K-cut Cosmic Shear

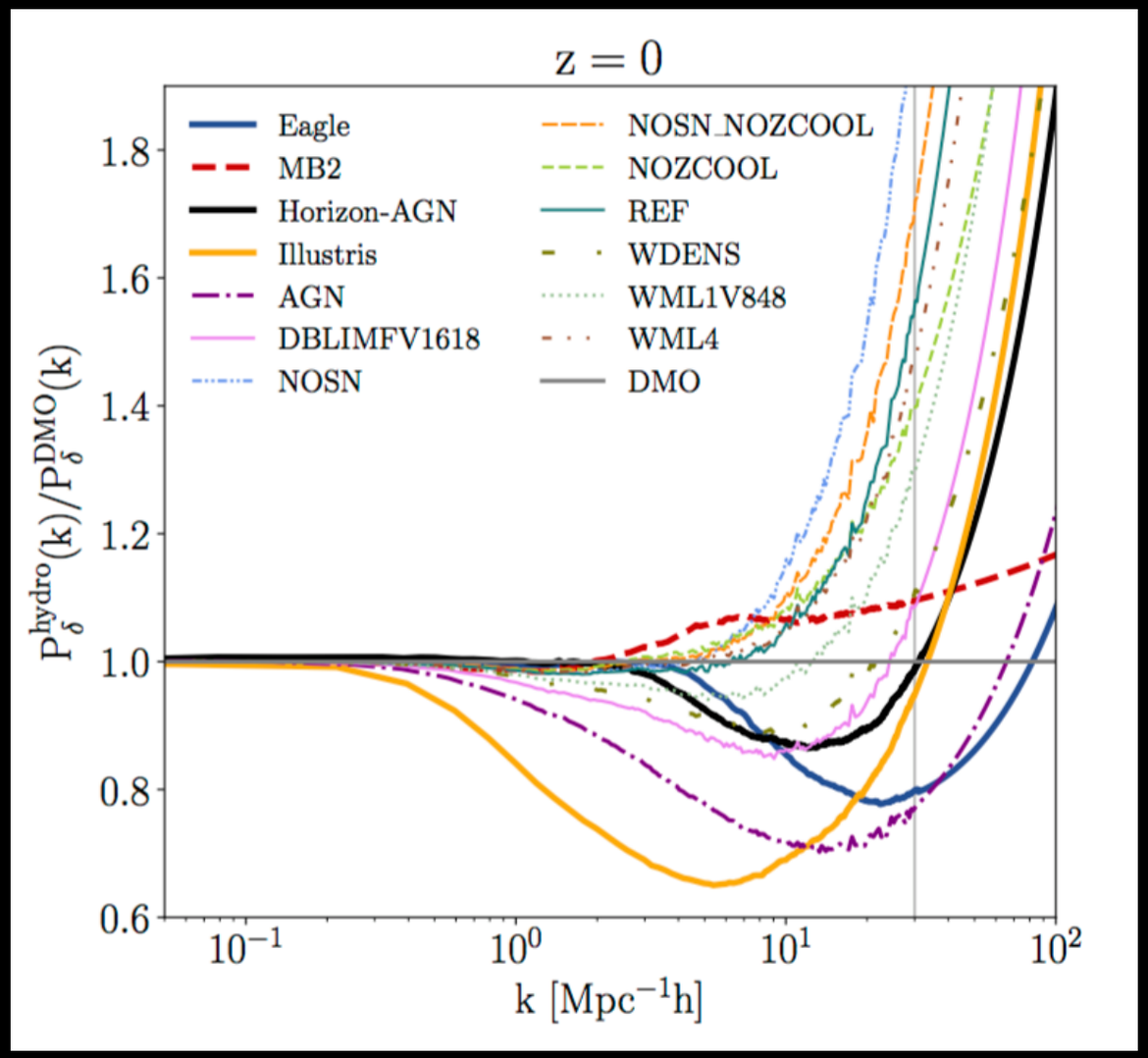
Peter Taylor in collaboration with
Francis Bernardeau & Tom Kitching

Peter Taylor

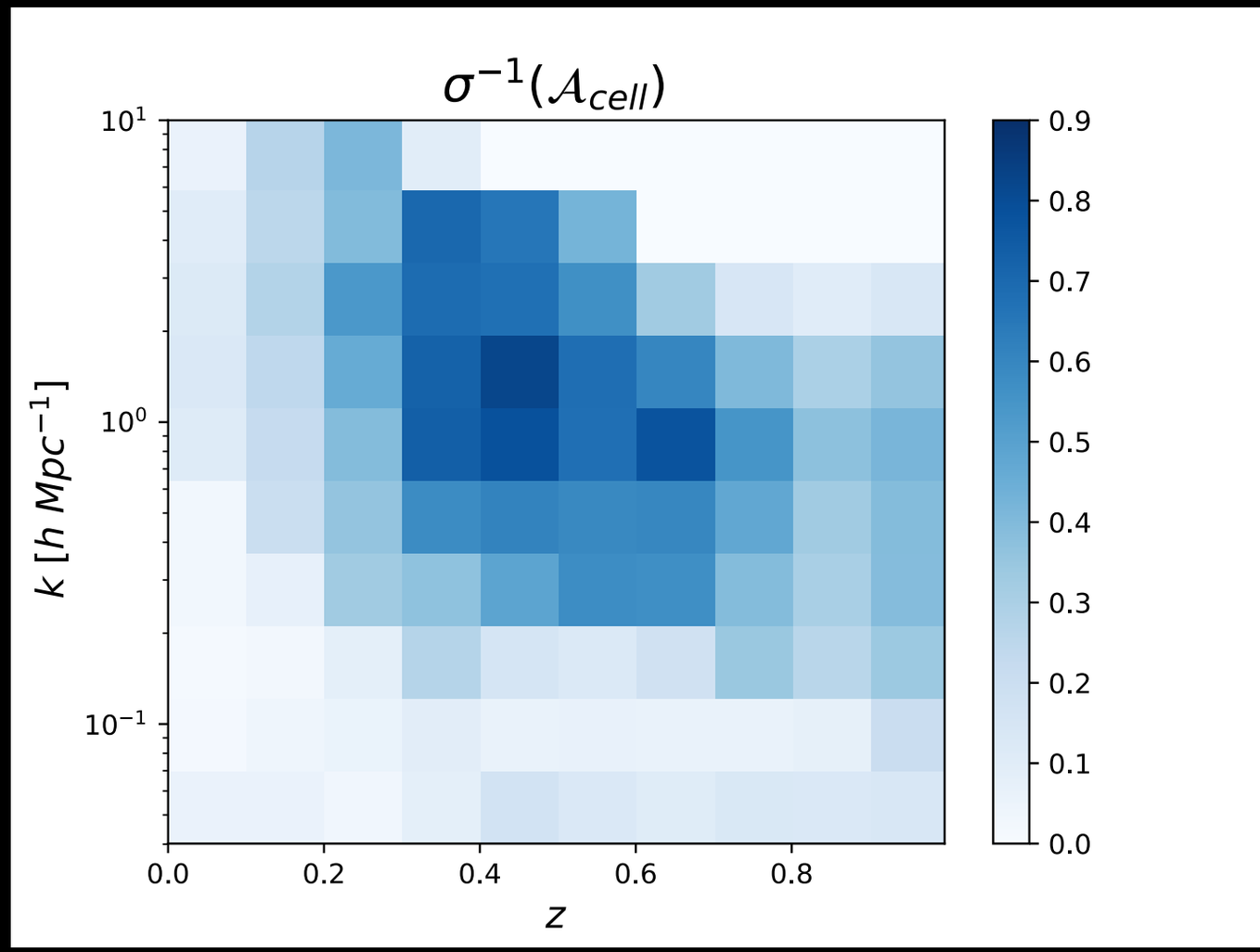
Motivation

Peter Taylor

Lensing Sensitive to Difficult to Model Scales



Huang et al. 2018



Taylor et al. 2018

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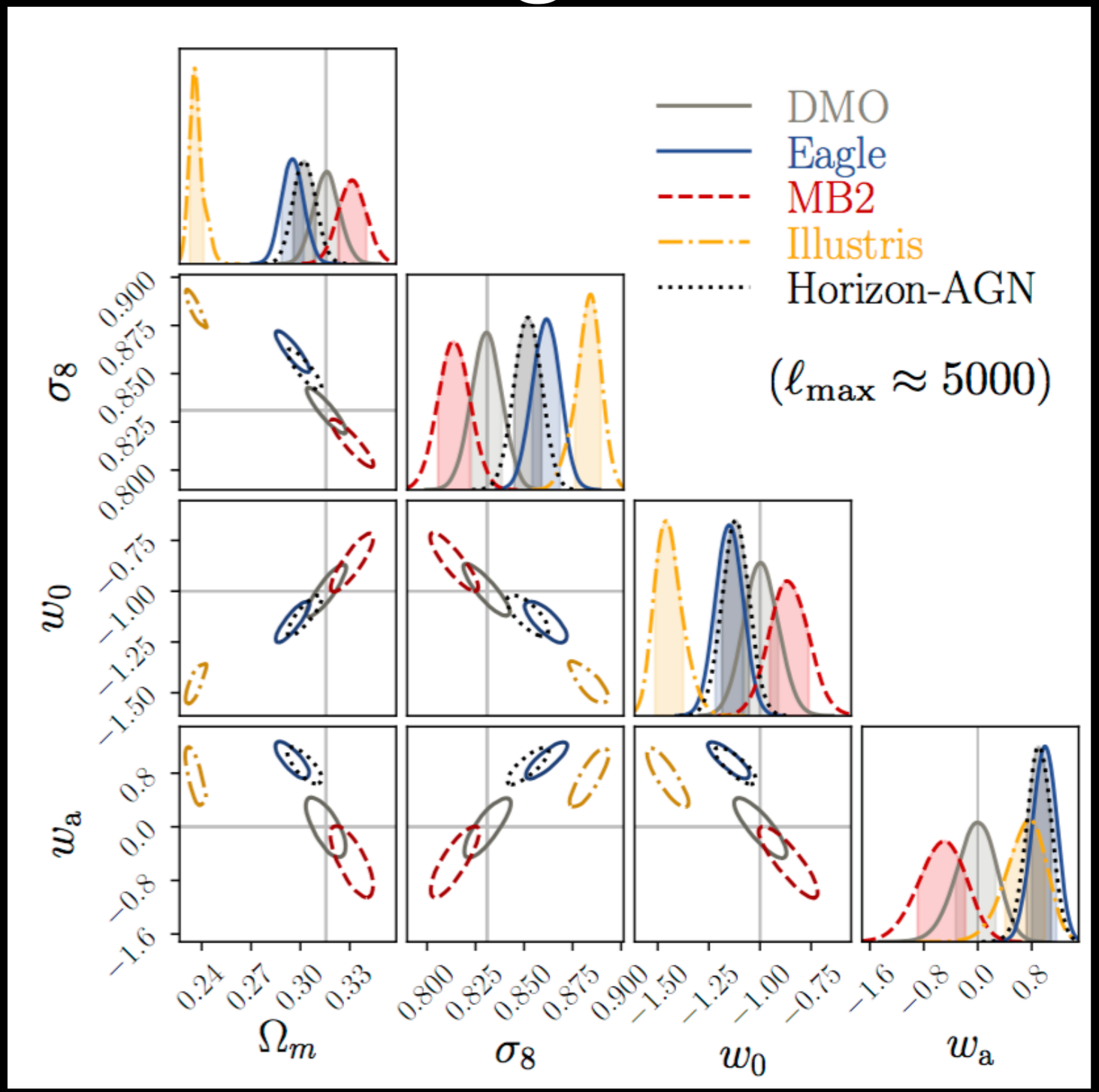
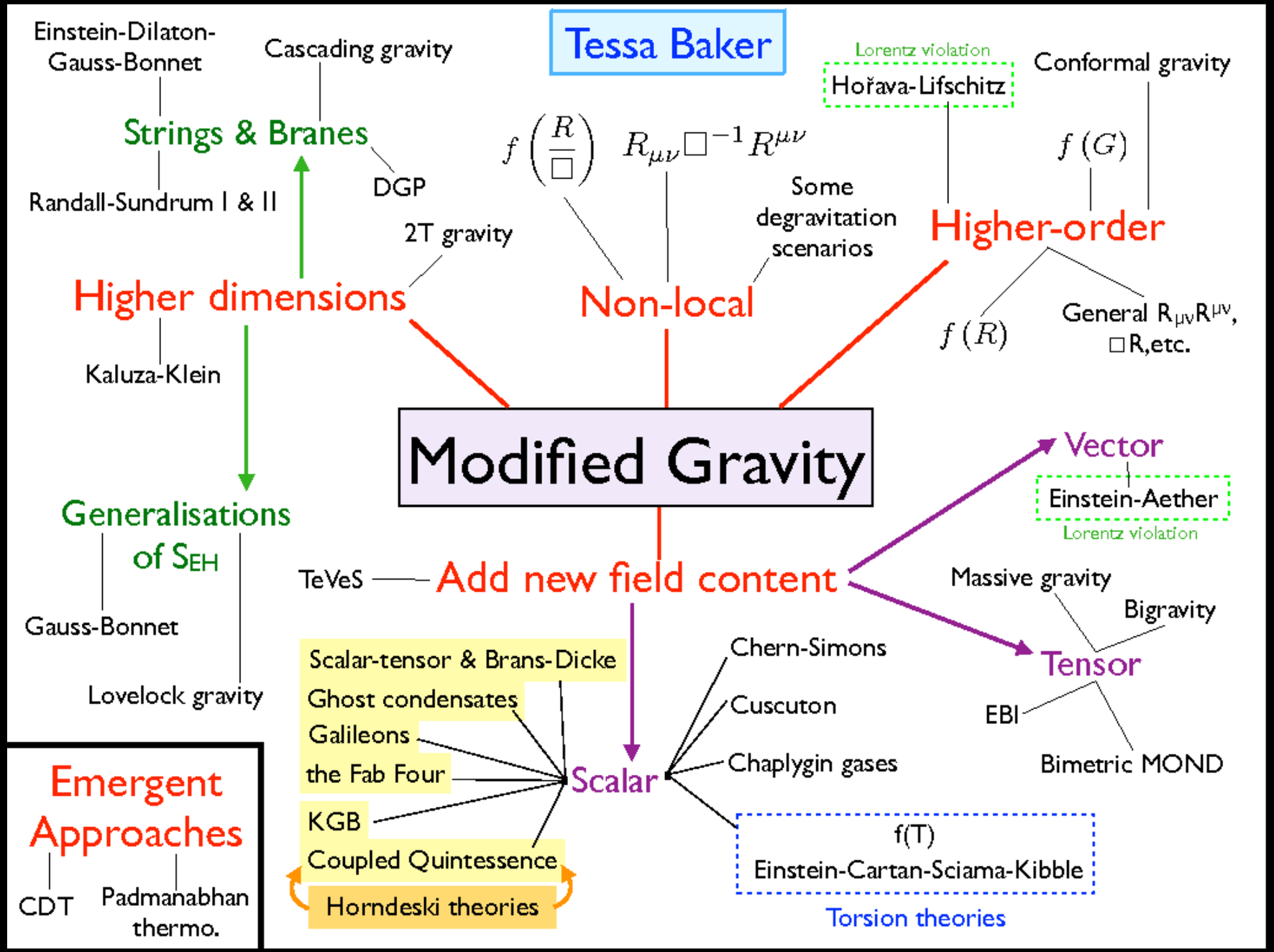
N-body Simulations Don't Agree



Huang et al. 2018

Don’t Want to Just Test LCDM



Tessa Baker, Oxford

Reality

- Euclid launch ~3.5 years
- 1% accuracy requirement for k < 7 h/Mpc (Taylor, Kitching, McEwen, 2018)
  - HALOFIT 5% for k ≤ 1h/Mpc; 10% for k ≤ 10h/Mpc
  - COSMIC EMU and HMCode 1% for k≤1h/Mpc; 5% for k≤10h/Mpc
  - N-body sims don’t agree
  - Best emulators only available for w0/wa cosmology

K-cut Cosmic Shear

The Limber Relation & the Shell Universe

If all matter lies at distance r

to cut all $k > k_{cut}$

Limber relation $\implies$ cut $\ell > k_{cut} r$

Problem: Lensing Kernels Are Broad

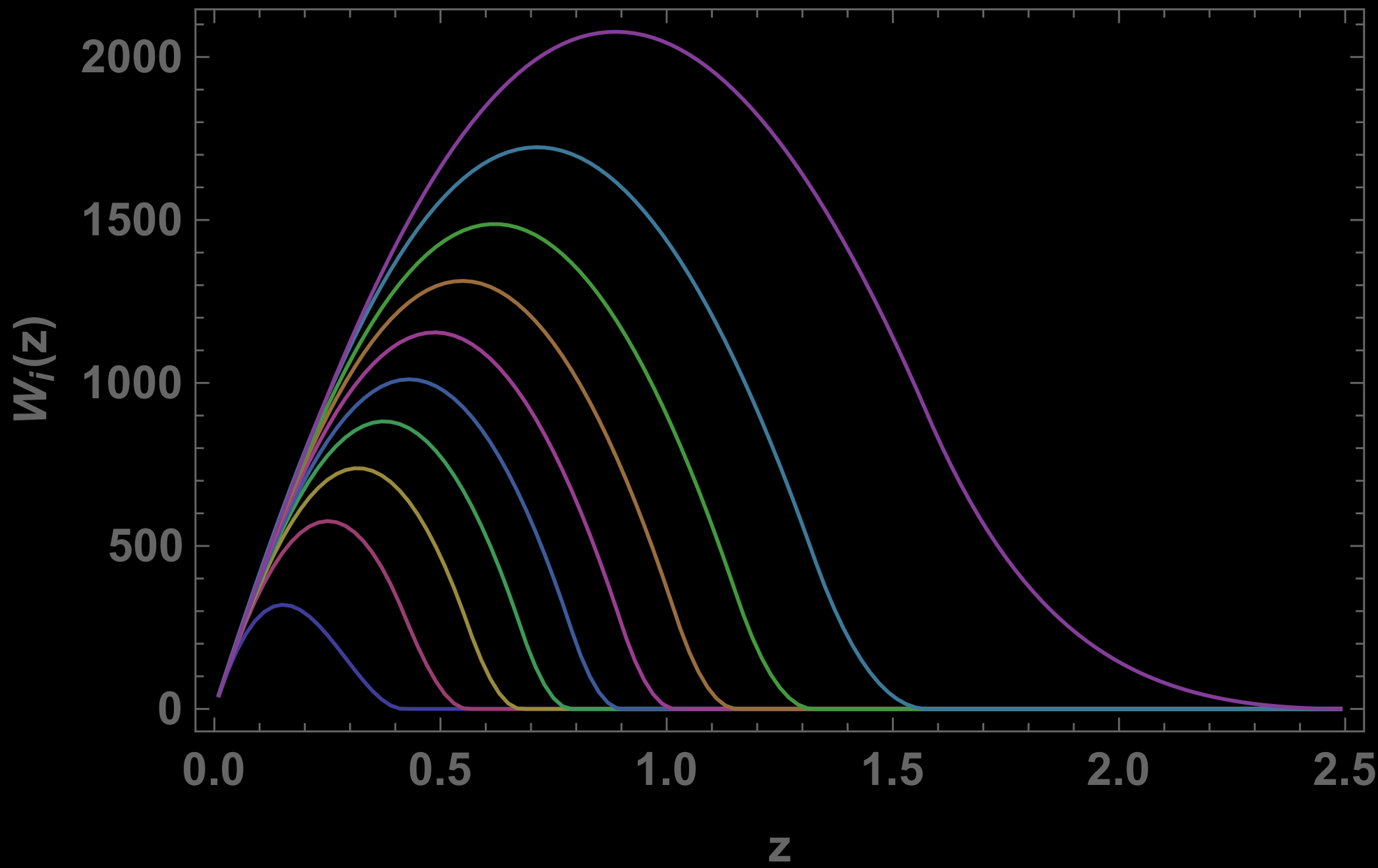


Image Credit: Francis Bernardeau

Bernardeau-Nishimichi-Taruya (BNT) Nulling Scheme

Assume 3 source planes: $r_1 < r_2 < r_3$

$$\tilde{\kappa} = \frac{3\Omega_m H_0^2}{2c^2} \int_0^{r_i} \mathrm{d}r \frac{\delta(r)}{a(r)} w(r)$$

$$w(r) = \sum_{i, r_i > r} p_i \frac{r_i - r}{r_i}$$

construct $w(r) = 0$ for $r < r_1$

see arxiv 1312.0430

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Bernardeau-Nishimichi-Taruya (BNT) Nulling Scheme

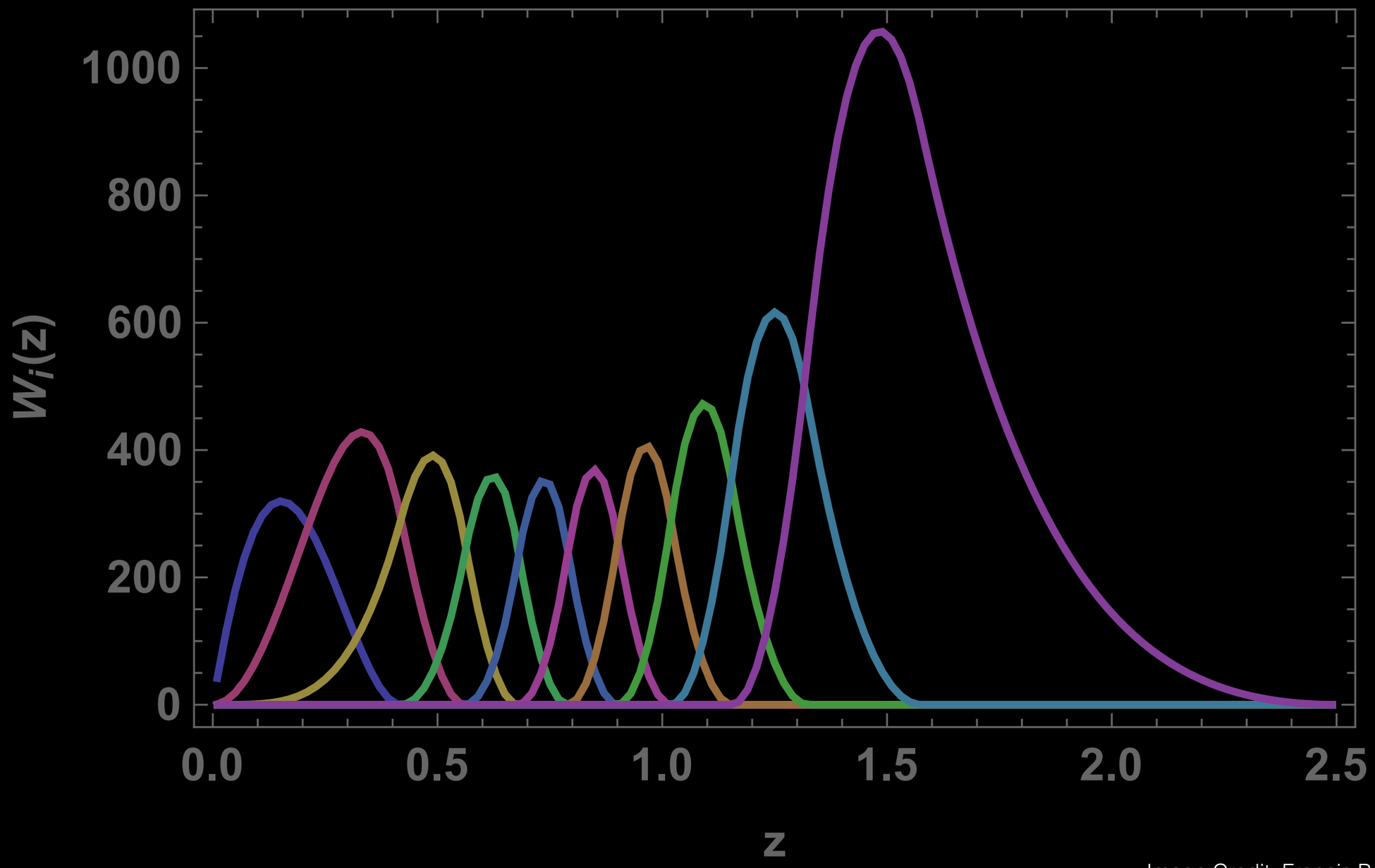
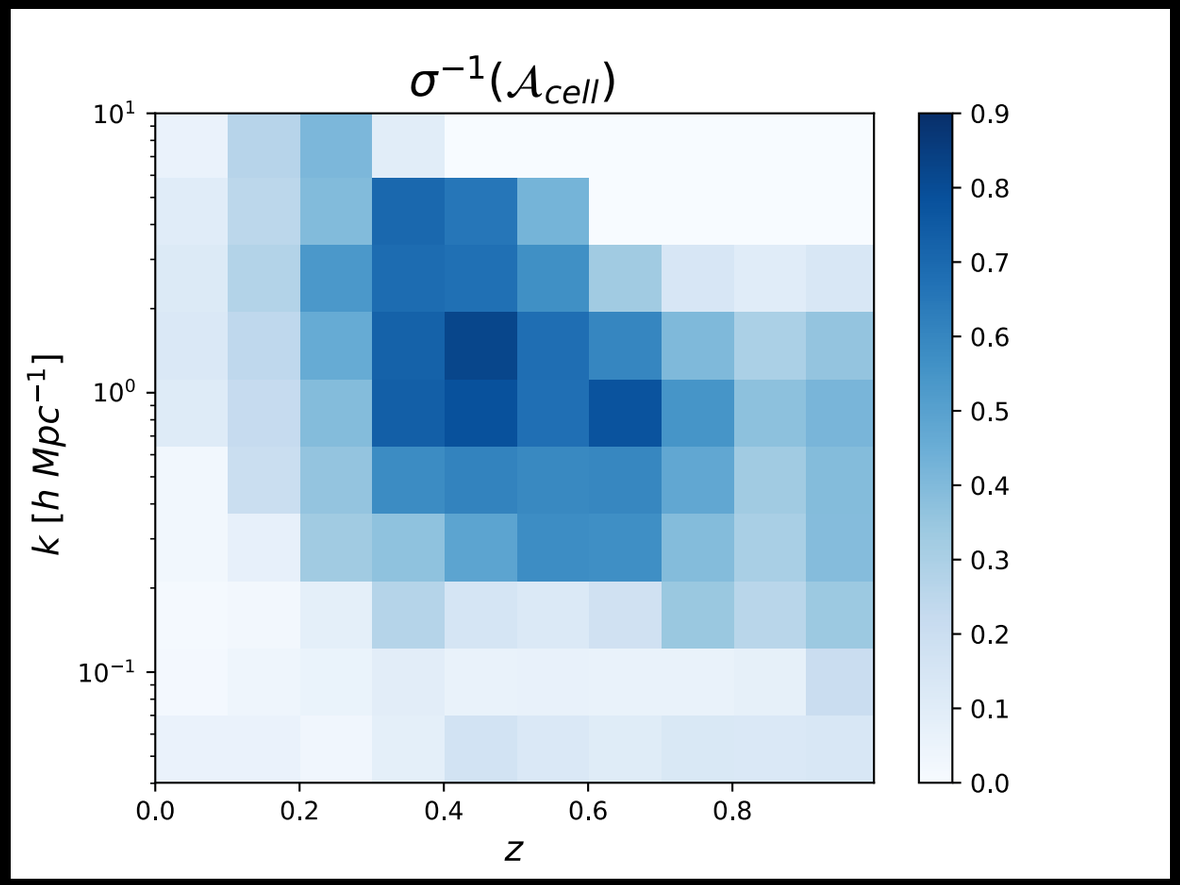


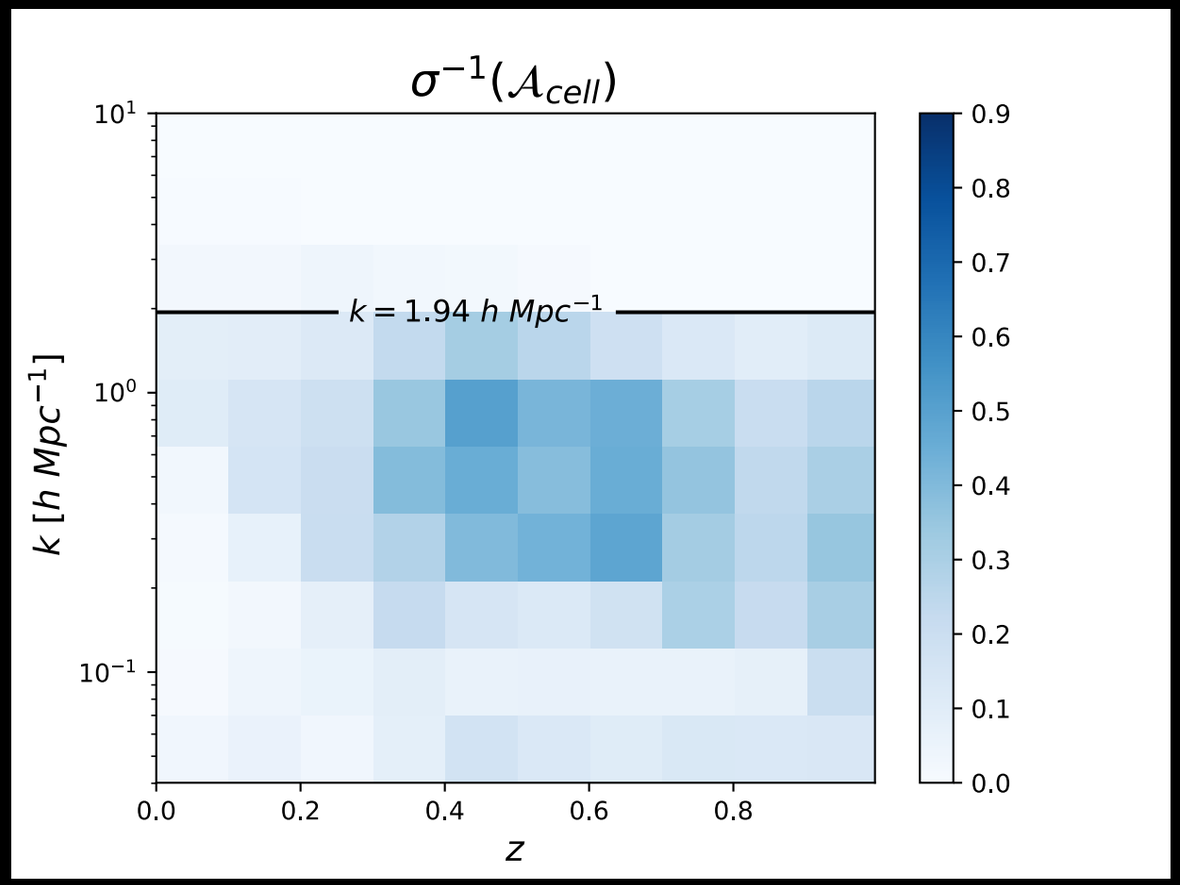
Image Credit: Francis Bernardeau

K-cut Cosmic Shear

- Step 1: BNT transform
- Step 2: Bin dependent l-cut

Result





$$\frac{\sigma_{1.94}\left(w_0\right)}{\sigma_{fid}\left(w_0\right)} = 1.3$$

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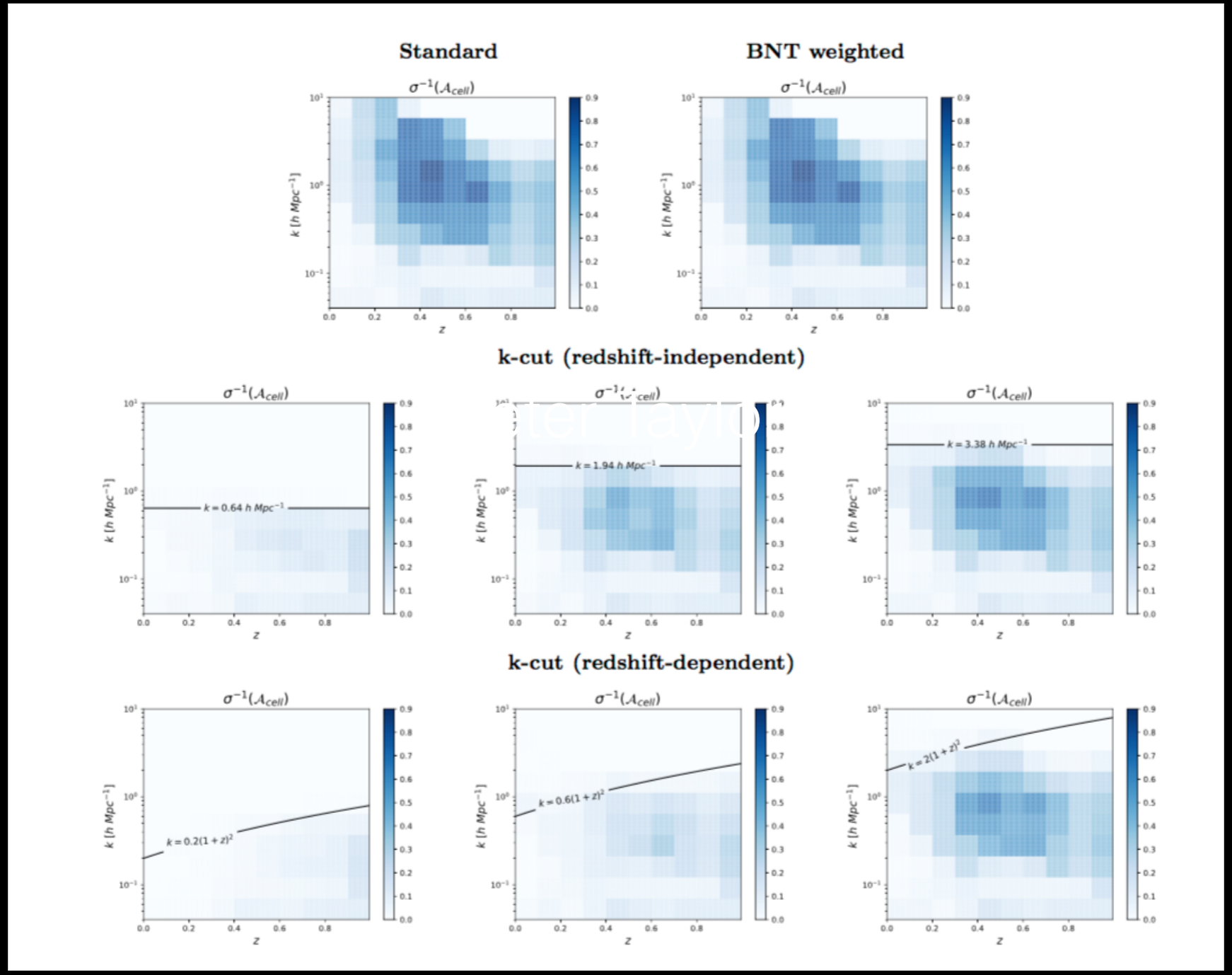
Effectiveness



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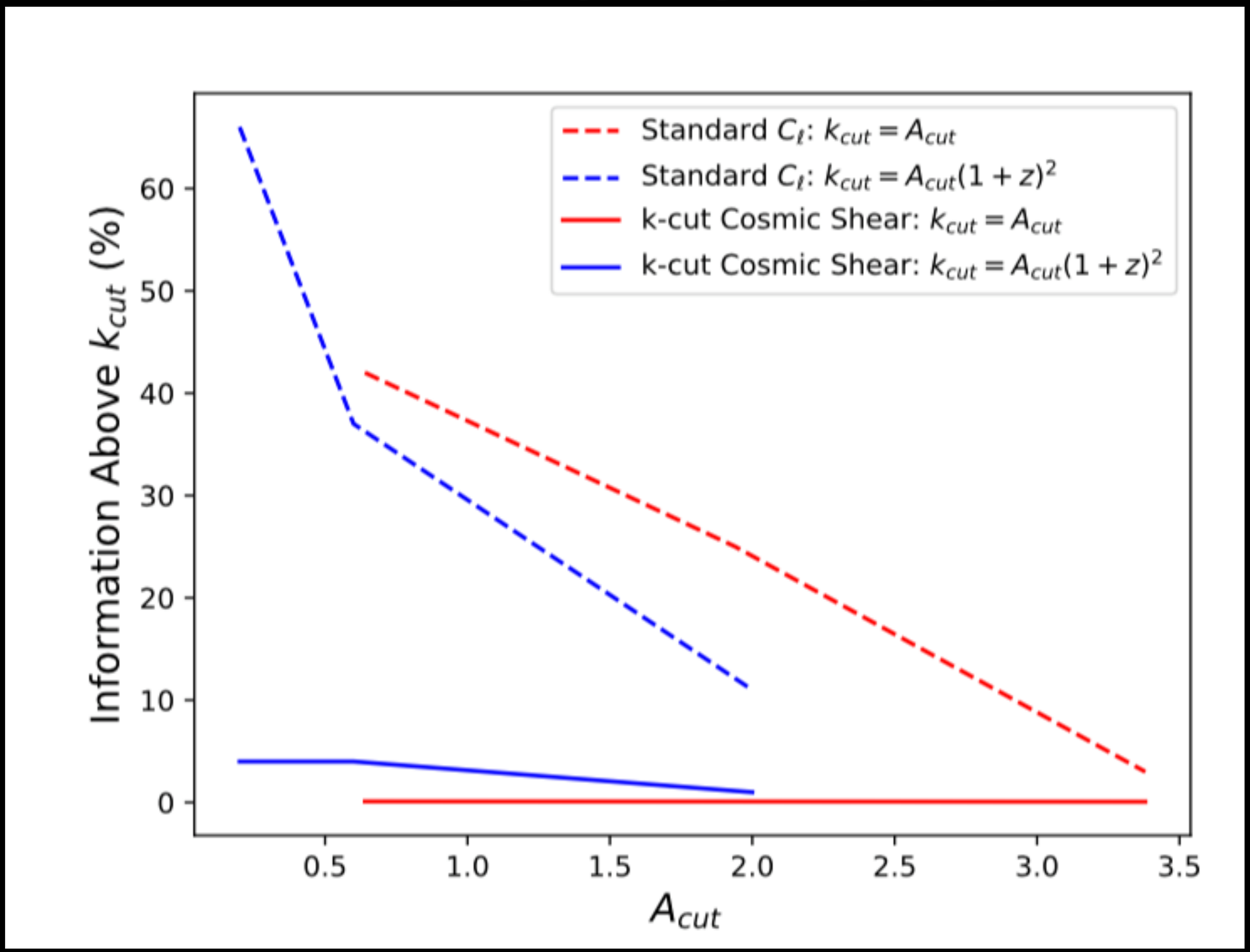
Effectiveness



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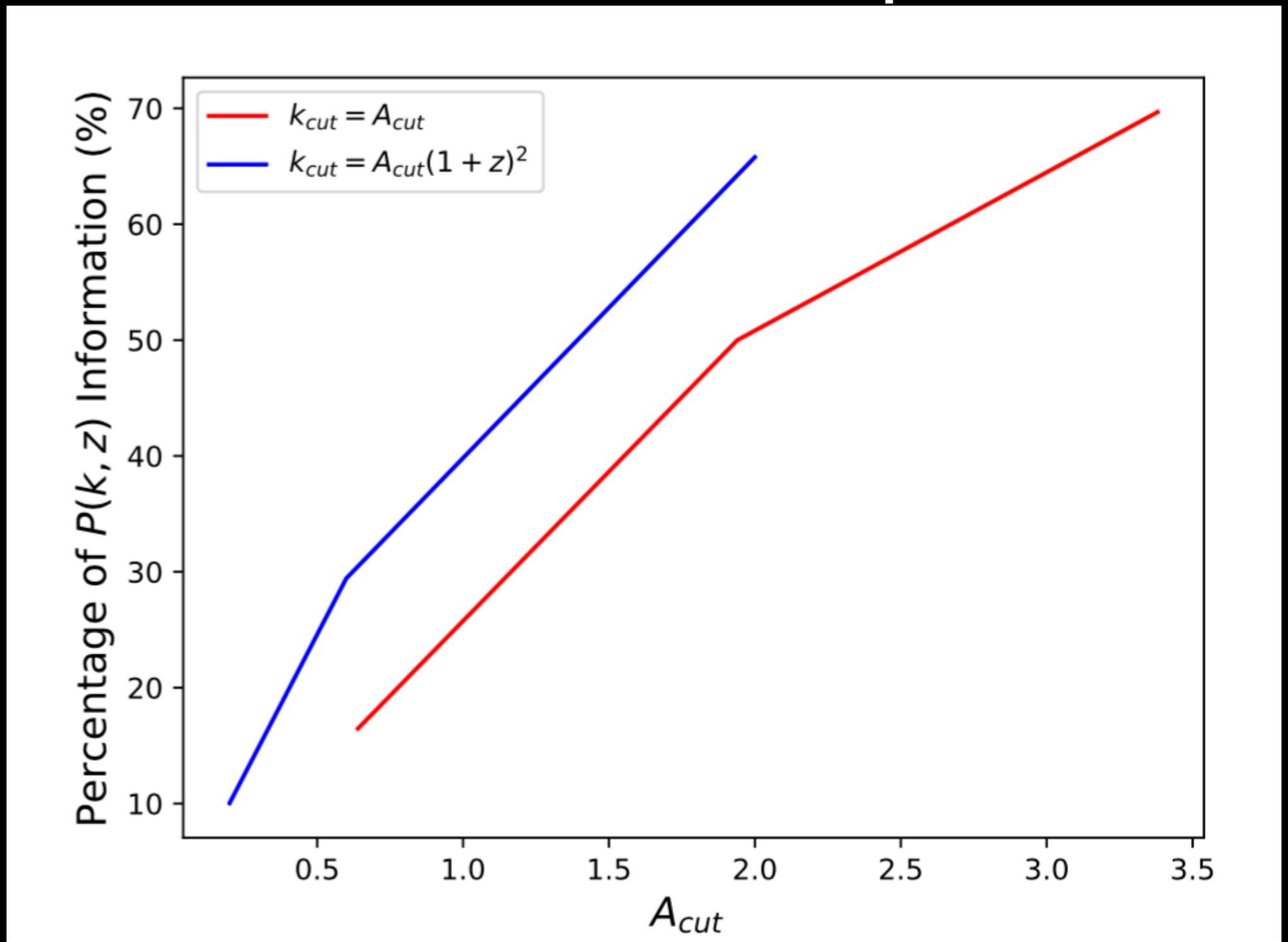
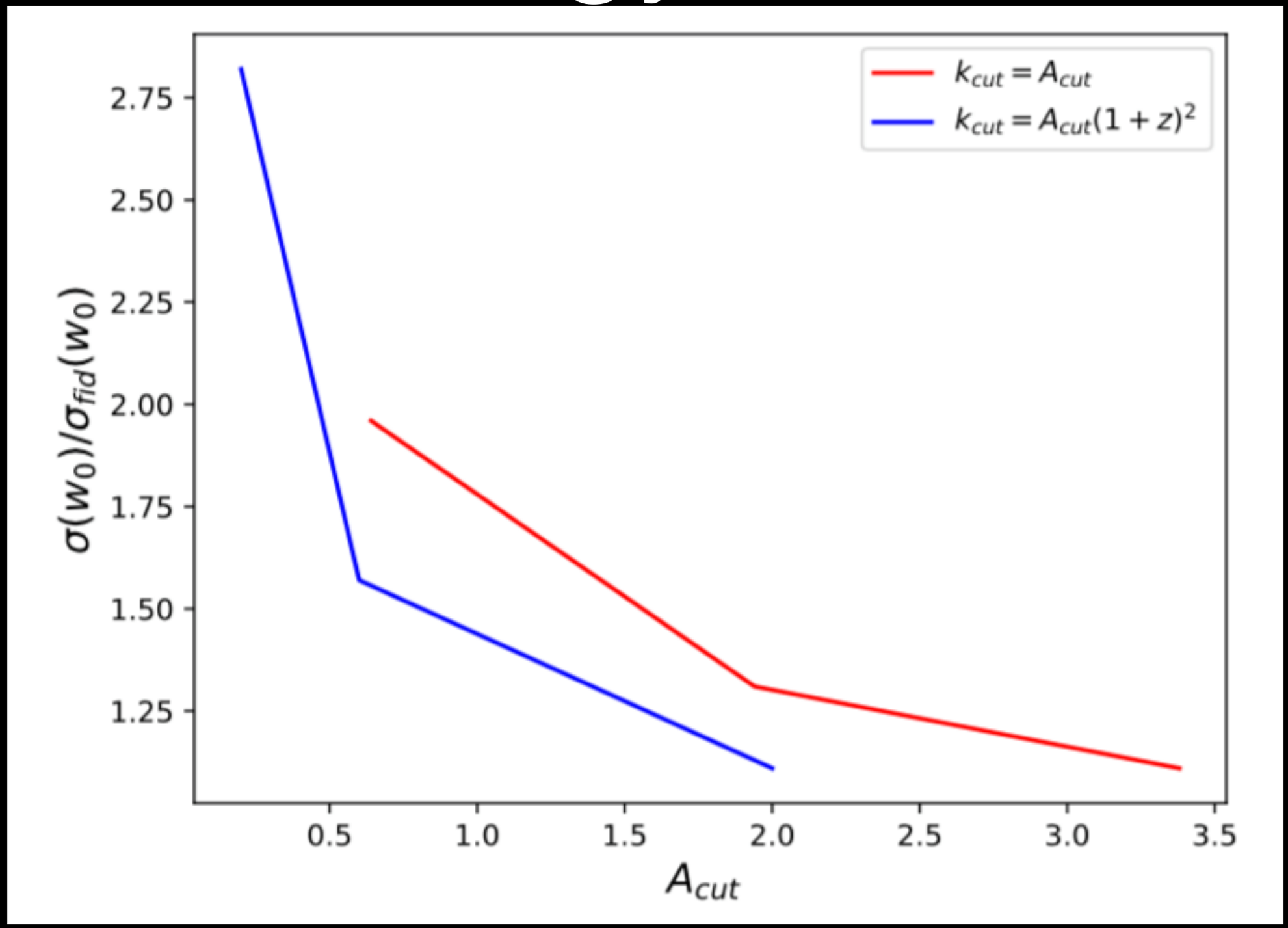
Information Captured



Dark Energy Constraints



Taylor et al. 2018

A To-do List

- Varying cosmology?
- Intrinsic alignments?
- What k-cut should we take?
- Can we get away with gaussian covariances?
- Apply to data.

Conclusion

- k-cut cosmic shear removes sensitivity to large k.
- Small degradation in dark energy constraints
- Next Steps:
  - Apply to data
  - Test impact of IA + varying cosmology
  - arxiv 1809.03515