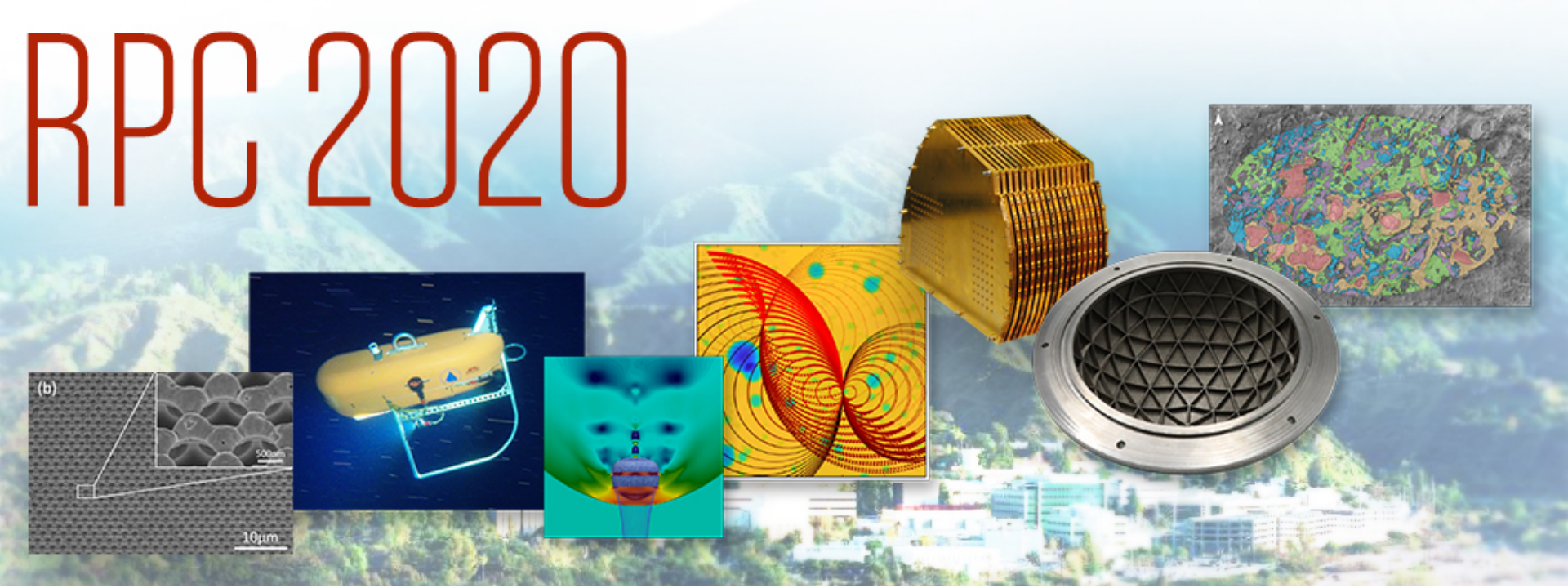


Virtual Research Presentation Conference

Maximizing the Scientific Impact of the SPHEREx All-sky Spectral Survey

Principal Investigator: Olivier Doré (326)
Collaborator: Henry Gebhardt (326)
Program: Topic

Assigned Presentation #

Jet Propulsion Laboratory
California Institute of Technology

Tutorial Introduction

Abstract

The main goal of this proposal is to develop a code to measure the 3D galaxy clustering on the largest scales. It is directly relevant to the recently selected SPHEREx MIDEX mission core science goals. The overall goal of this Topical RTD is to maximize the scientific impact of the SPHEREx All-sky Spectral Survey.

SPHEREx Dataset

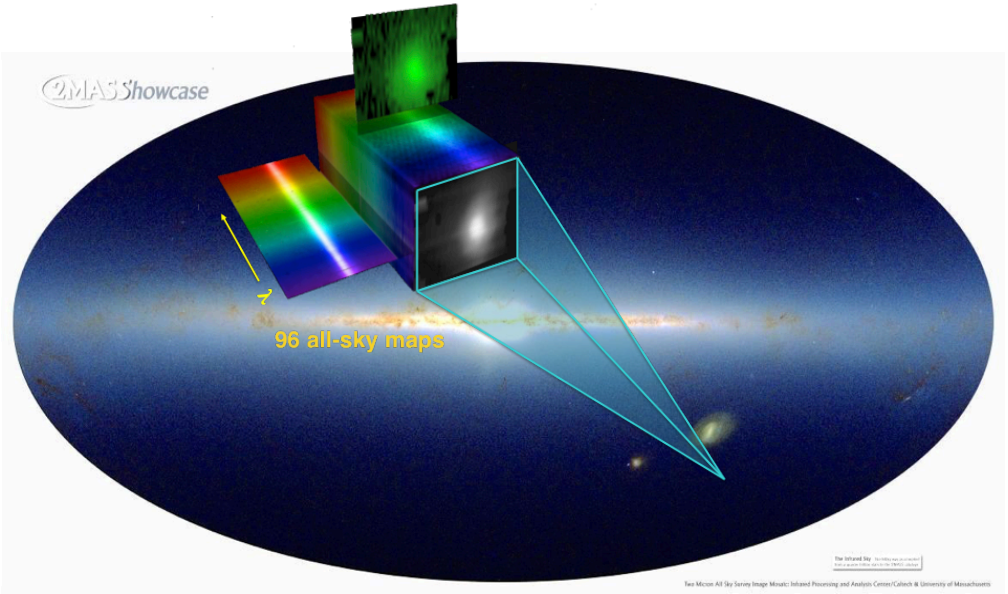
For every 6.2” pixel over the entire sky:

- R=35-41 spectra spanning 0.75 μm < λ < 3.82 μm
- R=110-130 spectra spanning 3.82 μm < λ < 5.0 μm

≃ all-sky survey with 96 fine photometric bands

It will lead to a ~500M large galaxy spectroscopic catalog with a good enough redshift accuracy to make unprecedented galaxy clustering measurements on the largest scales in 3D.

Focus of this particular work: How do we optimally measure the 3D galaxy power spectrum in such a large volume?



Methodology

- For this first approach to this, we will rely on full sky Spherical Bessel Function, which combines spherical angular transform in the angular space with a Hankel transform in the radial direction.

$$\delta(\boldsymbol{r}) = \int \mathrm{d}k \sum_{\ell m} \left[\sqrt{\frac{2}{\pi}}\, k\, j_\ell(kr)\, Y_{\ell m}(\theta, \phi) \right] \delta_{\ell m}(k)\,,$$

$$\delta_{\ell m}(k) = \int \mathrm{d}^3\boldsymbol{r} \left[\sqrt{\frac{2}{\pi}}\, k\, j_\ell(kr)\, Y^*_{\ell m}(\hat{\boldsymbol{r}}) \right] \delta(\boldsymbol{r})\,,$$

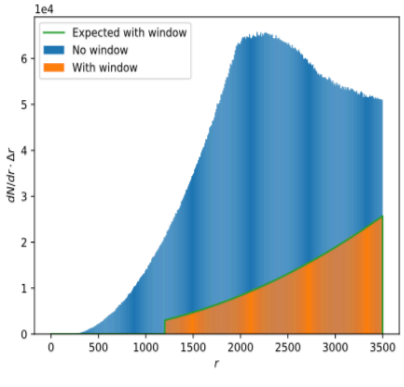
- We handle the masking using an analogous formalism to what was developed for CMB experiments like Planck (see Hivon et al. 2011)

Results

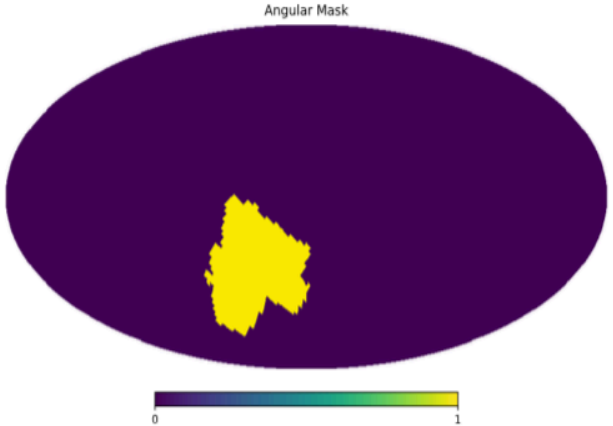
a) The code has been developed and validated on simulations using realistic masks for eg SPHEREx or Roman

b) The code has been written in Julia and runs efficiently. We plan to release it when we publish a paper.

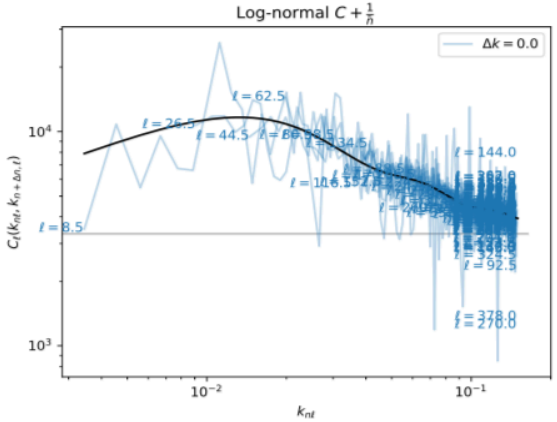
c) We have an advanced draft and plan to publish a paper in the coming month (Gebhardt & Doré 2020).



Realistic radial window



Example realistic angular mask for Roman



Recovered 3D power spectra for various l, m and n assuming assuming a realistic shot noise level. (Input is black curve)

Publications and References

- E. Hivon, K. M. Górski, C. B. Netterfield, B. P. Crill, S. Prunet, and F. Hansen, ApJ **567**, 2 (2002), arXiv:astro-ph/0105302 [astro-ph].
- W. J. Percival, D. Burkey, A. Heavens, A. Taylor, S. Cole, J. A. Peacock, C. M. Baugh, J. Bland-Hawthorn, T. Bridges, R. Cannon, *et al.*, MNRAS **353**, 1201 (2004), arXiv:astro- ph/0406513 [astro-ph].
- A. F. Heavens and A. N. Taylor, MNRAS **275**, 483 (1995), arXiv:astro-ph/9409027 [astro-ph].
- Gebhardt & Doré, in preparation, 2020