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Mock HI-galaxy catalogs and HI Mass Functions for future large-scale surveys

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The 21-cm neutral hydrogen (HI) survey is an important probe for cold gas and galaxy evolutions in the local and low-redshift universe. One of the key measurements used to study evolution and properties of local star-forming galaxies is the HI mass function (HIMF). Among the interested topics in modern astrophysics, the study could potentially shed more light and offer explanations for the discrepancy between the ΛCDM standard model prediction and observed HI-galaxy number density (e.g. ALFALFA, HIPASS). The simulation also over-predicted the abundance of small satellite and low-mass galaxies. Both problems still requires sensitive instruments for more larger and deeper HI surveys to detect the populations of low-mass HI-galaxy. Currently, the HI-galaxy surveys could only reach down to $\sim 10^7$ Solar mass ($M_\odot$). Since, the next-generation radio surveys such as FAST or Australian Square Kilometer Array Pathfinder (ASKAP) will provide deeper any more sensitive data for reaching lower HI-mass and high-redshift HI-galaxies. The HI source catalogs from cosmological simulation (mock catalogs) are used to determine the expected HIMF from the upcoming HI surveys. We aim to compare the variability in the HIMF obtained from various mock catalogs, which were simulated with different parameters and purposes. This work also demonstrates the dissimilarities between the HIMF from recent semi-analytic model and the observed HIMF. Moreover, we aim to create an accurate mock catalog for the upcoming large HI-galaxy survey with the focus on calibrating the calculation of HIMF using both $1/V_{\rm max}$ and 2DSWML determination methods. We therefore determined the HIMF from various mock catalogs (e.g. Multidark, Boishoi and Millennium), which the HI mass was evaluated by using the cold gas mass for each object. We found that the HIMF are relatively diverse on $\leq 10^7 M_\odot$ HI mass compare to the observed HIMF, which could be the effect of the mass resolution of the mock catalogs.

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