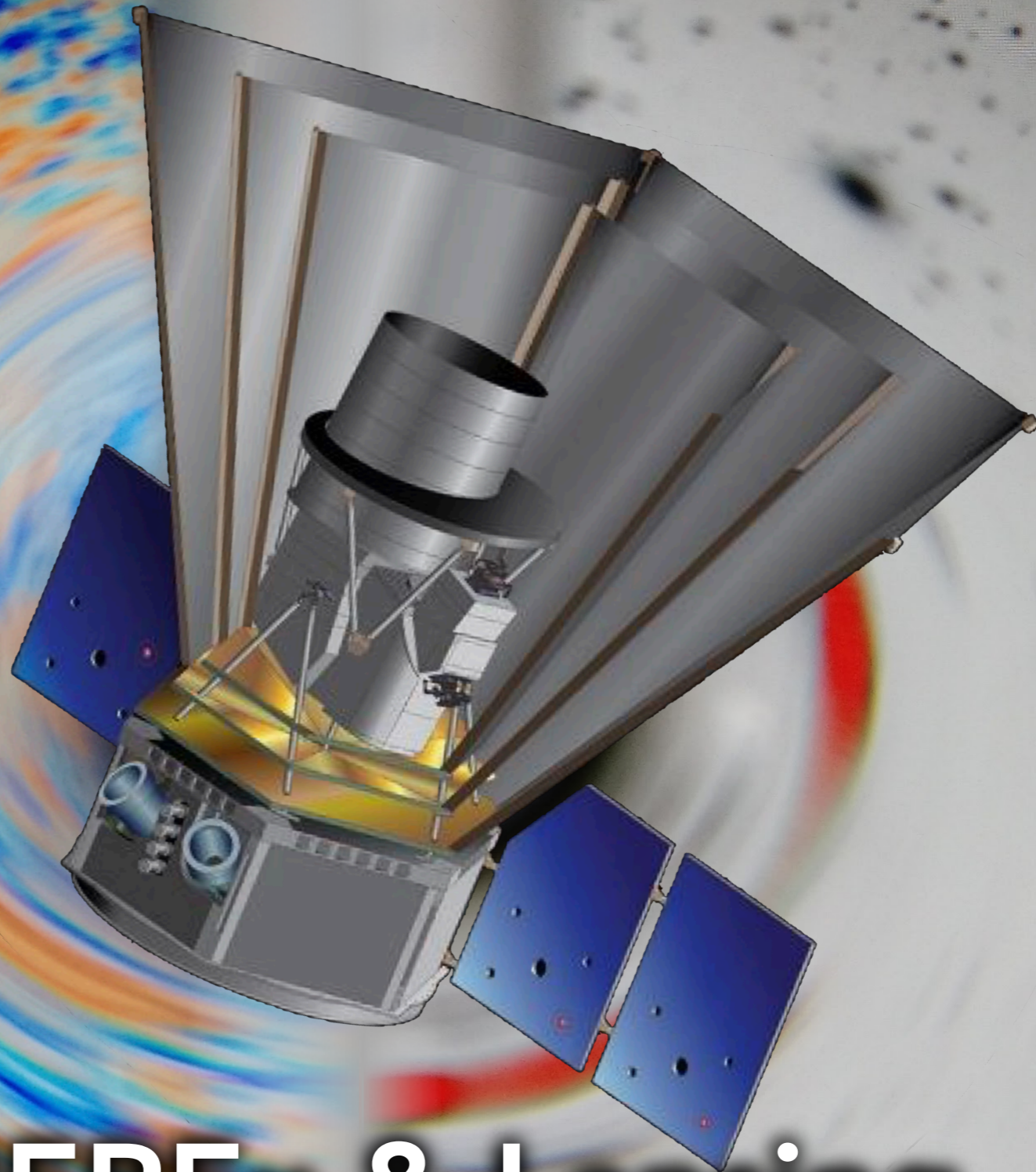
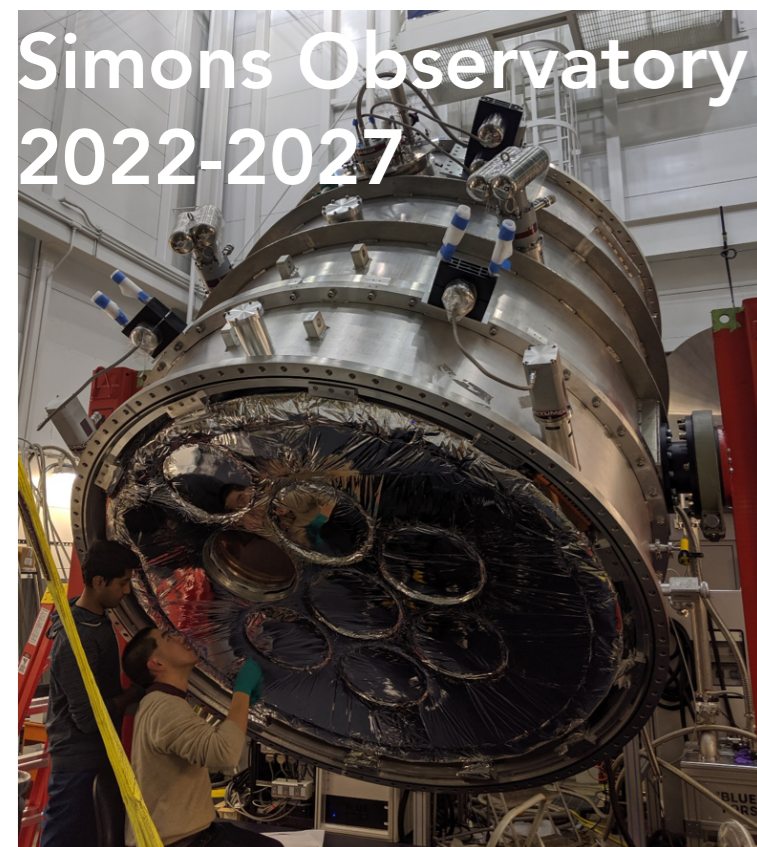




Emmanuel Schaan Chamberlain fellow



**SPHEREx & Lensing**



# Timeline



CMB S4  
2026-

WFIRST 2024-2029

**SPHEREx**

2020 | 2021 | 2022 | 2023 | 2024 | 2025 | 2026

PFS 2022

DESI 2020-2025



DARK ENERGY  
SPECTROSCOPIC  
INSTRUMENT

LSST 2023-2033



# Potential projects

## **SPHEREx galaxies X CMB/galaxy lensing**

$f_{\text{NL}}$  from  $gg, g\kappa, \kappa\kappa$  *Schmittfull Seljak 18, de Putter Schmittfull Doré*

$\sigma_8(z), M_v, (\text{delensing})$

Select lens sample with simpler HOD

IA mitigation

## **Improve photo-z for Euclid/LSST/WFIRST** *Brice's talk*

Clustering redshifts

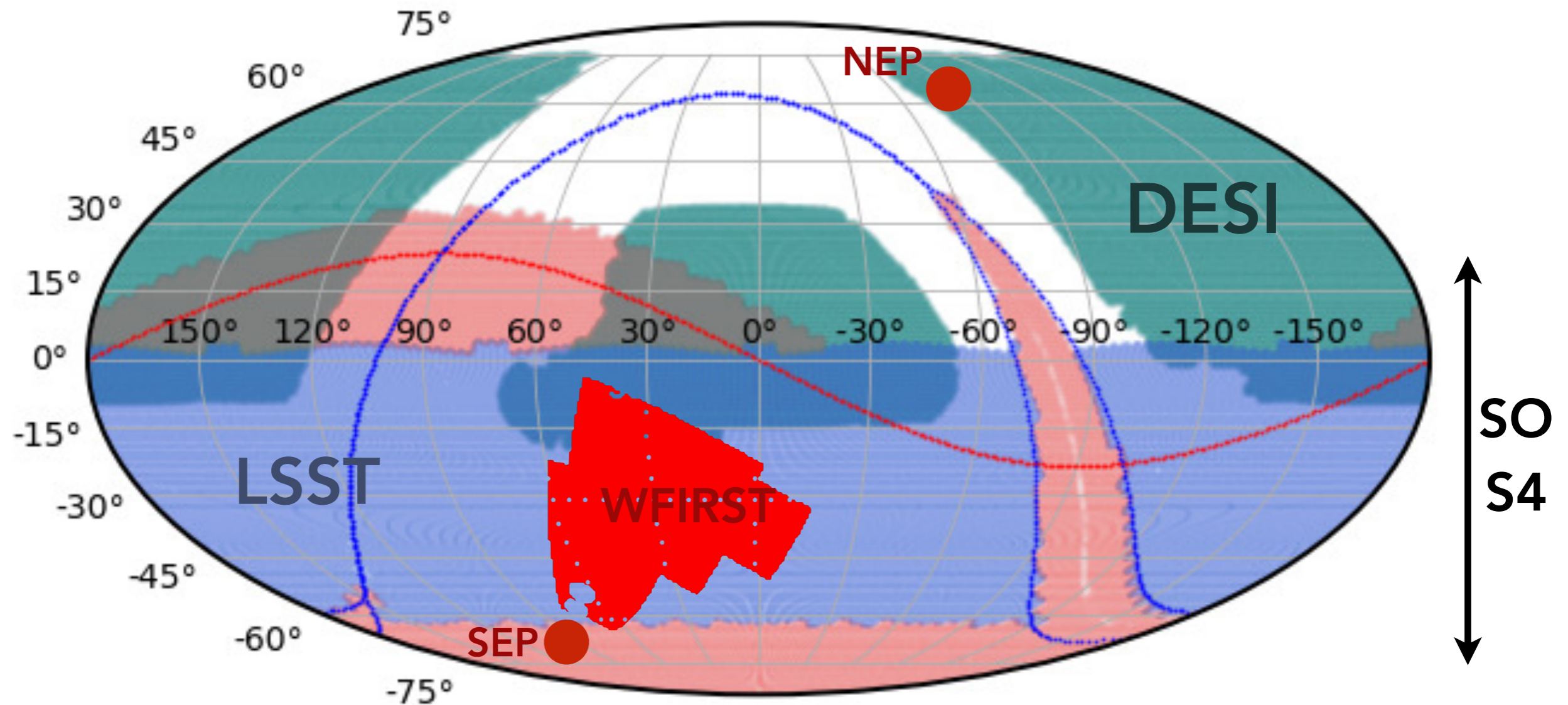
"Ensemble photo-z" *Padmanabhan+19*

## **IM lensing or tidal reconstruction in deep fields**

*Schaan Ferraro Spergel 18, Foreman+18*

Enable correlations with CMB/galaxy lensing

# Sky overlap



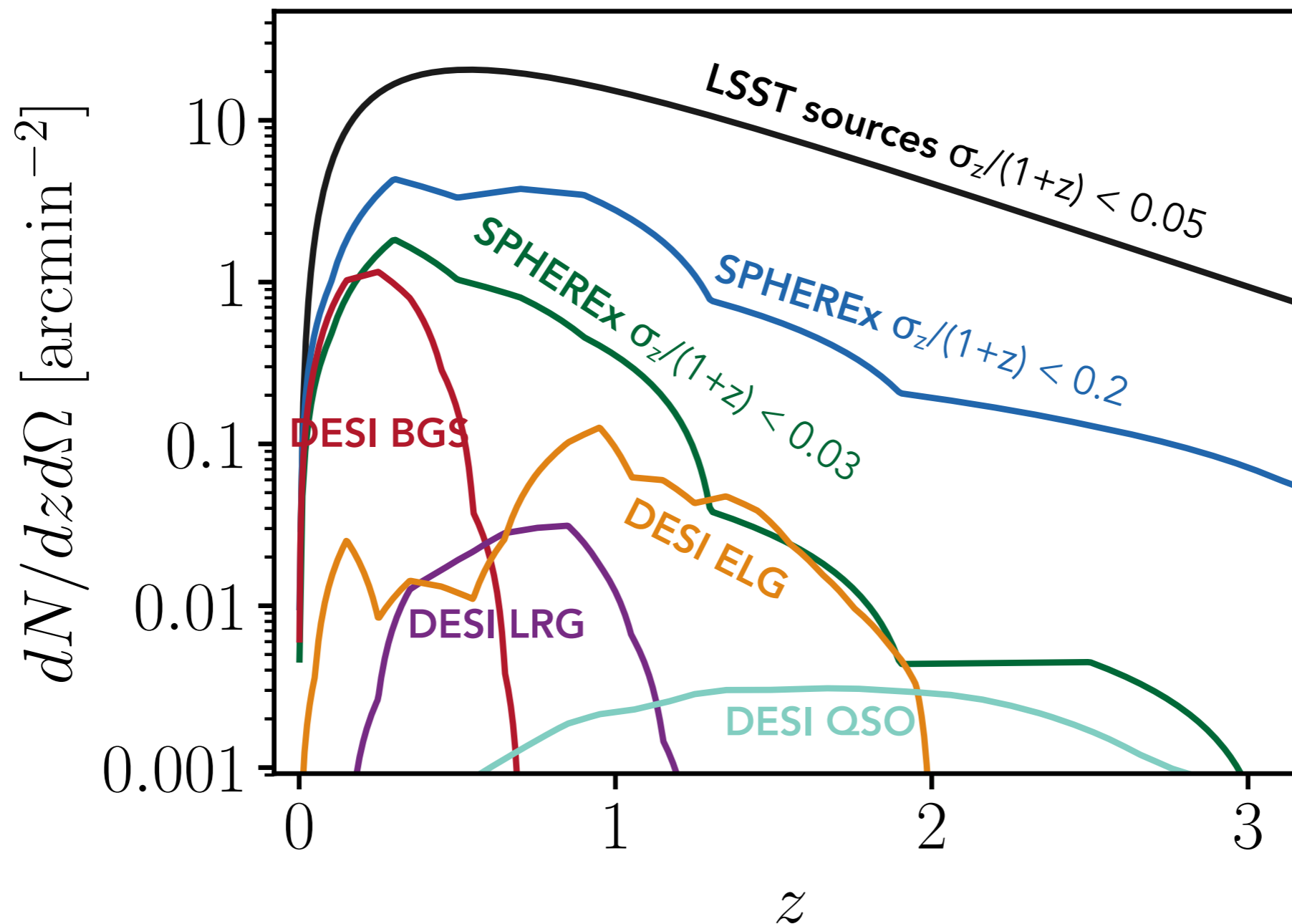
SPHEREx is full sky!

SPHEREx & Euclid deep fields coincide (ecliptic poles)

VS DESI & LSST (3-6k deg<sup>2</sup>) or PFS & LSST (~1.4k deg<sup>2</sup>)

But DESI & SO/S4 (~10k deg<sup>2</sup>)

# Galaxy samples

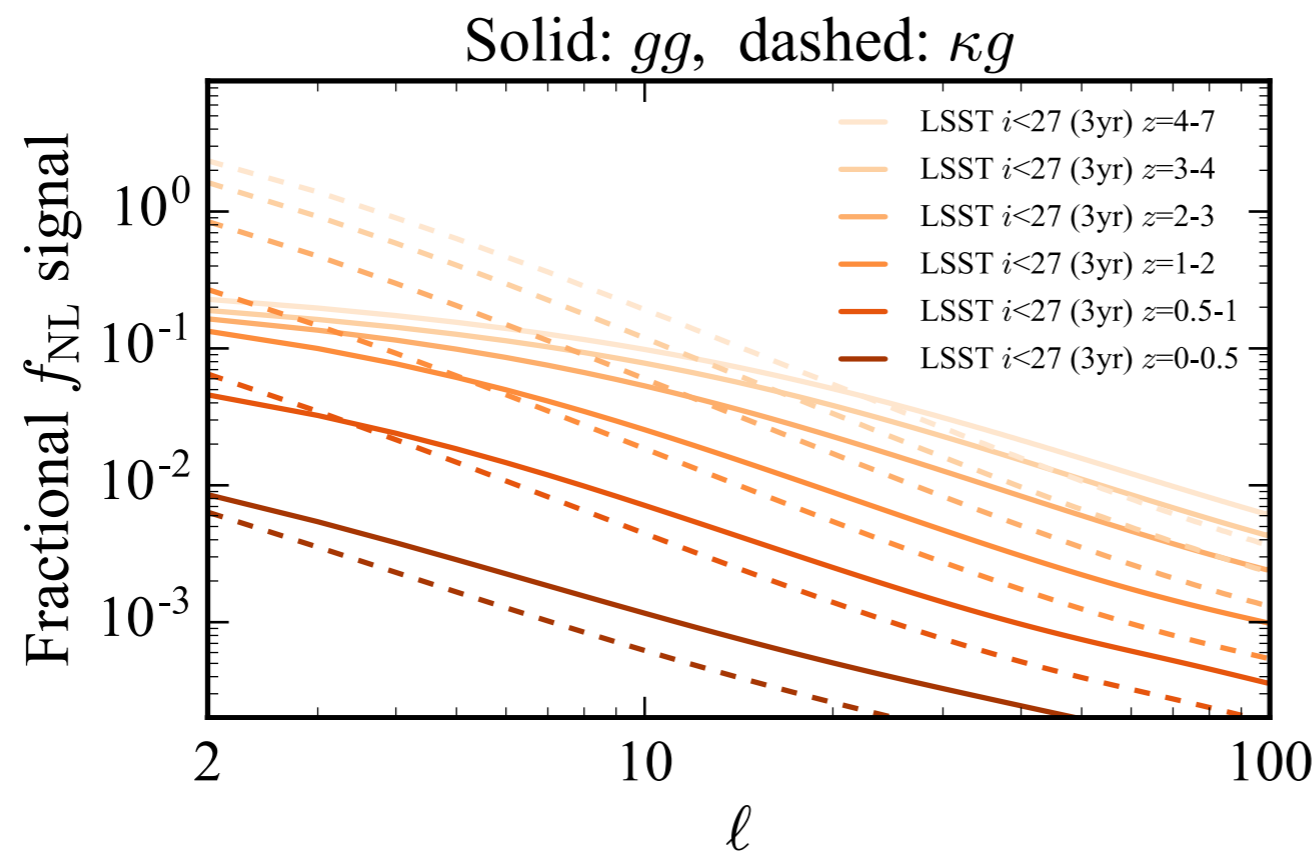


For LSST  $z$  quality: LSST is denser

For better than LSST  $z$  quality: DESI is denser (but less area!)

# SPHEREx x CMB/galaxy Lensing: $f_{\text{NL}}$

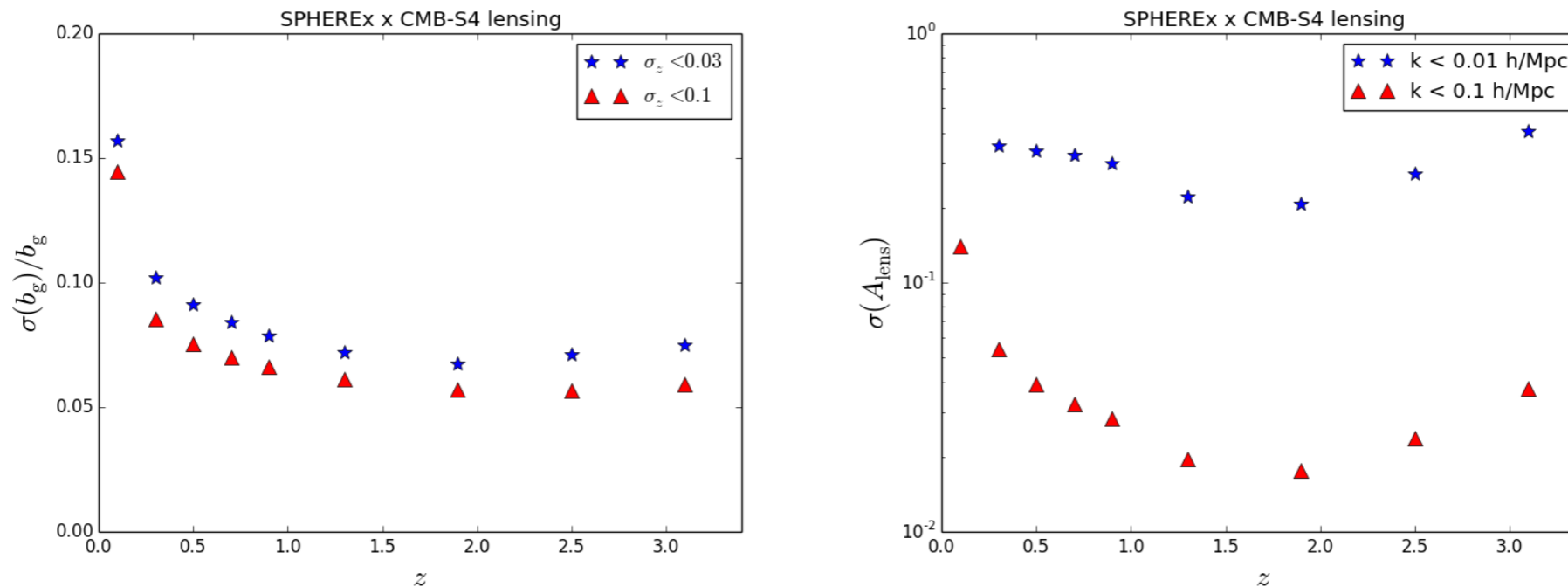
Validate and improve  $f_{\text{NL}}$  from clustering  
Multi-tracer: no cosmic variance on bias  
Cross-correlation: easier systematics  
Larger signal than in auto on largest scales



*Schmittfull Seljak 18*

Reproduce Schmittfull Seljak 18 for SPHEREx \* SO/S4/LSST lensing  
Roland, Marcel, Olivier's preliminary work: 2x improvement

# SPHEREx\*Lensing forecast



**Figure 6.** *Left:* Fractional constraints on galaxy bias in the nominal SPHEREx cosmology analysis redshift bins, derived by cross-correlating the SPHEREx galaxy catalog with the CMB lensing alone. The blue stars show forecasts for the  $\sigma_z < 0.03(1+z)$  galaxy sample, which is representative of galaxies in the bispectrum analysis, and the red triangles show forecasts for the  $\sigma_z < 0.1(1+z)$  galaxy sample, which is representative of galaxies in the power spectrum analysis *Right:* Constraints on the  $A_{\text{lens}}$  parameter as a function of redshift and wavenumber. The constraints shown with blue stars include only large scales, approximately  $k < k_{\text{eq}}$ , while the red triangles also include modes down to the quasi-linear regime.

Compare SNR for:

SPHEREx/LSST/DESI galaxies      X      LSST/SO lensing      ...

SPHEREx community report 2016

# Summary: Potential projects

## **SPHEREx galaxies X CMB/galaxy lensing**

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