SPHEREx projects: Cosmology

Needed from SPHEREx team:
- latest MEDEX specs: dn/dz, HOD
- Galaxy mocks (long term) / HOD (short term) for the various SPHEREx samples
- Expected rate of redshift catastrophic errors

Fnl:

- Use x-corr with spectro samples to quantify spectroscopic failures
      (- expected outlier fraction for SPHEREx? Propagate it to fnl bias)
      - if it's a problem, how accurately can we measure it with cross-correlation with BOSS + DESI?

- Build confidence in fnl forecasts from bispectrum
      - covariance: halo catalog in z-space from N-body sim
      - derivative: need sim w non-G IC. (Licia Verde's repo? Ask Paco)

- fnl from kSZ:
      - theory: effect of z outliers.
      - full analysis w effect on rec velocity would require more work. Shortcut possible

- fnl from SPHEREx * lensing from SO/S4/LSST.
      - theory work: add multi-tracer with different samples w different z accuracy needs to be added
      - few redshift slices should suffice for the large scales
      - code comparison with standard SPHEREx forecast is useful

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Clustering redshifts

- use BOSS/DESI as reference sample to validate SPHEREx redshifts.
- use SPHEREx as reference sample to validate LSST/Euclid/WFIRST redshifts.
      - straightforward forecast

Generalized Alcock-Paczynski:

- use age estimates as a "distance" proxy and use clustering, to get independent info from photo-z.

Voids:

- Develop halo-based void pipeline for SPHEREx.
- need realistic mock galaxy catalog. Longer term
- void codes exist

- Develop pipeline to identify voids directly from IM, rather than galaxy catalog.
- simulations almost ready (LIMFAST, Hidden valley; maybe Websky-like peak patch sims for part of it)
- use existing spherical overdensity algo as is. Try reionization bubble finders

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Baryons from tSZ/kSZ:

- kSZ from $\langle g*T^2\rangle$:
- need HOD for SPHEREx galaxies!
- use HOD with Websky sims to do end to end test, and quantify the biases (foregrounds, lensing)

- Optimal combination of $\langle g*T^2\rangle$ and $\langle g*g*T\rangle$.
- interesting theory project!

- What are useful ways to split the galaxy catalog?
- question: age, Mstar. How easy to get these?

Line intensity mapping:

- Ongoing simulation work. Related to websky effort

- various methods to undo line confusion and interlopers

- C_l(lambda1, lambda2). Parameterize time (~dn/dz) and spectral (~SED) response with a few parameters; data driven model, and fit only for a few modes in these responses. Degeneracies?
- apply to LIM sims

Lensing:

- forecast sigma8(z), Mnu from galaxy*lensing

Ideas to be fleshed out into more specific projects

- "Ensemble redshifts"
- Other methods to reduce photo-z outliers for LSST? Leverage the NIR spectroscopy
- SPHEREx deep fields: how to use them to improve photo-z for eg LSST?
- improving photo-z: LSST has high res, SPHEREx has NIR; redundancy with Euclid?

- Alcock-Paczynski clustering redshifts (https://arxiv.org/pdf/1808.06615.pdf)
- fnl from cross 2pt and 3pt of various surveys. Help with syst like star/galaxy separation, depth variations, zodiacal light.

- simulations for LIM (LIMFAST)
- Hidden valley: include multiple stellar lines and (CIB) continuum
- various methods to address line confusion / interlopers

- help select lens sample for galaxy - galaxy lensing
- IA mitigation: are the SPHEREx redshifts amazing enough?