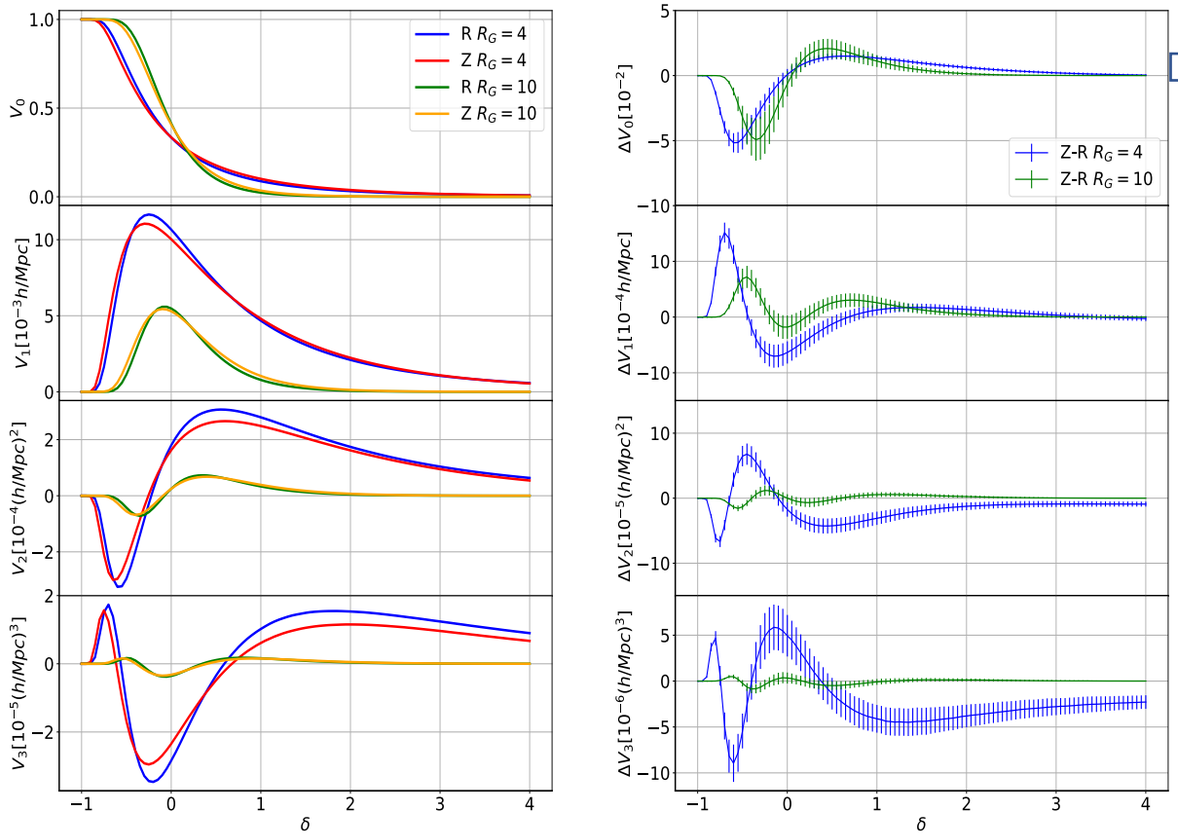
The effects of peculiar velocities on the morphological properties of large-scale structure

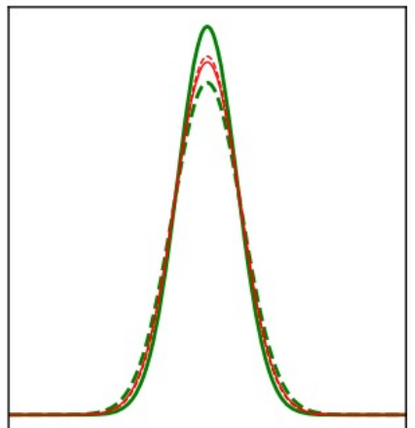
Aoxiang Jiang, Wei Liu, Wenjuan Fang and Wen Zhao

CAS Key Laboratory for Research in Galaxies and Cosmology, Department of Astronomy, University of Science and Technology of China, Hefei, Anhui 230026, China
and School of Astronomy and Space Sciences, University of Science and Technology of China, Hefei, Anhui 230026, China

The galaxy peculiar velocities distort the large-scale structure (LSS) mapped by galaxy redshift surveys, but the distortion of the LSS meanwhile provides a unique way to probe the peculiar velocity field. The four Minkowski functionals(MFs) (structures' volume fraction(V_0), surface area (V_1), integrated mean curvature (V_2) and Euler characteristic (V_3)) can fully capture the morphological properties of the LSS, and can give competitive constraints on cosmological parameters compared to the power spectrum, probably due to the nonlinear information contained.

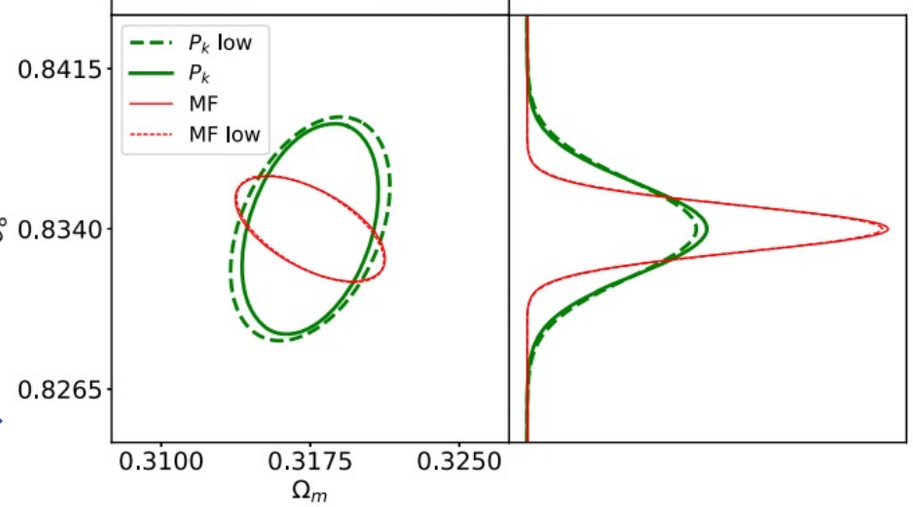


The MFs (left) and their differences (right) between real and redshift space LSS. We measure them from the simulation boxes with volume $1h^{-3}\mathrm{Gpc}^3$. **Significant effects on the four MFs** (errorbars are enlarged 10 times in the figure)



The more realistic choice (dashed lines) shows that compared to 2-point power spectrum (the combination of monopole, quadrupole and hexadecapole), the MFs can give **stronger constraint** on σ_8 and Ω_m.

Fisher matrix constraints obtained from the MFs and power spectrum of the redshift space LSS. Dashed lines for the results whose covariance matrices are estimated from the Quijote low-resolution simulations ($V_{box} = 1h^{-3}\mathrm{Gpc}^3$) with dark matter particle density $0.017h^3/\mathrm{Mpc}^3$, roughly the density of DESI's BGS galaxies. The solid lines represent results from higher resolution(~$0.13h^3/\mathrm{Mpc}^3$) simulations.



Email: jax9709@mail.ustc.edu.cn

Physical review D 105, 103028 (2022), *arXiv:2108.03851*