האוניברסיטה העברית בירושלים
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The Local Group Factory

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EC, J.G. Sorce, Y. Hoffmann, S. Gottlöber, G. Yepes, N.I. Libeskind,S.V. Pilipenko, A. Knebe, H. Courtois, R.B. Tully, M. Steinmetz, **MNRAS 2016**

EC, Y. Hoffmann, J.G. Sorce, S. Gottlöber, G. Yepes, H. Courtois, R.B. Tully, (accepted yesterday) **MNRAS 2016**

Motivation

Study the LG in a **controlled environment:**

Is the LG a **typical** object?

Is it an **unlikely** product of ΛCDM?

Can we learn something on cosmology?

Large scales/small scales relation?

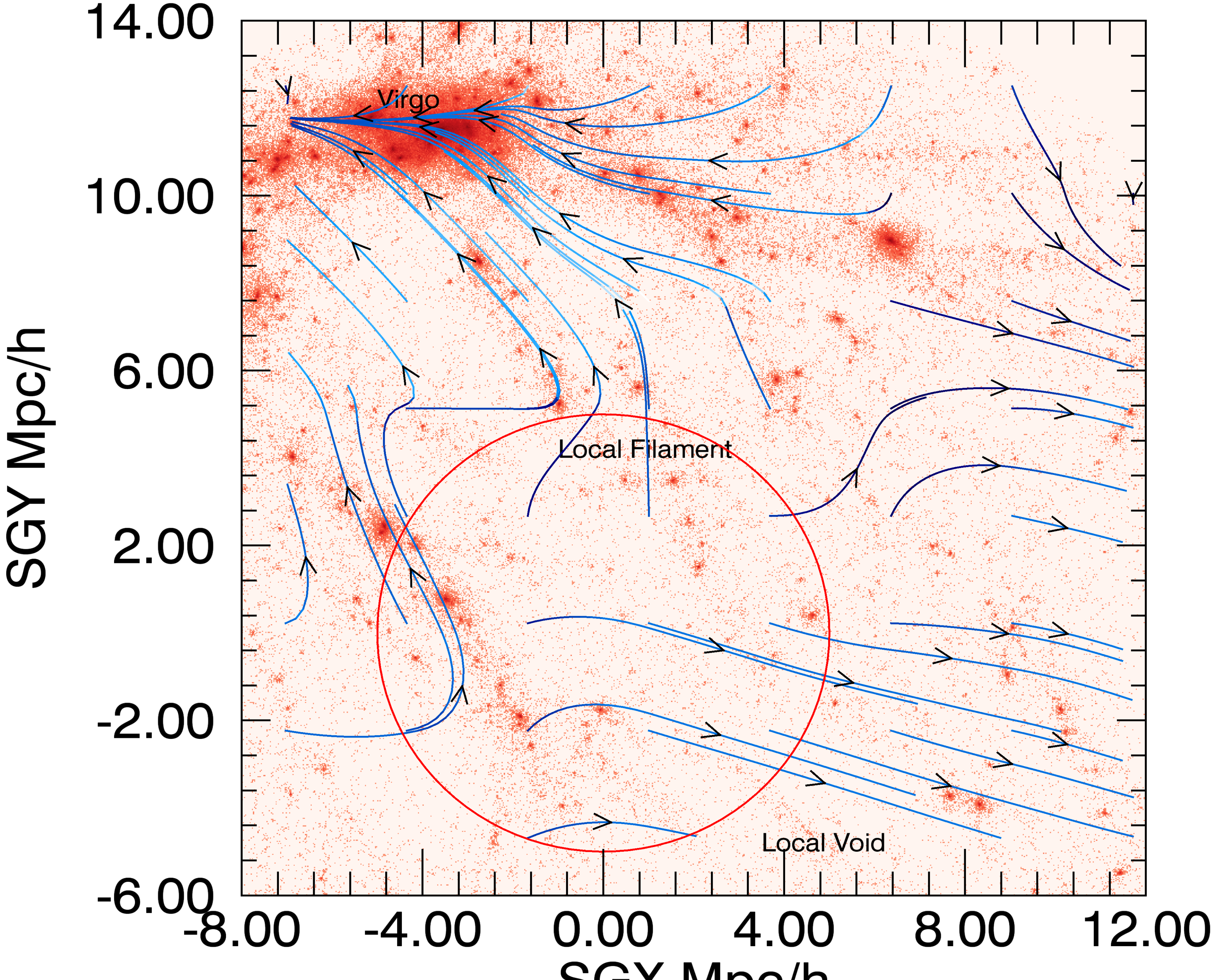
Algorithms & Data

Use peculiar velocities (Cosmic Flows 2, CF2) to constrain the ICs (WF/CR method)

Constrained Realisation: Random field + observational constraints

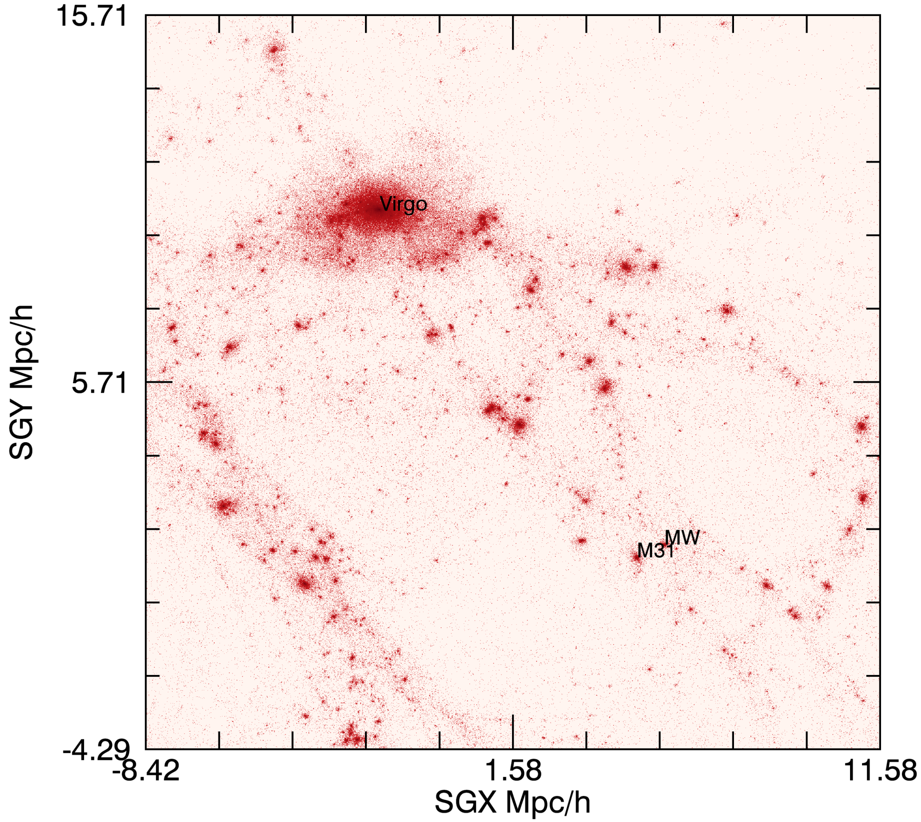
We generate **two** CR (large/small scales)

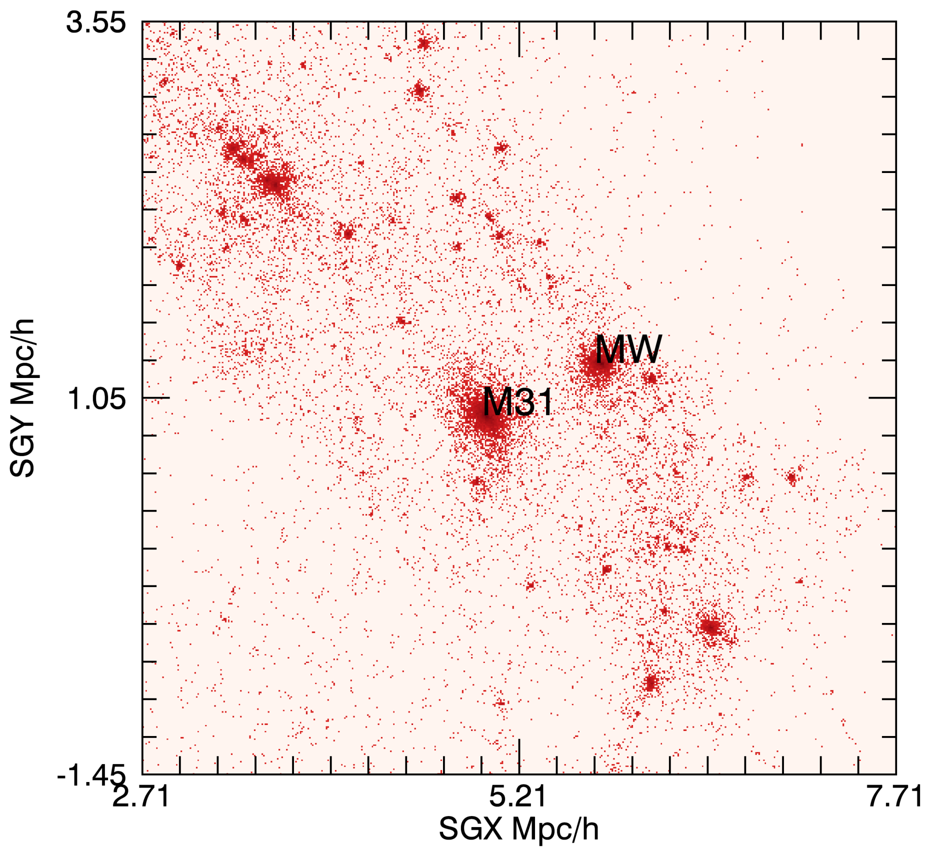
Each large scale realisation can be used with **different short wave** realisations.



Virgo
Local Filament
Local Void
14.00
10.00
6.00
2.00
-2.00
-6.00
-8.00
-4.00
0.00
4.00
8.00
12.00
SGY Mpc/h
SGX Mpc/h

Local Neighbourhood and Local Group Reconstruction





Local Group Definition (Model)

Take DM halo pairs and look at:

(I) Isolation, mass, separation and environment

(II) (I) + dynamical state (ang. mom. + energy)

(III) (II) + "phase" (i.e. specific values of mass, radial-tangential velocity and separation)

LG Factory Efficiency

Planck-I type of cosmology

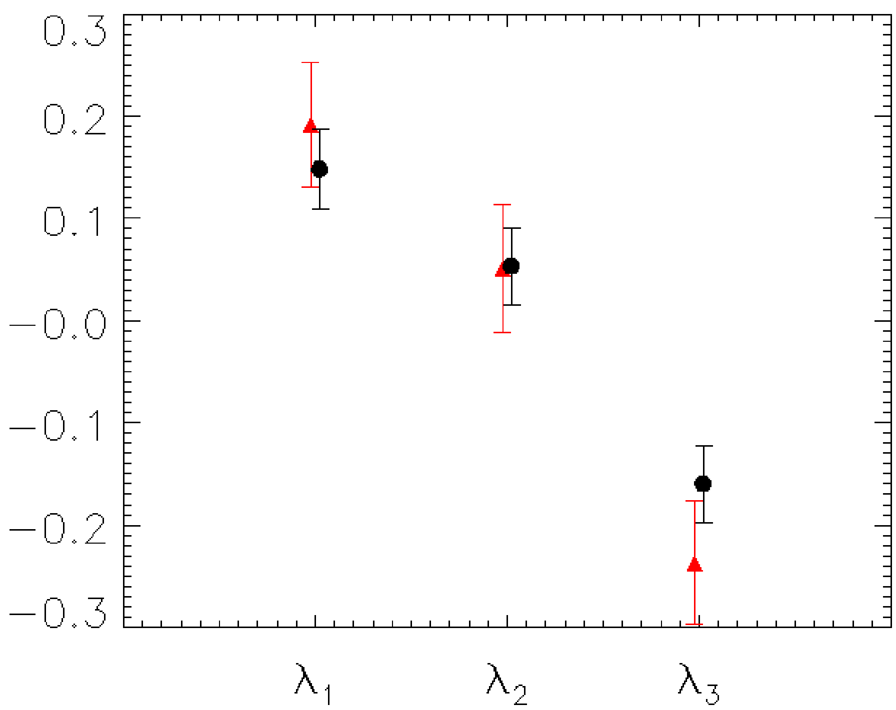
512^3 particles 1-layer zoom simulations:

700 simulations, 80 LS realisations, 344 Type I LGs, 120 Type II LGs, 19 Type III LGs

1024^3 particles 2-layers zoom re-simulations:

> 200 LGs

Constrained Environment: V-Web



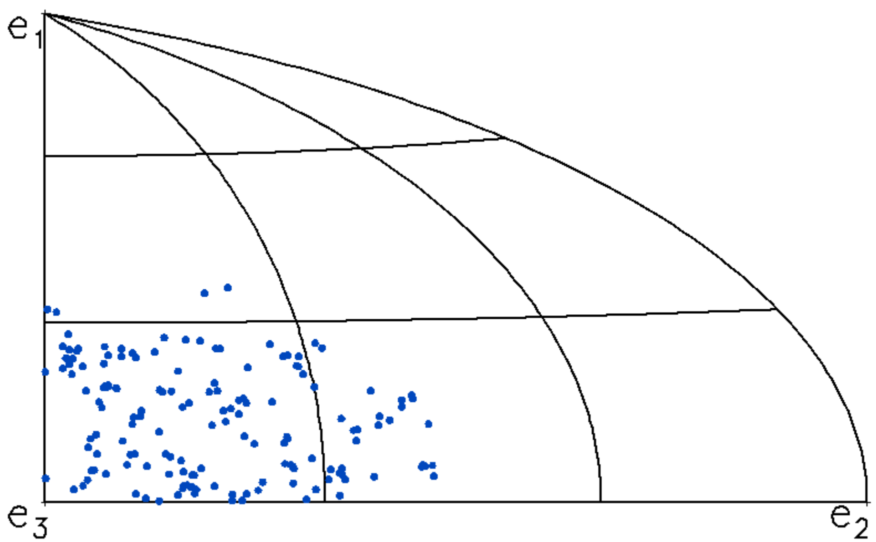
Velocity shear tensor eigenvalues/eigenvectors identify the kind of environment

(Hoffman et al. 2012)

Comparing simulated λs (red) to WF reconstructions (black) from observations

(Libeskind et al. 2015)

Constrained Environment: Virgo



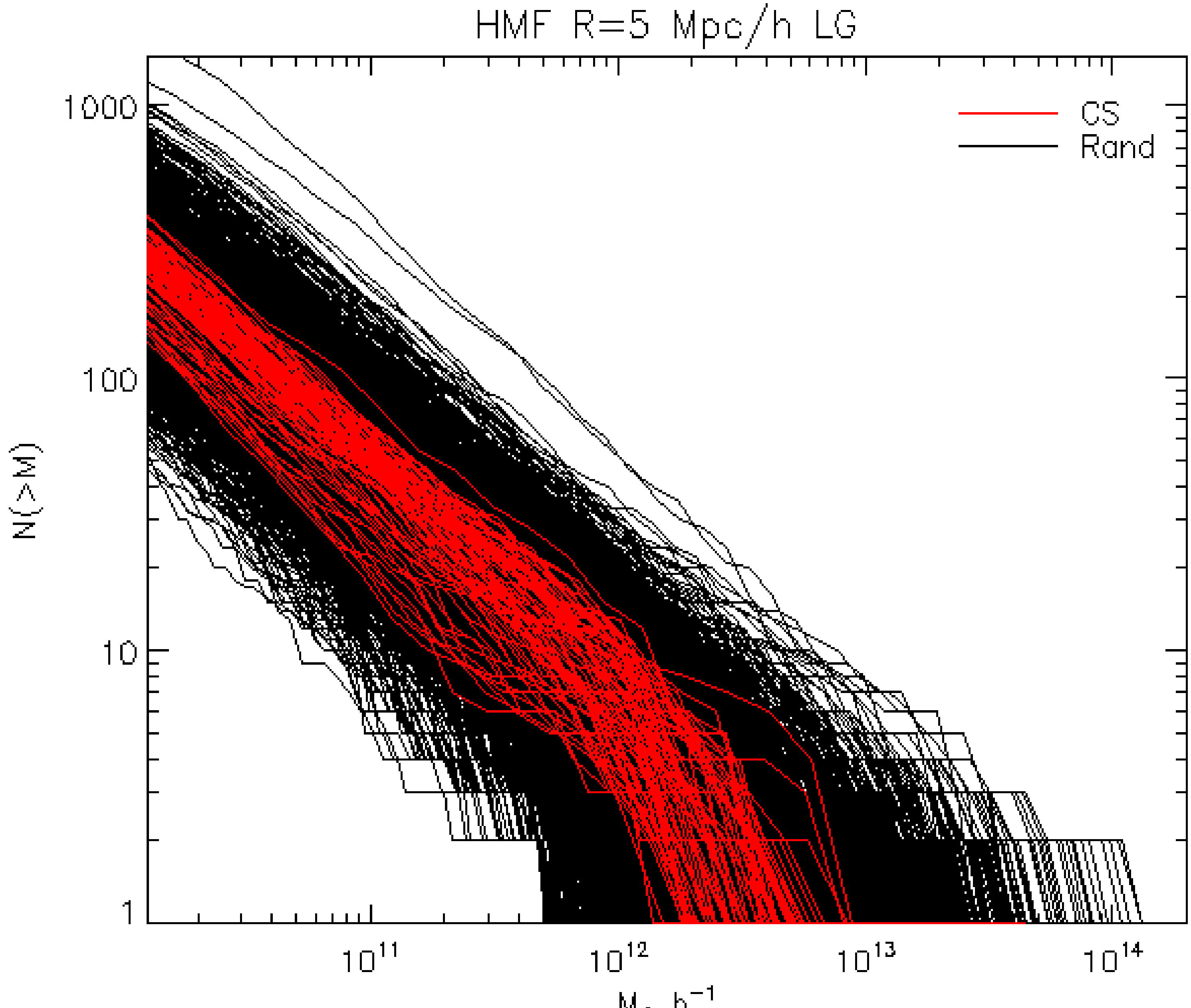
Aitoff projection:

Virgo projection in the eigenvector base at the center of mass LG position

Reconstructed Virgo:

	median	σ	*obs.*
SGX	-2.50	1.06	-2.56
SGY	+10.3	0.83	10.9
SGZ	+1.87	1.12	-0.512
M_{200}	2.09	0.69	> 4

Local Volume: Halo Mass Function



Applications: V_{tan} of M31

Use constrained simulations (CS) LG sample to study the distribution of M31's V_{tan}

Use standard Planck-I simulation (same LG model) as LG control sample (*Rand*)

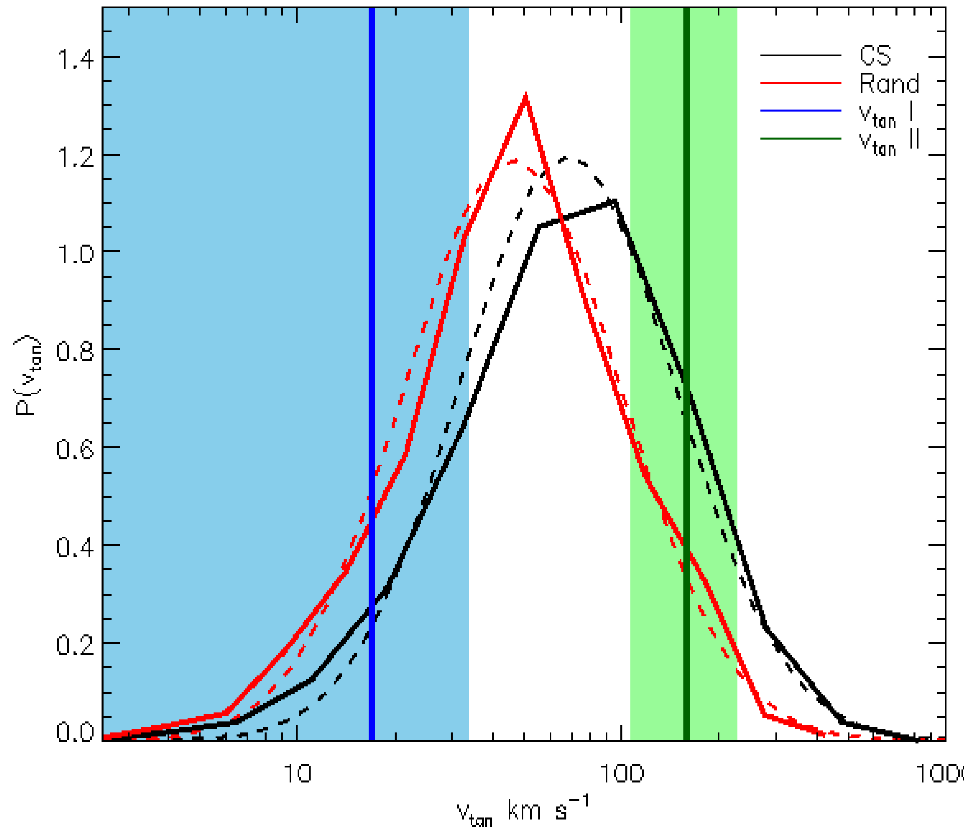
Compare to *van der Marel et al. 2012* and *Salomon et al. 2016* estimates

V_{tan} of M31

	v	$v+\sigma_v$	$v-\sigma_v$
$v_{\rm tan}^{(I)}$	17	34	0
$v_{\rm tan}^{(II)}$	164	225	103
$v_{\rm tan}{}^{CS}$	78	168	36
$v_{\rm tan}{}^{Rand}$	51	109	24

Probabilities of the different samples for the CS and Rand simulations:

Sample	P_I^A	P_{II}^A
CS	0.14	0.28
Rand	0.29	0.16



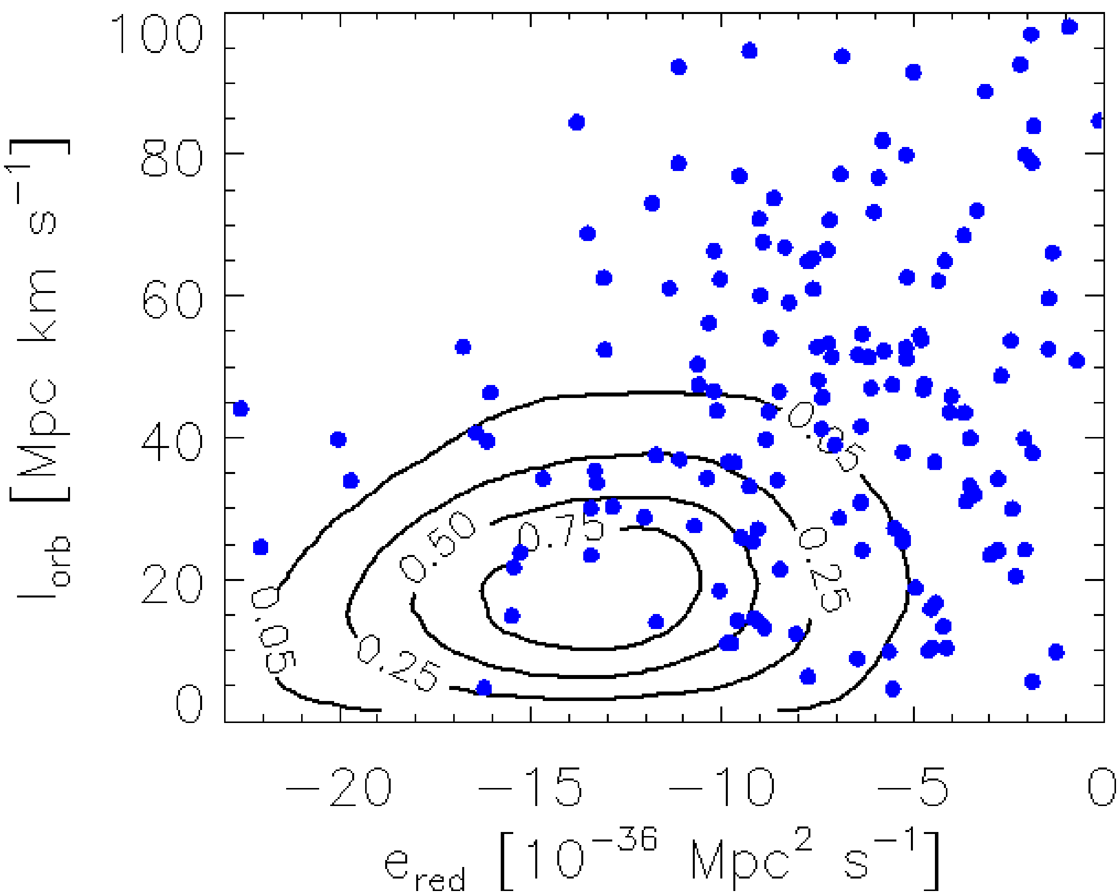
Conclusions

LG Factory: Efficient pipeline to produce LG-like objects in a realistic environment & study LG properties

Work in progress: M_{LG} , MAH, Local Volume

Future projects: Full hydro, satellites …

LG: Dynamical Definition



A) Using (semi) conserved quantities to define LG: Same initial perturbation

B) Generate contours with MC using 2σ intervals

C) Define as LGs those objects within the 95% boundary