

# HI (astrophysical) parameter estimation from Tianlai Dish / Galaxy Cross-correlations?

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## Cross-correlating 21 cm and galaxy surveys: implications for cosmology and astrophysics

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### ABSTRACT

We forecast astrophysical and cosmological parameter constraints from synergies between 21 cm intensity mapping and wide-field optical galaxy surveys (both spectroscopic and photometric) over  $z \sim 0-3$ . We focus on the following survey combinations in this work: (i) a CHIME-like and DESI-like survey in the Northern hemisphere, (ii) an LSST-like and SKA I MID-like survey, and (iii) a MeerKAT-like and DES-like survey in the Southern hemisphere. We work with the  $\Lambda$ CDM cosmological model having parameters  $\{h, \Omega_m, n_s, \Omega_b, \sigma_8\}$ , parameters  $v_{c,0}$  and  $\beta$  representing the cut-off and slope of the H I–halo mass relation in the previously developed H I halo model framework, and a parameter  $Q$  that represents the scale dependence of the optical galaxy bias. Using a Fisher forecasting framework, we explore (i) the effects of the H I and galaxy astrophysical uncertainties on the cosmological parameter constraints, assuming priors from the present knowledge of the astrophysics, (ii) the improvements on astrophysical constraints over their current priors in the three configurations considered, and (iii) the tightening of the constraints on the parameters relative to the corresponding H I autocorrelation surveys alone.

# Halo model for HI mass

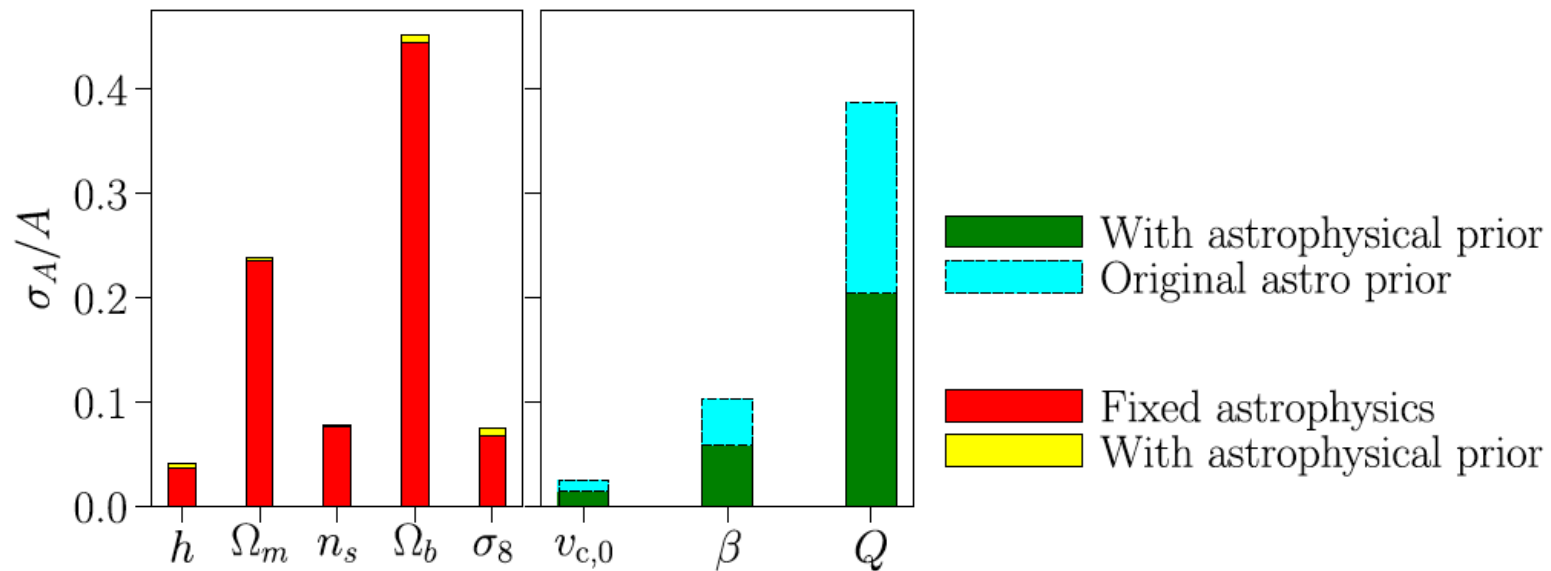
$$M_{\text{HI}}(M, z) = \alpha f_{\text{H,c}} M \left( \frac{M}{10^{11} h^{-1} M_{\odot}} \right)^{\beta} \times \exp \left[ - \left( \frac{v_{c0}}{v_c(M, z)} \right)^3 \right]$$

average HI mass in halo      halo mass

minimum virial velocity to host HI

halo virial velocity

# CHIME-DESI cross-correlation forecast



Can we do a similar analysis for Tianlai – galaxy cross-correlations?