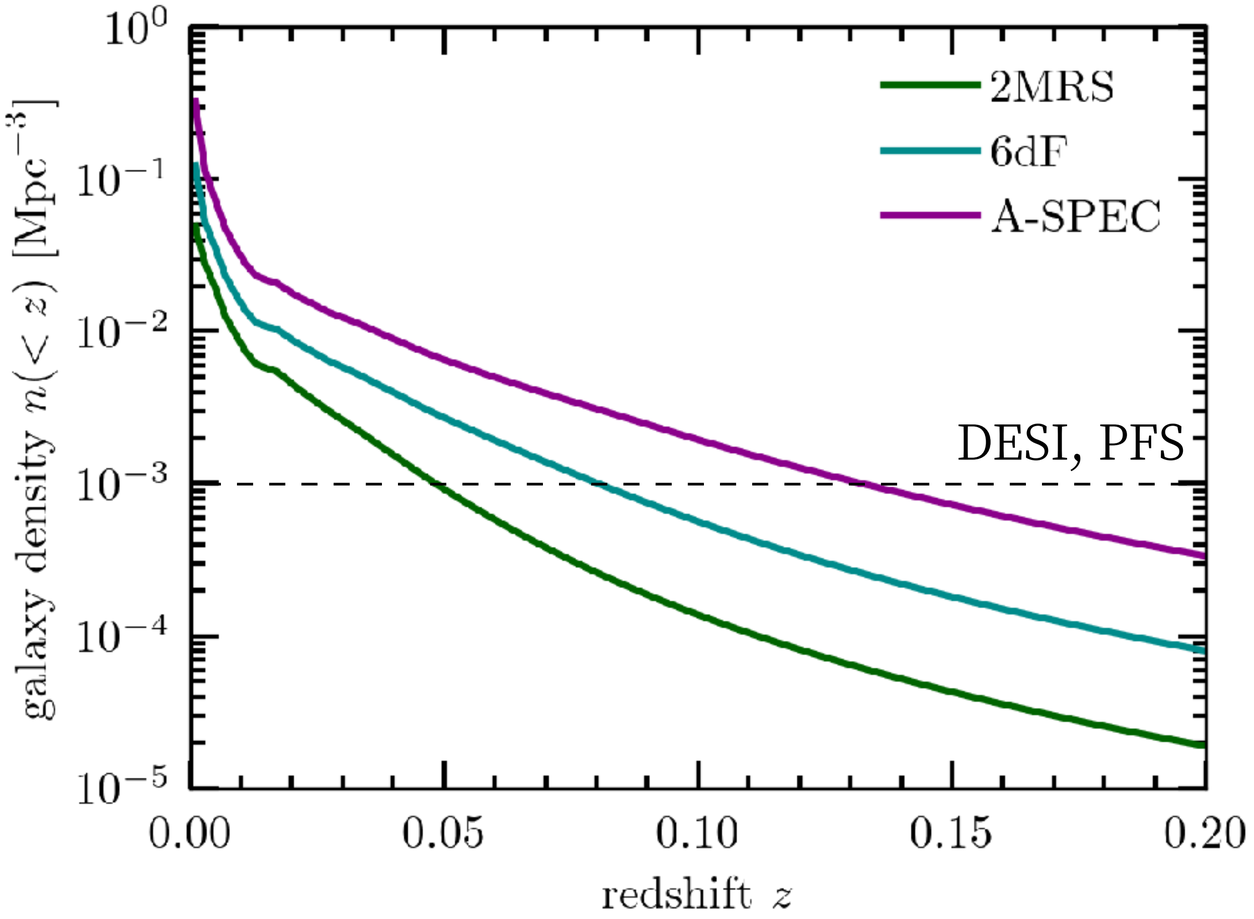
43,182 galaxies

75,117 galaxies

776,468 galaxies

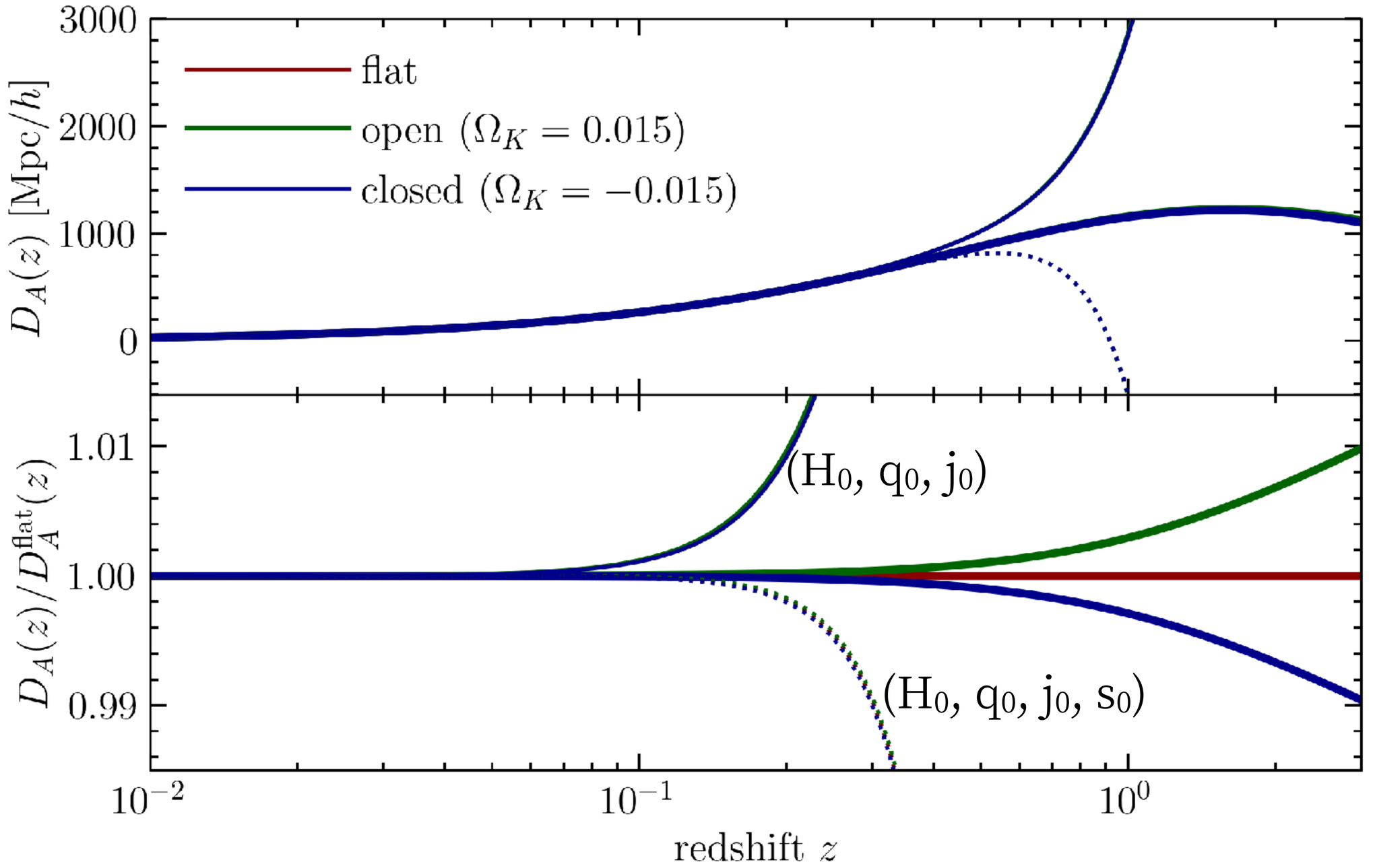
Three surveys in comparison (dn/dz)





Advantage of A-SPEC

- Surveying local universe ($z < 0.15$):
  - When the dark-energy effect dominates energy budget
  - When we can ignore the spatial curvature : $R \sim 640\mathrm{Mpc} \ll 1/(|\Omega_K|^{1/2}H_0)$
    - Parameters: $(H_0, \Omega_M, \Omega_\Lambda, w_\Lambda)$, or (H_0, q_0, j_0, s_0)
- Full-sky survey with high-enough galaxy number density:
  - **cosmic-variance limited** 3D survey


3000
2000
1000
0
$D_A(z)$ [Mpc/h]
flat
open ($\Omega_K = 0.015$)
closed ($\Omega_K = -0.015$)
1.01
1.00
0.99
$D_A(z)/D_A^{\rm flat}(z)$
(H_0, q_0, j_0)
(H_0, q_0, j_0, s_0)
10^{-2}
10^{-1}
10^{0}
redshift z

Shoji, Jeong & Komatsu (2009)

Projection for A-SPEC

Using the galaxy power spectrum ($z<0.15$)

	0.1 h/Mpc	0.2 h/Mpc	0.3 h/Mpc	BAO only
H(0.075)	13.0%	5.3%	2.9%	10%
$D_A(0.075)$	9.7%	4.2%	2.3%	4.3%
$R = D_A^2/H$	8.3%	3.8%	1.9%	3.1%
f = dlnD/dlna	0.11	0.057	0.037	f=0.53

Shoji, Jeong & Komatsu (2009)

Projection for A-SPEC

Using the galaxy power spectrum (z<0.2), **x2 better than 6dF**

	0.1 h/Mpc	0.2 h/Mpc	0.3 h/Mpc	BAO only
H(0.075)	8.7%	3.6%	2.2%	6.7%
$D_A(0.075)$	6.5%	2.9%	1.7%	2.9%
$R = D_A^2/H$	5.6%	2.6%	1.5%	2.2%
f = dlnD/dlna	0.07	0.039	0.027	f=0.55

$R=D_A^2/H$ and dark energy

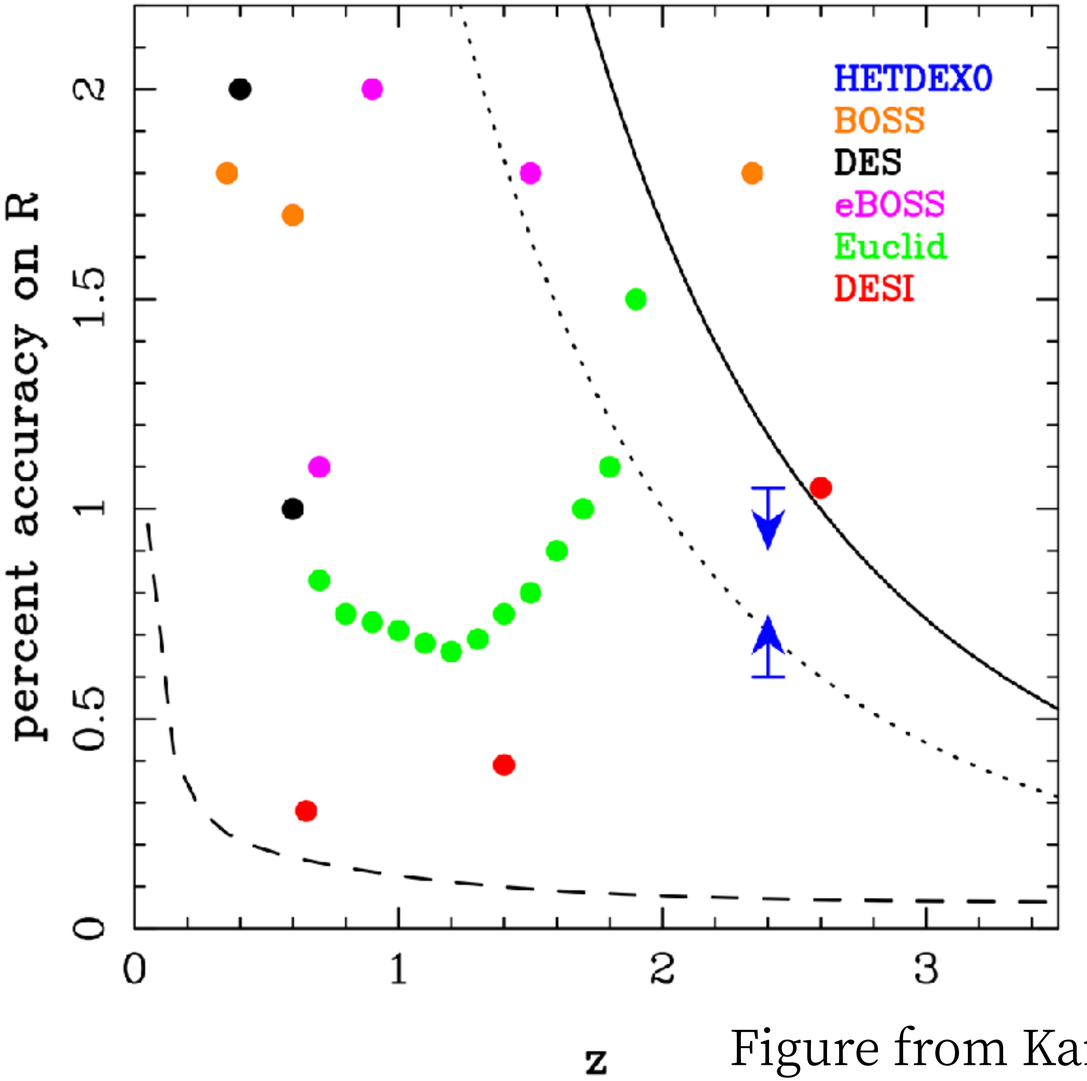
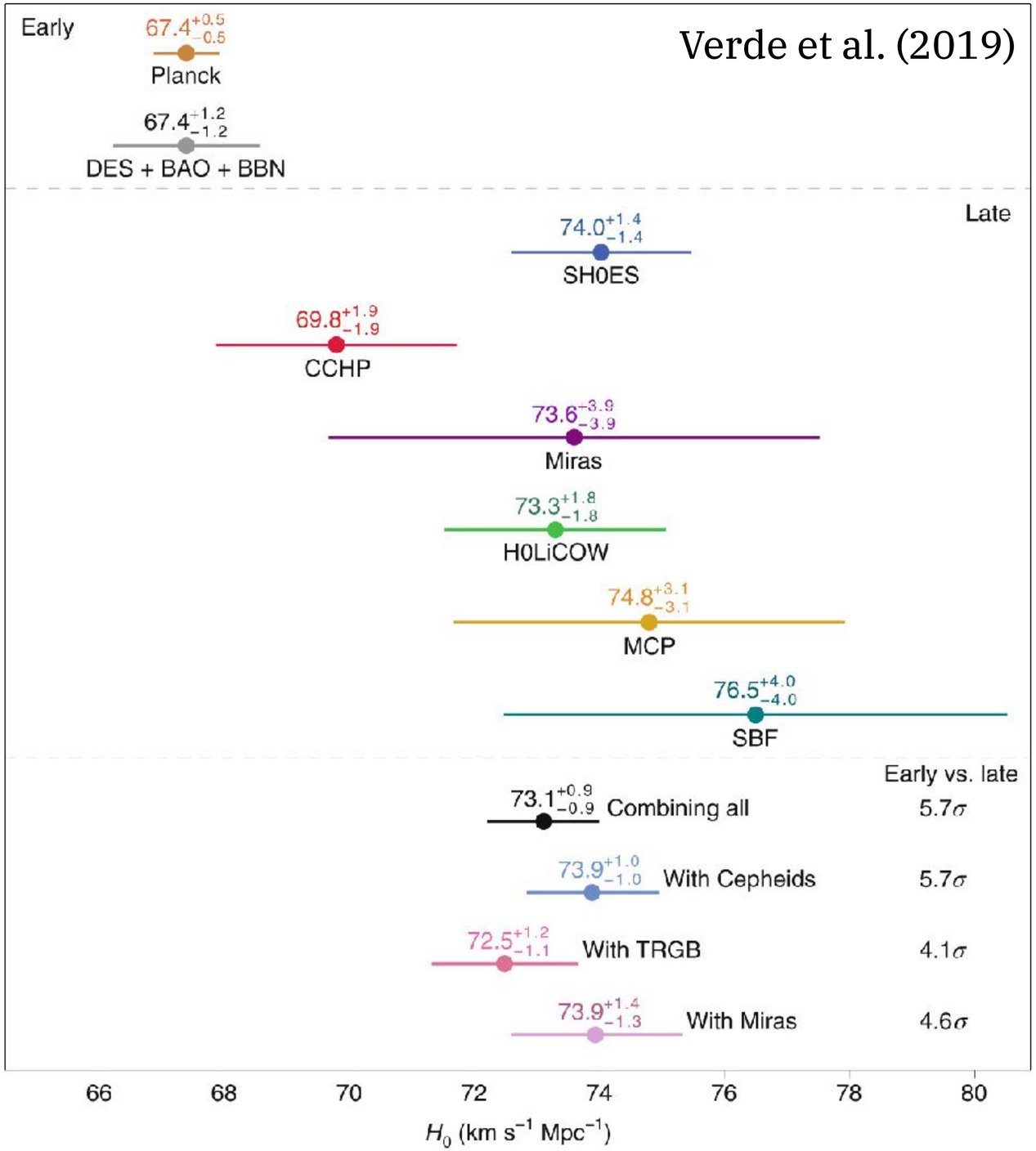


Figure from Karl Gebhardt



Hubble tension

- Planck (CMB)
- DES + BAO + BBN
- Variable stars + SN:
  SH0ES (Cepheid), Miras (Mira)
- TRGB + SN (CCHP)
- Strong lensing (H0LiCOW)
- Megamaser (MCP)
- Surface-brightness fluc. (SBF)

Further study

- Statistical power of the full-sky survey within $z < 0.15$ (or 0.2):
  - Accuracy of measuring (H_0, q_0, j_0, …) and how to relate them to DE?
  - Can we model the nonlinear P(k) to k~0.3 h/Mpc?
- Other opportunities & Challenges:
  - Integrated-Sachs-Wolfe effect (A-SPEC x CMB)
  - Additional information from the peculiar velocity
  - Overcome the cosmic-variance by using the multi-tracer?
  - The most efficient way to analyze the full-sky dataset?

Competitor

- DESI Bright Galaxy Survey (BGS):
  - 20M galaxies: r<19.5, 0 < z < 0.4 [ch. r<17 for A-SPEC]
  - 14,000 sq. deg. [cf. 37,127 sq. deg. for A-SPEC]
  - 360 - 980nm (R = 2000 - 5000)
- Q: what is the killing science application using the full-sky A-SPEC survey? / Proxy for various foreground sources?