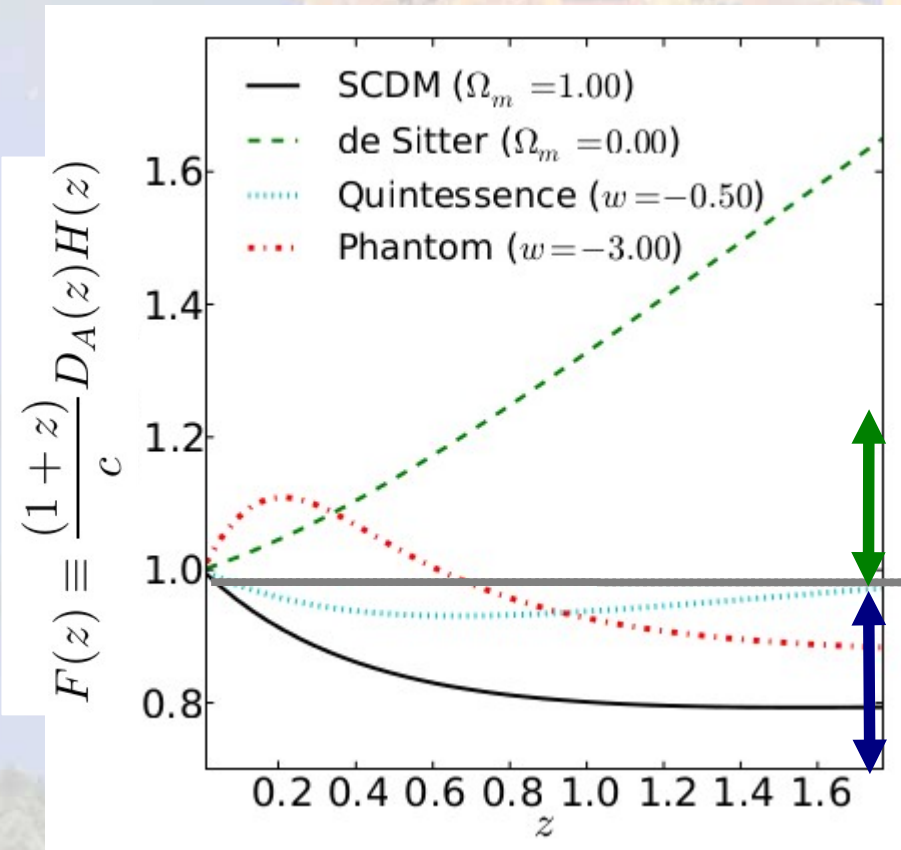
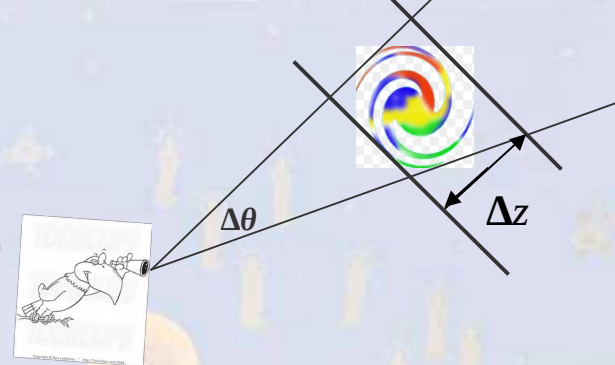




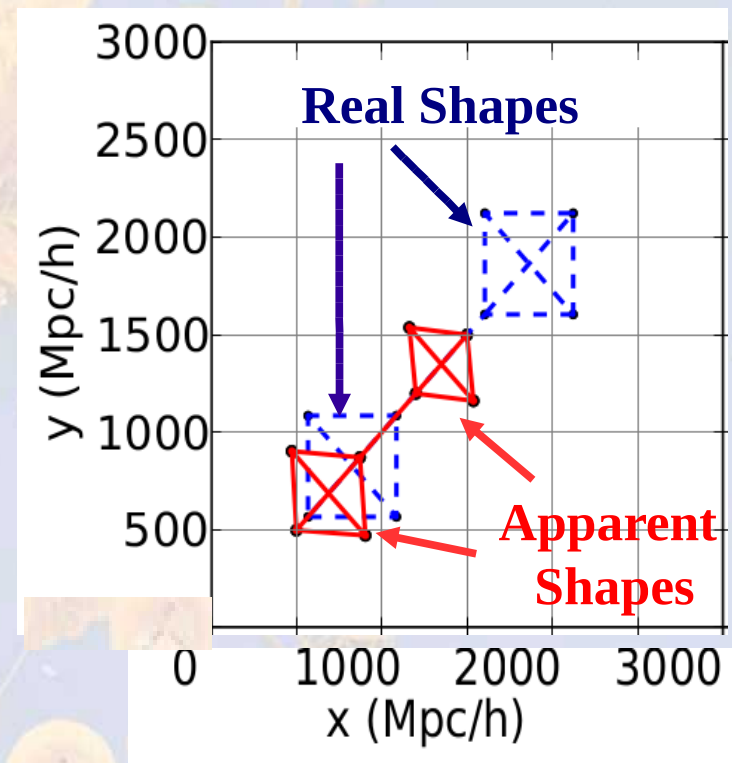
Cosmological Constraints From Clustering Shells

Xiao-Dong Li
KIAS

Alcock-Paczynski Test



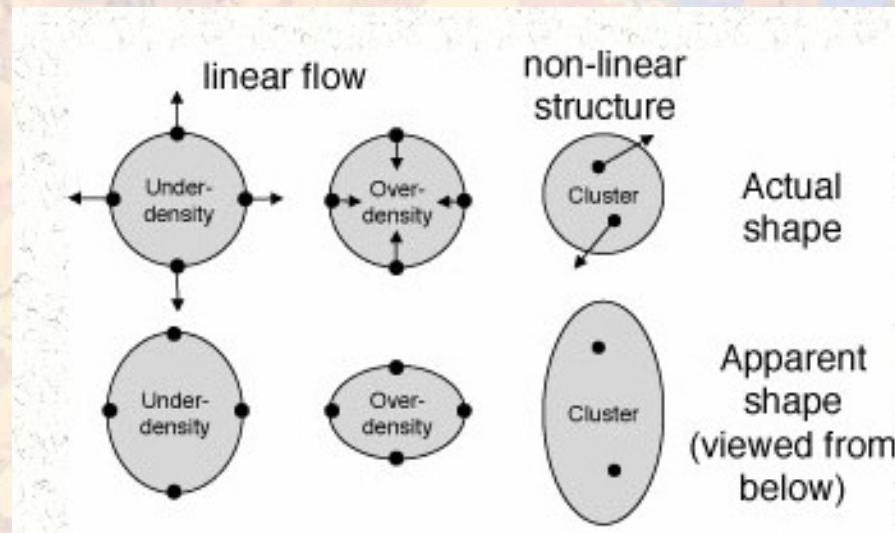
Stretch
Isotropy
Compression



- If we adopt a wrong cosmology to compute distances from redshifts, shapes of objects appear stretched/compressed along the LOS.
- Attention: **the apparent anisotropy evolves with redshift**

Redshift Space Distortion

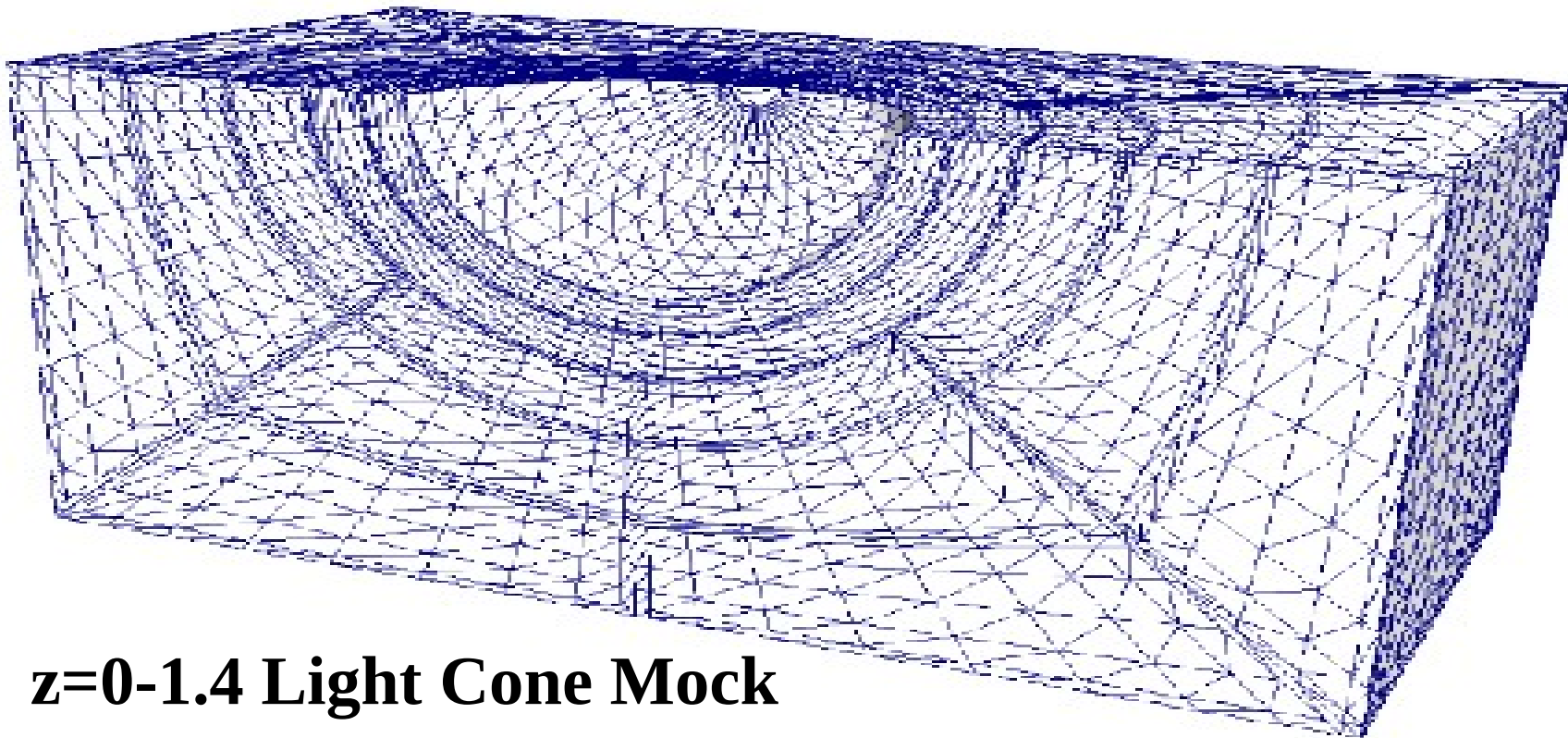
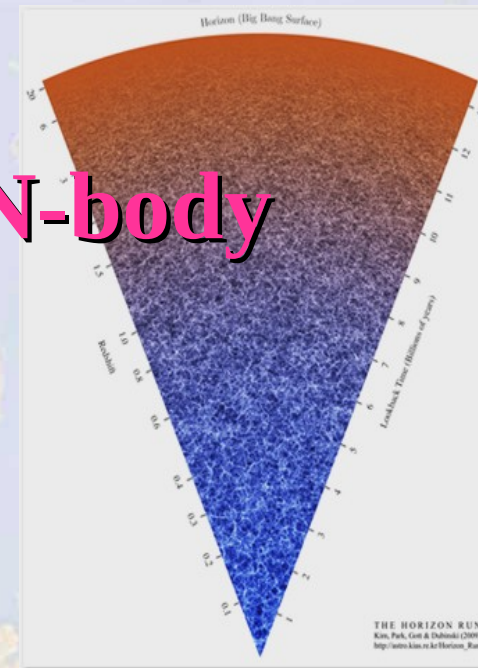
$$r = \int_0^{z_{\text{cosmo}} + \Delta z} \frac{dz'}{H(z')}, \quad \Delta z = \frac{v_{\text{LOS}}}{c} (1 + z_{\text{cosmo}})$$



- Finger-of-god/large-scale-flow introduces distortion @ small/large scales
- **Maybe the redshift evolution of RSD is less significant than AP?!**

Proof-of-Concept on Horizon Run 3 N-body

- Step 1. Adopting a cosmology, reconstructing the galaxy density gradient field in redshift shells
- Step 2. Looking at the anisotropy of the gradient field as a function of redshift

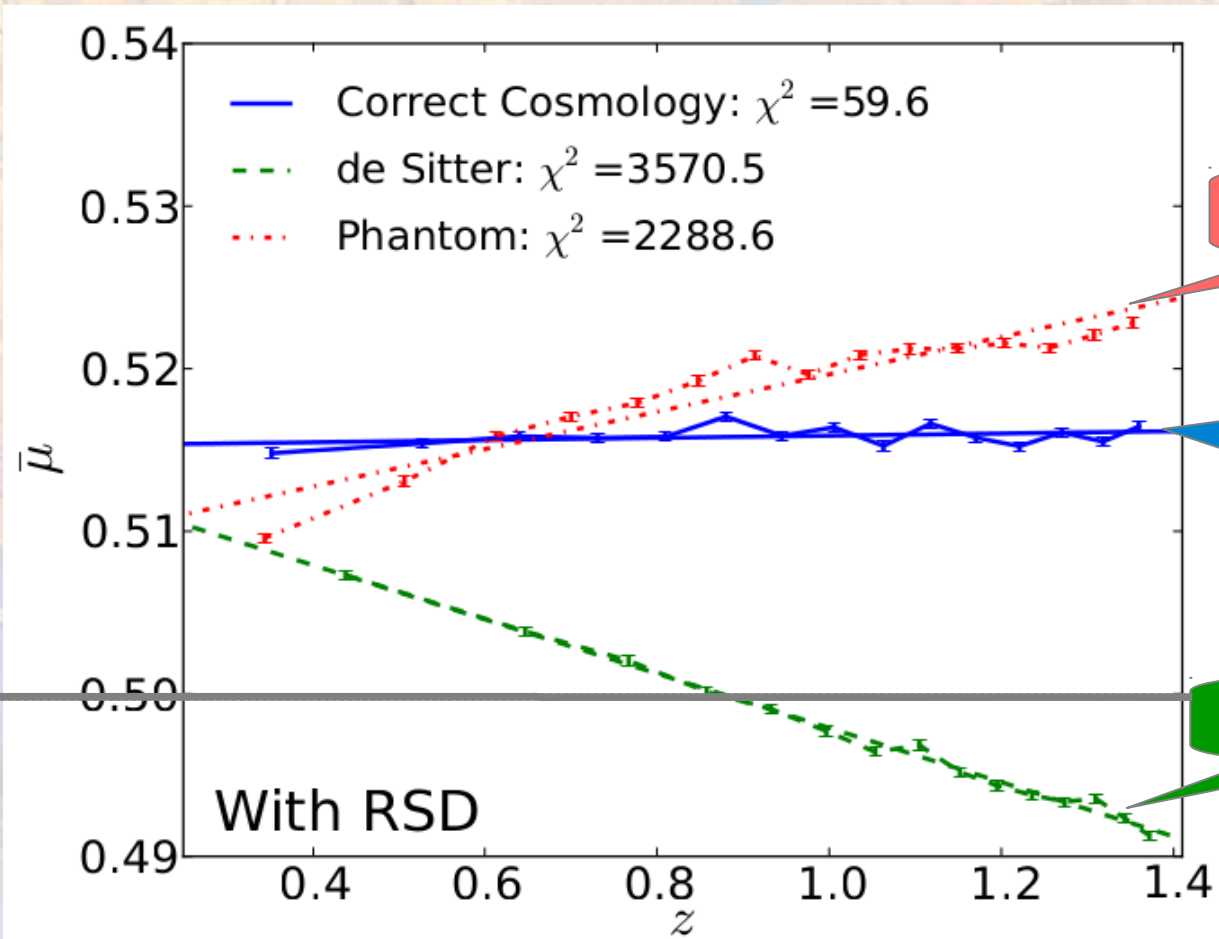


z=0-1.4 Light Cone Mock

Proof-of-Concept on Horizon Run 3 N-body

In correct cosmology, magnitude of anisotropy maintains a constant

In wrong cosmologies, magnitude of anisotropy evolves with z



Phantom $w = -3.0$

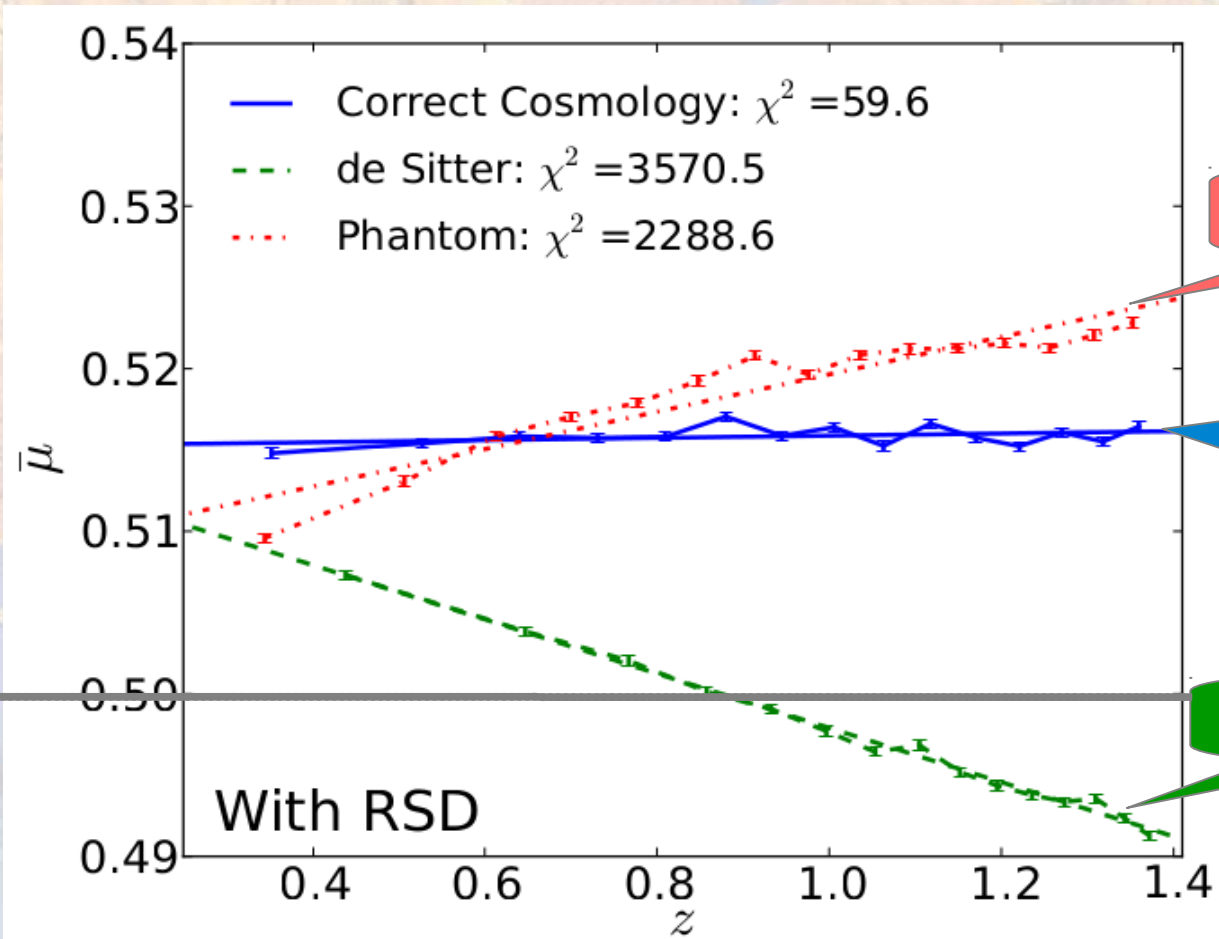
Correct Cosmology

De Sitter $\Omega_m=0$

Proof-of-Concept on Horizon Run 3 N-body

In correct cosmology, magnitude of anisotropy maintains a constant

In wrong cosmologies, magnitude of anisotropy evolves with z



Phantom $w = -3.0$

Correct Cosmology

De Sitter $\Omega_m=0$

Isotropy

With RSD

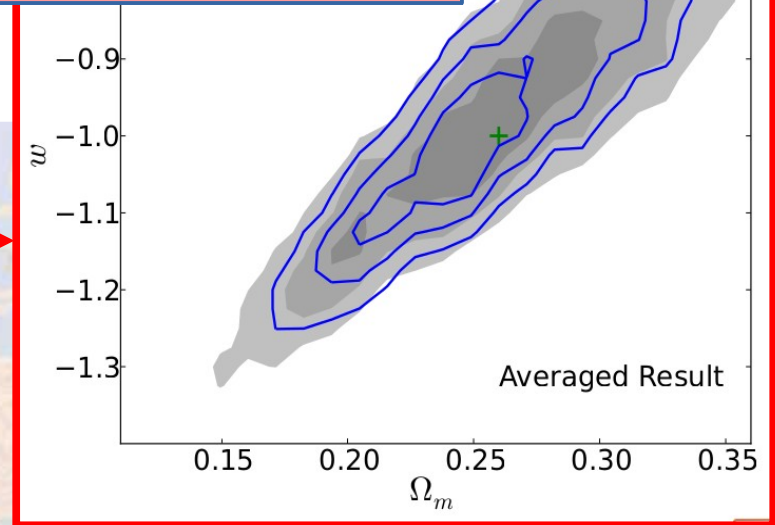
Cosmological Constraints

Prediction from HR3 N-body

* C. Park, X.-D. Li, J.E. Forero-Romero, J. Kim,
accepted by ApJ

1/4-sky, $z=0-1.4$

$\delta w \sim 0.1$



Cosmological Constraints

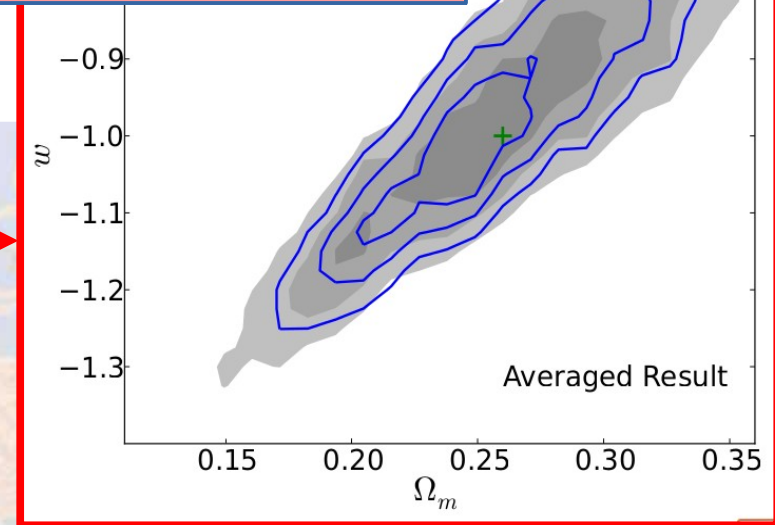
1/4-sky, $z=0-1.4$

$\delta w \sim 0.1$

Prediction from HR3 N-body

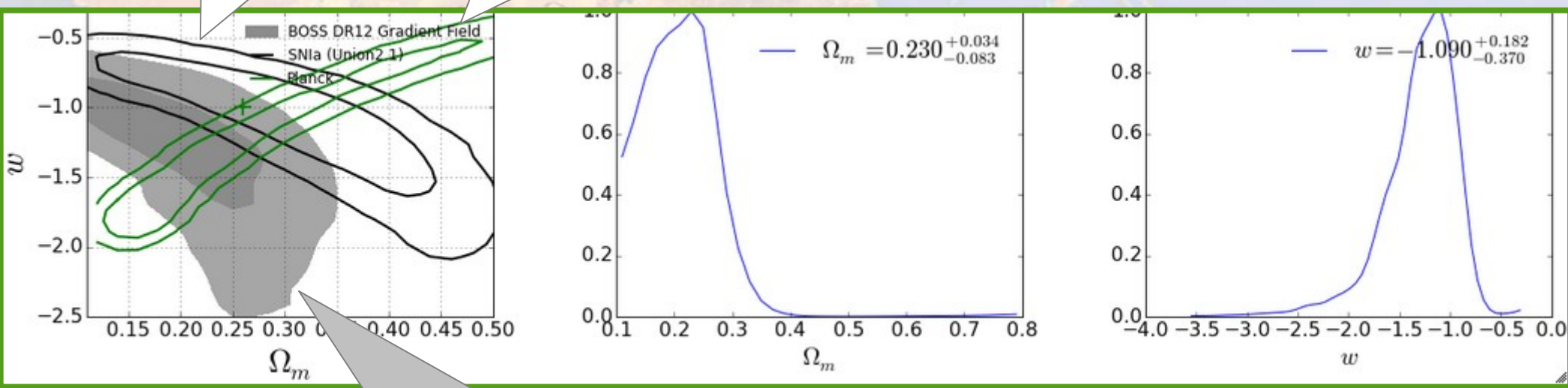
* C. Park, X.-D. Li, J.E. Forero-Romero, J. Kim,
accepted by ApJ

Preliminary result from BOSS DR12



Union2.1 SNIa

Planck



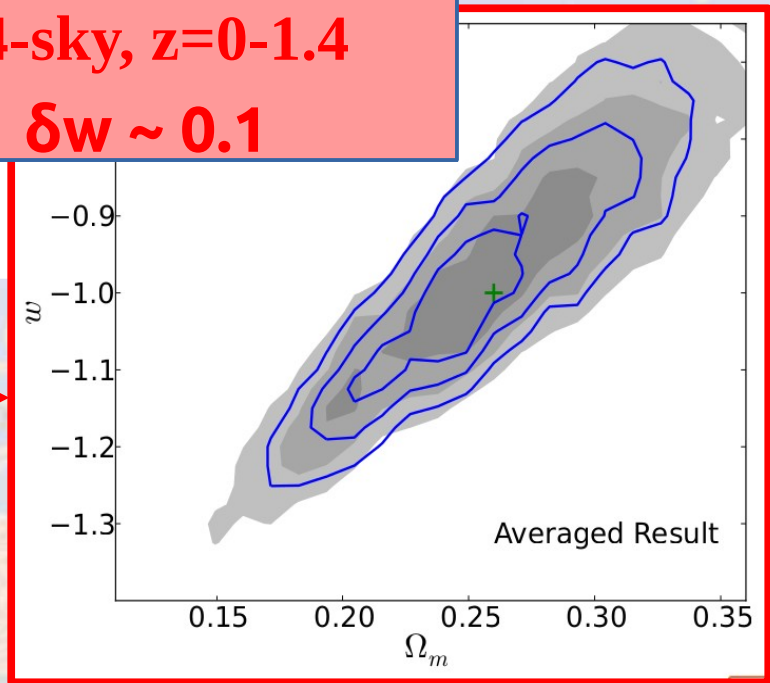
Our method @ BOSS DR12

Cosmological Constraints

1/4-sky, $z=0-1.4$
 $\delta w \sim 0.1$

Prediction from HR3 N-body

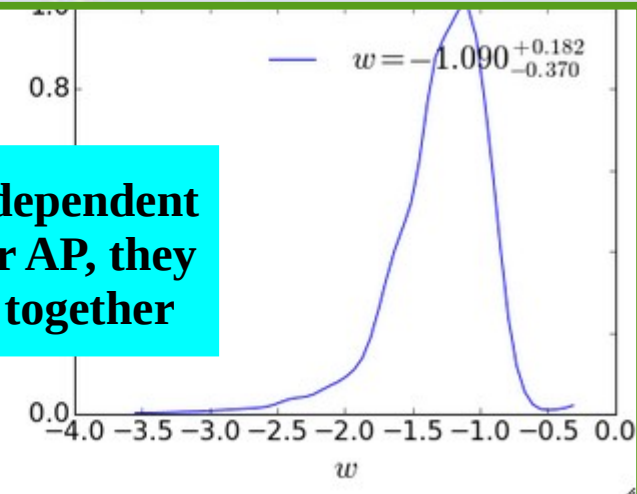
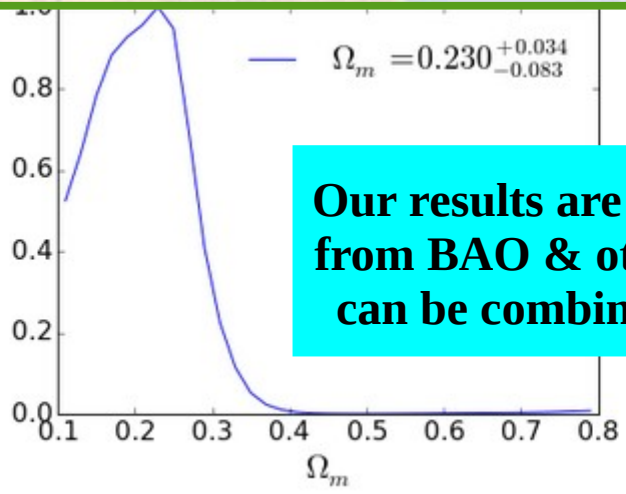
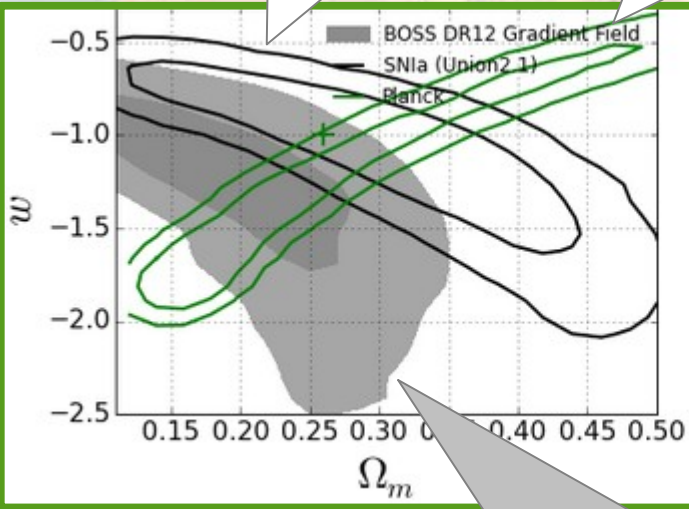
* C. Park, X.-D. Li, J.E. Forero-Romero, J. Kim,
accepted by ApJ



Preliminary result from BOSS DR12

Union2.1 SNIa

Planck



Our results are independent from BAO & other AP, they can be combined together

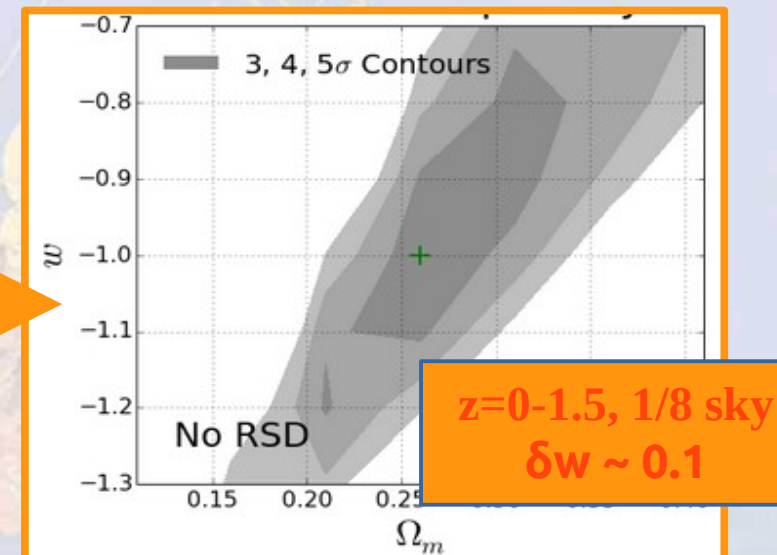
Our method @ BOSS DR12

Concluding Remarks

- **Redshift evolution of anisotropy: sensitive to AP & insensitive to RSD**
- Digging up more information encoded in LSS [$d(D_A * H) / dz$]
 - Complimentary to others (Other AP: $D_A * H$; BAO: D_A, H, D_V)
- **Novel statistics [Galaxy Density Gradient Field]**
 - » Complimentary to 2pCF
 - » Information from $\sim 10\text{Mpc}/h$

- **Follow-up studies**

Cosmological Constraints from
Redshift Dependence of 2pCF



A traditional Buddhist painting depicting a central Buddha figure with a large golden halo, seated on a lotus throne. He is surrounded by a large assembly of monks and celestial beings, all with golden halos, arranged in a semi-circle around him. The scene is set against a blue background with a mountain range at the bottom left. The text "Thank you" is overlaid in the center.

Thank you