Measuring the growth rate of structure around cosmic voids in VIPERS

Adam Hawken
Osservatorio Astronomico di Brera

Daniele Micheletti, Angela Iovino, Ben Granett, + VIPERS team
Micheletti et al. arXiv:1407.2969, Hawken et al. (in prep)
- Remove the most isolated galaxies from the catalogue to increase the contrast between the high and low density regions.
- Look for empty spheres using a regular grid.
- 'maximal spheres' are defined as a subset non-overlapping empty spheres.
- To avoid finding spurious under densities caused by the mask, we only select the most significant empty spheres.
- 'voids' are regions connected by overlapping significant spheres.

Micheletti et al '14
The void-galaxy cross correlation function

\[ \xi(\eta, \alpha) = \frac{N_R \ DD(\eta, \alpha)}{N_g \ DR(\eta, \alpha)} - 1 \]

We apply the Davis & Peebles estimator to VIPERS to estimate the anisotropic cross-correlation function.

Any observed enhancement along the line of sight should be caused by coherent outflows.

The rate at which material is evacuating from the voids is an indicator of the strength of gravity.
RSD around voids

The void galaxy cross-correlation function provides information on the dynamics of galaxies in voids and in the structure around them. Because the densities of the environments we are considering are small, the relationship between density and velocity is pretty much linear.

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RSD model from Paz et al '13
Results

We found the best fitting correlation function (with RSD) using an MCMC chain, varying the profile shape parameters and the growth rate.

First we fit to the mocks (red) and then to the VIPERS data (black).

The results are consistent with each other.

However, this is an underestimate of the growth rate measured on the same mocks using conventional methods.

This bias needs to be understood before we can be truly confident of the result.
Known knowns

- Method systematically underestimates the true growth rate.
- Highly model dependant; fitting different models yields different values for the growth rate.
- Error bars are an underestimate because we do not have a covariance matrix.

Known unknowns

- How do the centres of the spheres correspond to the centres of expansion?
- Are our chosen voids truly significant and dark energy dominated?
- Is the assumption of spherical symmetry smoothing out the growth signal?
- Are the galaxies we are pruning out truly 'void galaxies'?

Unknown unknowns

- Who knows?

Unknown knowns

- How do the decisions we make, i.e. which galaxies to use, which voids to discard etc, affect our results?
- Are our statistical assumptions correct?