Challenges in Panchromatic Modelling with Next Generation Facilities
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Radial resolved galaxy disks models based on semi-analytic models of galaxy formation†

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Abstract. We show our work on the L-Galaxies semi-analytic models of galaxy formation, which includes the radial resolved distribution of star, gas, SFR and metallicity on each galaxy disk. The newest version of the codes include the H_2-to-HI gas transition prescriptions and the chemical enrichment of various elements. Our revised model can give results on cold gas components, radial metallicity gradients and scaling relations, which can fit the recent observations.

Keywords. galaxies: formation, galaxies: ISM, ISM: atoms, galaxies: abundances

1. Model Introduction

Our work are based on the newest version of the Munich group L-Galaxies semi-analytic models of galaxy formation (Henriques *et al.* 2020), which combines the previous work on the prescriptions of radial profiles, atomic-to-molecular gas components (Fu *et al.* 2013) and chemical enrichment models (Yates *et al.* 2014) in AGB star, SN-Ia and SN-II for many different chemical elements. The models now run on Millennium and Millennium II haloes to study disk and elliptical galaxies in different mass ranges. Aquarius haloes are adopted to study the dwarf satellite galaxies in the local group. On the other hand, ELUCID (Wang *et al.* 2014) haloes give opportunities to compare the model results directly to the local universe, which are based on the reconstruction of the initial density field according to local observations from SDSS.

2. Results

The following are the main results from our current models:
(i) The new models can fit the HI mass function from ALFALFA 100 to very low mass end, which gives a success for ELUCID simulations (see Fig. 1).
(ii) Our radial resolved galaxy disks can give the results of chemical gradient of various elements, which are consistent with recent IFU results (see Fig. 2).
(iii) We construct mock catalogues for 21cm HI gas survey for future SKA and FAST (see Fig. 3), which offers opportunities to test the models and ΛCDM cosmology.
(iv) Current single phase cooling prescription predicts too high X-ray luminosity compared to the X-ray observations (e.g Chandra), which implies more realistic cooling prescriptions (e.g multiple phase cooling) and hot gas radial distribution prescriptions are needed in the models.

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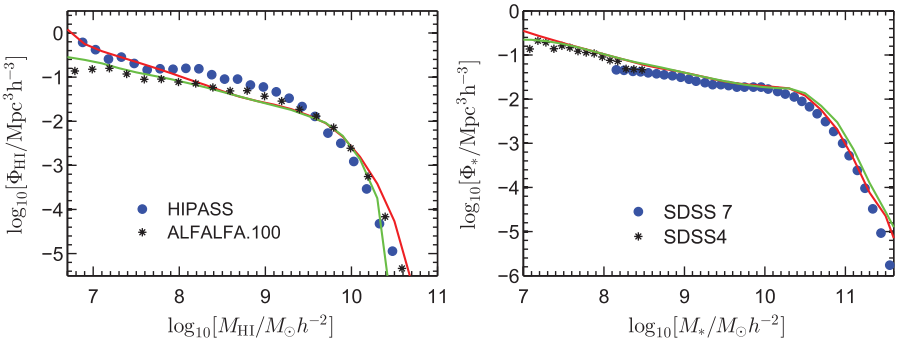

Figure 1. Model results of HI mass functions and stellar mass functions at z=0. Green curves are based on ELUCID haloes and red curves are based on Millennium haloes. Black dots and blue dots are from various observations.

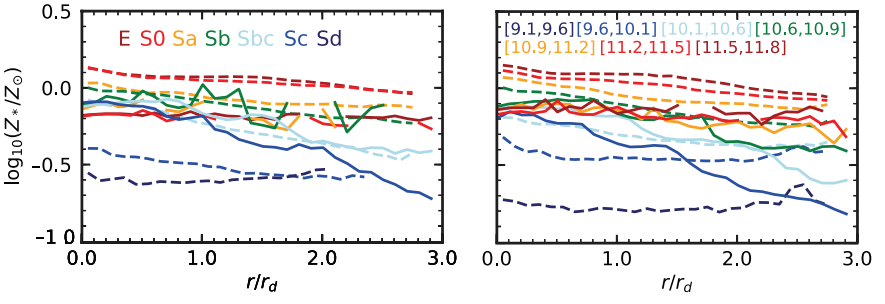

Figure 2. The model results of chemical radial gradient (dashed curves) vs. observational results from CALIFA (solid curves). In the left panel, galaxy samples are divided into different galaxy types. In the right panel, the samples are divided into different stellar mass bins.

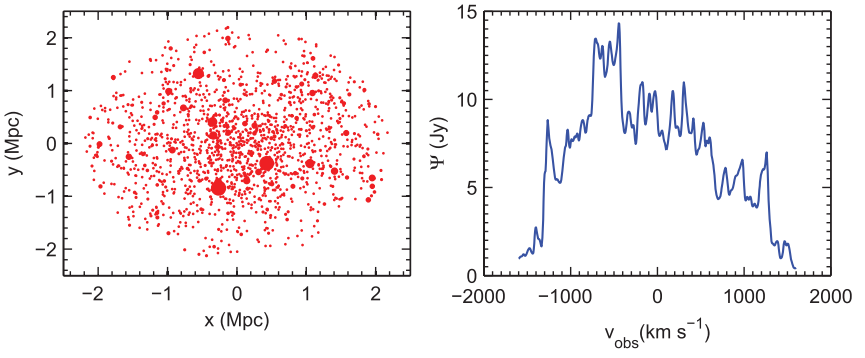

Figure 3. The synthetic observations of a Virgo sized galaxy cluster in the model samples. The left panel shows the HI gas distribution, in which the size represents the mass of HI gas. The right panel shows the 21cm flux profiles, in which the velocity resolution is 5 km/s.

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