Theoretical Models of Galaxy Formation including HI

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Zoldan et al. 2017; 2018
MNRAS, 465, 2236
MNRAS, 481, 1376Z

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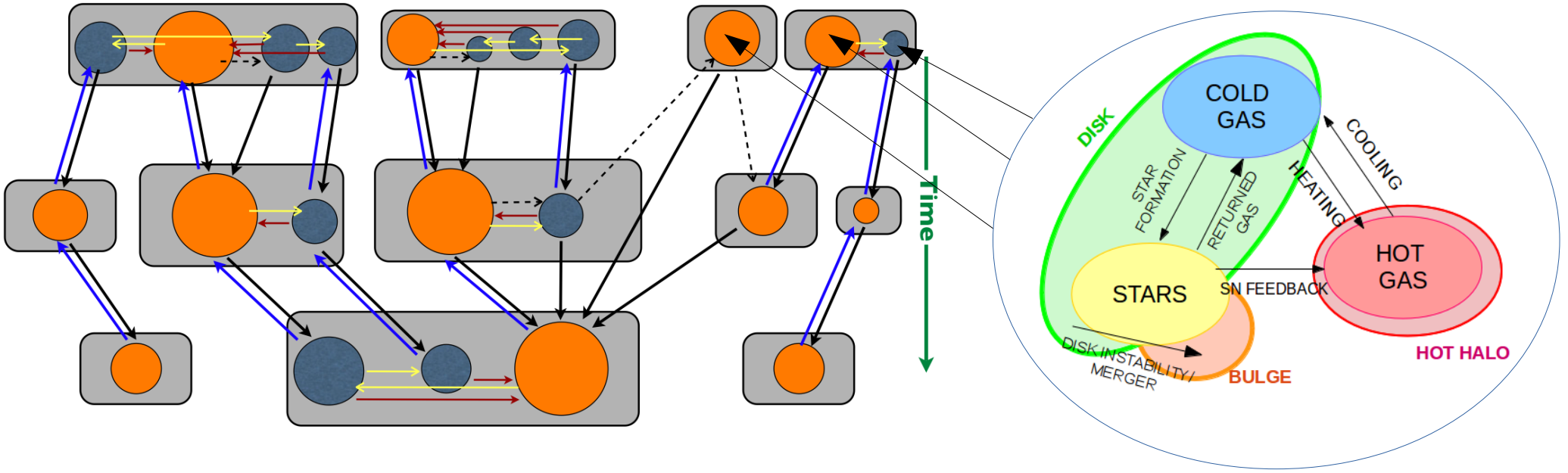
Semi-analytic models

N-body DM simulation:
Millennium Simulation
(Springel et al. 2005)

Semi-analytic model



Sub-halo properties:

- M_{200};
- Spin;
- Rotational velocity;
- Etc.

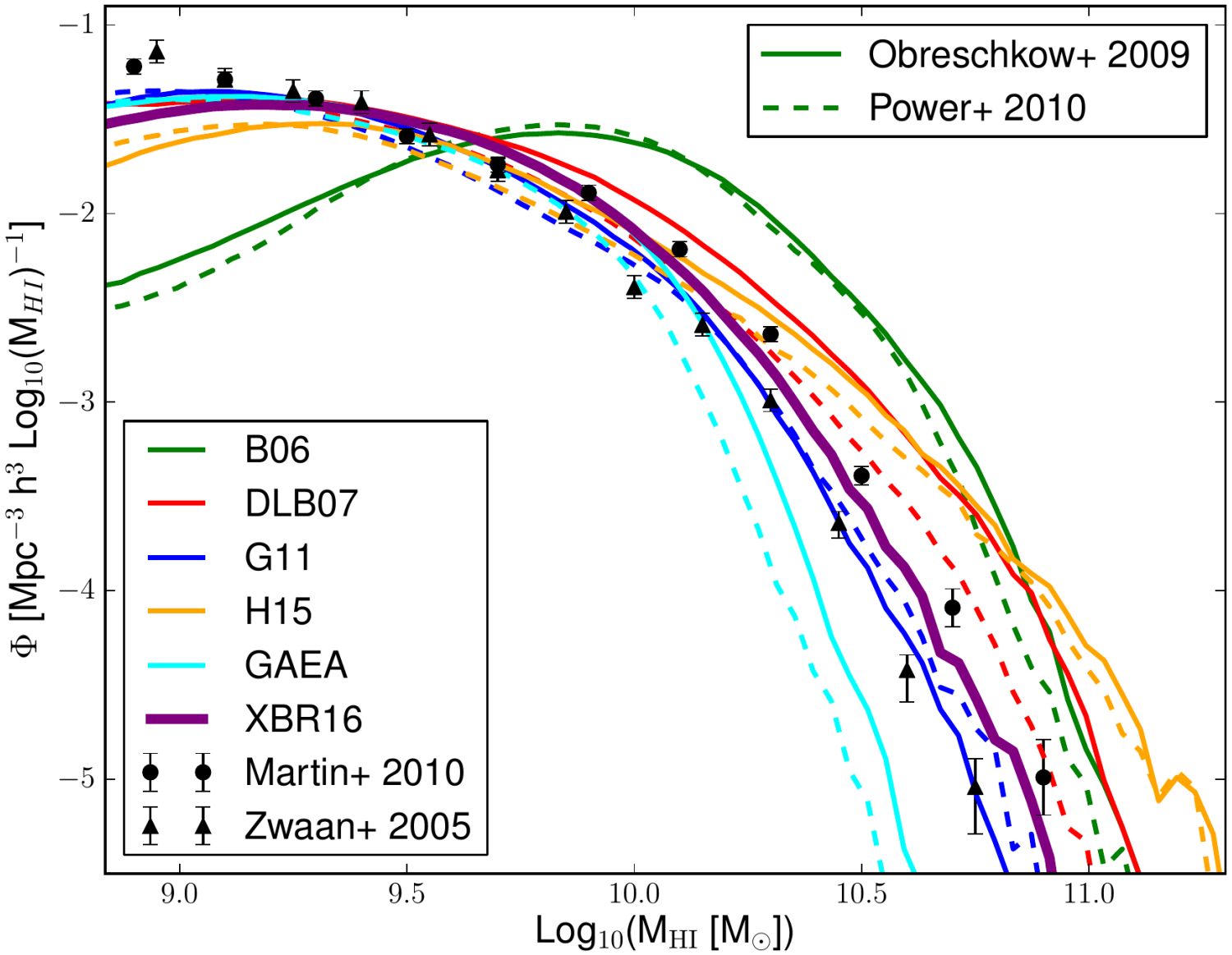
HI in semi-analytic models

Bower et al. 2006 → **B06**
De Lucia & Blaizot 2007 → **DLB07**
Guo et al. 2011 → **G11**
Henriques et al. 2015 → **H15**
Hirschmann et al. 2016 → **GAEA**
Xie et al. 2017 → **XBR16**

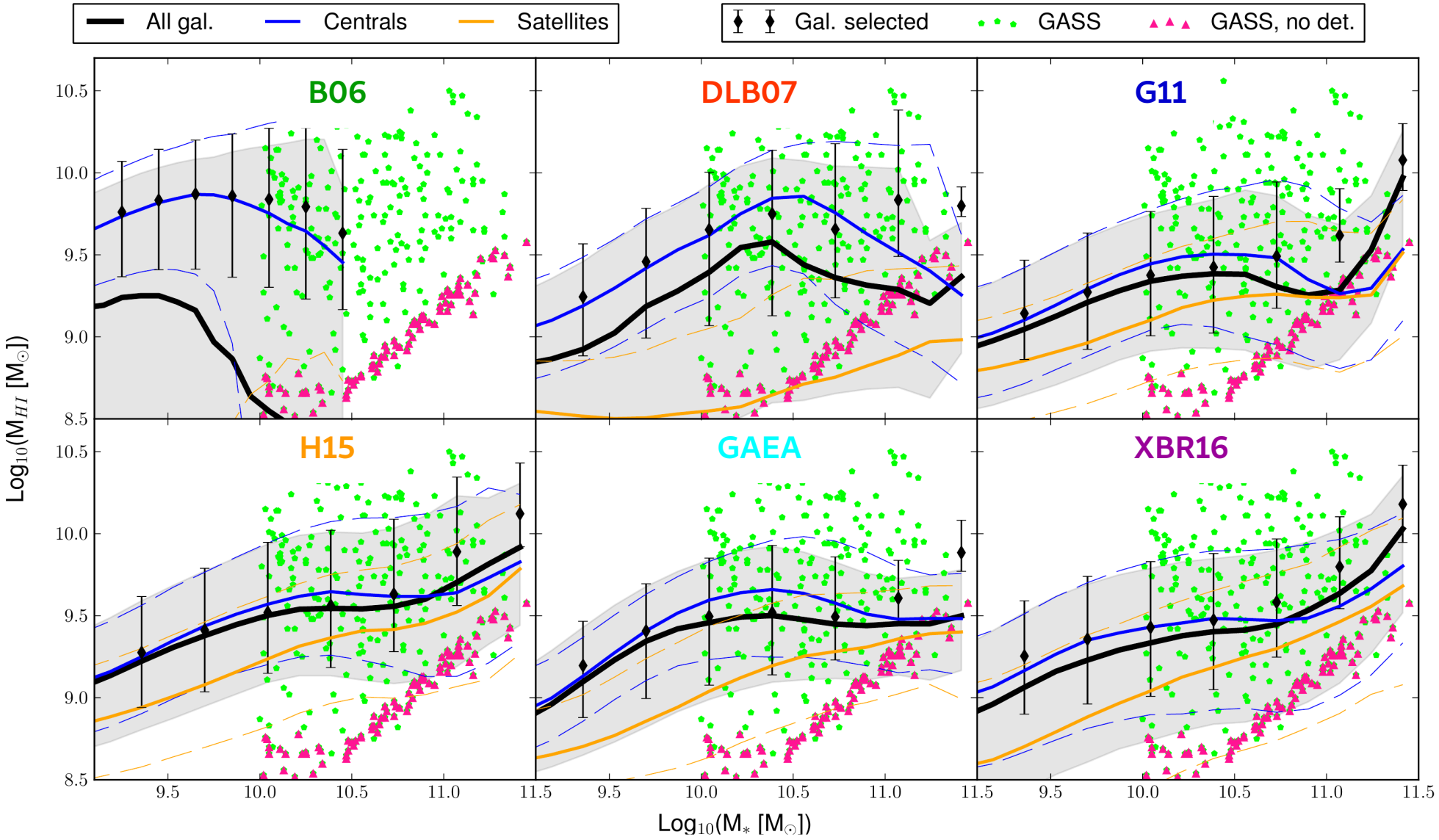
Star Formation based on **cold gas surface density**.
HI and H_2 partitioned in post-processing, assuming hydrostatic equilibrium in a symmetric, exponential disk
(Obreschkow et al., 2009)

Star Formation based on H_2 surface density (Wong & Blitz, 2002; Kennicutt et al., 2007; Leroy et al., 2008; Bolatto et al., 2011; Krumholz, 2013).
HI and H_2 partitioned at each time-step
(Blitz & Rosolowsky, 2006)

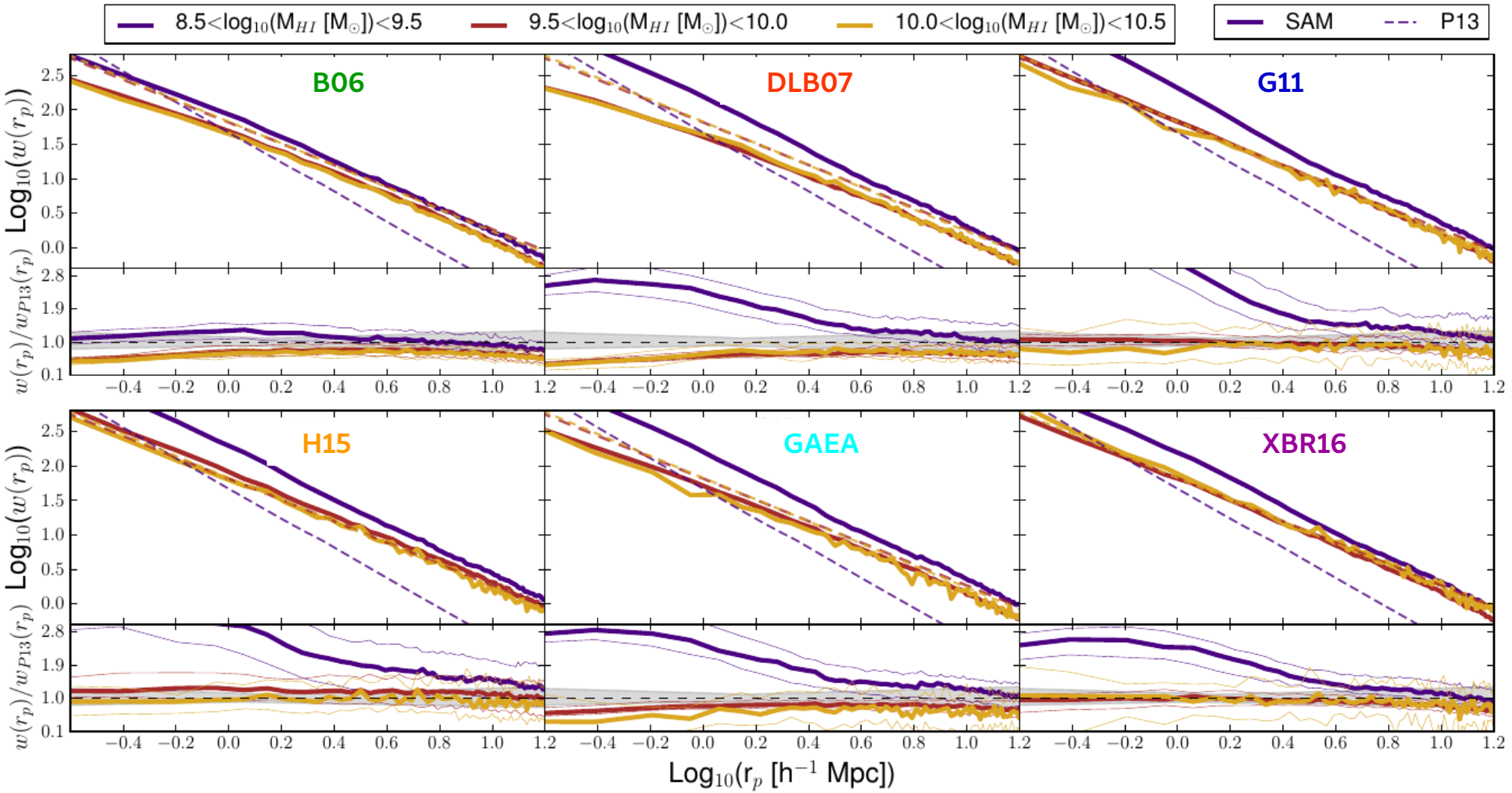
The HI mass function



The HI-M_* relation

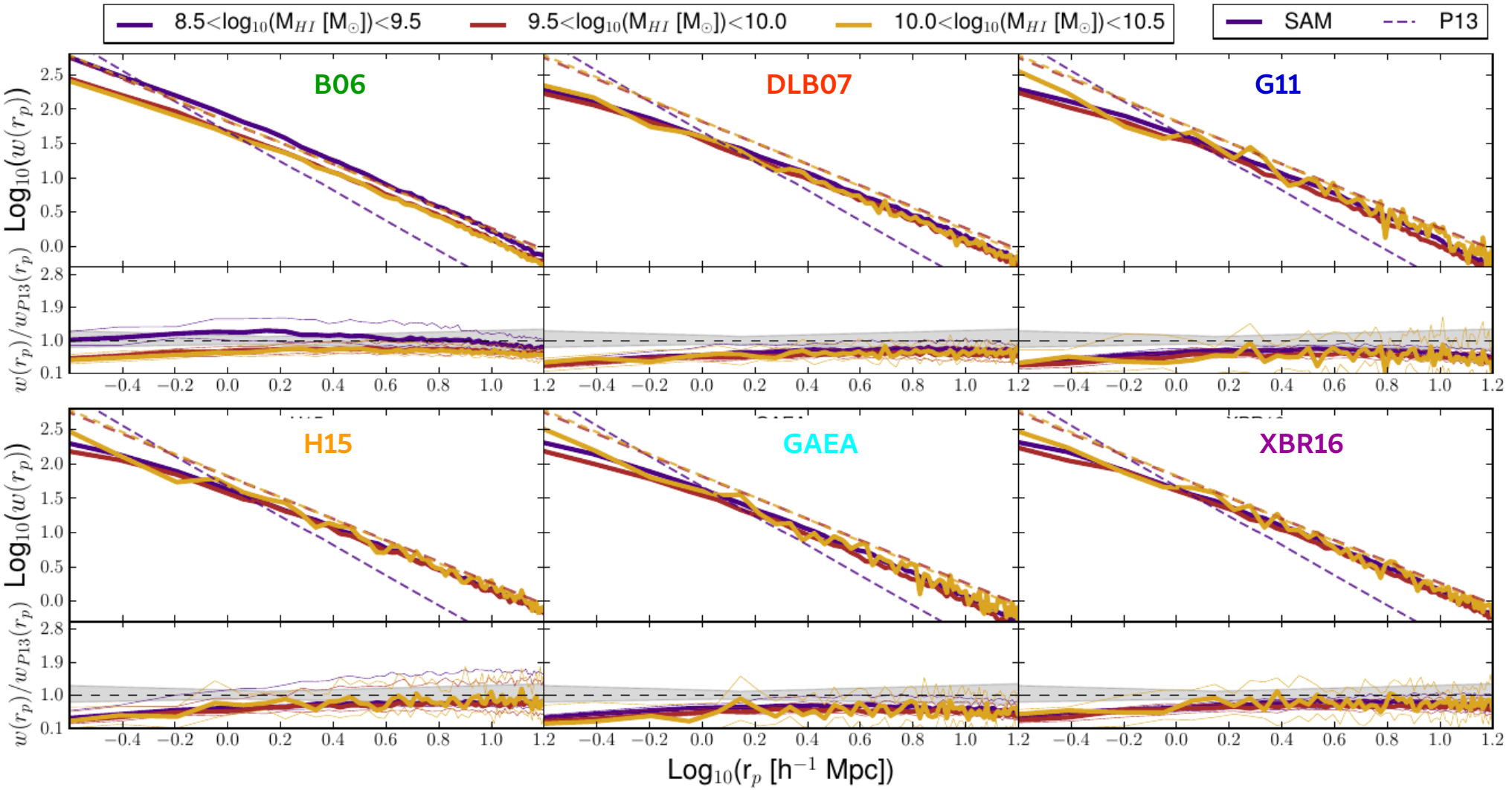


The 2-point correlation function



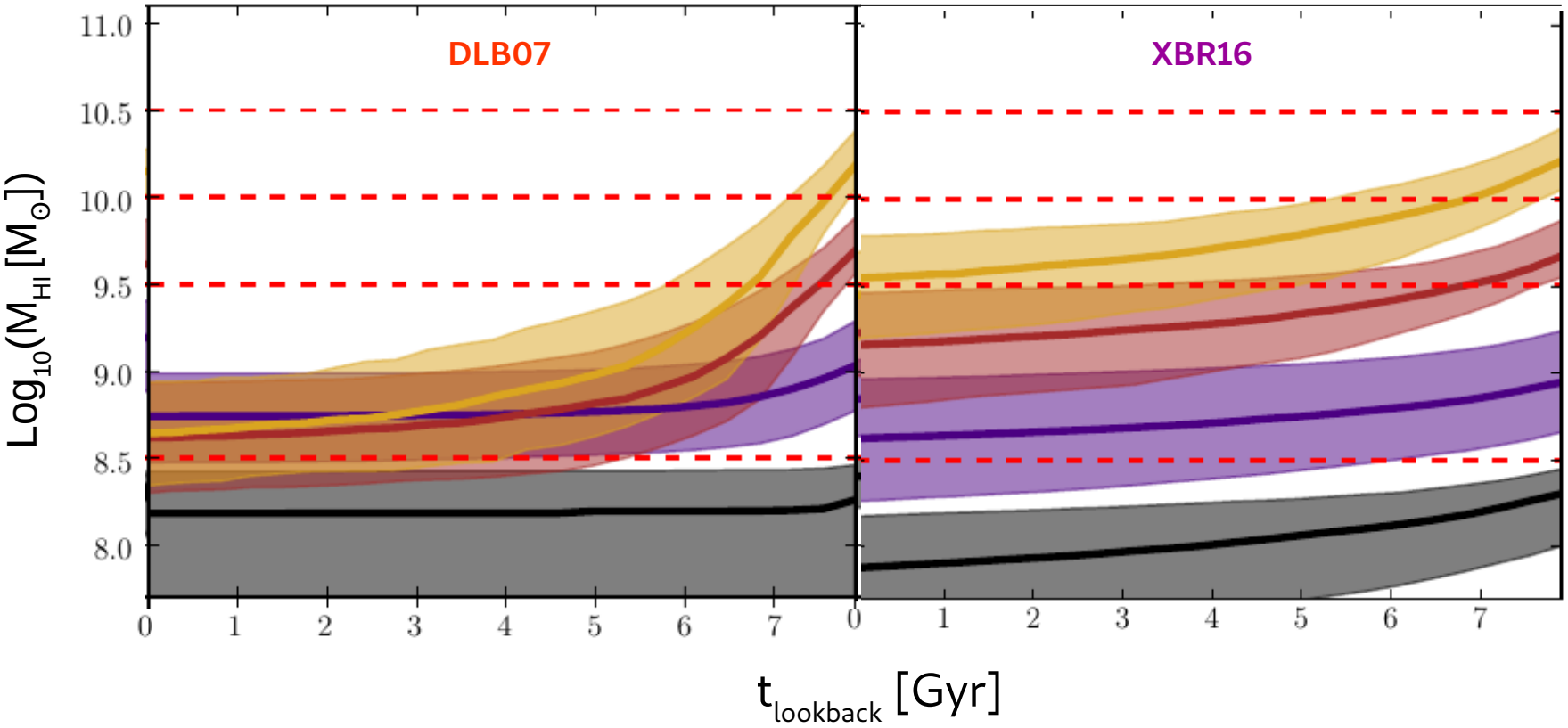
P13 = Papastergis et al. (2013)

The 2-point correlation function



NO SATELLITES

HI evolution in satellites



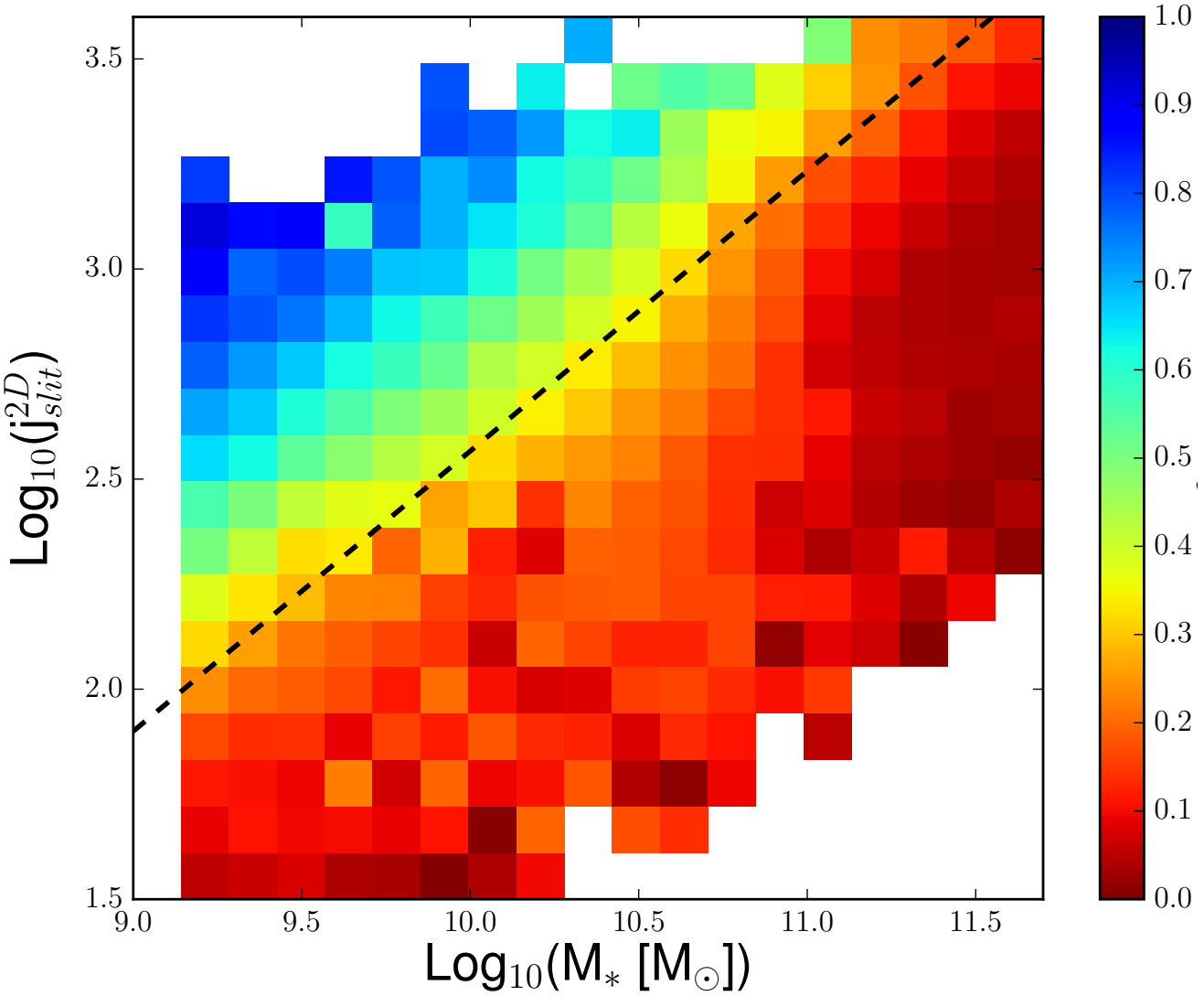
SAME STRIPPING TREATMENT

GAEA model by Xie et al. (2017)

We use **XBR16** model:

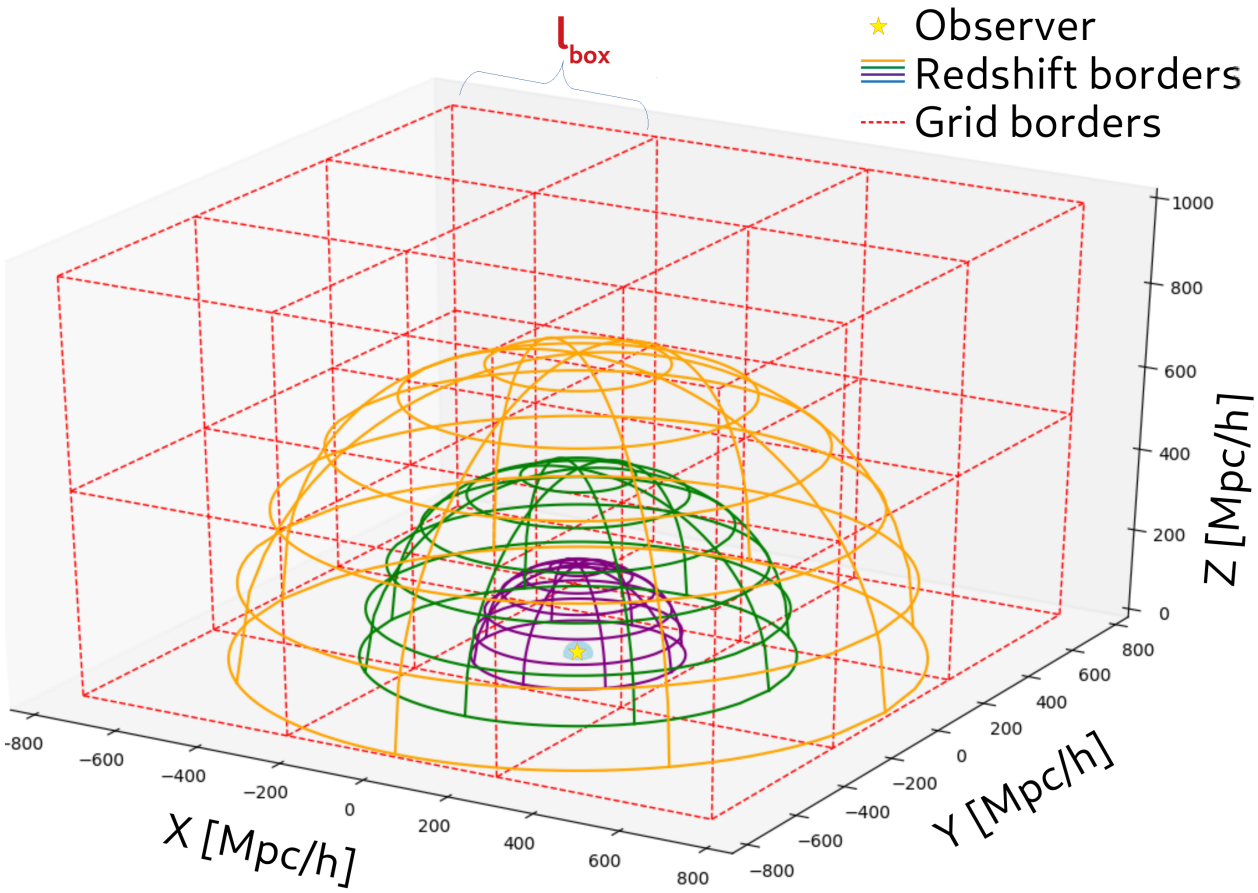
- Non-instantaneous recycling of metals and energy (De Lucia et al. 2014);
- Stellar feedback scheme based on results of recent hydrodynamical simulations (Hirschmann et al. 2016);
- HI-H_2 self-consistent partition;
- Star Formation based on H_2;
- Specific angular momentum exchange among components (Xie et al. 2017);
- Dissipation during mergers (Zoldan et al. 2018);

j_* and cold gas



$f_{cold} = M_{cold} /(M_{cold}+M_*)$

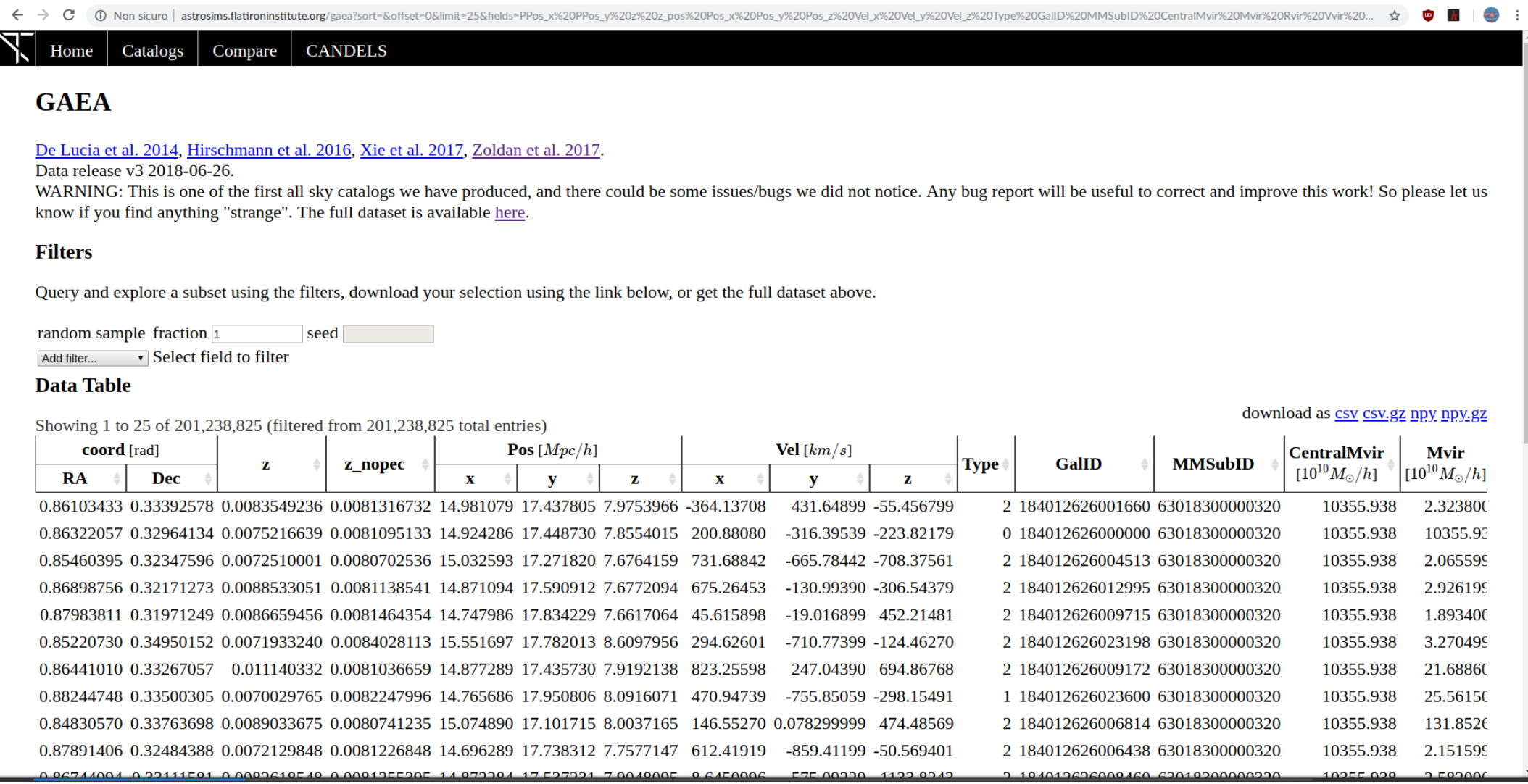
All sky catalog



Preliminary catalog:

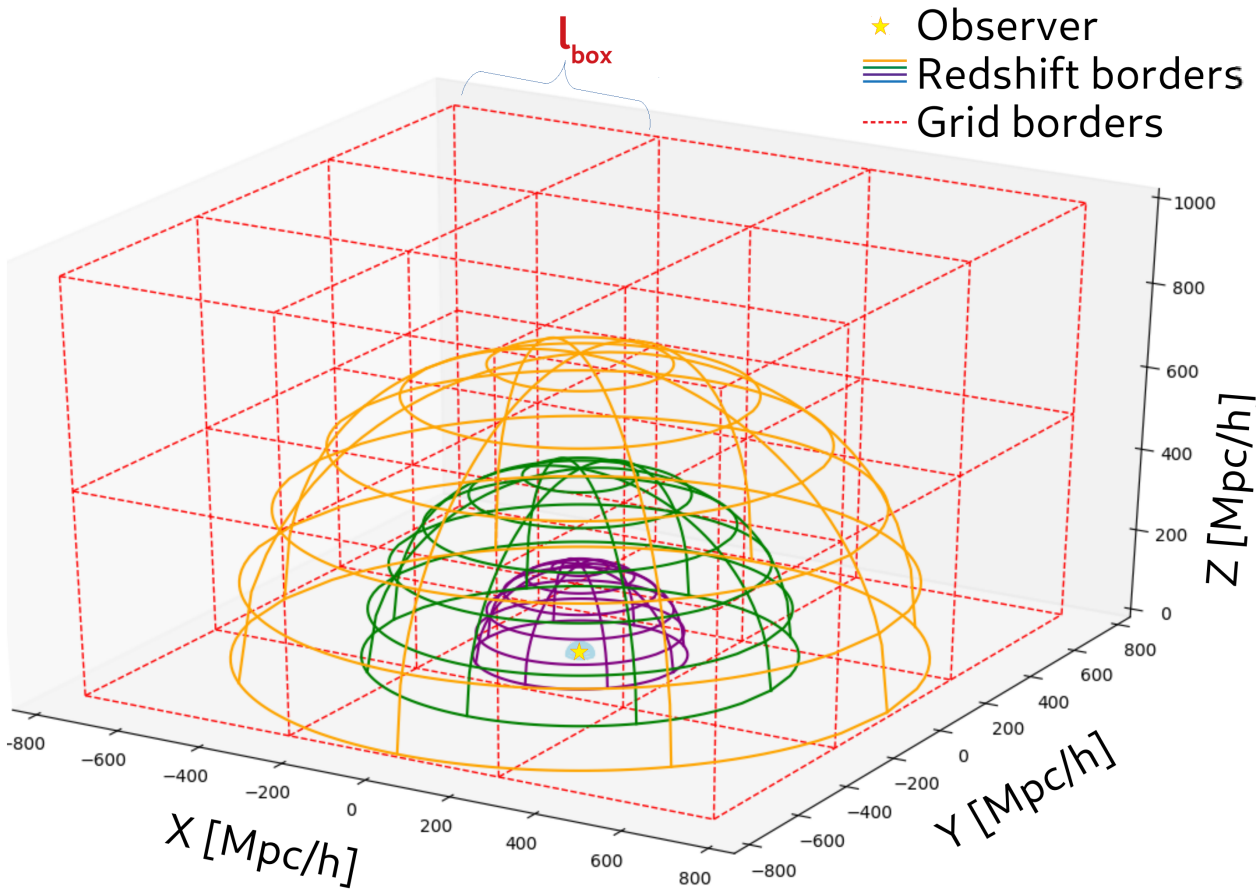
- $0<z<0.45$
- $M_* > 10^9 M_\odot$
- Millennium Simulation (WMAP1)
- Galaxy and halo properties

Available at: http://astrosims.flatironinstitute.org/gaea



coord [rad]		z	z_nopec	Pos [Mpc/h]			Vel [km/s]			Type	GalID	MMSubID	CentralMvir [$10^{10} M_\odot/h$]	Mvir [$10^{10} M_\odot/h$]
RA	Dec			x	y	z	x	y	z					
0.86103433	0.33392578	0.0083549236	0.0081316732	14.981079	17.437805	7.9753966	-364.13708	431.64899	-55.456799	2	184012626001660	63018300000320	10355.938	2.323800
0.86322057	0.32964134	0.0075216639	0.0081095133	14.924286	17.448730	7.8554015	200.88080	-316.39539	-223.82179	0	184012626000000	63018300000320	10355.938	10355.93
0.85460395	0.32347596	0.0072510001	0.0080702536	15.032593	17.271820	7.6764159	731.68842	-665.78442	-708.37561	2	184012626004513	63018300000320	10355.938	2.065599
0.86898756	0.32171273	0.0088533051	0.0081138541	14.871094	17.590912	7.6772094	675.26453	-130.99390	-306.54379	2	184012626012995	63018300000320	10355.938	2.926199
0.87983811	0.31971249	0.0086659456	0.0081464354	14.747986	17.834229	7.6617064	45.615898	-19.016899	452.21481	2	184012626009715	63018300000320	10355.938	1.893400
0.85220730	0.34950152	0.0071933240	0.0084028113	15.551697	17.782013	8.6097956	294.62601	-710.77399	-124.46270	2	184012626023198	63018300000320	10355.938	3.270499
0.86441010	0.33267057	0.011140332	0.0081036659	14.877289	17.435730	7.9192138	823.25598	247.04390	694.86768	2	184012626009172	63018300000320	10355.938	21.68860
0.88244748	0.33500305	0.0070029765	0.0082247996	14.765686	17.950806	8.0916071	470.94739	-755.85059	-298.15491	1	184012626023600	63018300000320	10355.938	25.56150
0.84830570	0.33763698	0.0089033675	0.0080741235	15.074890	17.101715	8.0037165	146.55270	0.078299999	474.48569	2	184012626006814	63018300000320	10355.938	131.8526
0.87891406	0.32484388	0.0072129848	0.0081226848	14.696289	17.738312	7.7577147	612.41919	-859.41199	-50.569401	2	184012626006438	63018300000320	10355.938	2.151599
0.86744094	0.33111581	0.0082618548	0.0081255295	14.872284	17.537231	7.9048095	8.6450996	575.09229	1133.8243	2	184012626008460	63018300000320	10355.938	2.582006

All sky catalog



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Future plans:

- Higher z;
- PLANCK cosmology;
- 21 cm line;
- Others ….

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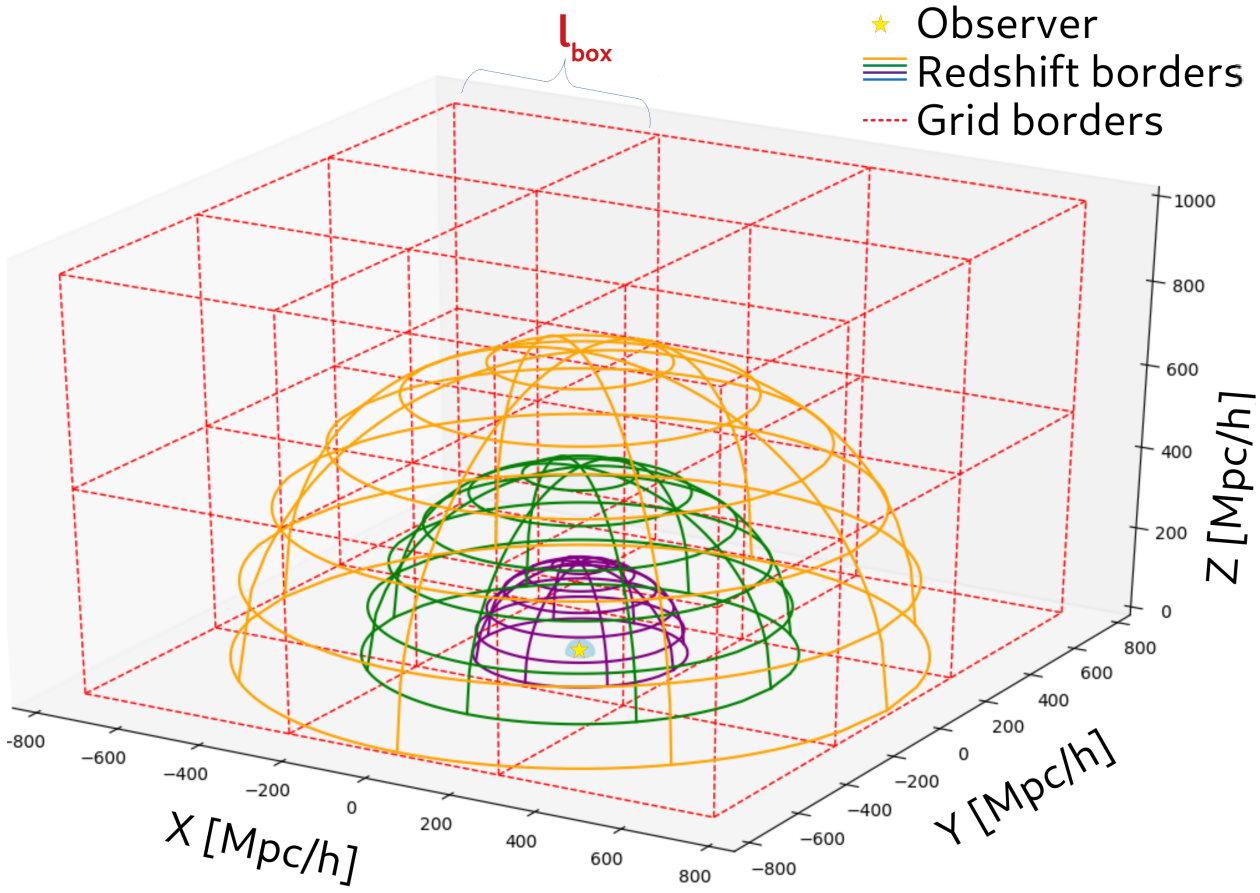

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