Science with a Stage V galaxy survey: a few worked examples

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Motivation is clear:

- AMAZING!
- I could b[redacted]s[redacted] on demand for 30 mins on this, but AMAZING!

Quote from Anže Slosar, Cosmic Visions @BNL, Oct 1 2015, regarding the Billion Object Spectrograph

Below I list 3 examples:
somewhat non-standard cosmological tests for which my students and I have worked out forecasts

1. Measuring kinematic dipole with LSS

- Our motion through LSS rest frame
- Test: same as motion through CMB rest frame?
- Leads to relativistic aberration ("bunching up" of galaxies in direction of motion)

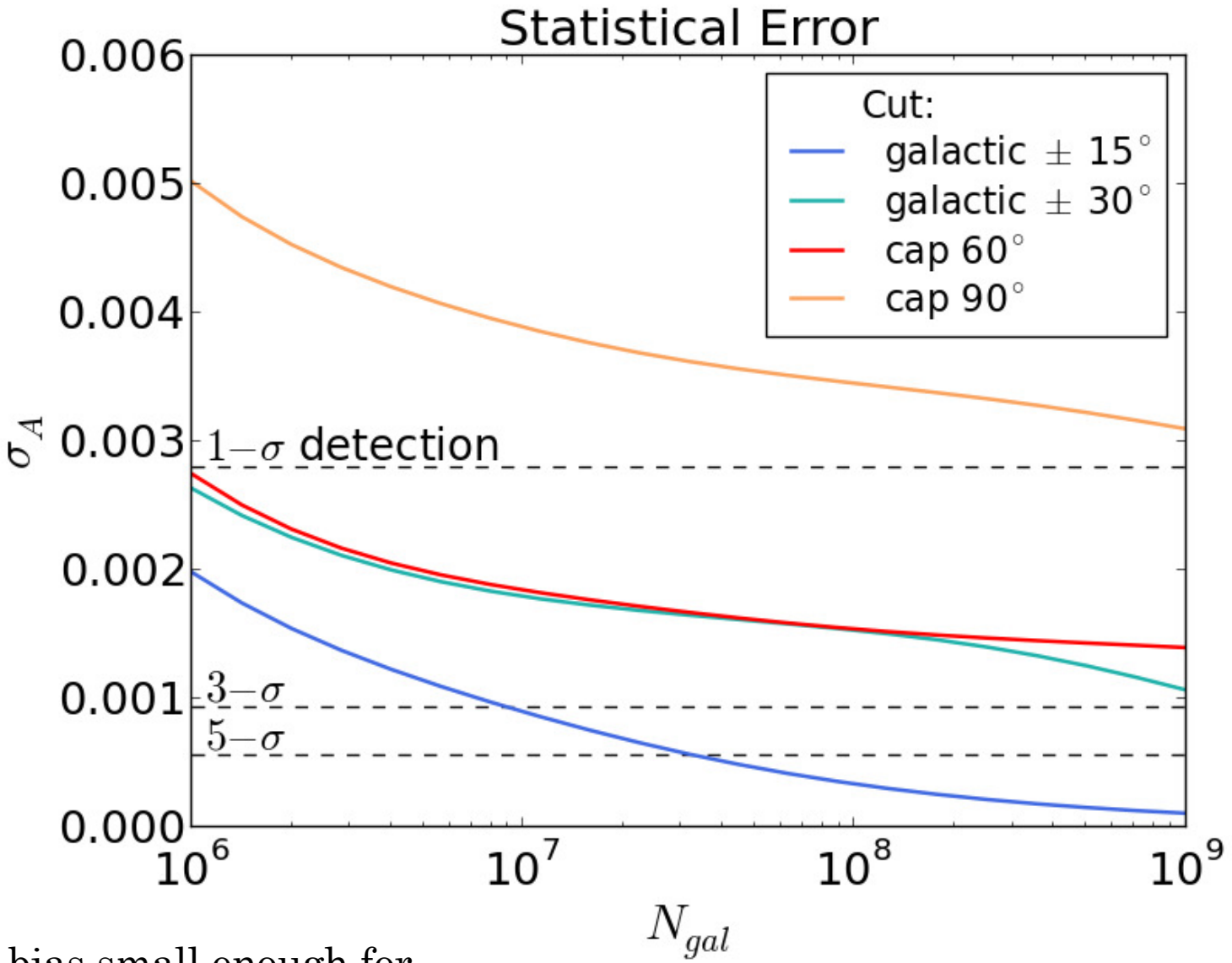
$$\frac{\delta N(\hat{\mathbf{n}})}{\bar{N}} = A\,\hat{\mathbf{d}}\cdot\hat{\mathbf{n}} + \epsilon(\hat{\mathbf{n}})$$

with amplitude A $\simeq$O(v/c)$\simeq$O(10^{-3})

Major contaminant: local-structure dipole
(the "usual" C_l signal due to finite depth)

1. need a wide ($f_{sky} \gtrsim 3/4$) survey to measure dipole well
2. need a deep ($z_{med} \gtrsim 1$) survey to suppress contam to $\ll 10^{-3}$

1. Measuring kinematic dipole with LSS



Also: sys bias small enough for
$z_{med} \gtrsim 0.75$ – not shown here

Yoon & Huterer, arXiv:1509.05374

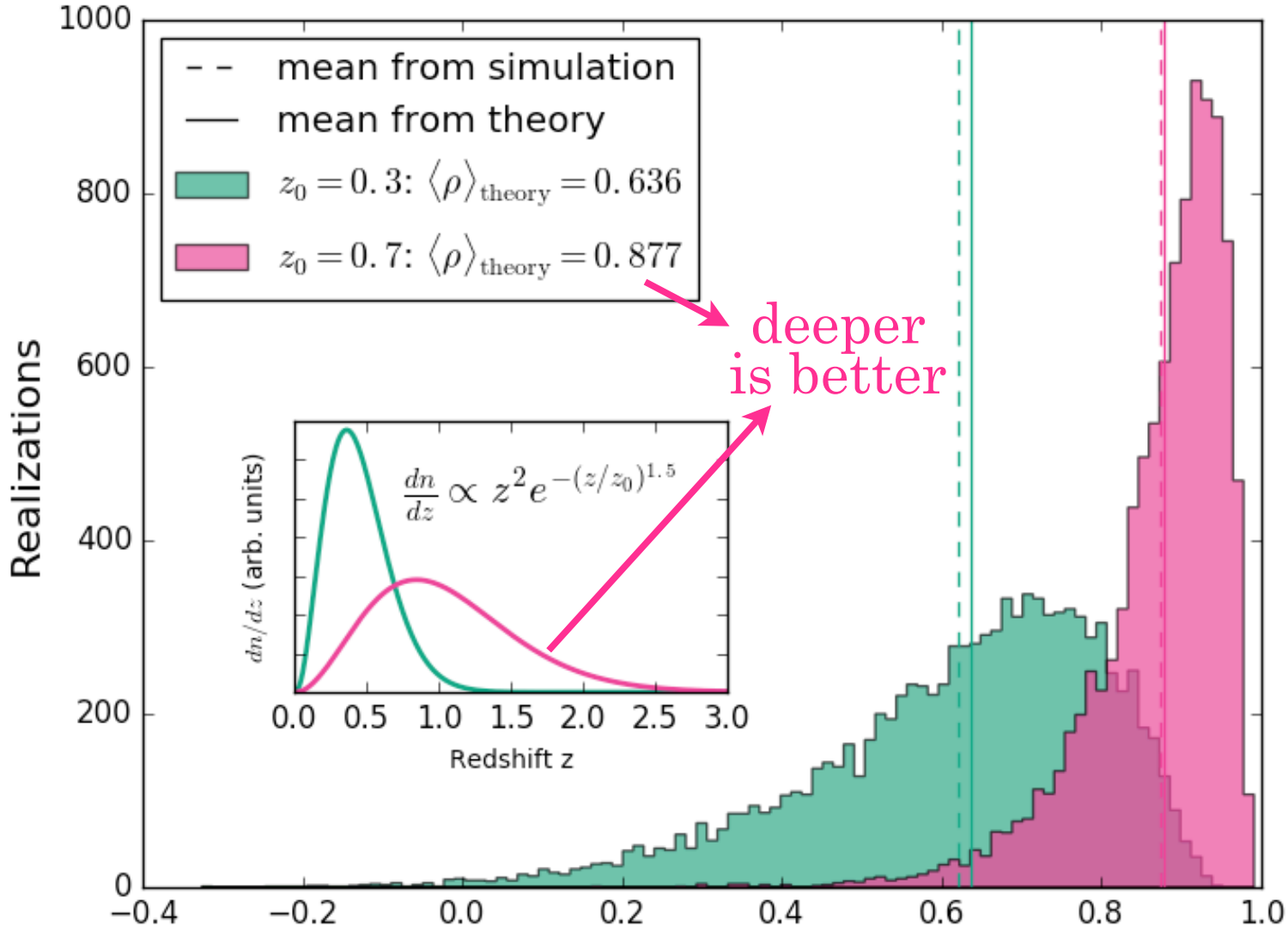
2. Reconstructing the ISW signal

- Use LSS maps to "peel off" the ISW contribution to CMB maps at low-ish multipoles
- $\Rightarrow$ Can separate the late-time and early-time CMB contributions
- LSS gives info about gravitational potential (and its decay) that governs the ISW

$$\left.\frac{\Delta T}{\bar{T}}\right|_{ISW}(\hat{n}) = \frac{2}{c^2}\int_{t_*}^{t_0} dt\, \frac{\partial \Phi(\vec{r},t)}{\partial t}$$

- Previous work: Manzotti & Dodelson 2014; Peacock & Francis 2010
- **Having a deep, very wide LSS survey would be great!**

2. Reconstructing the ISW signal



$\rho = \langle T_{\rm true} T_{\rm rec} \rangle_{\rm pix} / \sigma_T^{\rm true} \sigma_T^{\rm rec}$ = goodness of ISW reconstr.

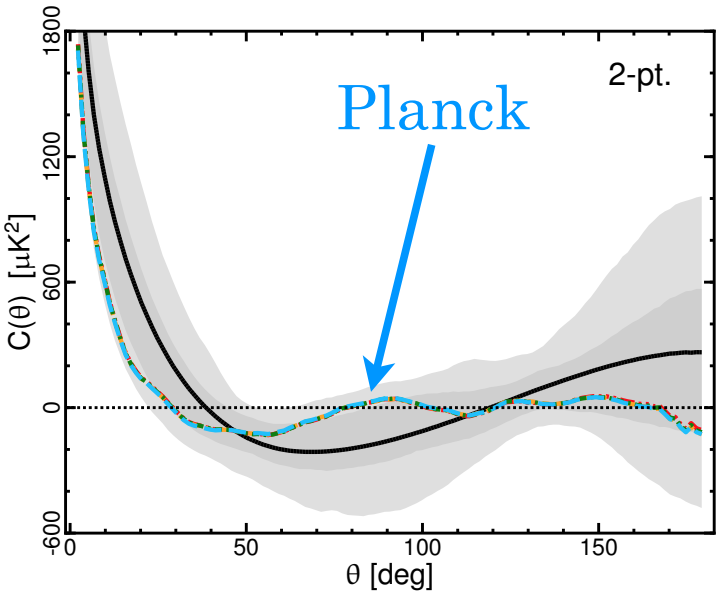
Muir & Huterer, in preparation

3. Constraining large-angle suppression in LSS

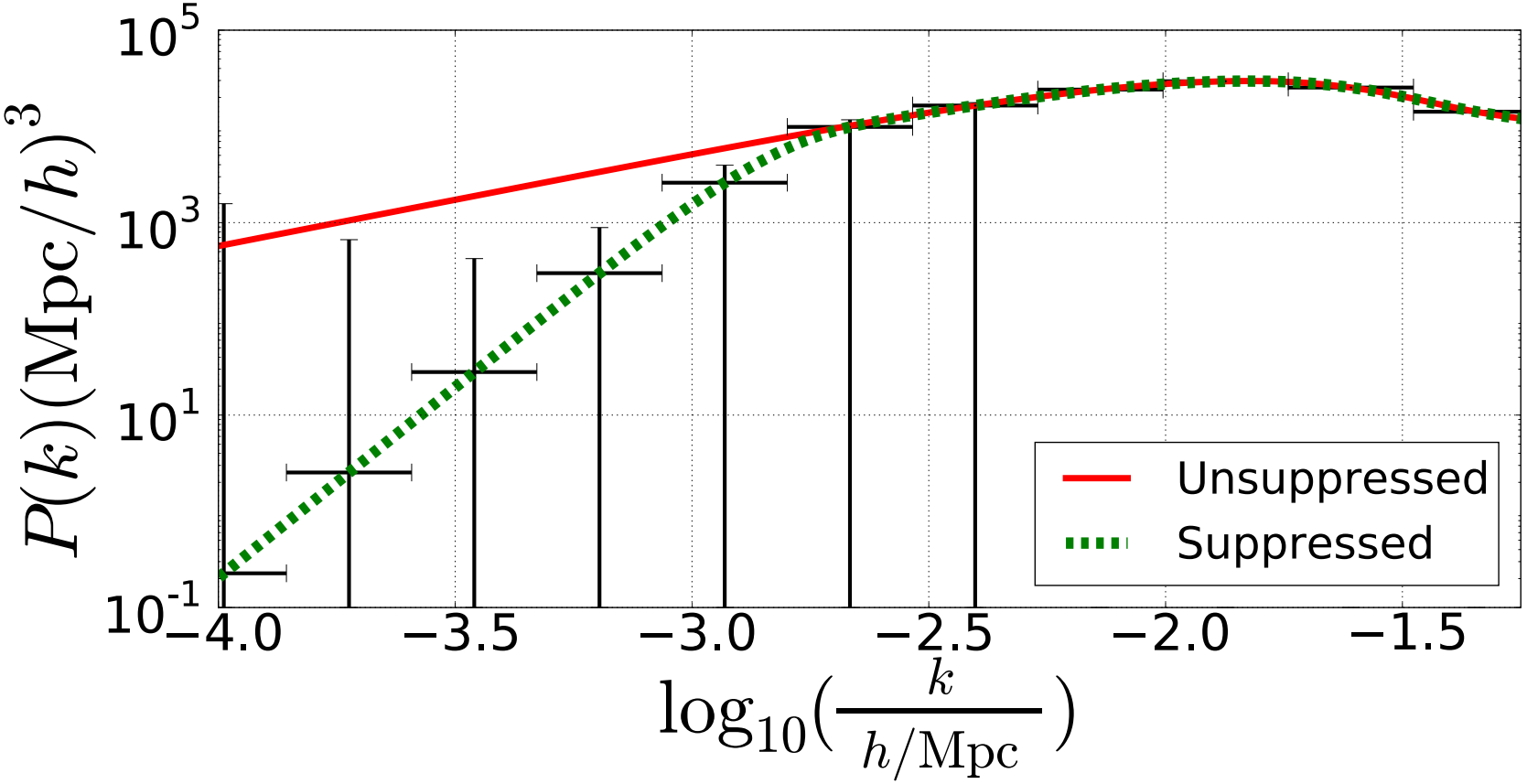
- WMAP and Planck indicate a severe lack of correlations at very large angles in the CMB...
- ... that is, C(θ≳60) is near-vanishing
- No good explanation, but it could be a (very unlikely) fluke - in that case, power in LSS is also suppressed...
- ... and we'd expect P(k) to be suppressed at $k \lesssim 1 h\mathrm{Gpc}^{-1}$

To check with LSS, need a huge-volume survey with good/excellent photo-zs

True for all CMB anomalies, not just this example!



3. Constraining large-angle suppression in LSS



Error bars are LSST volume and N_{gal} with spectroscopic redshifts
(7.6 sigma detection forecasted for the above suppression)

Gibelyou, Huterer & Fang, PRD 2010

Conclusions

Discussed three tests:

1. Kinematic dipole with LSS
2. ISW map reconstruction with LSS
3. Checking missing large-angle corr. with LSS

These and others would benefit enormously from
LSS survey with
huge volume and good z information