Modeling the Nonlinear Power Spectrum in Low-redshift H I Intensity Mapping

Zhixing Li[1,2], Laura Wolz[2], Hong Guo[3], Yi Mao[1]

[1.] Department of Astronomy, Tsinghua University, Beijing 100084, China
[2.] Jodrell Bank Centre for Astrophysics, Department of Physics and Astronomy, The University of Manchester, Manchester M13 9PL, UK
[3.] Key Laboratory for Research in Galaxies and Cosmology, Shanghai Astronomical Observatory, Shanghai 200030, China

Introduction

- More than 95% of HI resides in cold dense region inside galaxies in low redshifts ($z < 1.0$) universe, making HI a novel tracer of matter distribution.
- With more and more interferometers under construction or already in operation, it is increasingly critical to provide accurate theoretical references to HI power spectrum at nonlinear scale, thus improving the interpretation of the data.
- Previous works demonstrate that the inner motion of HI discs can strongly depress the HI power spectrum at nonlinear scale, and some of them construct models for HI velocity profile to explore the relation between the profile and HI power spectrum. However, there are still several questions that remain to be answered (see upper right column).
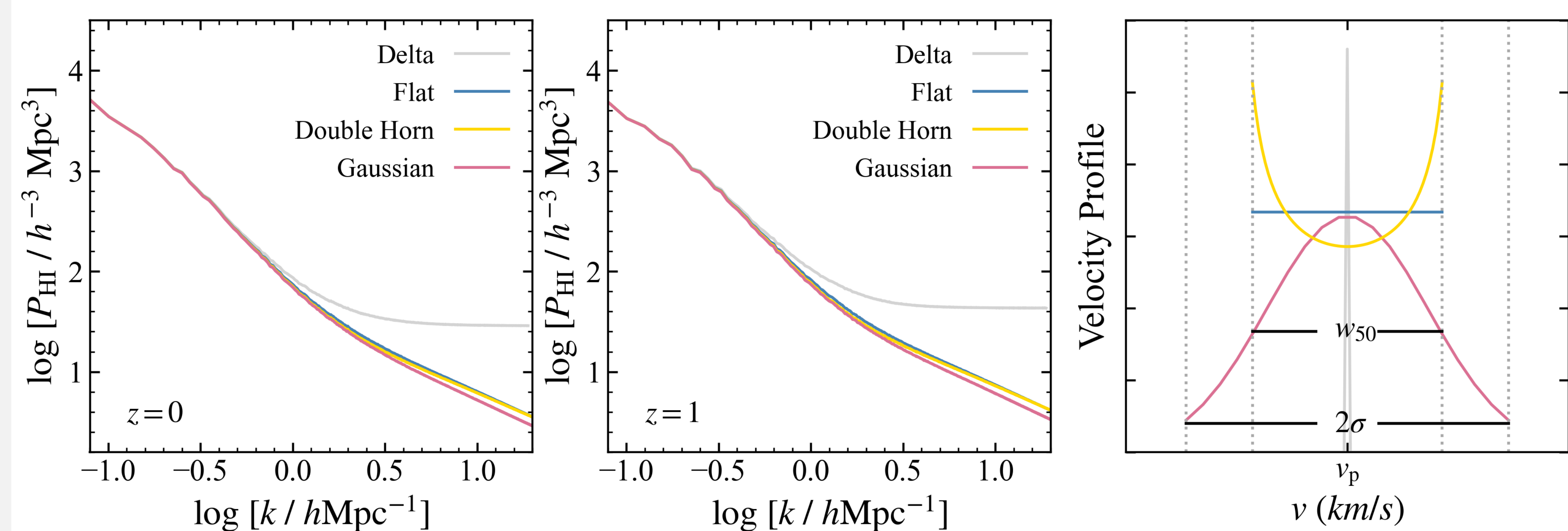
Questions

- Galactic- or halo- HI catalogs?
- Size of HI discs?
- HI velocity dispersion?
- Shape of HI velocity profile?
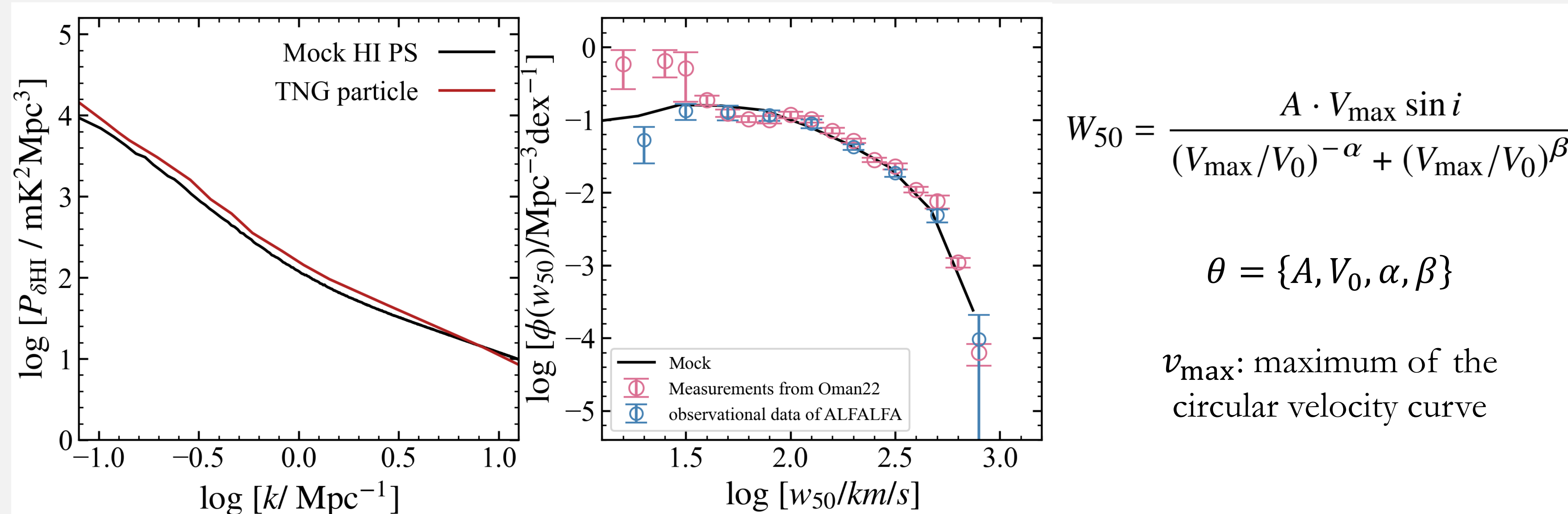- Observational settings?
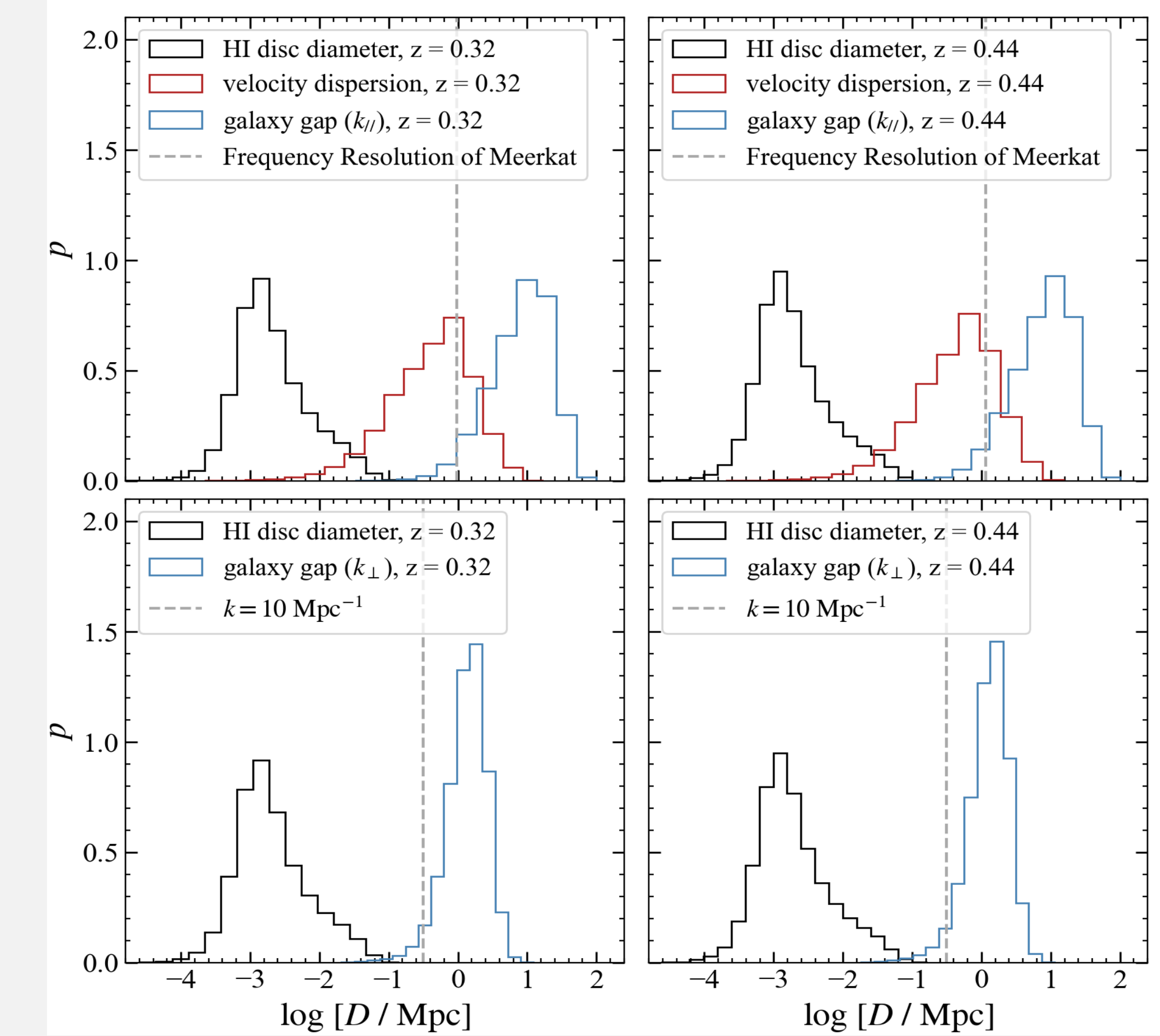
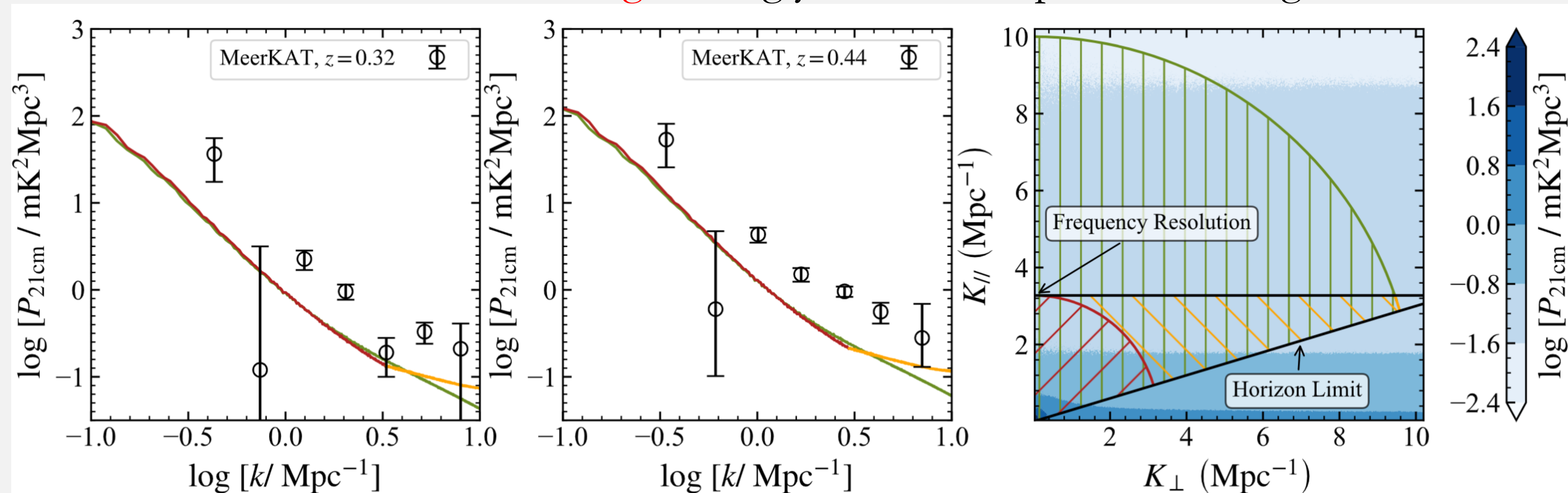## Impacts on HI Power Spectrum

- The power spectrum is insensitive to the shape of HI emission line profile

- The power spectrum correlates strongly with the velocity dispersion, i.e., w_{50} in this work.

$$W_{50} = \frac{A \cdot V_{\max} \sin i}{(V_{\max}/V_0)^{-\alpha} + (V_{\max}/V_0)^{\beta}}$$

$$\theta = \{A, V_0, \alpha, \beta\}$$
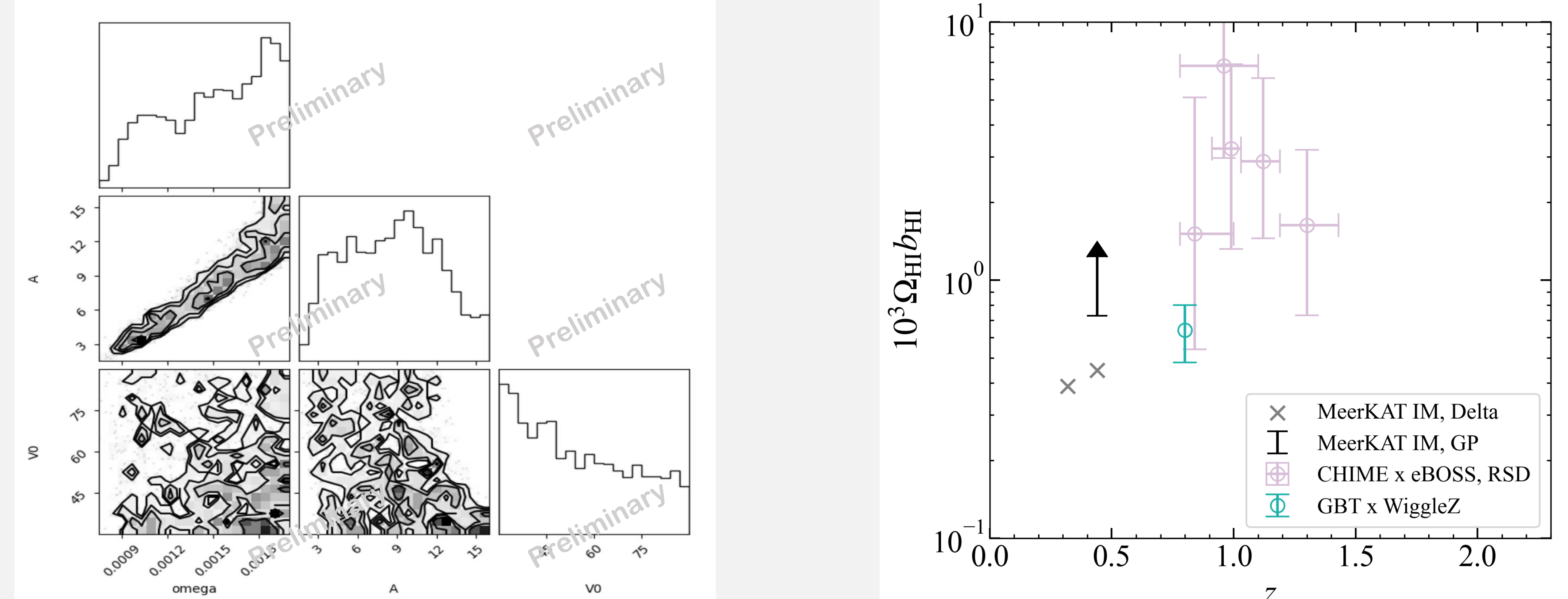
$v_{\max}$: maximum of the circular velocity curve

- A comparison between our prediction and the first measurements by MeerKAT at z=0.32, 0.44. Observational settings strongly affects the spectrum at large k-modes.

Parameter Constraints (Preliminary)

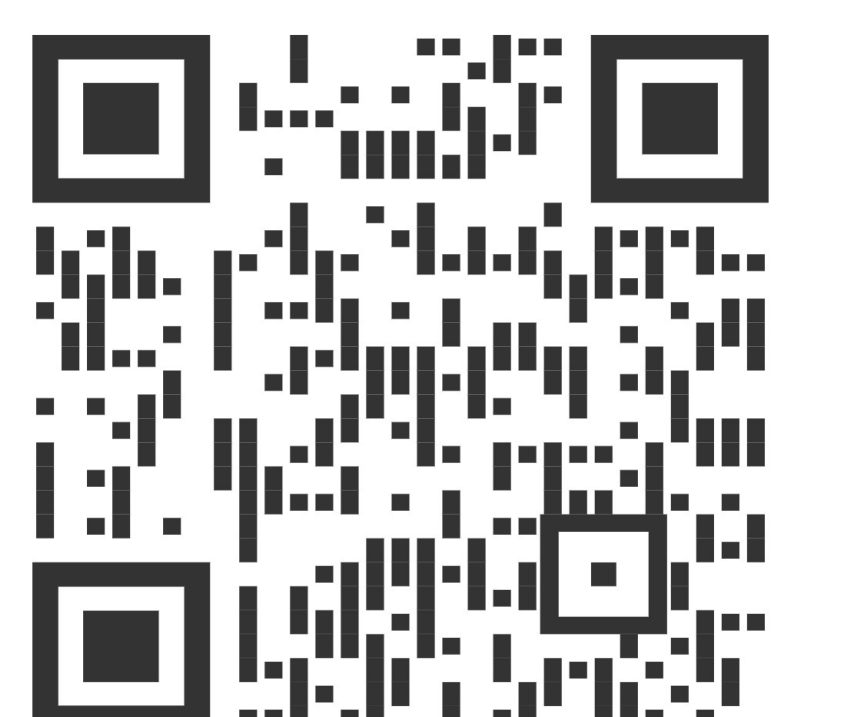- Constraints for HI abundance and parameters of velocity profile model

Conclusion

- HI power spectrum is insensitive to the shape of HI emission line profile, while it correlates strongly with the velocity dispersion.
- Truncation due to the Horizon limit can suppress the spectrum badly, while the frequency resolution of MeerKAT leads to a slower decline.
- We got a parameter constraint for HI abundance and get a lower limit of $10^3 \Omega_{HI} b_{HI} \approx 0.729$ at $z = 0.44$ (Preliminary).

About Me: I'm a PhD student in Tsinghua University and also a visiting PhD student in University of Manchester.

Research Interests: Theoretical HI Structures from Galaxy scale to Cosmological Scale, HI Intensity Mapping Surveys, Statistics of Large Scale Structure

Contact Me: lizhixing1998@foxmail.com

Scan to copy my Email address 😊