Studies of the selection effect of galaxies on clustering analysis in a wide-area spectroscopic survey

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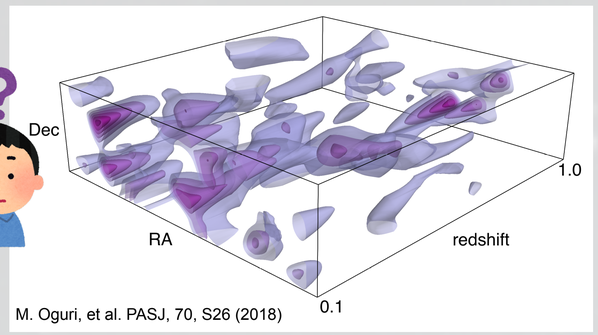
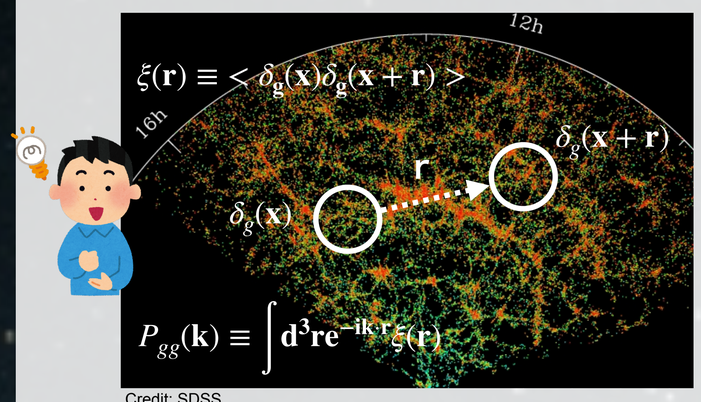
1. What's the selection effect ?

Galaxy Clustering Analysis



Distribution of Dark Matter

- **cannot observe directly**



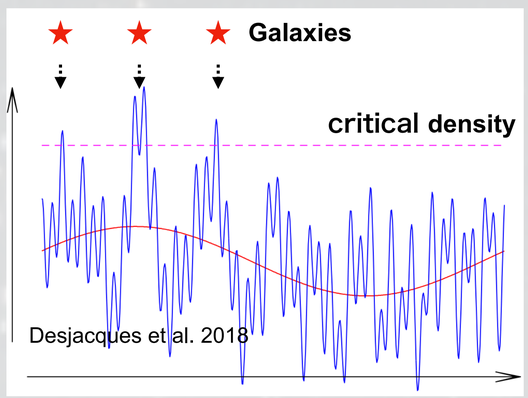
Distribution of Galaxy

We can compare theory and observation using "**Power Spectrum $P(\mathbf{k})$**" .

$$< \delta_g(\mathbf{k})\delta_g(\mathbf{k}') > = 2\pi\delta^D(\mathbf{k}+\mathbf{k}')\mathbf{P_{gg}}(\mathbf{k})$$

- RSD, BAO features

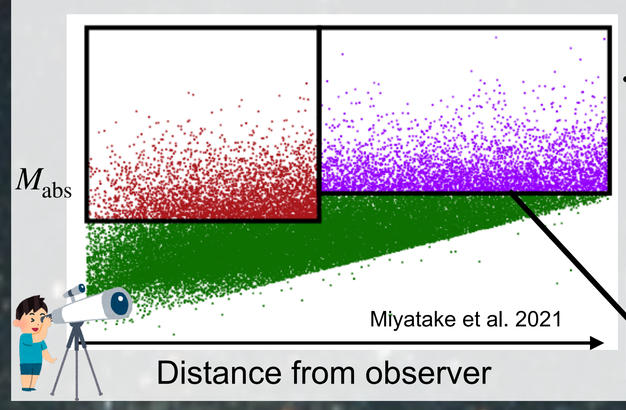
Problem: selection effect



Galaxy bias

- Galaxy distribution ≠ underlying DM distribution
- Depends on the types of galaxy (e.g. brightness …)

⇒ **different types of galaxy trace DM in different ways !**



Selection effect

- The inhomogeneity of the types of galaxy in data, driven by limits in observation techniques

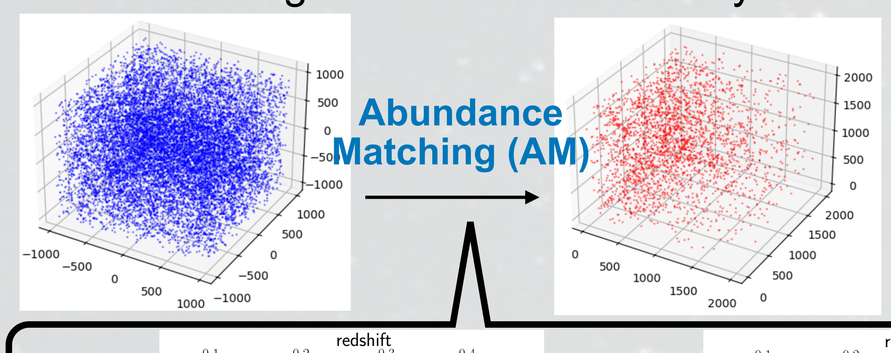
However,

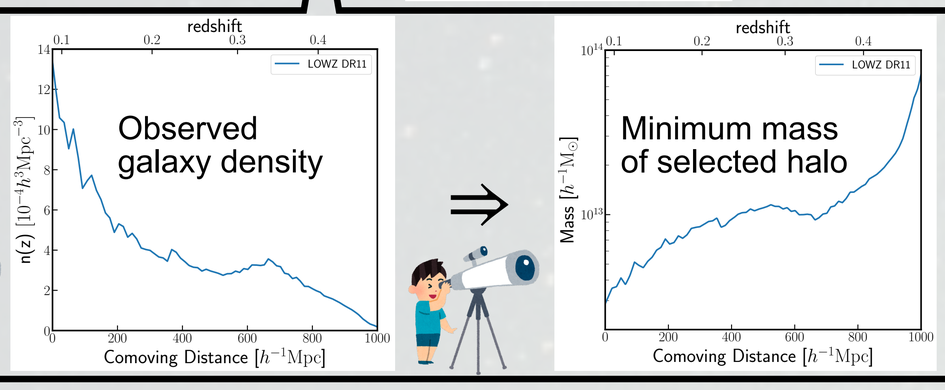
theoretical prediction of $P(\mathbf{k})$ assumes homogeneity …

2. Evaluation of the effect: Comparison of two power spectra

$P(\mathbf{k})$ with selection effect

Halo Catalog → (Abundance Matching (AM)) → Mock Galaxy Catalog → **This power spectrum includes the selection effect !** → $P_{\rm AM}(\mathbf{k})$



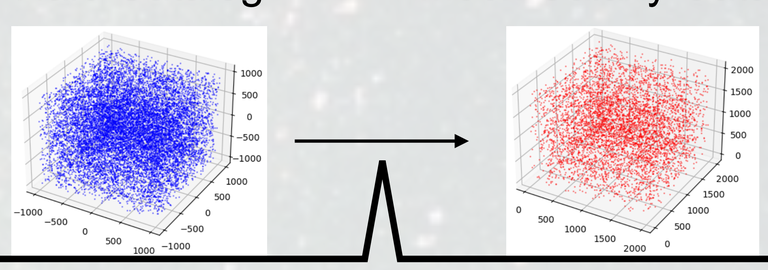


Populate galaxies into halos by order of halo mass, until we match observed galaxy density.

(halo mass ≃ brightness of galaxies inside it)

$P(\mathbf{k})$ without selection effect

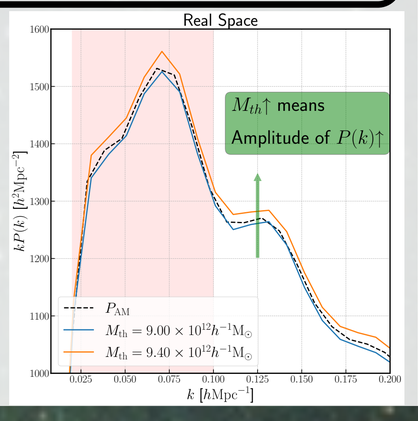
Halo Catalog → Mock Galaxy Catalog → **This is what the existing theory predicts !** → $P_{M_{\rm th}}(\mathbf{k})$



Set a single mass threshold $M_{\rm th}$, and select halos which satisfy $M \geqq M_{\rm th}$ uniformly to populate galaxies

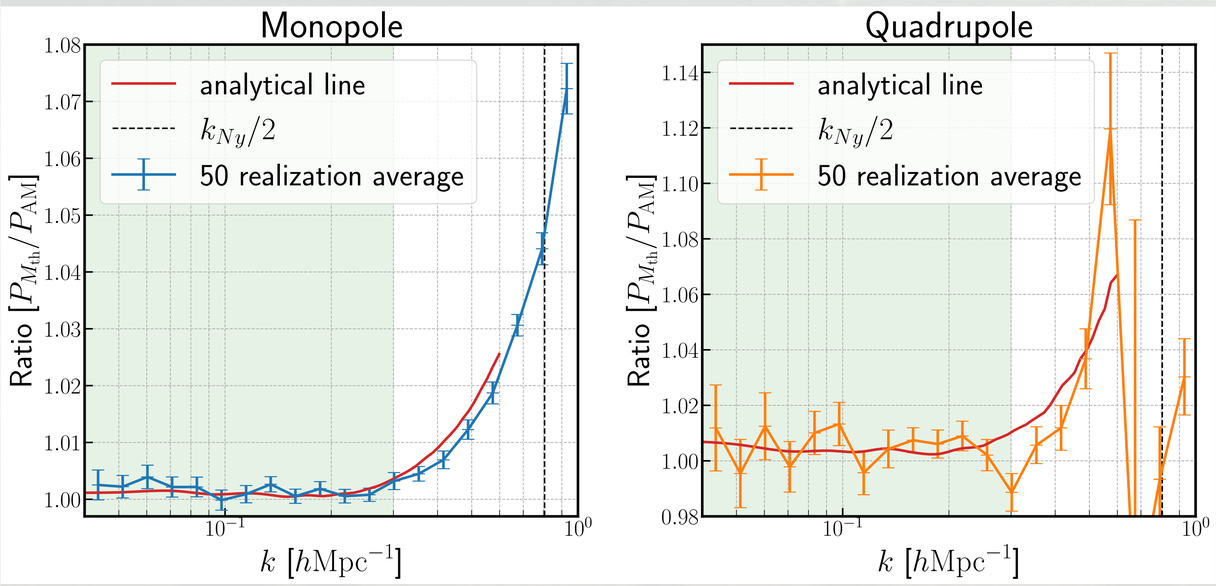
(halo mass ≃ brightness of galaxies inside it)

We can find appropriate $M_{\rm th}$ such that the power spectrum $P_{M_{\rm th}}(k)$ matches $P_{\rm AM}(k)$ in linear regime (in real space)



3. Result

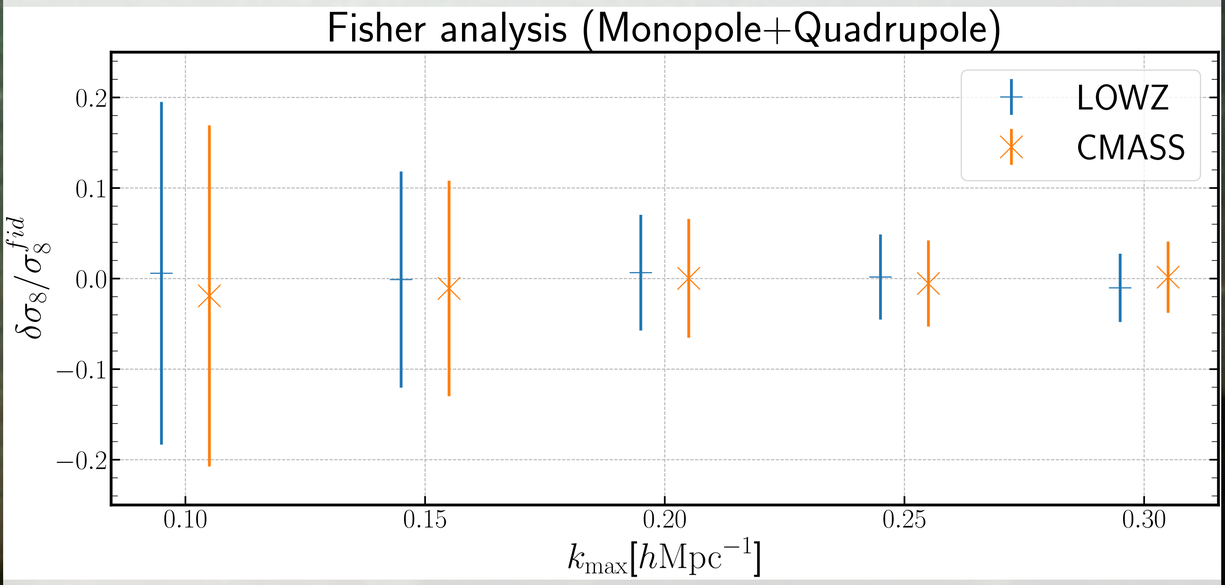
$P_{\rm AM}$ vs $P_{M_{\rm th}}$ (LOWZ)



Green area: around 1 until $k \simeq 0.3$ $h\mathrm{Mpc}^{-1}$!

Red curves: We succeeded in explaining the upturn behavior !

Impact on the LCDM parameters



The selection effect doesn't cause large biases in LCDM parameter estimation, because $P_{M_{\rm th}}/P_{\rm AM} \simeq 1$ up to $k \simeq 0.3$ $h\mathrm{Mpc}^{-1}$!