Depth Systematics for Redshift Tomography on the Cosmic Infrared Background

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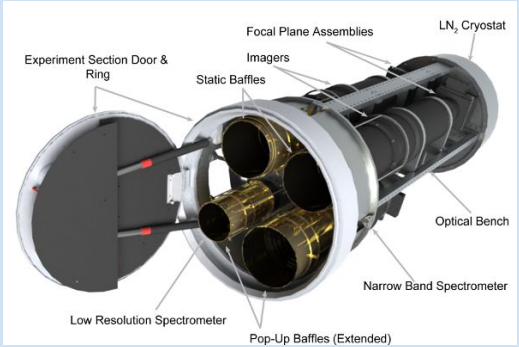
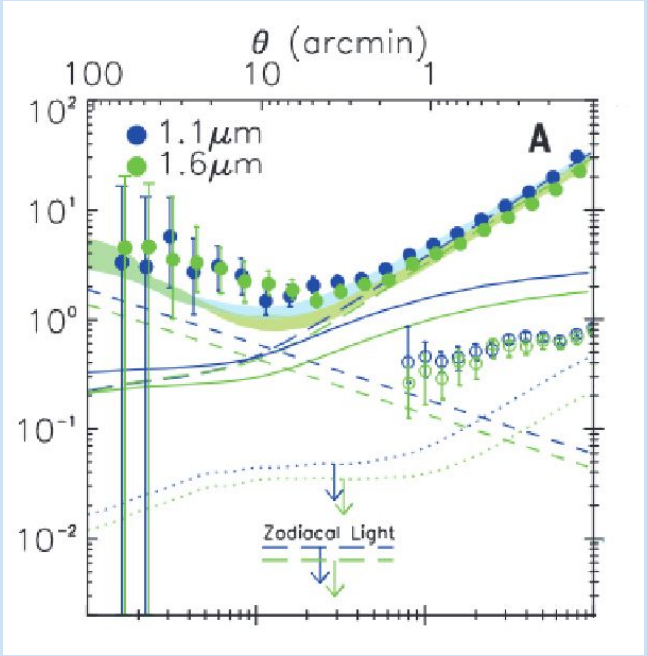
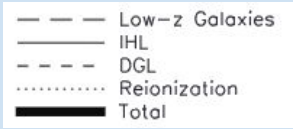
EBL x Redshift Tracers: Another Probe of 3D Structure

- CIBER/CIBER2: Sounding rocket based suborbital instruments to measure near-infrared CIB
- **CIB fluctuations, rather than direct measurement, can bypass Zodiacal Light contamination**



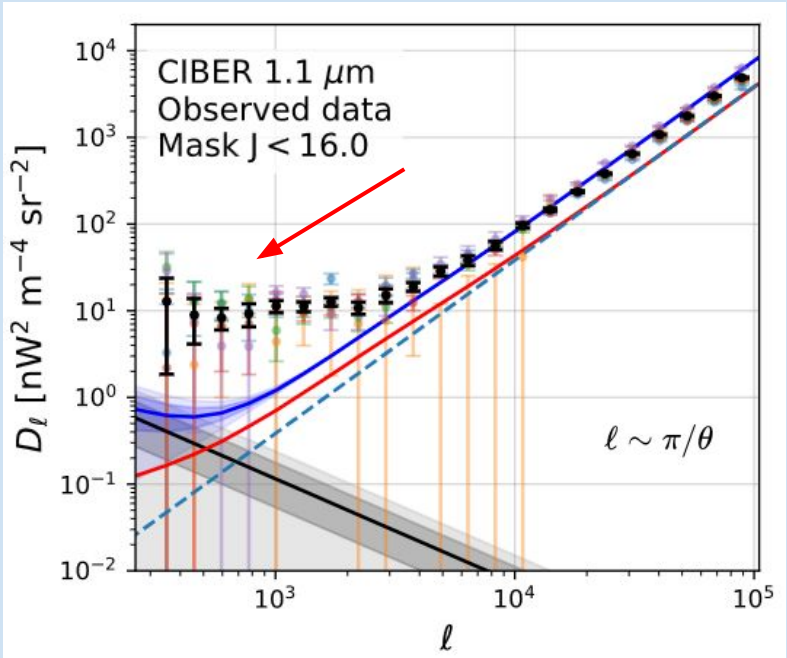


CIBER autospectrum (Zemcov+ 2013)



EBL x Redshift Tracers: Another Probe of 3D Structure

- Cross-correlating intensity maps with known redshift tracers promises insights into 3D structure of CIB fluctuations (Cheng & Chang 2022)
- **Redshift sources from galaxy catalogs:** HSC, Legacy, WISE
- **Fluctuation maps:**
  - **SPHEREx** (Cheng & Chang 2022 forecasts)
  - **CIBER** (Feder, in prep)
- Ex: **What redshifts contribute to power at large scales?**



CIBER autospectrum
(Feder+ 2025b)

CIB x Redshift Measurements: Depth Systematics

Galaxy surveys typically not uniform

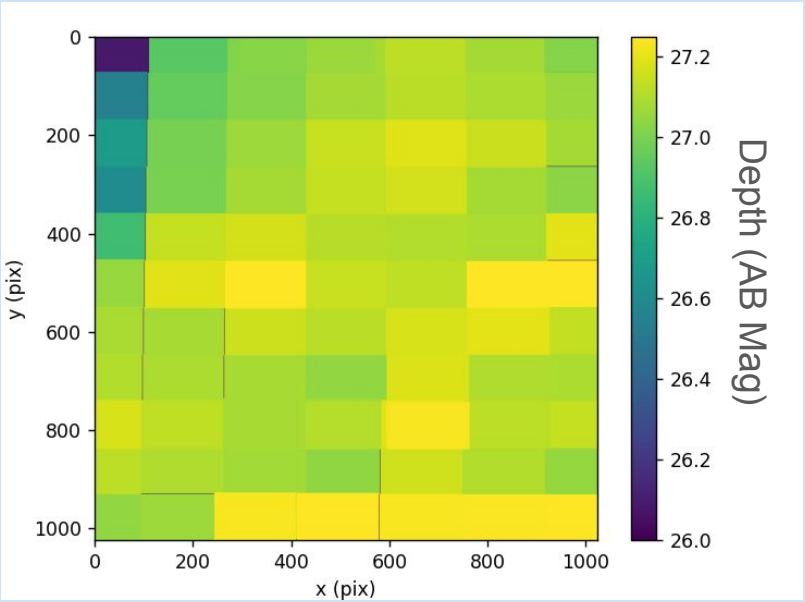
→ **Small variations in source depth add power to spatial cross-spectra at relevant scales**

Case study: **HSC**
(HSC-i → 1st in priority order)

→ Why not use the easy way out: **Magnitude cutoff?**

→ **We can - but…**

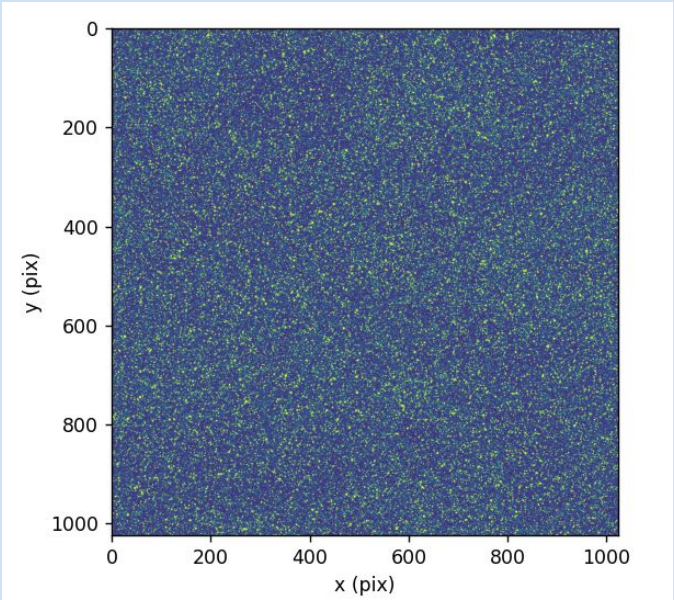
- For **CIBER**: Small FOV → Poisson levels may be an issue
- Ideally, would like to avoid removing large numbers of faint sources



HSC-i Deep/UltraDeep patch depths on a 2x2deg CIBER-like field

Modeling Depth Map Impacts with Galaxy Mocks

Using mock sources with simulated clustering (J. Mirocha+, in prep), we can model the effects of non-uniform survey depth on CIB x Photo-Z with CIBER-like maps



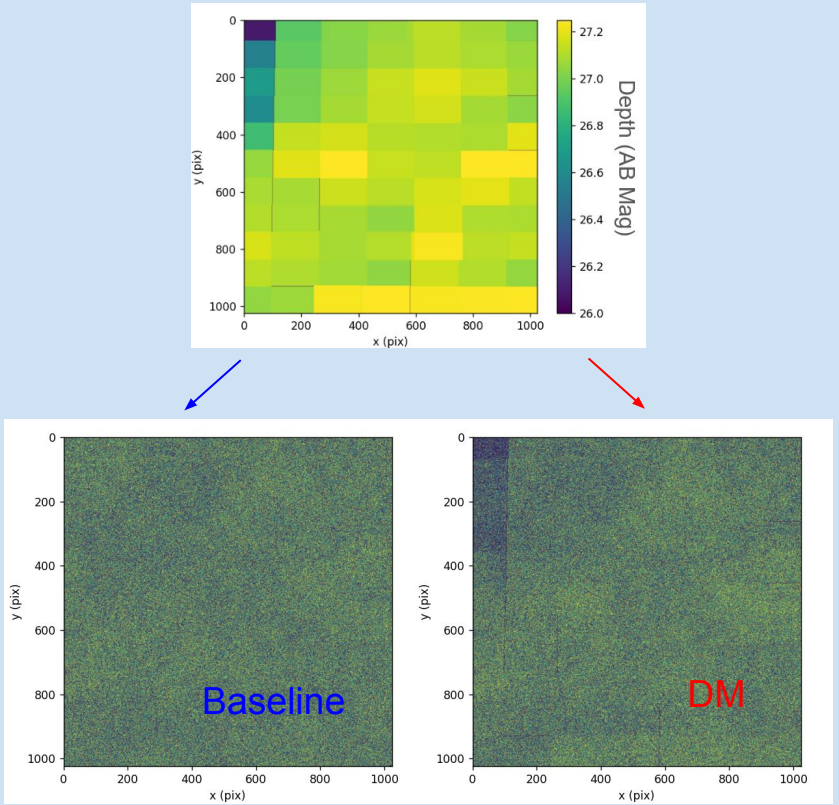
CIBER-like 2x2deg mock intensity maps

Modeling Depth Map Impacts with Galaxy Mocks (cont.)

Overdensity maps of mock redshift tracers

- HSC-i D/UD Depth Map
- Simplify rolloff by excluding all sources above depth
- **1: Baseline**
- **2: Depth-mapped**

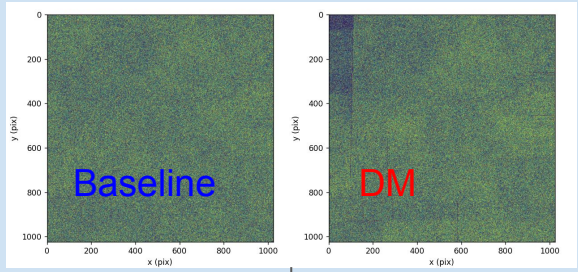
→ Adds power at large scales

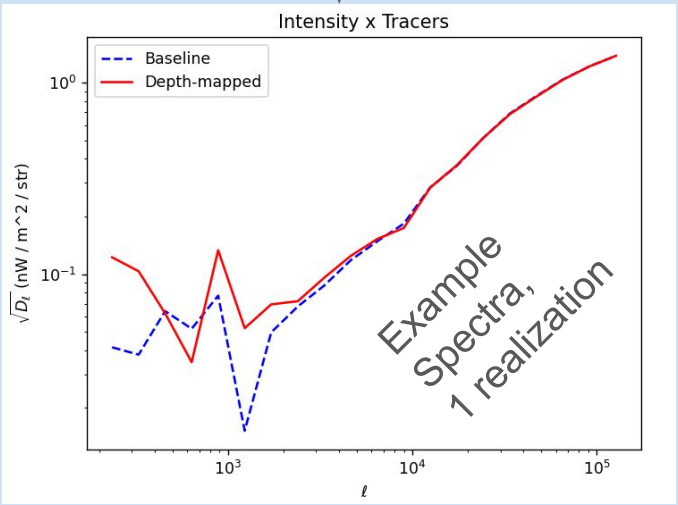


Modeling Depth Map Impacts with Galaxy Mocks (cont.)

→ **Adds power at large scales**

ℓ~1000 scale corresponds to
~12arcmin HSC patches





Conclusions & Next Steps

It can benefit redshift x CIB measurements to not ignore depth variation

1. **More comprehensive models with many mock realizations**

2. **Model and apply corrections**
   - Imprinting depth map as density variations on custom HSC random maps

3. **Potentially inform an optimal magnitude cutoff / other catalogs**