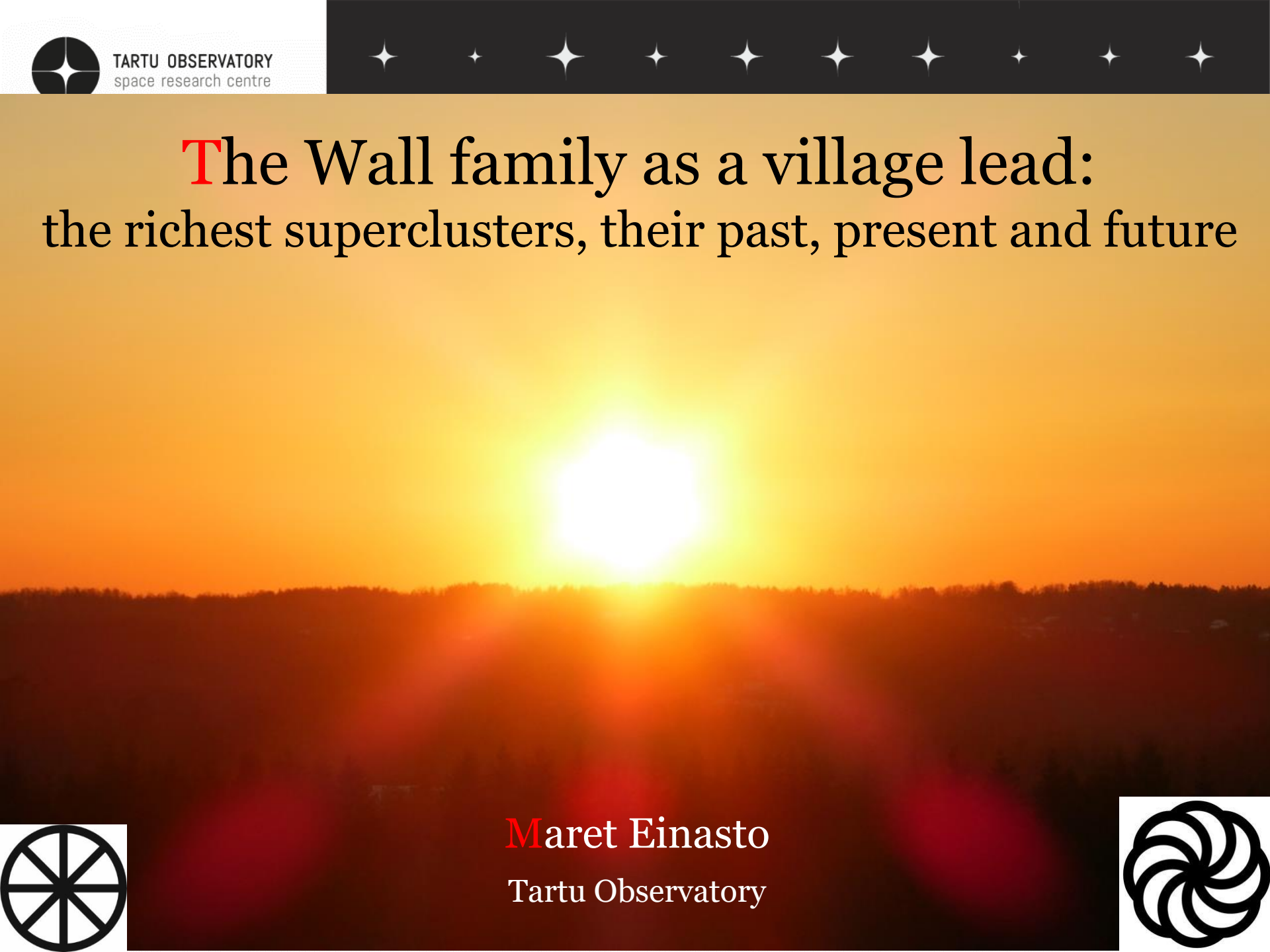


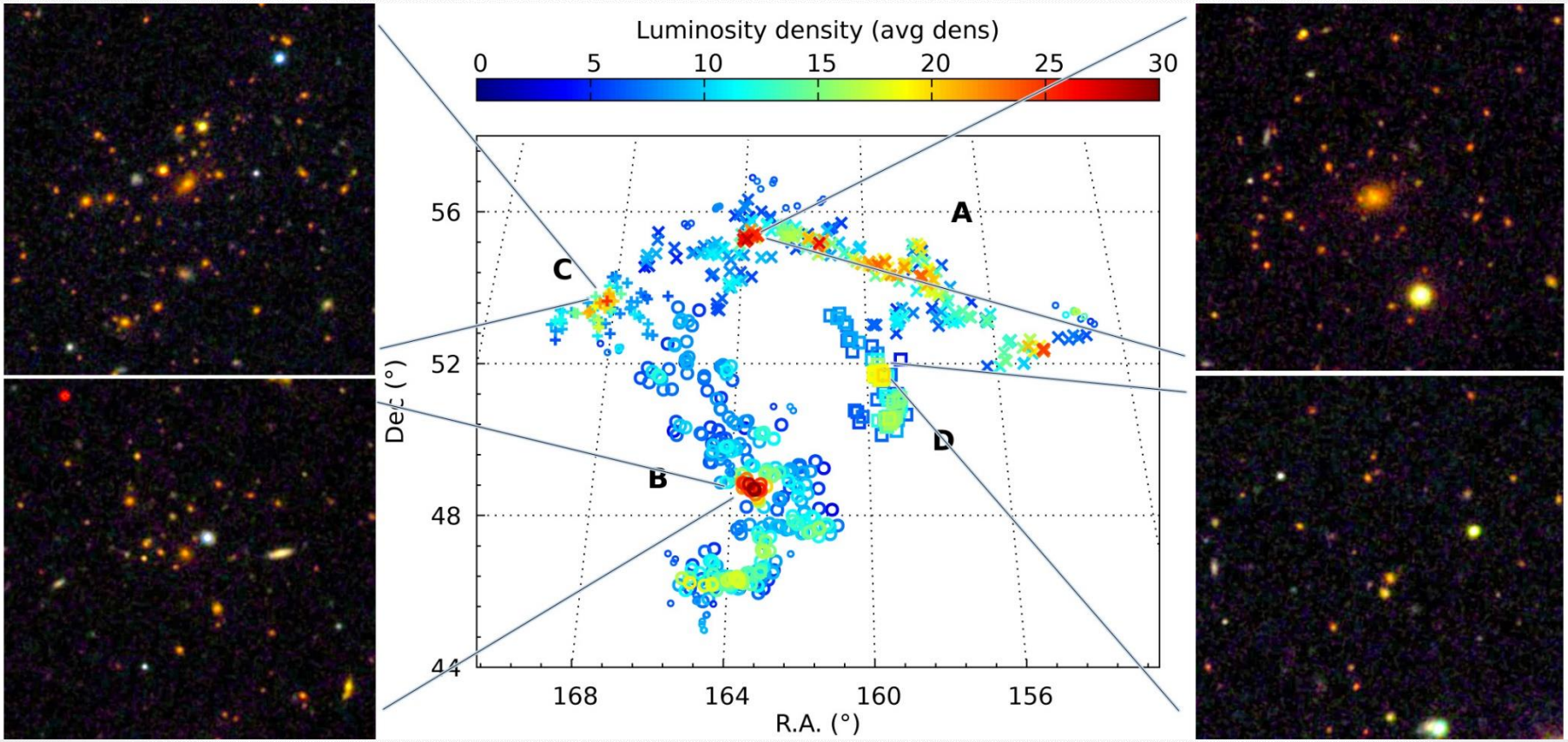
The Wall family as a village lead:
the richest superclusters, their past, present and future

Maret Einasto

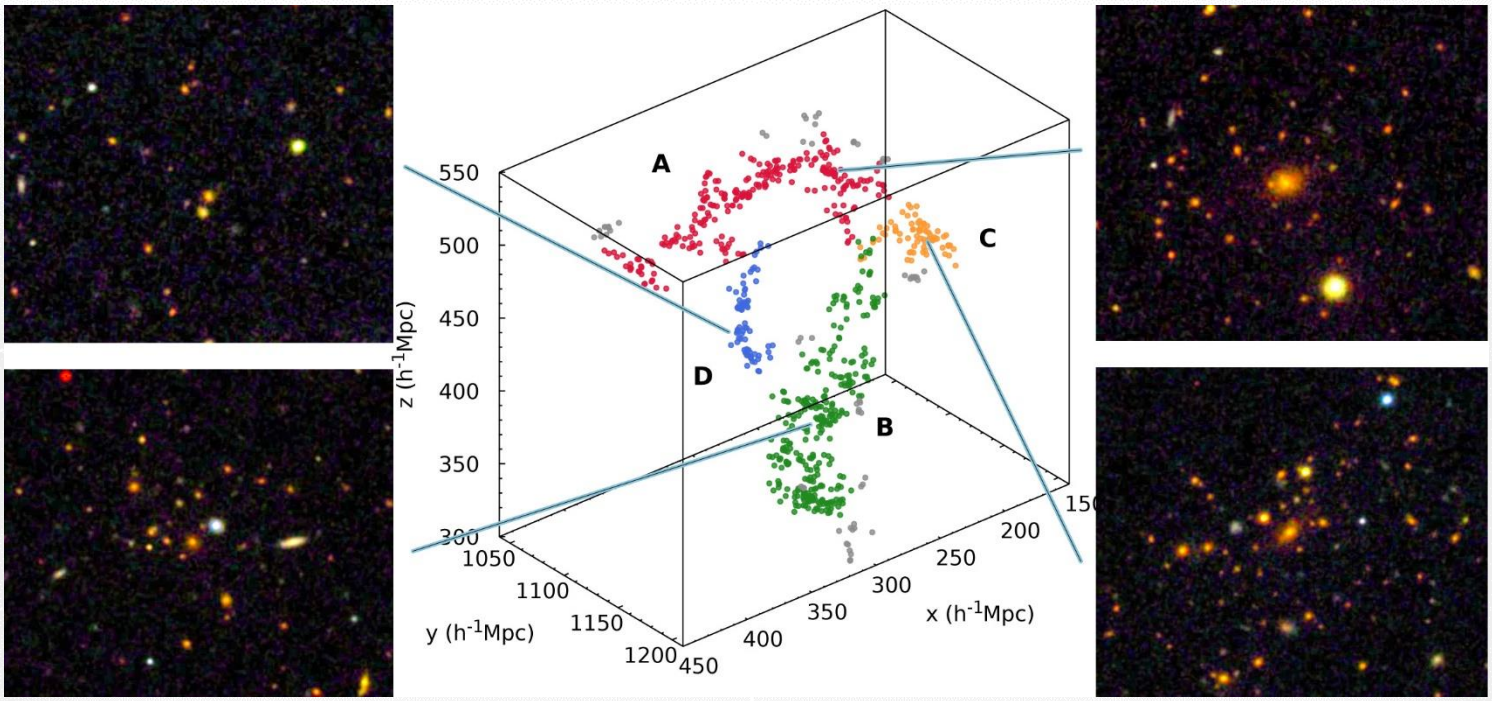
Tartu Observatory

TARTU OBSERVATORY
space research centre

The BOSS Great Wall at z = 0.47



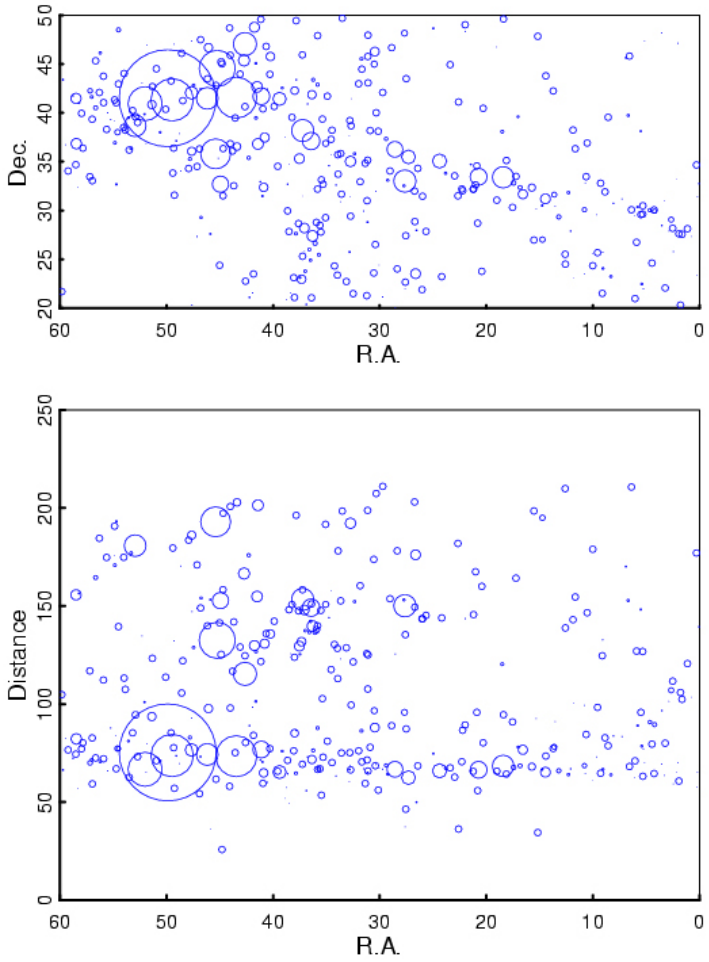
H. Lietzen, E. Tempel, L. J. Liivamägi, A. Montero-Dorta, M. Einasto, A. Streblyanska, C. Maraston, J. A. Rubiño-Martín and E. Saar.
A&A Letters, Volume 588, L4.



BGW: four superclusters: 2x ~180 h^{-1} Mpc and 2x ~80 h^{-1} Mpc,
~800 galaxies with $M^* > 10^{10.3}\ h^{-1}\ M_\odot$
Total mass of the BGW: ~2 x $10^{17}\ h^{-1}\ M_\odot$
Volume: 2.4 x $10^5\ (h^{-1}\ M_\odot)^3$

The richest supercluster complex at redshifts z > 0.2

A brief history of the Wall family



First hints:

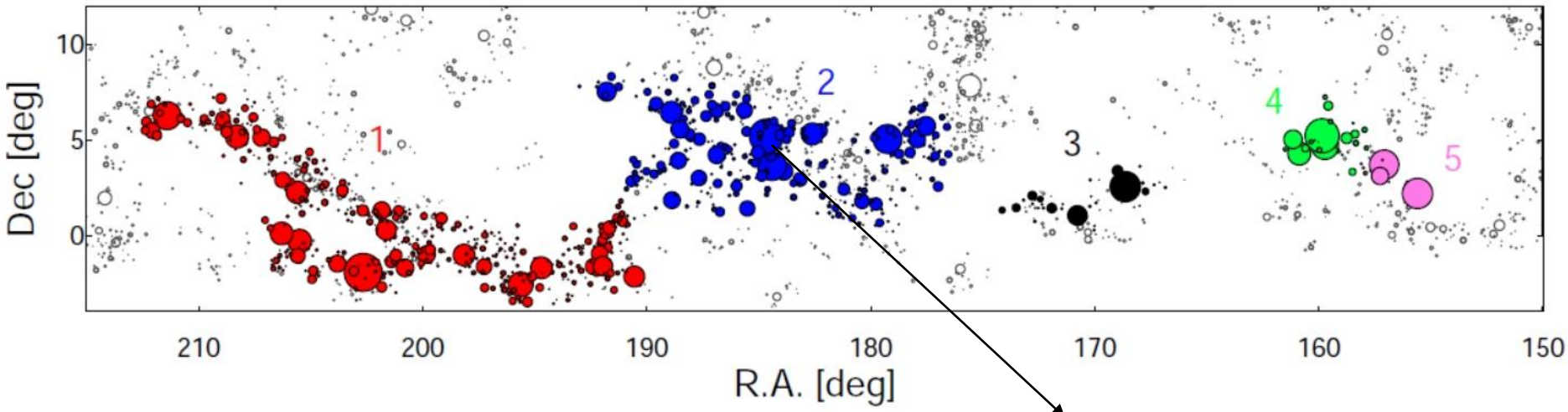
W. Herschel in ~ 1800 – clusters and superclusters
of nebulae in Virgo and Coma constellations
The Shapley supercluster (1930)
Perseus chain of galaxies and clusters (1977, Jõeveer, Einasto, Tago)

Smaller siblings:

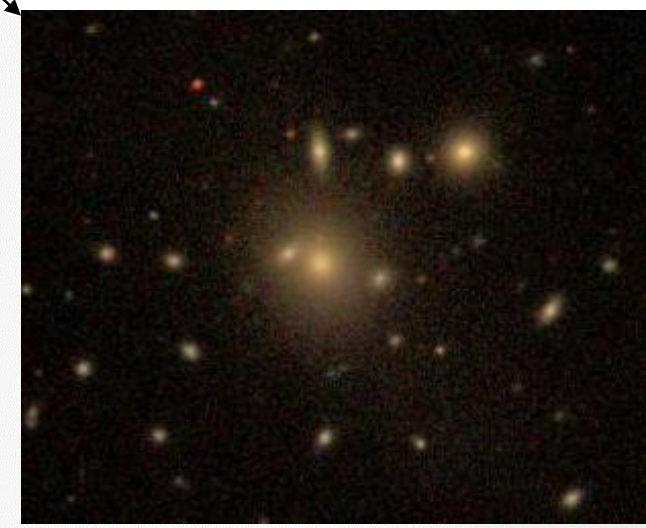
CfA Great Wall
Sculptor Wall,
Cetus Wall etc.

View to Perseus chain with galaxy groups from Tempel et al. (2016)

The Sloan Great Wall



Vogeley et al. 2004, Gott et al. 2005
see also Einasto et al. 2003, 2008, 2010, 2011, 2014
Park et al. 2012, Sheth and Diaferio 2011,
Luparello et al. 2011



ME, H. Lietzen, M. Gramann, E. Tempel,
E. Saar, L.J. Liivamägi, P. Heinämäki, P. Nurmi,
J. Einasto 2016, A&A, submitted
The Sloan Great Wall as a complex of collapsing superclusters

The Sloan Great Wall superclusters

(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
No.	Name	ID	N_{gal}	N_1	N^{gr}_{2-9}	N^{gr}_{10}	Dist.	Diam.	$D8_{max}$	Vol.	L_{tot}
1	SCl 027	202-001+008	3222	706	381	50	255.6	107.0	14.0	25.9	51.6
2	SCl 019	184+003+007	2060	456	274	33	230.4	56.4	15.0	14.4	29.2
3	SCl 0499	168+002+007	408	60	26	7	227.7	34.1	7.5	2.0	4.77
4	SCl 0319	159+004+006	245	30	23	3	206.2	21.4	7.5	1.4	2.16
5	SCl 1109	157+003+007	120	4	5	3	219.2	12.1	5.2	0.2	1.49
	SGW		6055	1256	709	96				43.9	89.22

The Sloan Great Wall superclusters: masses

(1) No.	(2) Name	(3) M_{dyn} $10^{15}h^{-1}M_\odot$	(4) M^g_{tot} $10^{15}h^{-1}M_\odot$	(5) M^* $10^{13}h^{-1}M_\odot$	(6) M^*/M^g_{tot}	(7) M^*_{tot} $10^{15}h^{-1}M_\odot$	(8) M^{*g}_{tot} $10^{15}h^{-1}M_\odot$	(9) M^g_{tot}/L $h\,M_\odot/L_\odot$
1	027	10.41	14.28	16.61	0.012	11.13	12.24	277
2	019	5.42	7.05	9.09	0.013	6.41	7.05	241
3	0499	1.41	2.09	1.69	0.008	1.15	1.27	437
4	0319	0.66	0.94	0.87	0.009	0.76	0.84	435
5	1109	0.56	0.82	0.69	0.008	0.29	0.32	550
	SGW	18.46	25.18	28.95	0.011	19.74	21.71	282

M_{dyn} = sum of group masses from Tempel et al. 2014

$M^g_{tot} = M_{dyn} + M_{faint\ groups} + M_{ICM}$

M^* = sum of stellar masses of galaxies

M^* / M^g_{tot} stellar mass fraction

M^*_{tot} = sum of halo masses from stellar masses of galaxies (Moster et al. 2010)

$M^{*g}_{tot} = M^*_{tot} + M_{ICM}$

Spherical collapse model

The spherical collapse model describes the evolution of spherically symmetric perturbation in an expanding universe
under influence of the gravitational attraction (dark matter), and antigravity of the dark energy.

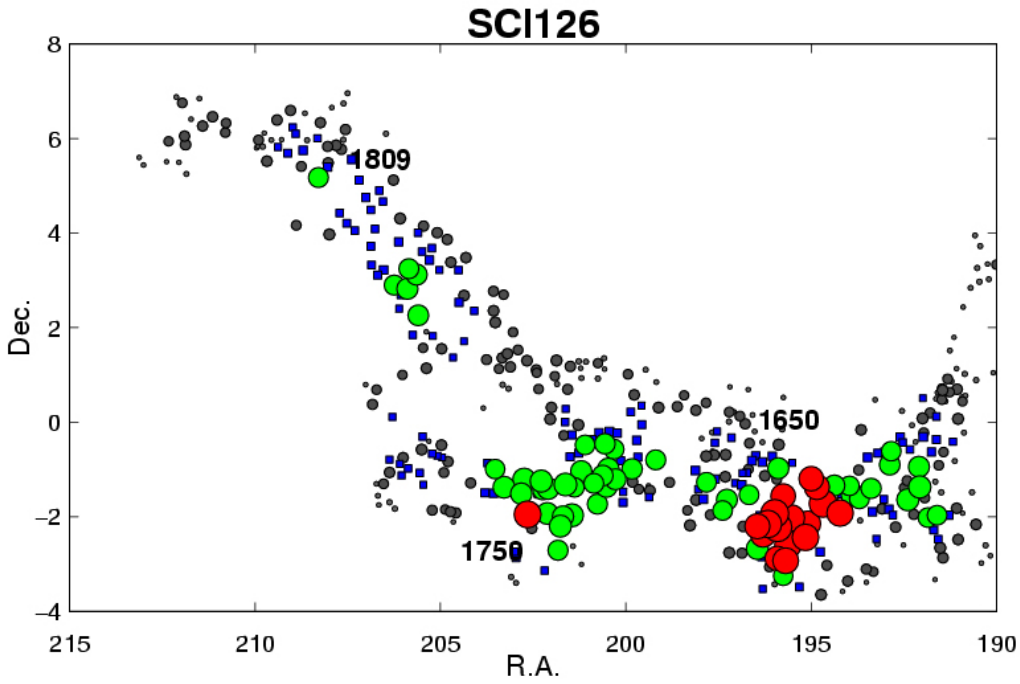
1. Turnaround: the collapse begins, $\Delta\rho = 13.1$
2. Future collapse: collapse in the distant future, $\Delta\rho = 8.73$

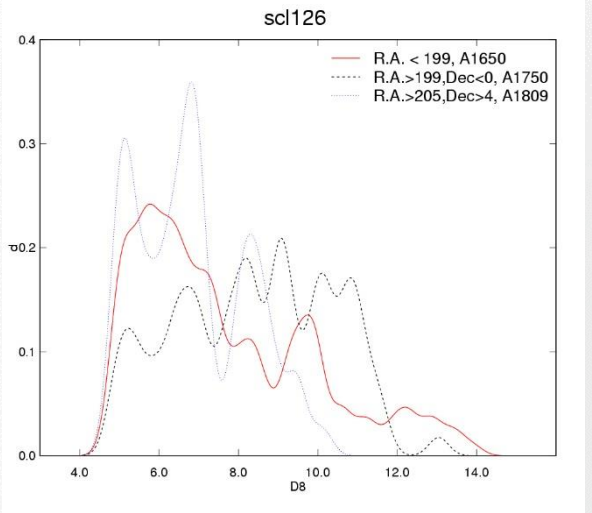
Mass of the structure:

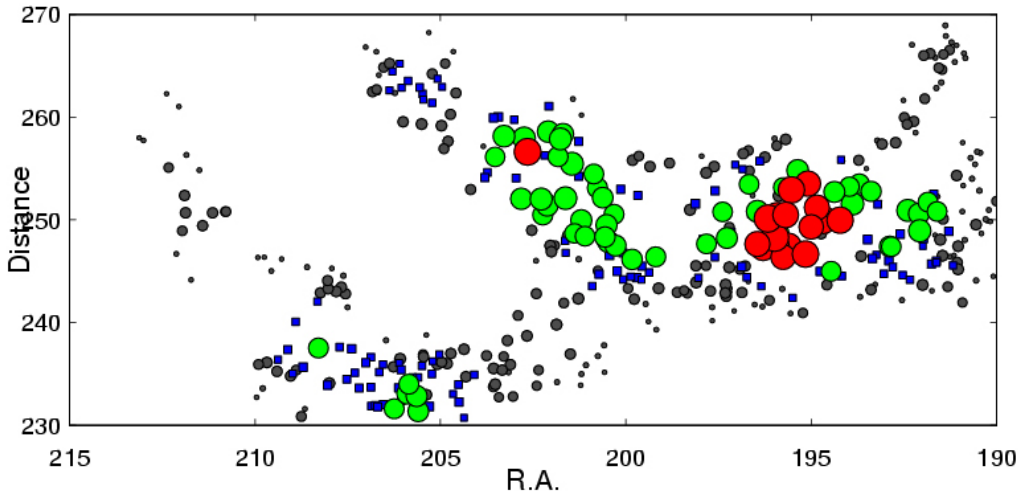
$$M(R) = 1.45 \cdot 10^{14}\ \Omega_m\ \Delta\rho\ (R/\ 5\ h^{-1}\,\mathrm{Mpc})^3\ h^{-1}\,M_\odot$$

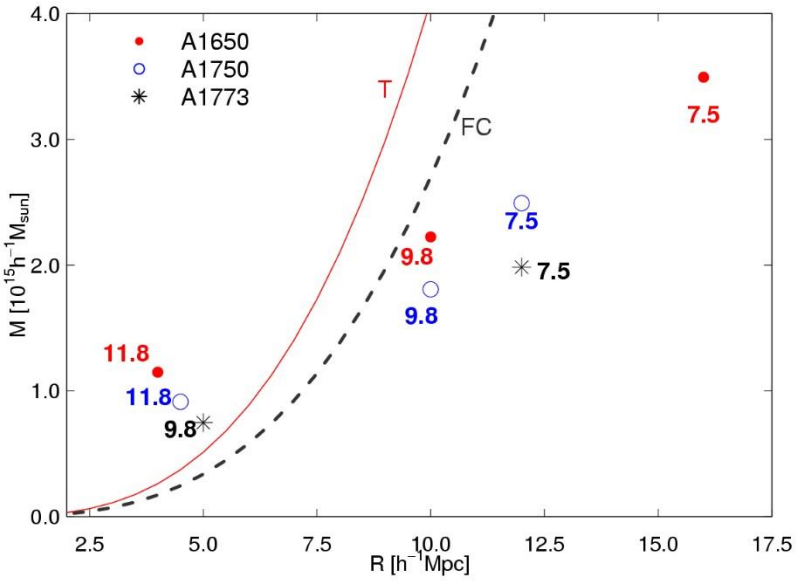
Gramann et al. 2015, Einasto et al. 2016

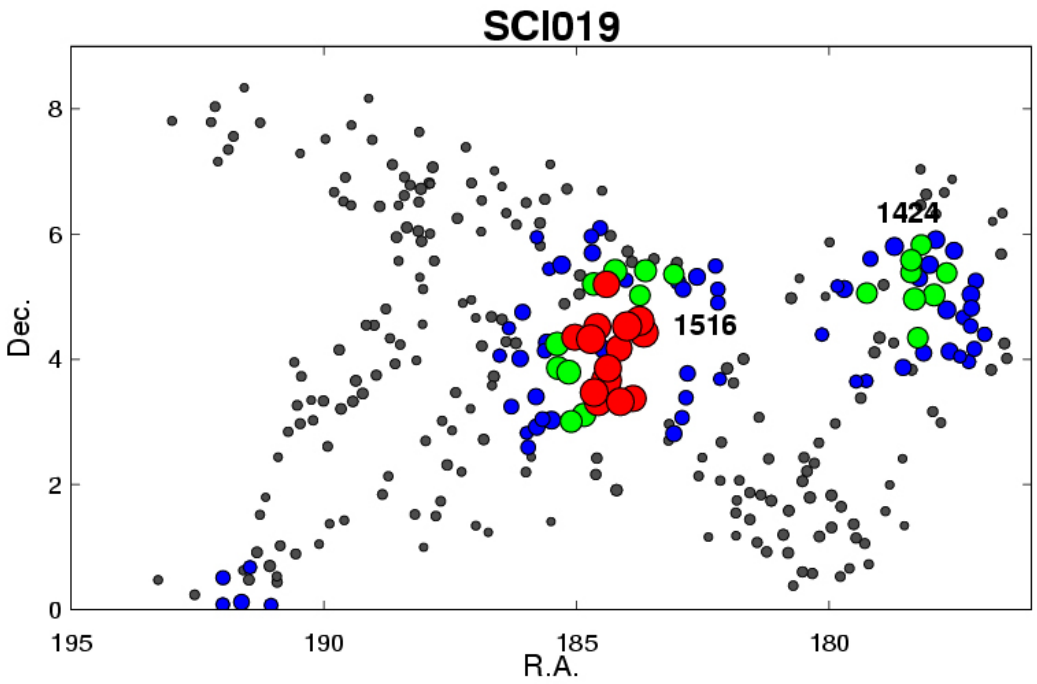
SCl 27 in the Sloan Great Wall



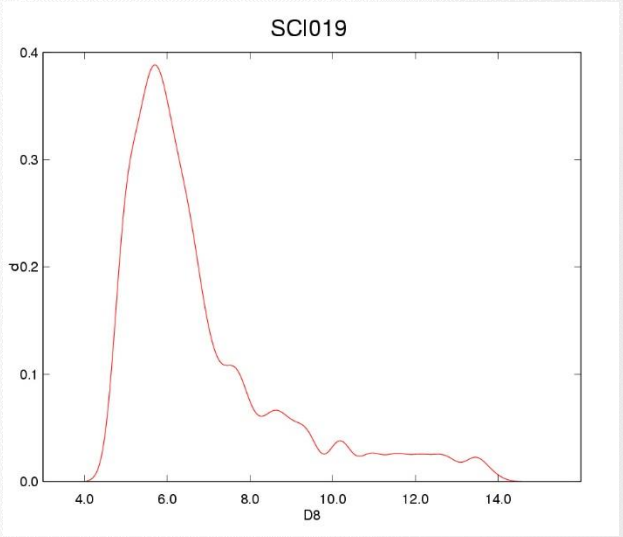


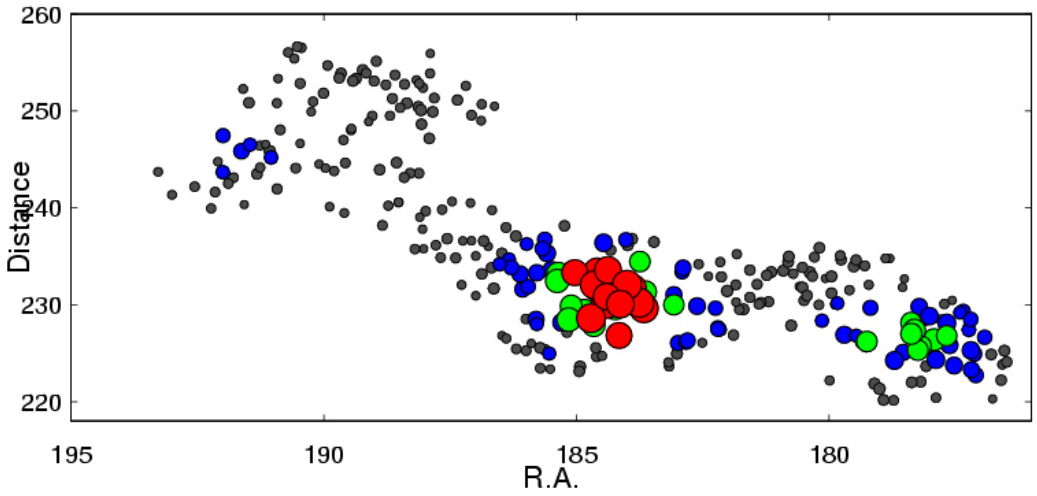


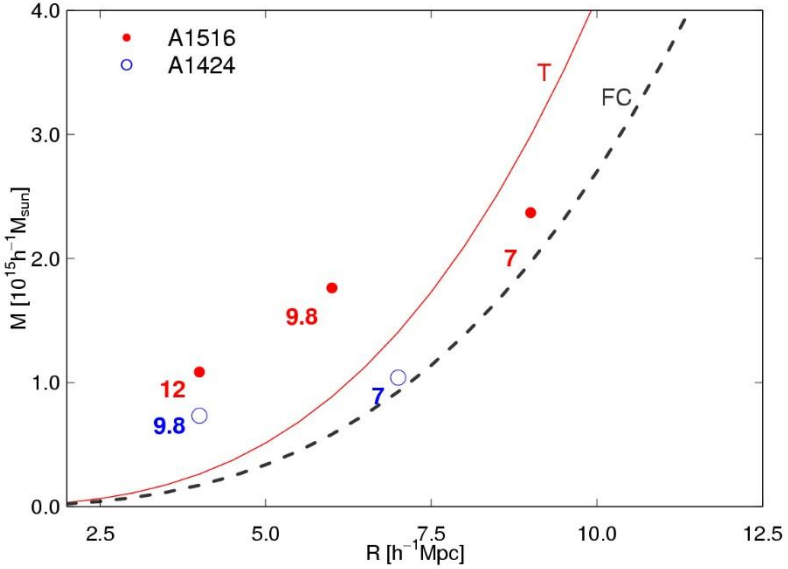


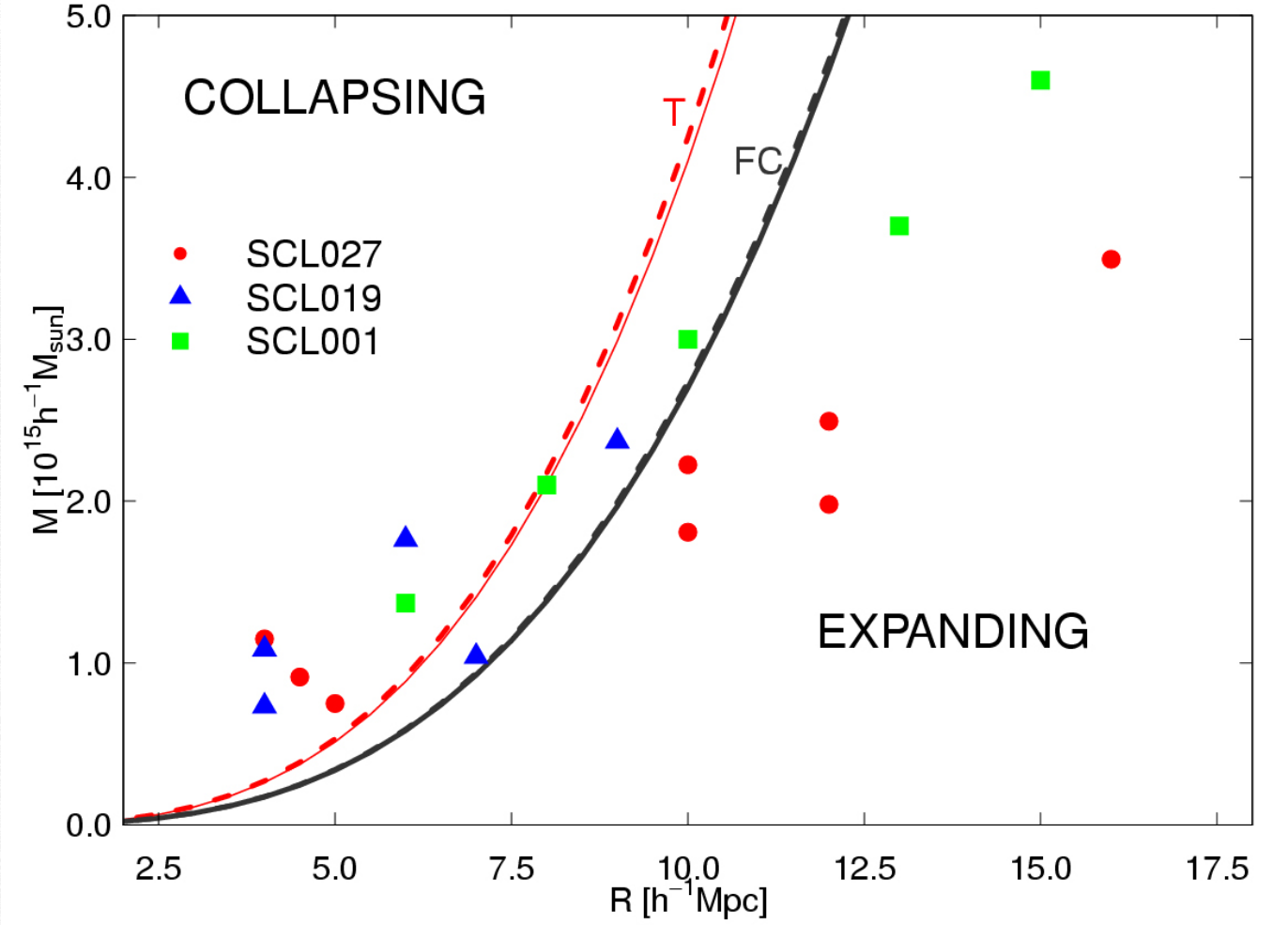


SClo19 in the Sloan Great Wall



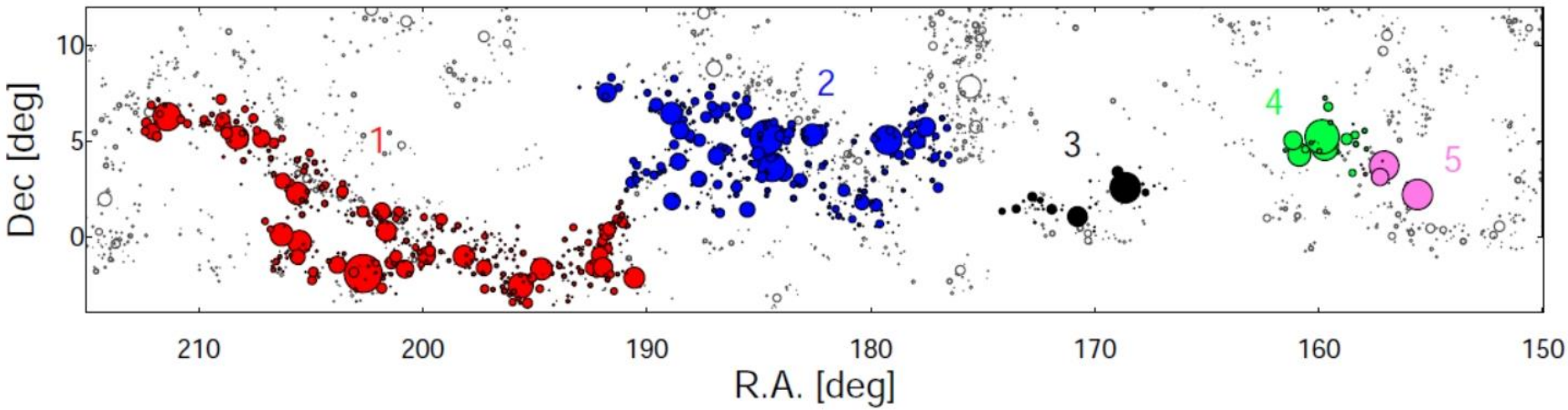






The sizes of collapsing cores < 10 h^{-1} Mpc

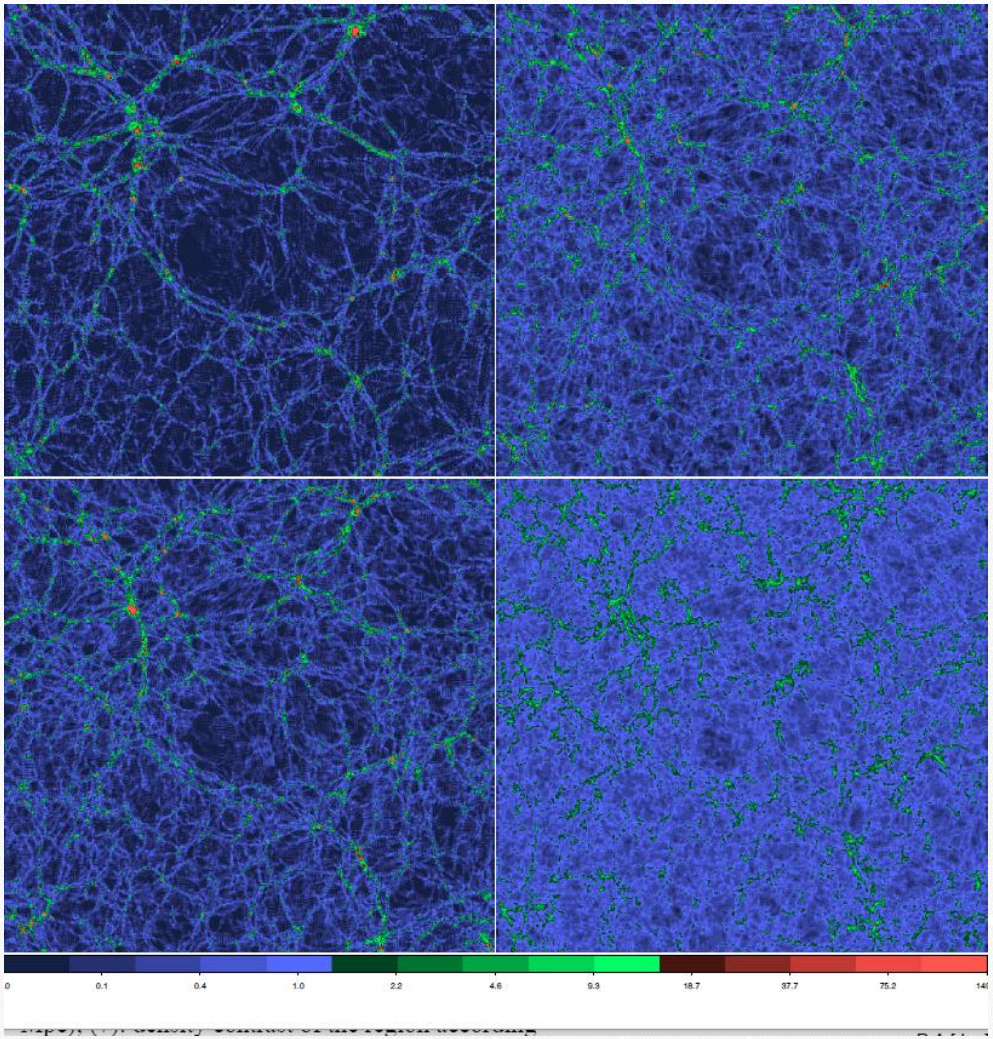
M-R relation depends weakly on Ω_m (Ω_m = 0.27, 0.3)



Distances between high-density cores of superclusters: 20, 30, 40, and 50 Mpc/h.

Galaxy filaments as necklaces (Tempel et al. 2014)

Cosmic web at different redshifts



z = 0, 1, 5, 10, simulations by Einasto and Suhhonenko (2011)

?

BGW in detail?

SGW and BGW – too big for this Universe?

Morphology not recovered in simulations?

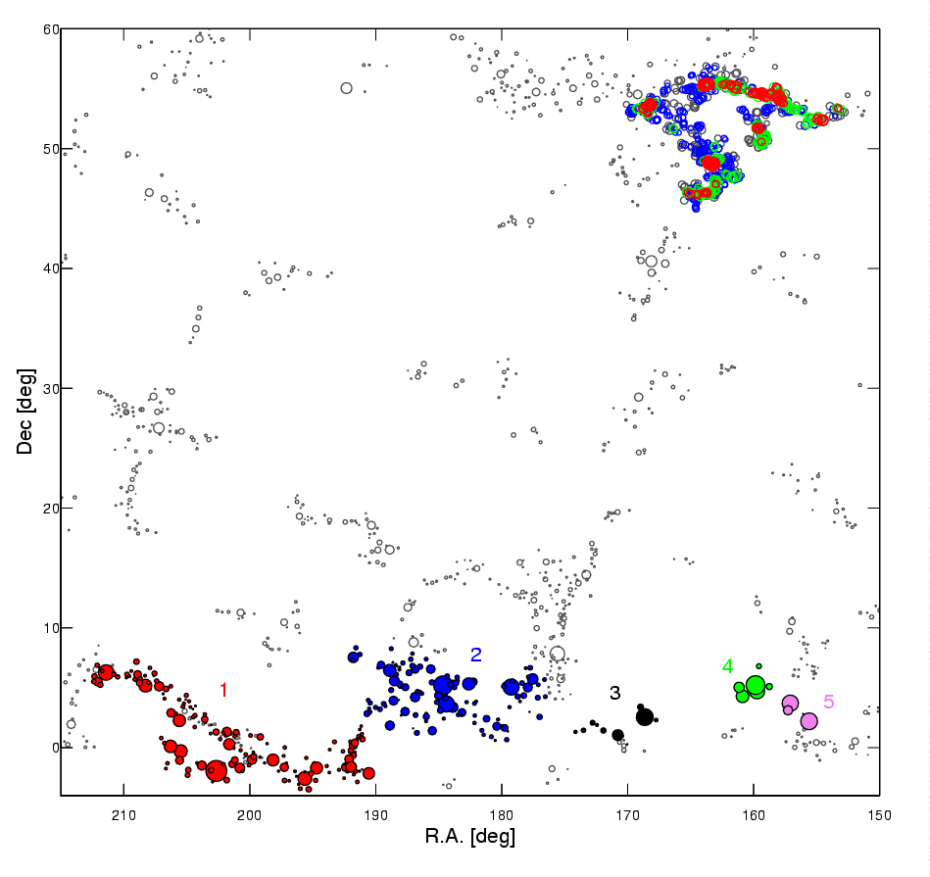
Too elongated?

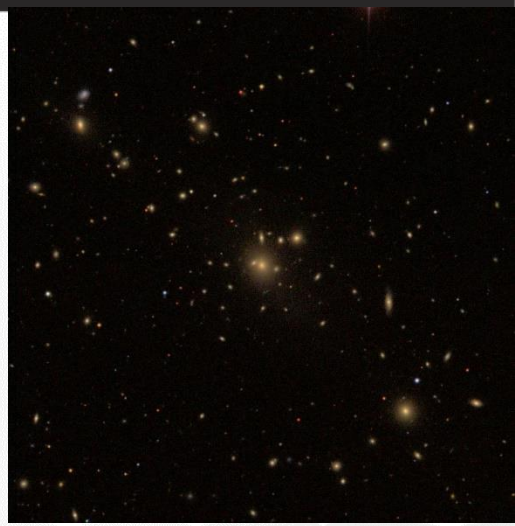
SGW superclusters: shape parameter = 0.27, 0.48

BGW superclusters: shape parameter < 0.2

The properties of galaxies and groups in walls and outside?

Superclusters with high–density, possibly collapsing cores: environments to study supercluster structure, dynamics, evolution, and group, filament, and galaxy content at different redshifts and to test cosmological models.





Thank you!

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Tempel et al. 2014, A&A 566, A1

Einasto et al. 1975, Astr. Tsirkulyar 895, 2