

KIDS-450 + 2DFLENS: OVERLAPPING WL/RSD

SHAHAB JOUDAKI UNIVERSITY OF OXFORD IN COLLABORATION WITH THE KIDS AND 2DFLENS TEAMS

COMBINING WL AND GC ("3 X 2PT")

SELF-CONSISTENT ANALYSIS OF PROBES OF LSS: COSMIC SHEAR, GALAXY-GALAXY LENSING, GALAXY CLUSTERING. UNIFIED SET OF COSMOLOGICAL & NUISANCE PARAMETERS. FULL COVARIANCE BETWEEN OBSERVABLES (ANALYTIC / NUMERICAL). —> JOINT WL/GC LIKELIHOOD.



 $\gamma \kappa_{\rm CMB}$ $\delta_{\rm g} \kappa_{\rm CMB}$ $\kappa_{\rm CMB} \kappa_{\rm CMB}$

BENEFITS:

 $\gamma\gamma$

1) INCREASE IN CONSTRAINING POWER

2) DECREASE IN SYSTEMATIC UNCERTAINTIES

3) FLEXIBILITY (SIMPLE TO DE-SCOPE)

4) TESTS OF INTERNAL CONSISTENCY

COMBINING WL AND GC ("3 × 2PT")

EXISTING "3 × 2PT" ANALYSES INCLUDE:

KIDS × (2DFLENS + BOSS): SJ ET AL (2018)

KIDS × GAMA: VAN UITERT ET AL (2018)

DES-Y1: ABBOTT ET AL (2018)

PHOTOMETRIC (DES Y1) VS OVERLAPPING SPECTROSCOPIC (KIDS-450) GALAXIES. ANGULAR CLUSTERING VS REDSHIFT-SPACE CLUSTERING.

KIDS × (2DFLENS + BOSS) INCLUDES RSD. KIDS × GAMA CONSIDERS POWER SPECTRA. DES-Y1 "INTERNAL" 3 × 2PT.

COMBINING WL AND GC: KIDS × (2DFLENS + BOSS)

CONSTRAINING COSMOLOGY FROM OVERLAPPING SPECTROSCOPIC & TOMOGRAPHIC LENSING SURVEYS: RSD, GALAXY-GALAXY LENSING, COSMIC SHEAR.

5 statistics: $(\xi_+, \xi_-, \gamma_t, P_0, P_2)$. Full covariance included.

COSMOLSS: INTRINSIC ALIGNMENTS, PHOTO-Z ERRORS, BARYONS, GALAXY BIAS, VELOCITY DISPERSION, SHOT NOISE.

KIDS/2DFLENS/BOSS OVERLAPS



KIDS (VST):2DFLENS (AAT):BOSS (SLOAN): $450 DEG^2$ 70,000 z's $1.5 x 10^6 z's$ $z_M = 0.55$ z < 0.9z < 0.7 $N = 8 ARCMIN^{-2}$ $730 DEG^2$ $10,000 DEG^2$

COSMIC SHEAR MEASUREMENTS



HILDEBRANDT, SJ ET AL 2017

GALAXY-GALAXY LENSING MEASUREMENTS



MULTIPOLE POWER SPECTRUM MEASUREMENTS



COVARIANCE MATRIX $\{\xi^{ij}_{\pm}(\theta), \gamma^{i}_{t}(\theta), P_{0,2}(k)\}$



FULLY JOINT CONSTRAINTS $\{\xi_+, \xi_-, \gamma_t, P_0, P_2\}$

KIDS/{2DFLENS, BOSS}



FACTOR OF 2 IMPROVEMENT ALONG DEGENERACY DIRECTION. S₈ CONSTRAINT 20% IMPROVEMENT.

ASTROPHYSICAL CONSTRAINTS



FIDUCIAL: $A_{\rm IA} = 1.69^{+0.48}_{-0.48}$ Conservative:

 $A_{\rm IA} = 1.42^{+0.50}_{-0.50}$

Baryonic feedback B < 3.3 (95% CL) $B_{\text{peak}} = \{1.6, 2.0\}$ COSMOLOGICAL CONSTRAINTS ROBUST TO EXTENDED SYSTEMATICS TREATMENT

COMPARISON OF 3 × 2PT RESULTS: KIDS VS DES



COMPARISON OF 3 × 2PT RESULTS: KIDS VS DES



HOMOGENIZED ANALYSIS SETUPS:

- REDSHIFT
 CALIBRATION (SPEC VS COSMOS-2015)
- PARAMETER PRIOR
 RANGES
- PARAMETERS SAMPLED
 (As, logAs)
- NONLINEARITIES
 (HALOFIT —>
 HMCODE+FEEDBACK)
- NEUTRINO MASS
 (FIXING, VARYING)
- IA REDSHIFT
 DEPENDENCE AND
 PIVOT Z

KIDS X GAMA CONSTRAINTS



Power spectrum analysis cosmic shear P^E in agreement with H17. Larger S₈ preferred by GAMA clustering.

Combined probes improvements in $\{S_8, \Omega_m, A_{IA}\}$, in agreement with Planck and H17.

CONCLUSIONS

FIRST SELF-CONSISTENT LENSING/CLUSTERING ANALYSES PERFORMED BY KIDS AND DES. ALLOWED FOR IMPROVEMENTS TO COSMOLOGICAL CONSTRAINTS AND DECREASE IN SYSTEMATIC UNCERTAINTIES.

COMBINED PROBES KIDS × (2DFLENS + BOSS) IMPROVE S₈ = 0.742 +/- 0.035 CONSTRAINT BY 20%, MATTER DENSITY BY FACTOR OF 2. MILD DISCORDANCE WITH PLANCK. NO EXTENSION TO ΛCDM FOUND FAVORED.

EXCITING TIMES AHEAD, WITH INCREASES IN AREA EXPECTED FOR ALL THREE SURVEYS (KIDS, DES, HSC), AND STRONGER CONSTRAINTS ON THE UNDERLYING COSMOLOGY.

THANKS FOR LISTENING.