THE SLOAN DIGITAL SKY SURVEY: FROM ASTEROIDS TO COSMOLOGY

An International Symposium

Poster Review

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hosted by The Kavli Institute for Cosmological Physics

SLOAN DIGITAL SKY SURVEY

20TH ANNIVERSARY OF SDSS

Observational: Misc	
Dustin Lang (Toronto)	Measuring the undetectable: parallaxes and proper motions of extremely faint sources.
Ned Wright (UCLA)	WISE - the Wide-field Infrared Survey Explorer
Observational: SN	
Chen Zheng (Stanford)	Spectroscopy for the SDSS II SN Survey
Observational: LSS measurements + modeling	
Felipe Marin (Chicago)	LRG bias from the 3-pt correlation function
James Cresswell (Portsmouth)	Scale-dependent galaxy bias as a function of luminosity and color
Fiona Hoyle (Widener)	Voids in the SDSS: void properties
Danny Pan (Drexel)	Voids in the SDSS: void shapes
Ramin Skibba (MPIA)	A halo model of galaxy colors and clustering in the SDSS II
Young-Rae Kim (KIAS)	Cosmological parameter estimation from LSS topology
Hwajung Kang (Dartmouth)	Peculiar motion and power spectrum of early-type galaxies
Issha Kayo (Tokyo)	Model-independent method to measure peculiar velocity dispersion of galaxies
Beth Reid (Princeton)	Reconstructing the LRG halo density field to improve LSS cosmological constraints

Theory: Misc	
Sergey Koposov (MPIA)	Quantitative explanation of the observed population of Milky Way satellite galaxies
Rahul Biswas (Illinois)	Bayesian forecasting of constraints on cosmological parameters from future experiments
Theory: LSS mock catalogs	
Doug Watson (Vanderbilt)	LasDamas SDSS mock catalogs
Yanchuan Cai (Durham)	Mock galaxy catalogs and their applications for the Pan-STARRS dataset
Theory: LSS methods	
Marcelle Soares-Santos (Fermilab)	Cosmography with galaxy clusters

Measuring the undetectable: parallaxes and proper motions of extremely faint galaxies

Dustin Lang & David Hogg

- Stripe 82: look at objects that are undetected in a single epoch
- Fit a model of a moving point source to all epochs
- Fit an extended galaxy model to all epochs
- If moving point source provides better fit, it yields proper motion with an uncertainty that depends on PSFs, S/N

Apply to SDSS: distinguish red brown dwarfs from high-z QSOs.

Find all 10 known brown dwarfs in stripe 82 and discover 12 new ones due to their high proper motions

WISE: the Wide-field Infrared Survey Explorer
Ned Wright & WISE team

- NASA MIDEX mission

- Map the entire sky in 4 mid-IR bands at 6’’ resolution
- 40cm telescope, 4 1024x1024 pixel arrays, 47’x47’ field of view

- Find the most luminous IR galaxies (ULIRGs)
- Find closest brown dwarfs to sun
- Measure diameters of asteroids
- Study the SFH in galaxies
- Measure the ISW effect

Set to launch in Nov. 2009. Two planned data releases 6 and 17 months after the end of the survey.

LRG bias from the 3-pt correlation function

Felipe Marin et al.

- Measure the 3-point correlation function of DR3 LRGs on small and large scales

- On small scales, fit a HOD model to get how the number of satellite galaxies depends on halo mass (M_1 and s). These values agree with results from fitting the 2-point correlation function.

- On large scales, fit quadratic bias model to get b_1 and b_2. Use b1 to get s_8.
  b_1 ~ 2.5-3 b_2 ~ 0.5-1 s_8 ~0.7+/- 0.1

- b_1 agrees with halo model bias computed from small scales

Voids in the SDSS: void properties & shapes

Fiona Hoyle, Danny Pan & Michael Vogeley

Method: Measure distance to 3rd nearest neighbor for each galaxy. If this is >7Mpc/h, remove galaxy. Grow maximal spheres. If sphere has a radius >10Mpc/h, call it a void.

- Apply to DR5 volume-limited sample with Mr<-20 (61K galaxies)
- Find 526 voids
- Voids fill 50% of total volume and contain 5% of all galaxies
- Number and volume of voids are not sensitive to changes in the Mr sample limit
- Radial density profiles of voids are consistent with gravitational instability

Shapes: When growing maximal spheres, connect overlapping spheres. Measure ellipticity and orientation of connected void volume.

- Voids are more prolate than oblate
- Alignments are isotropically distributed
- Use mock catalogs to test effect of z-distortions

A Halo model of galaxy colors and clustering in the SDSS

Ramin Skibba & Ravi Sheth

- Measure the g-r distribution in Mr bins. Fit double Gaussian model to get the mean color of red and blue galaxies as a function of Mr
- From HOD fits to the clustering of galaxies as a function of luminosity, get the dependence of luminosity on mass, as well as the satellite fraction
- Assume that satellite galaxies follow the red sequence.
- From the above, get the mean color of centrals and satellites as a function of mass and compute the predicted clustering of red/blue galaxies.
- Clustering is too high for red galaxies compared to SDSS.
- Allowing some satellite galaxies to be blue yields agreement.
- Predict color vs. group richness for centrals and satellites and compare with SDSS group catalogs

Cosmological parameter estimation from LSS topology

Young-Rae Kim & Changbom Park

- Genus of isodensity surface = number of holes - number of isolated regions (swiss cheese topology: high genus, meatball topology: low genus)
- Topology is a good probe of the initial density field because it is insensitive to galaxy bias and z-space distortions. Tests with N-body simulations show this.
- Measured genus for SDSS LRGs using a large smoothing scale (~25Mpc/h) agrees with linear theory prediction from WMAP parameters
- Different cosmologies produce different comoving volumes for a fixed smoothing scale. So if we assume the wrong cosmology when comparing measurements to linear theory, data will not agree with theory. ---> Method to constrain cosmology.
- Preliminary results are shown. Should do this at high redshift, where the comoving volume is more sensitive to cosmology.

Peculiar motion and power spectrum of early-type galaxies

Hwajung Kang & Gary Wegner

- On large enough scales, the bulk flow of galaxies should converge to the CMB dipole
- On scales less than 60 Mpc/h, measurements agree with theory, but on scales larger than 100 Mpc/h there are discrepancies.
- Preliminary study: use 28 Lauer & Postman (1994) clusters that overlap with SDSS DR6
- Construct fundamental plane for each cluster (logs - log R_e - <s). Offset from the Coma FP yields the angular diameter distance.
- redshifts + distances --> peculiar velocities
- Bulk flow on 100 Mpc/h scale is ~440 km/s, which agrees with theory. However, direction of flow is not toward the CMB dipole or toward that of previous studies.
- Errors are large. Will do with full DR6 cluster dataset.
- SDSS can do cosmic flows.

Quantitative explanation of the observed population of Milky Way satellite galaxies

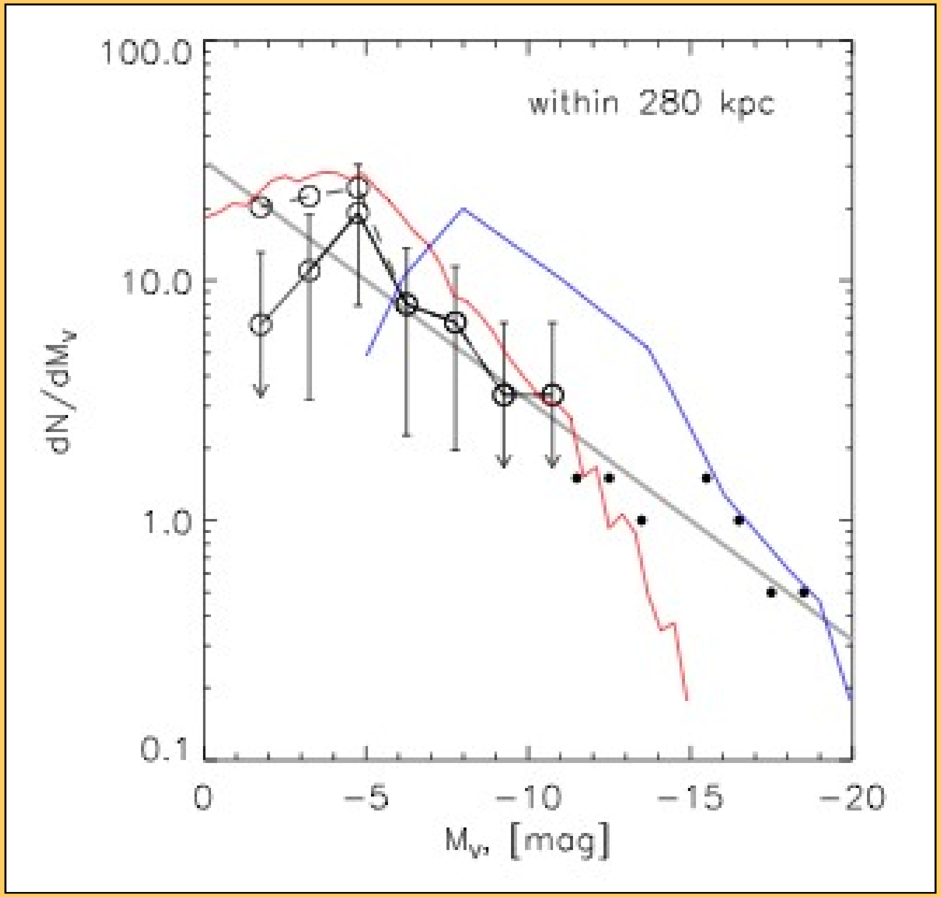
Sergey Koposov et al.

- Koposov et al. (2008) estimated the completeness of the SDSS sample of dwarf satellites discovered around the MW. Obtained the luminosity function

Compare to theoretical predictions using DM halo substructure and different models for connecting subhalo mass to light.

- Simple model $M_* = f_* \times M_{DM}$ predicts too many low luminosity dwarfs
- Making f_* a power-law function of mass is able to fix this, but only with a steep relation (slope ~ 3)
- A reionization model, where halos stop forming stars after reionization if they are below a critical mass (V_{crit}~35km/s), works but only for a very high redshift of reionization (z~30)
- Better model: also have a smaller mass cutoff (V_{cut}~10km/s) for pre-reionization

Quantitative explanation of the observed population of Milky Way satellite galaxies
Sergey Koposov



Reconstructing the LRG density field to improve LSS cosmological constraints

Beth Reid, David Spergel & Paul Bode

- Goal: reduce z-space distortions and scale-dependent bias by collapsing clusters
- Measure counts-in-cells of LRGs. Identify groups and measure multiplicity function.
- Use n(N) and large-scale amplitude of the correlation function to constrain the HOD of LRGs using mock catalogs
- Replace LRG groups with one point at center of group. Computing P(k) for groups instead of galaxies brings the shape of P(k) closer to that of the linear theory P(k)

Bayesian forecasting of constraints on cosmological parameters from future experiments

Rahul Biswas & Ben Wandelt

- Traditional way: select “best-fit” parameters from posterior distribution, make fake datasets using that cosmology, and measure parameters using fake data. --> forecasting of error ellipses.

- However, different parameter combinations within posterior distribution can result in error ellipses with different shapes, widths.

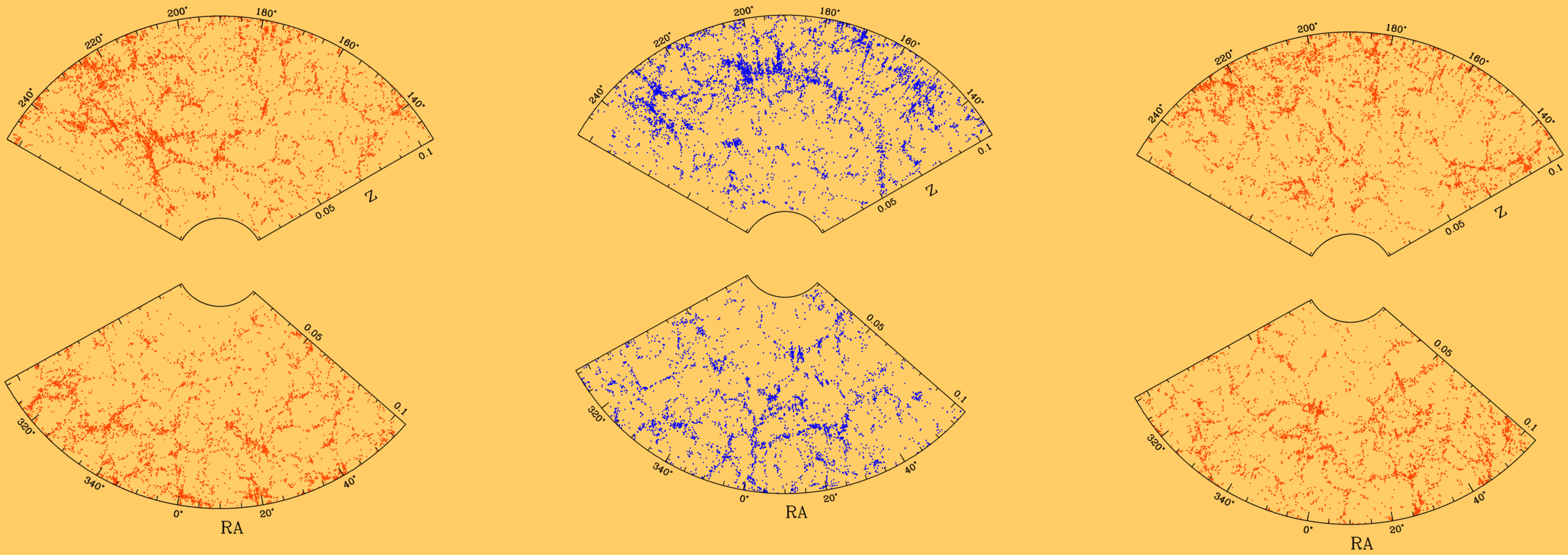
- Better way: draw many sets of parameters from posterior distribution, make many fake datasets, and compute many error ellipses. Correct forecasting of errors involves averaging over these error ellipses.

- Demonstrate using Planck and DES SN surveys

LasDamas mock catalogs

Doug Watson, et al.

- Run many realizations of N-body simulations designed to model SDSS volume-limited samples (~8 million cpu-hours).
- Produce 100 mock catalogs for each sample that match the SDSS clustering
- Good for error estimation, testing analysis methods, etc.
- Publicly available very soon!



Mock galaxy catalogs and their applications for Pan-STARRS

Yanchuan Cai et al.

- Millenium DM simulation + Bower et al. (2006) semi-analytic model (gets the luminosity function right from z=0 to 1.5)
- Put in Petrosian mags, photo errors, galaxy properties etc.
- Measure photometric redshifts and test their accuracy
- predict how well the BAO method will yield cosmology constraints given photo-z errors.

Cosmography with galaxy clusters
Marcelle Soares-Santos et al.

- Test a 2D Voronoi cluster finder for future use on imaging surveys (e.g., DES)
- Tesselate galaxy distribution, and identify clusters as N contiguous area elements above some threshold density
- Test on mock catalog using magnitude bins to reduce projection
- Method yields very high completeness, but also high false detection rate. Photo-z's will help to reduce this problem.