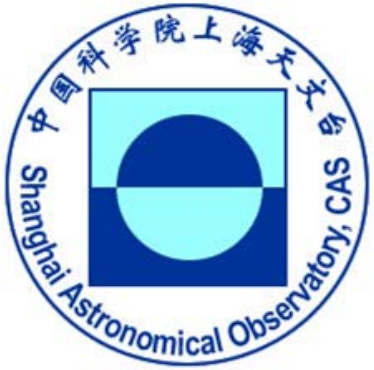
Recent progress on modelling gas components in L-Galaxies



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2018-11-28
MPA, Garching

- The models on ELUCID halos
- Mock the 21cm HI gas observations for galaxy groups and clusters
- Hot gas and X-ray luminosity in CGM

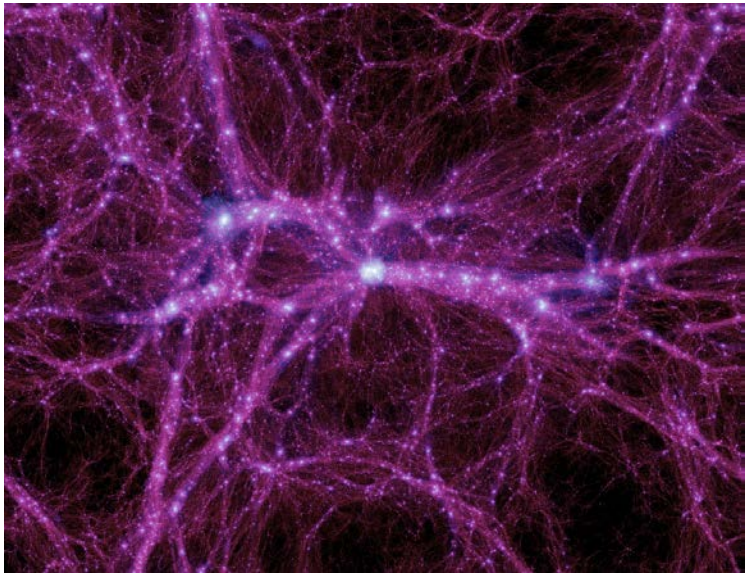
The L-Galaxies models on ELUCID haloes

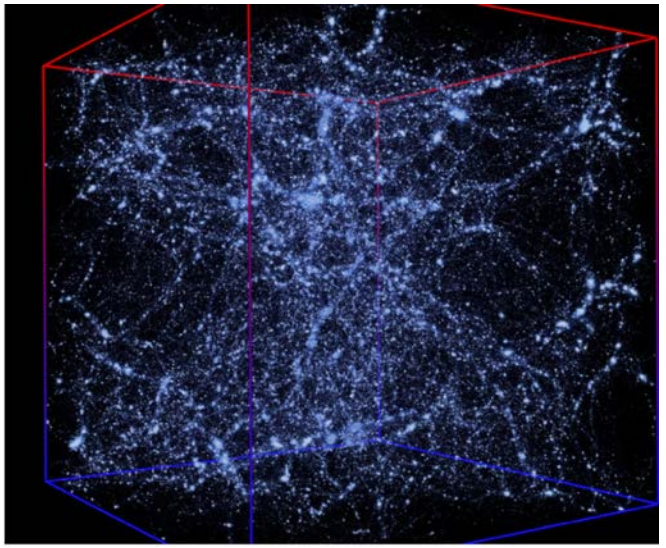
Millennium vs ELUCID

- Particle number: 2160^3 vs 3072^3
- Particle mass: $8.6\times10^8 M_\odot h^{-1}$ vs $3.1\times10^8 M_\odot h^{-1}$
- Box size: 500 h^{-1} Mpc
- Cosmology parameters: WMAP1 vs WMAP 5 (rescaling method: WMAP7, Planck, etc.)

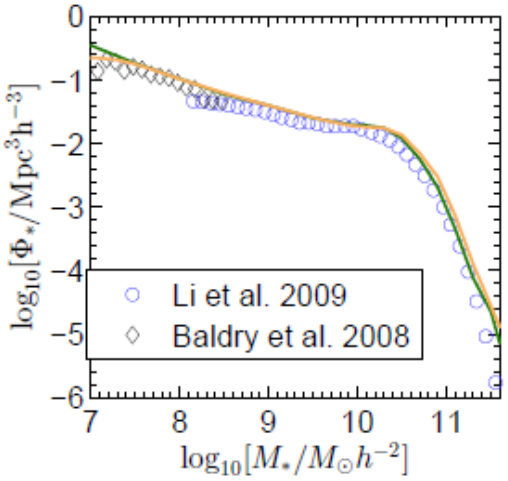
- 512 files vs 2048 files
- 64 snapshots vs 100 snapshots

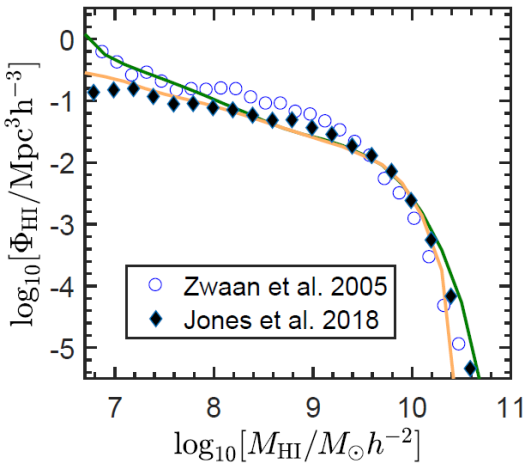
- Reconstruct the initial density field (Wang, Mo, Yang et al. 2014)
- One to one comparison to SDSS
- Avoid cosmic variance





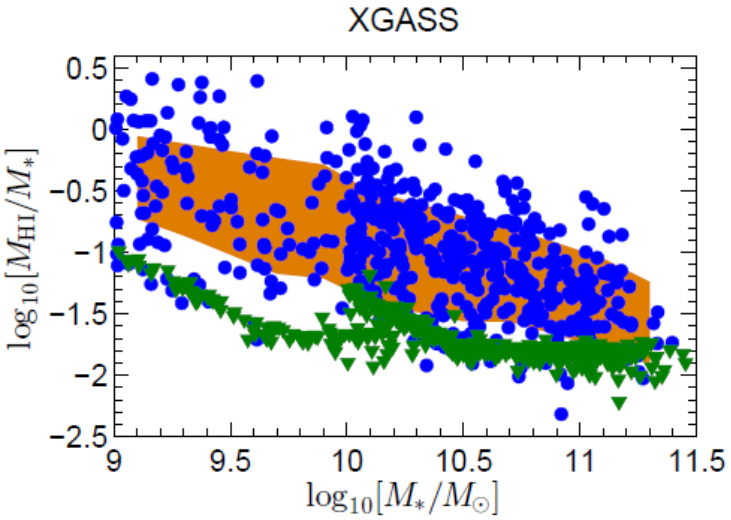
HI Mass functions at z=0

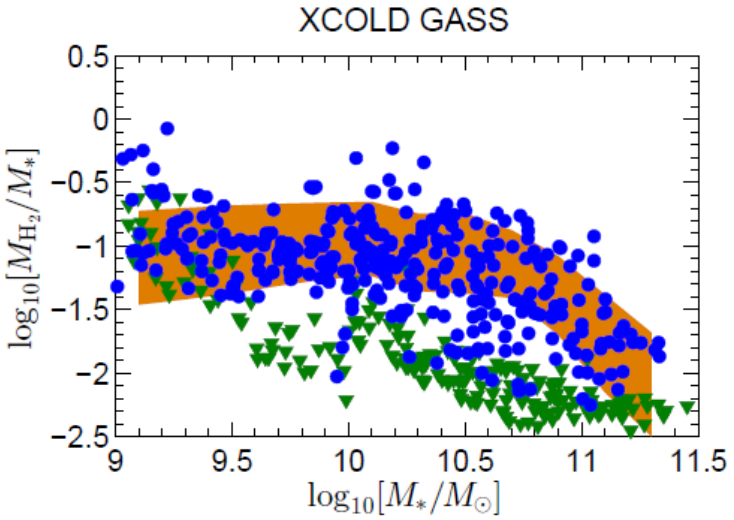




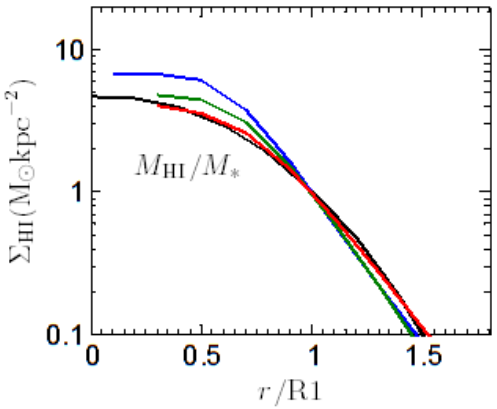
Models based on ELUCID halos predict low HIMF at low HI mass end

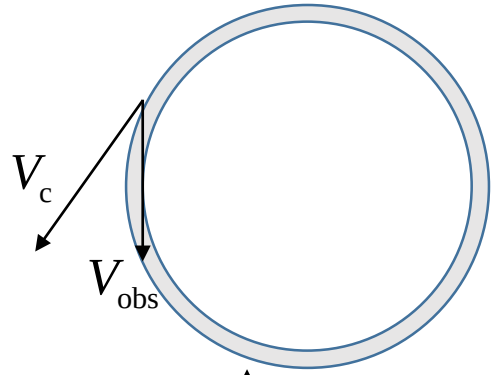
Scaling relations with XGASS & XCOLD GASS

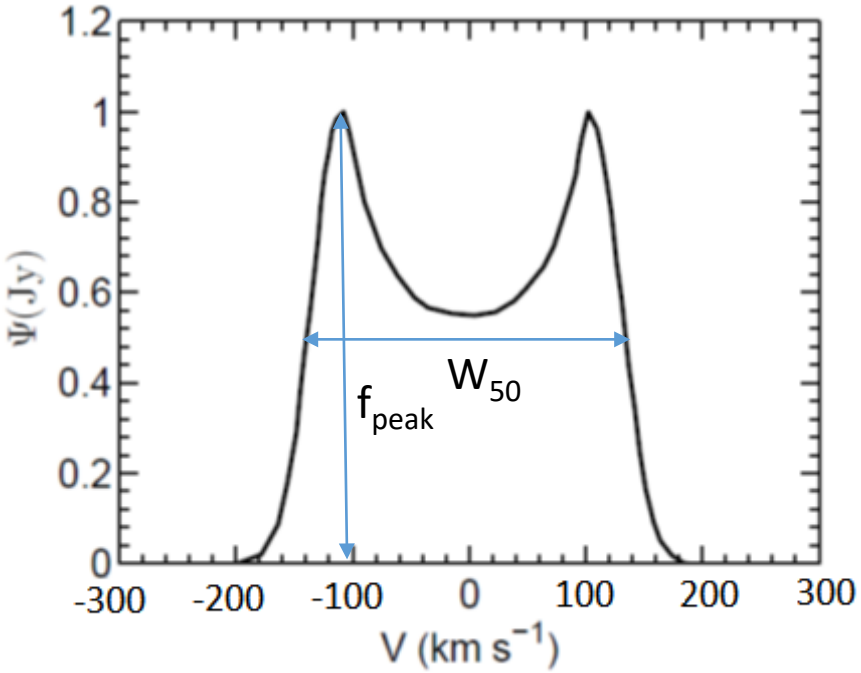


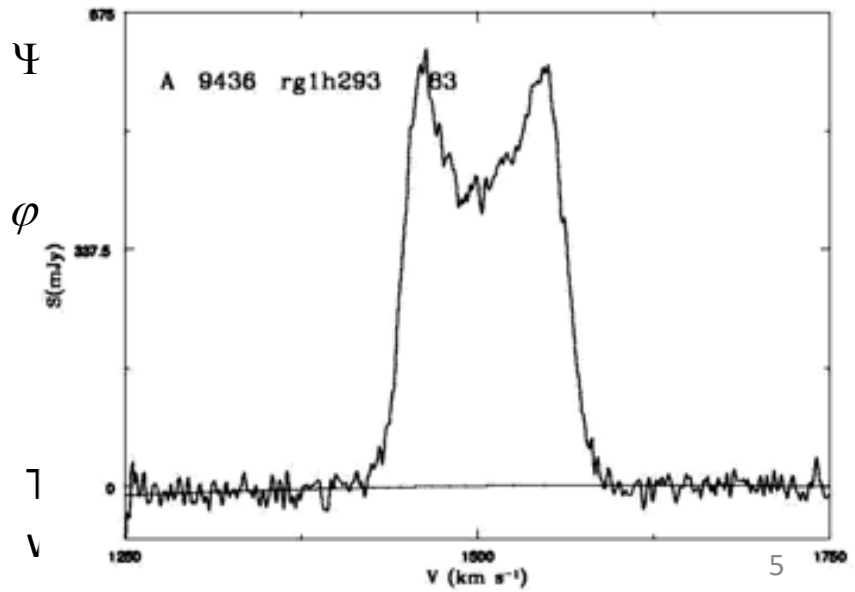


21cm flux profiles of HI gas disks

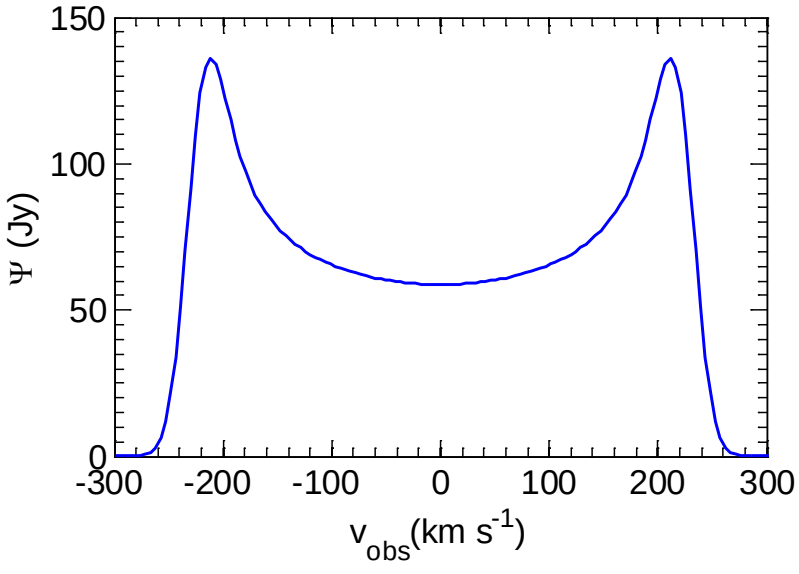




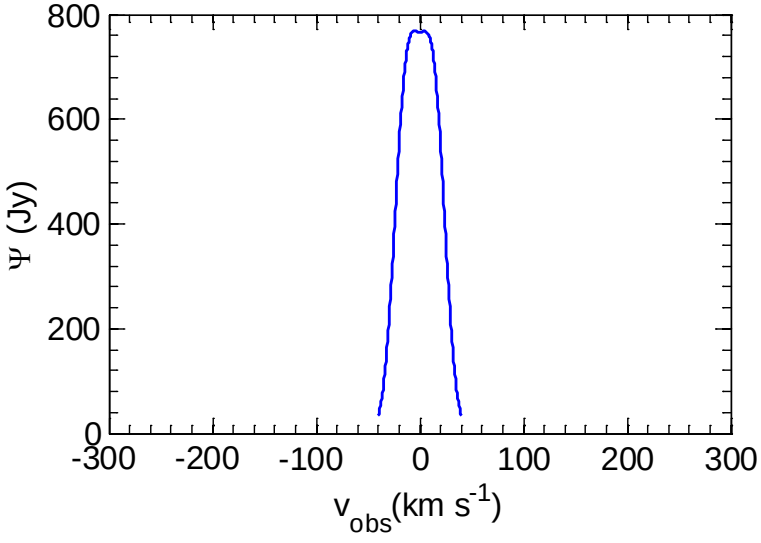




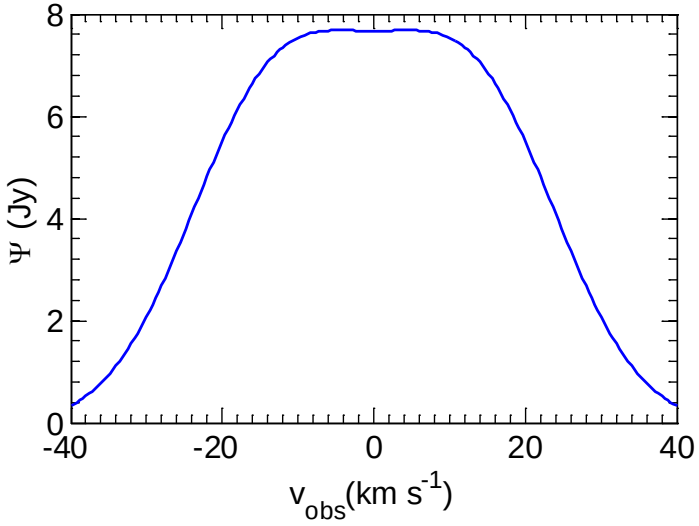
edge on disk galaxy



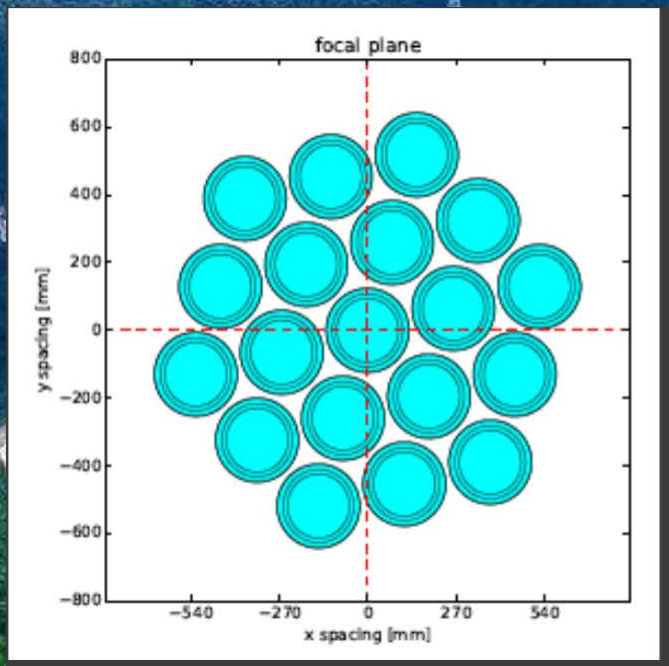
face on disk galaxy

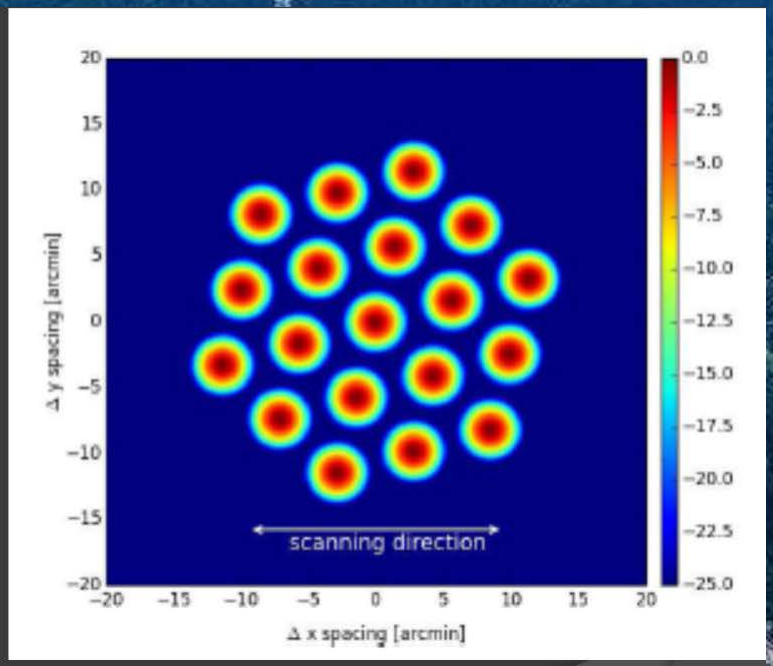


edge on dwarf galaxy



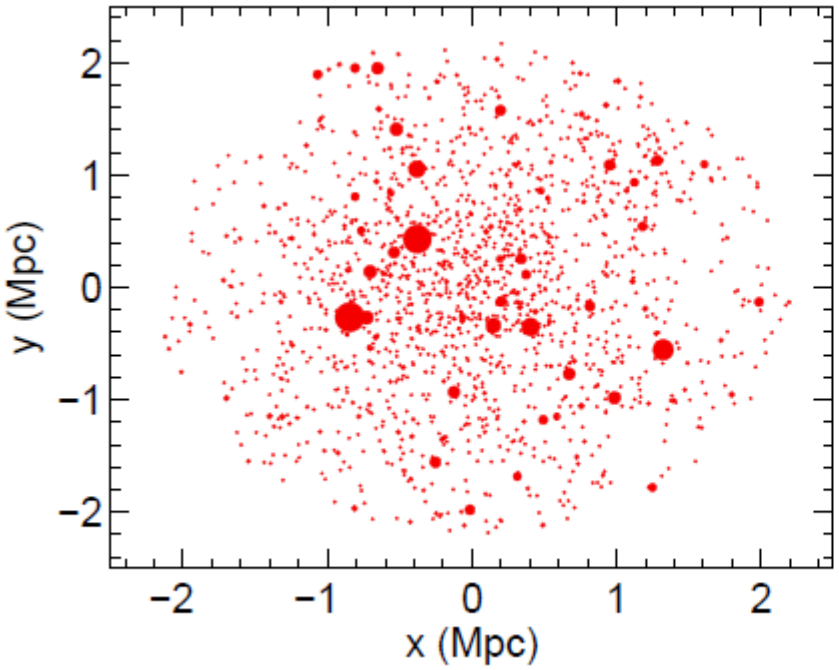
Simulations for FAST HI survey (Hope to start in 2019)



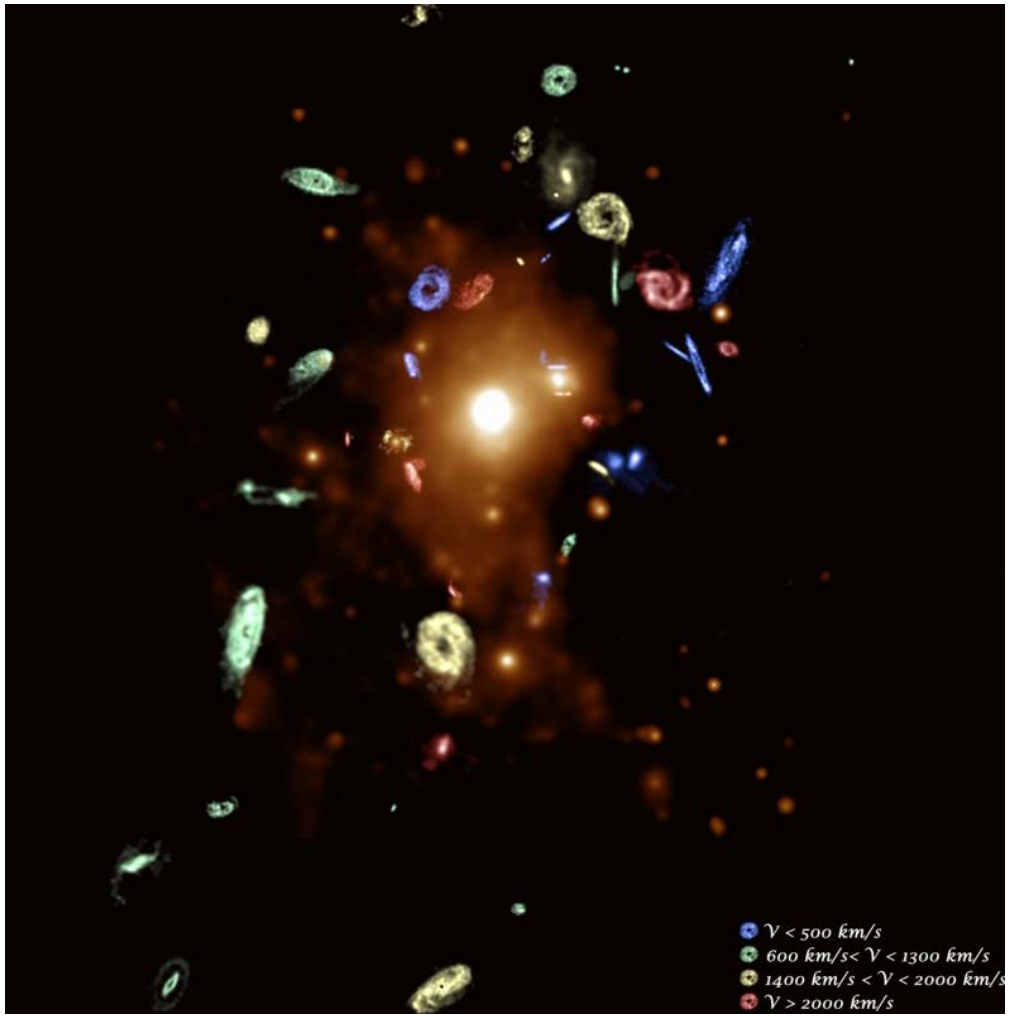


FAST telescope	
Frequency (L-band)	1050-1450 MHz
Number of beams	19
Dish diameter	300 m
Survey region	-14°~+66°
System temperature	18K

Synthetic observation of Virgo sized galaxy cluster

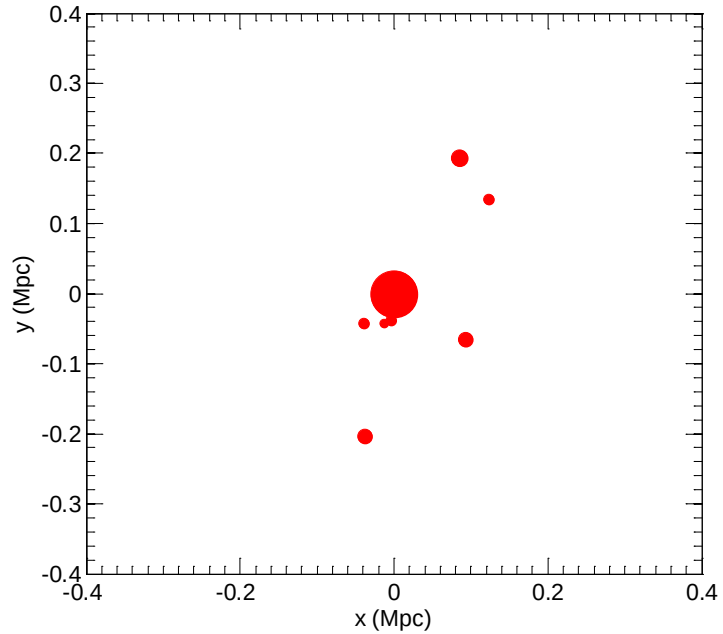


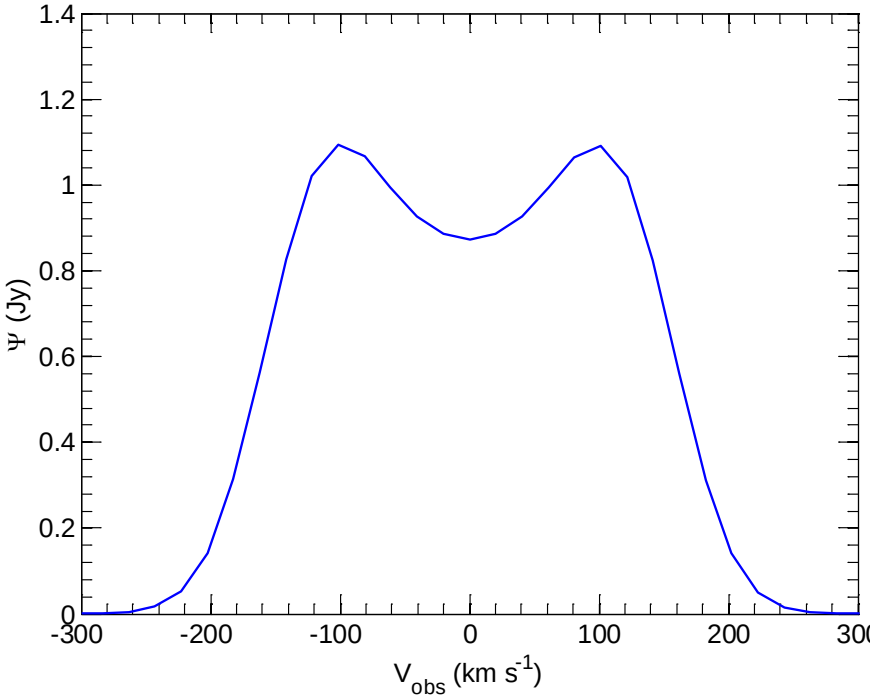
M_{vir}~$10^{15}M_{\odot}$, V_{dis}~1600km/s,
r_{vir}~2.2Mpc, distance~16.5 Mpc

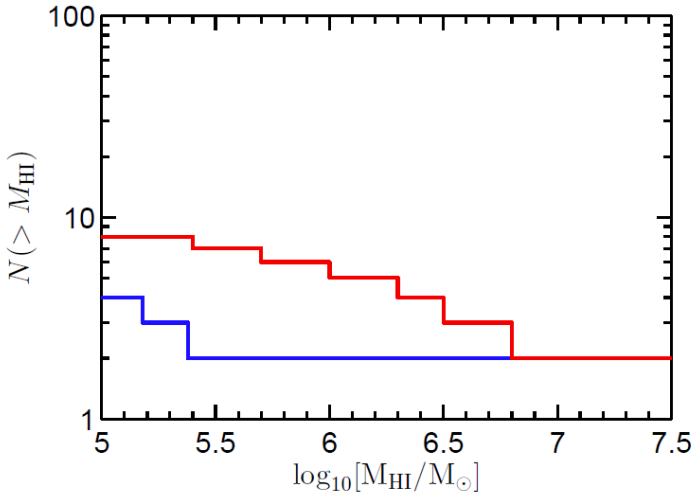


Synthetic observation of MW & satellites

Models based on Aquarius haloes







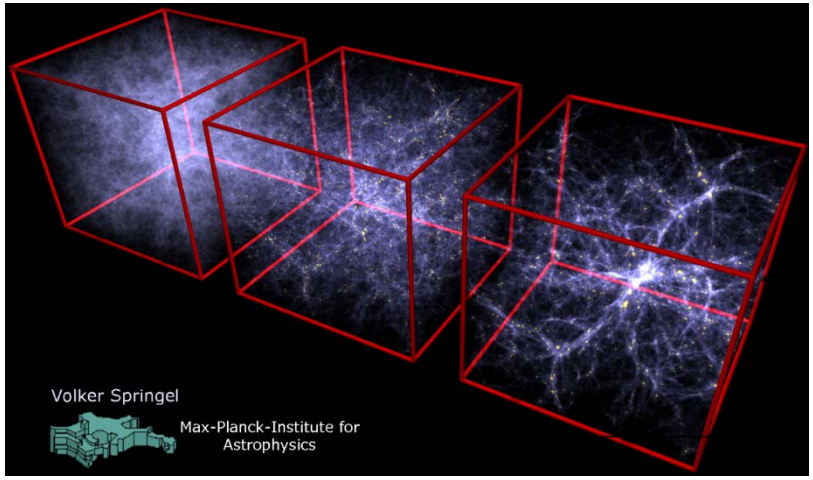
4 MW satellites with HI detected within 280 kpc (HIPASS, Grcevich&Putman 2009)

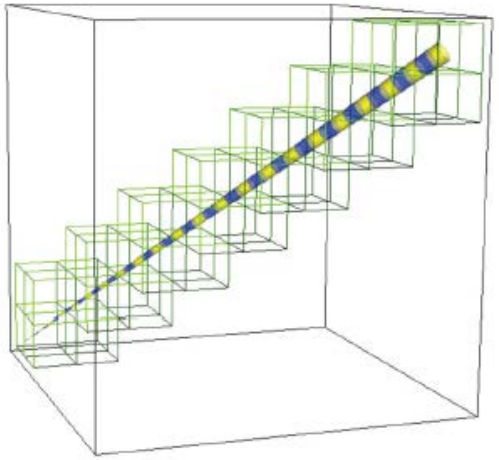
"missing satellite problem" in HI gas?

RELHICS?

(Reionization-Limited HI Clouds)

Light-cones algorithms



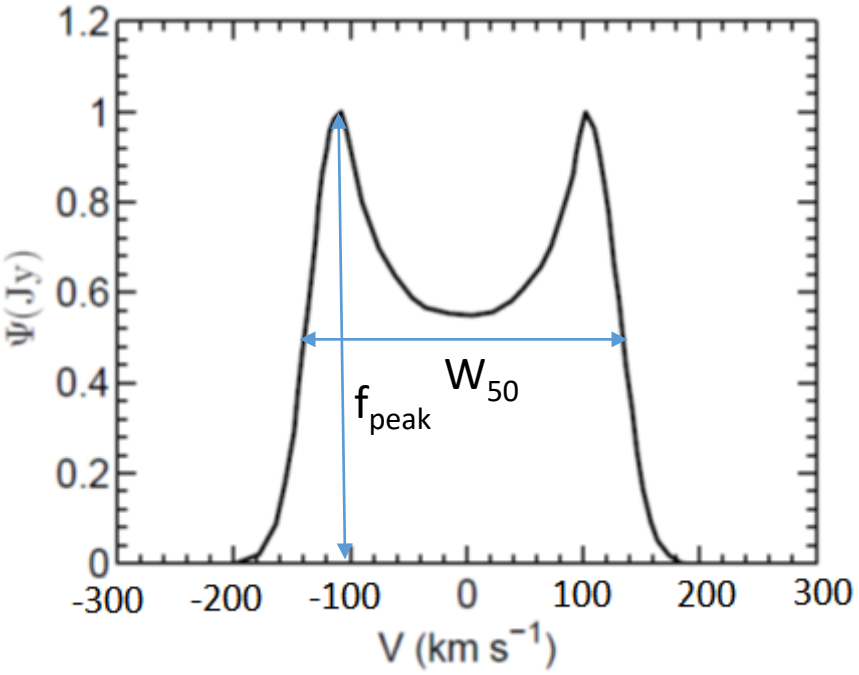


Periodic box

$$\mathrm{R.A} = \arctan\left(x / z\right), \quad \mathrm{decl.}=\mathrm{arc}$$

- HI gas in low redshift nearby galax
- HI result for high redshift galaxies/c

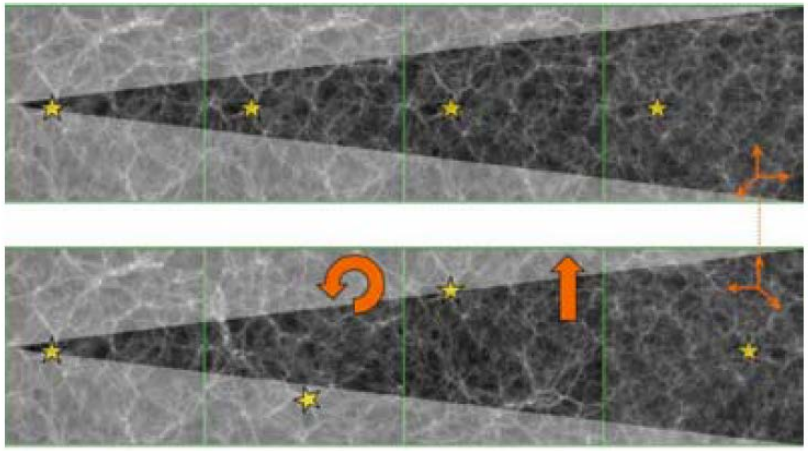
$$\mathrm{RA,\ Dec,}\ z,\ M_{*},\ M_{\mathrm{HI}}, F_{\mathrm{HI}}, W$$

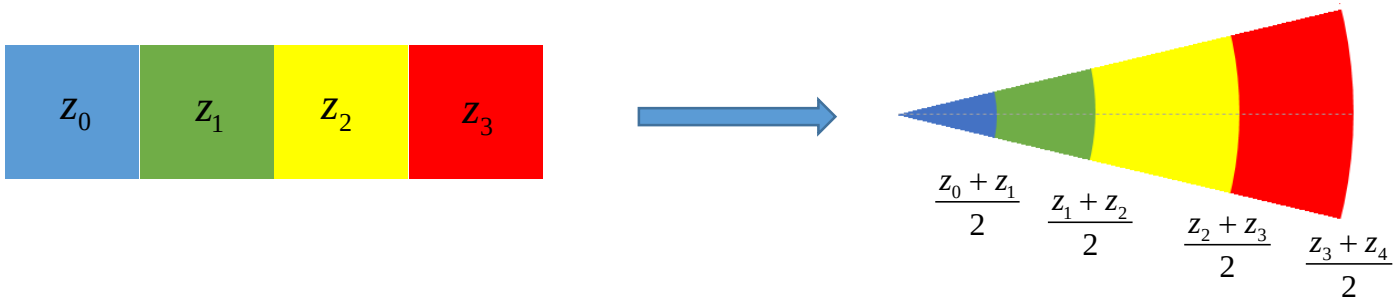


Light-cones algorithms
random tiling and redshift interpolation

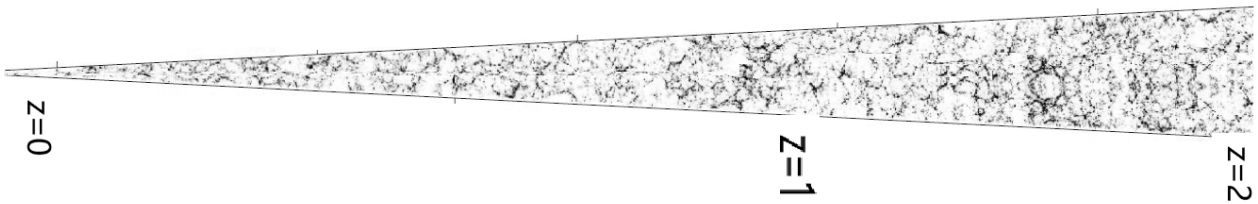
random tiling to avoid radial replications
Random transformations on the box:

- Shift (0-L_{box})
- Rotation (0°, 90°,180°,270°)
- Inversion (x→-x, y→-y)

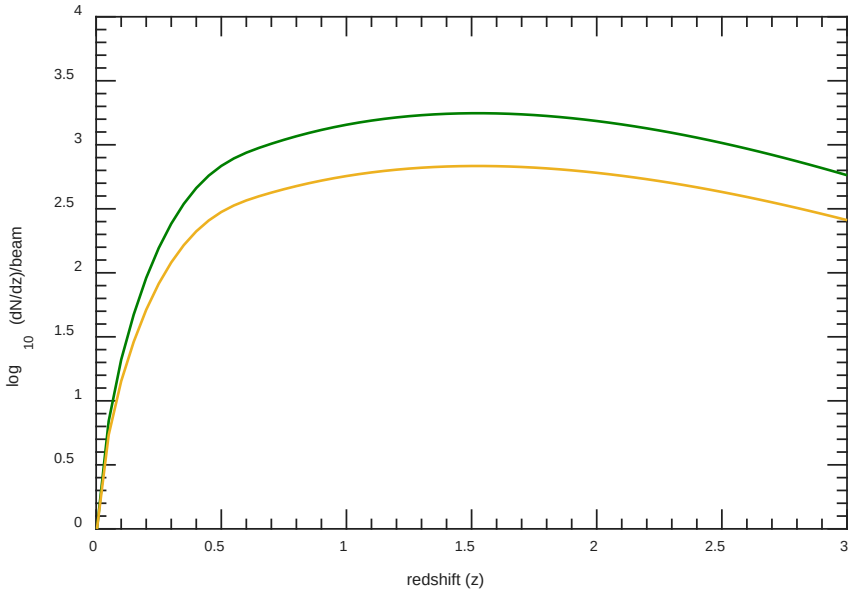




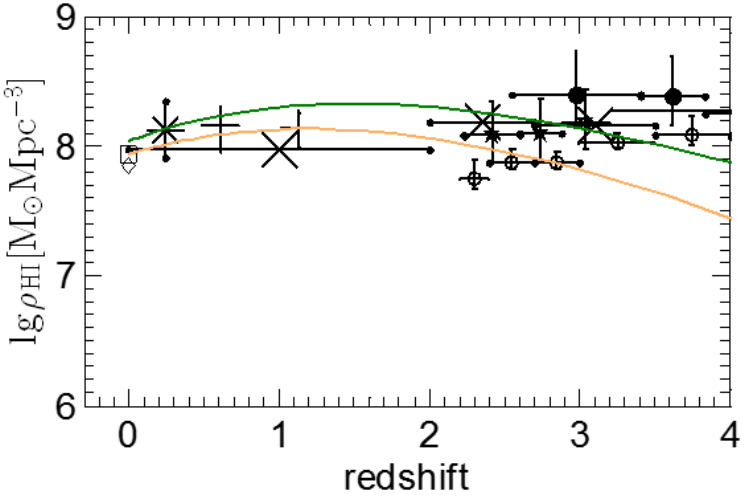
Discrete redshift snapshots → continuous redshift

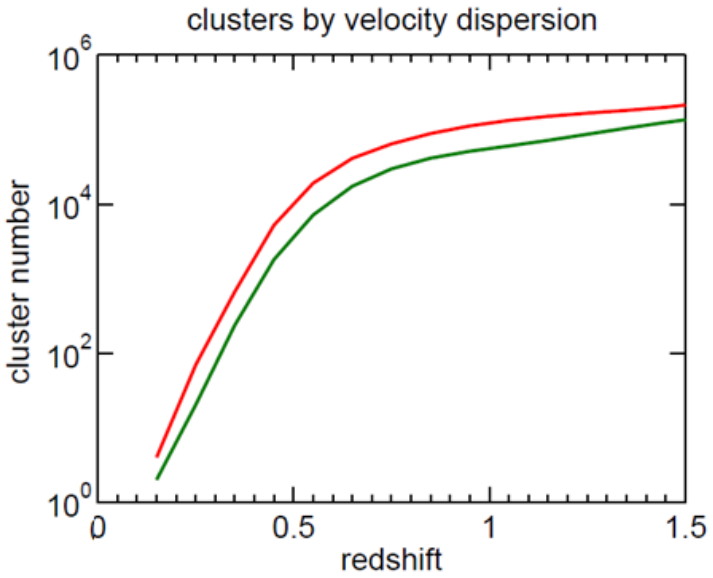


Number of sources with f_{peak}= 1mJy detection limit in a 3’ beam



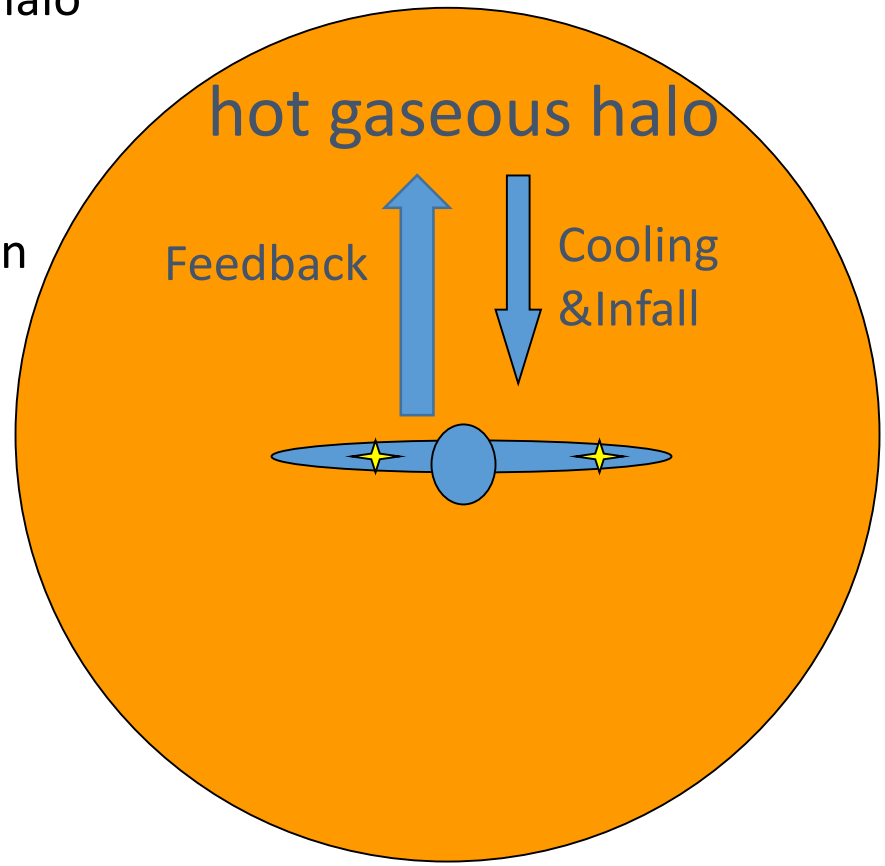
Cosmic HI density evolution





CGM & Hot gas in SAMs

- CGM and missing baryons in hot gaseous halo
- X-ray luminosity in hot gas and cooling
- Mock for x-ray survey (e.g HUBS)
- 0.1-2kev, 1 deg^2 field, 1-2 arcmin resolution (Hope to launch before 2030)
- To detect missing baryons in IGM/CGM

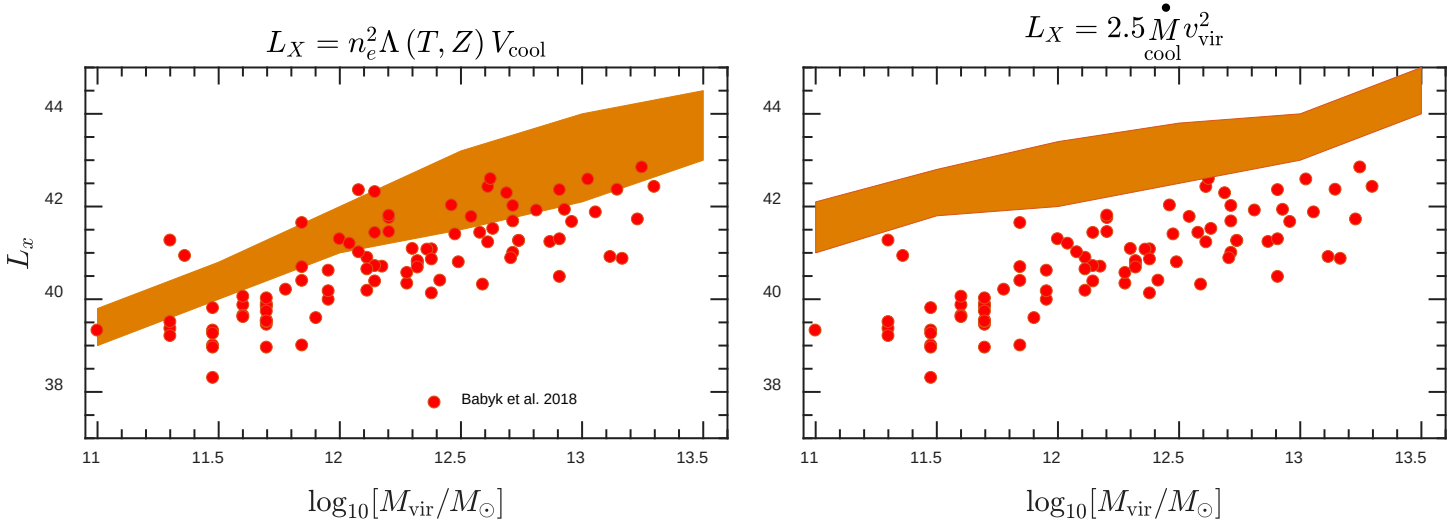


X-ray luminosity

- X-ray luminosity: $L_X = 2.5\dot{M}_{\rm cool} v_{\rm vir}^2$

$$L_X = n_e^2 \Lambda(T,Z) V_{\rm cool} = 4\pi \int_0^{r_{\rm cool}} n_e^2(r)\Lambda(T,Z) r^2 dr$$

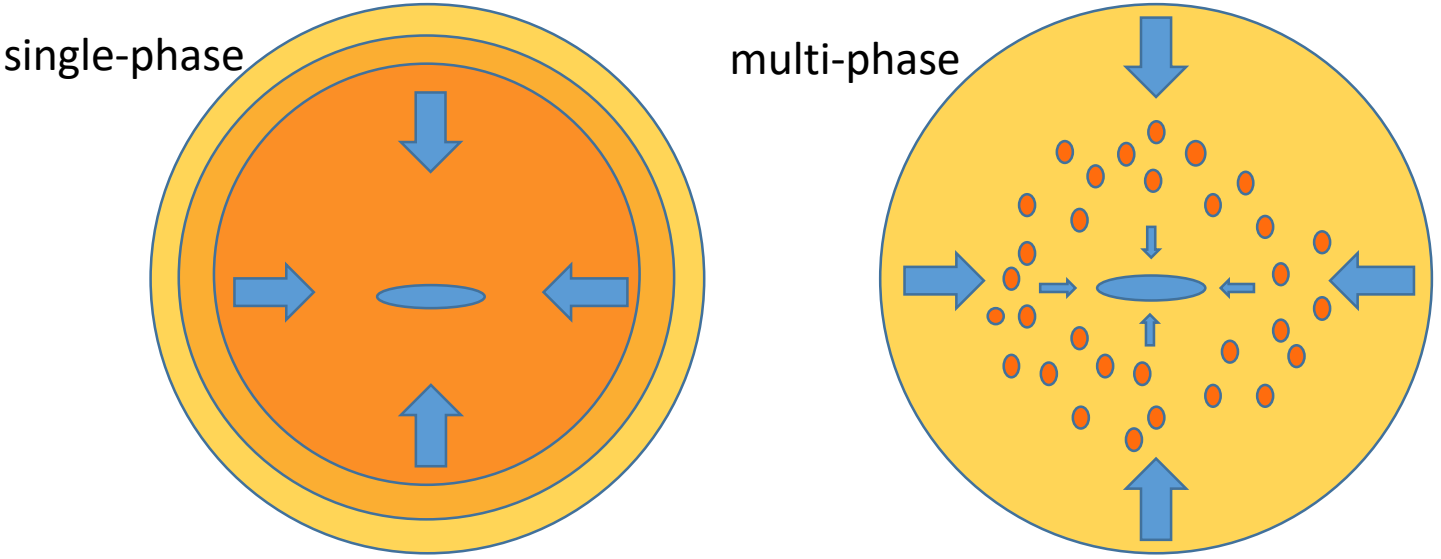
- $n_e(r)$: electron density—isothermal distribution
- $V_{\rm cool}$: $0.15R_{\rm vir}$ or $r_{\rm cool}$



Cooling prescriptions

$$L_X = n_e^2 \Lambda(T,Z) V_{\rm cool} = 4\pi \int_0^{r_{\rm cool}} n_e^2(r)\,\Lambda(T,Z) r^2 dr$$

- $n_e(r)$: the radial profiles of hot gas (Prakriti's work)
- Cooling function $\Lambda(T,Z)$: change the cooling prescriptions



Two-phase model (Maller & Bullock 2004)

Summary

- Currently, we find the SAMs based on ELUCID haloes show similar results compared to Millennium haloes, but predict lower HI mass functions at low mass end

- Our model results of the HI radial profiles can used to study and analysis various of observational results

- Current models overpredict the X-ray. Future work should change the prescriptions.

Thank you!