The Shapley Supercluster Survey

Mapping the Shapley supercluster with the VST, VISTA and AAOmega

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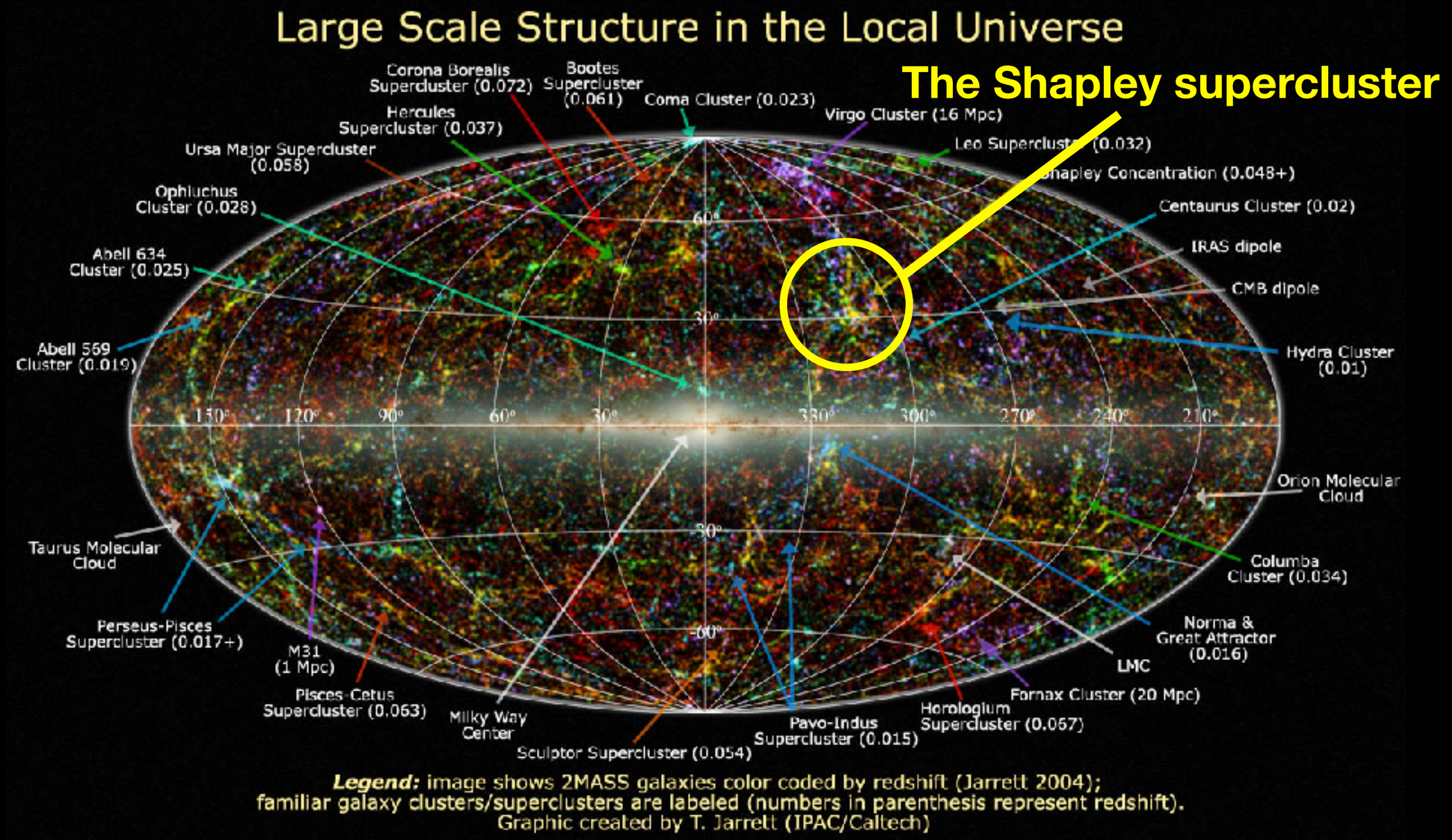
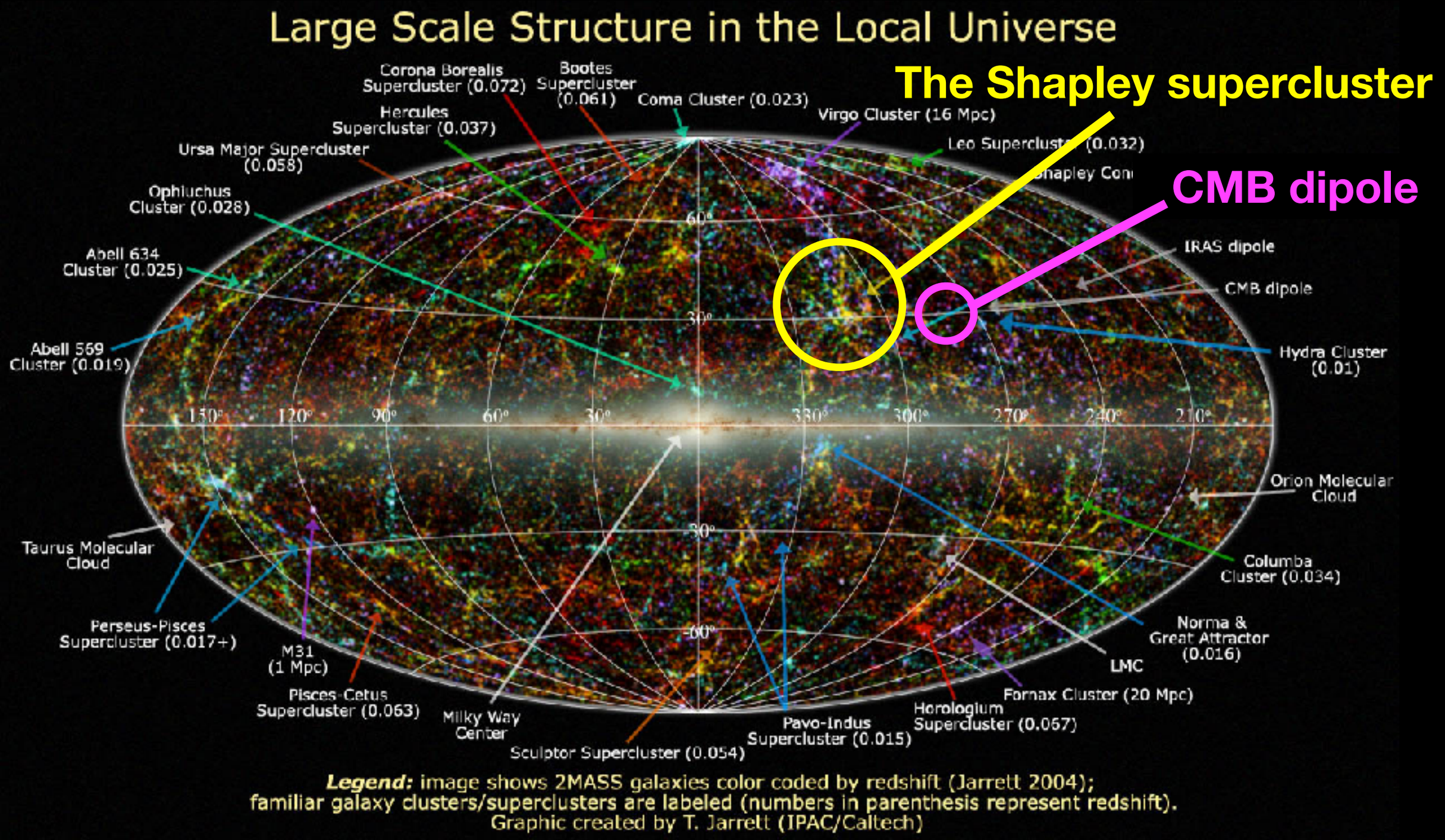
The Shapley Supercluster



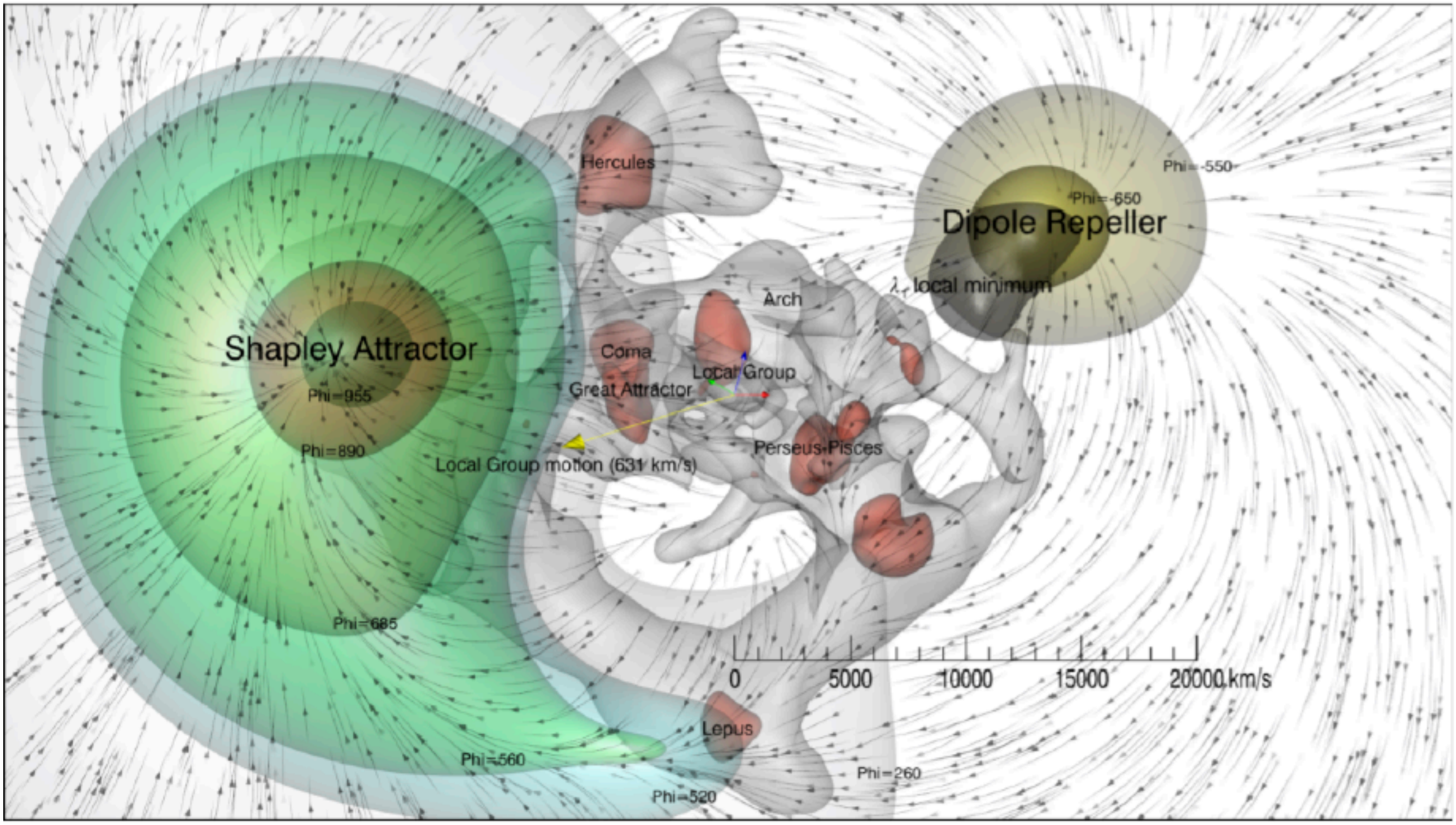
The Shapley supercluster (25 Abell clusters at z=0.048) is the most massive concentration of matter in the local Universe

The Shapley Supercluster



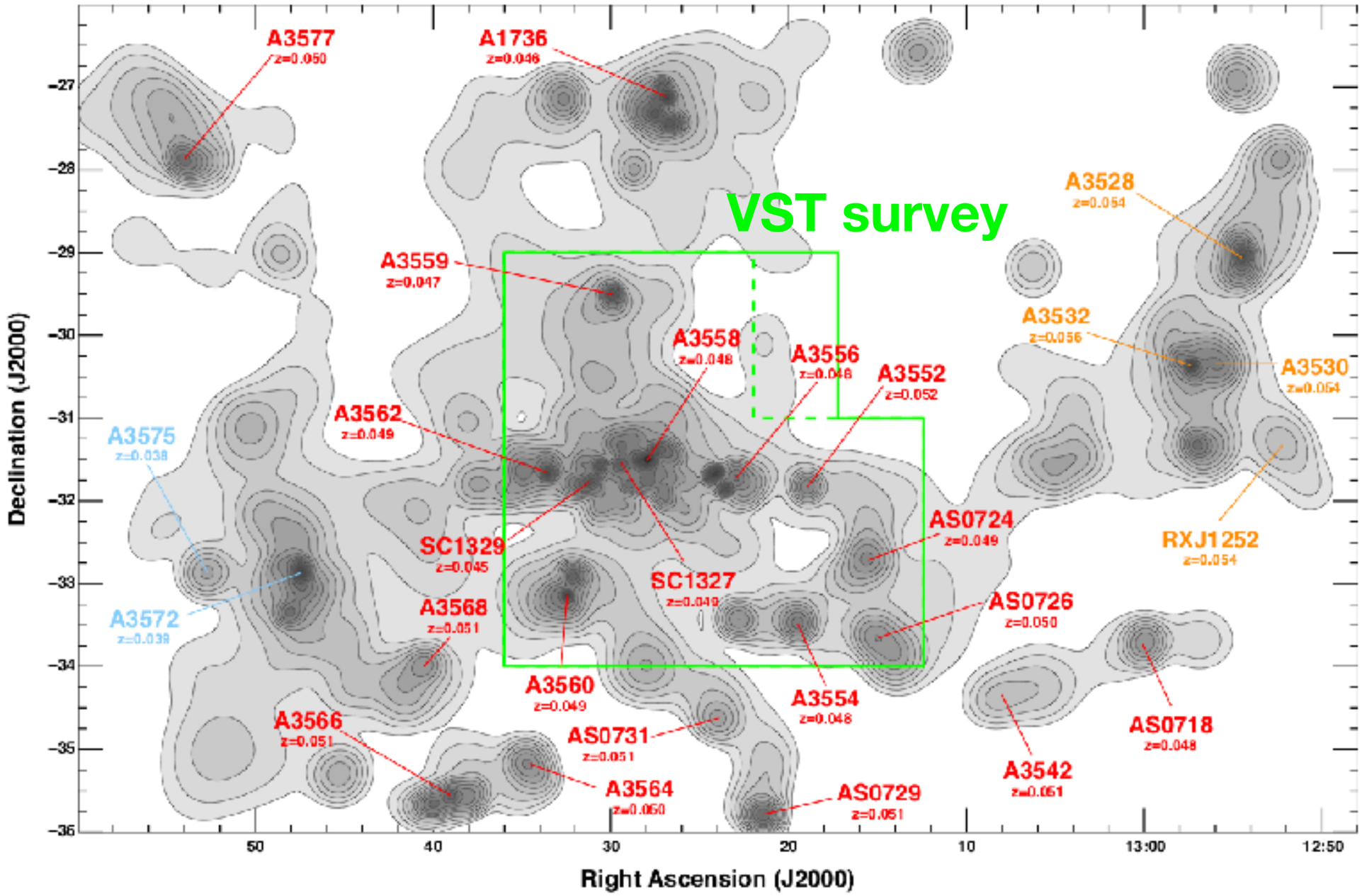
The local group is moving at 627±22 km/s in a direction almost directly towards the Shapley supercluster. Is its mass sufficient to cause this?

The Shapley Supercluster



Hoffman et al. (2017): Cosmicflows-2

The VST Shapley Supercluster Survey



K-band luminosity density map of Shapley supercluster using 2MASS photometry, known galaxies with 0.035<z<0.060, 25 Abell clusters.

The VST-ACCESS survey

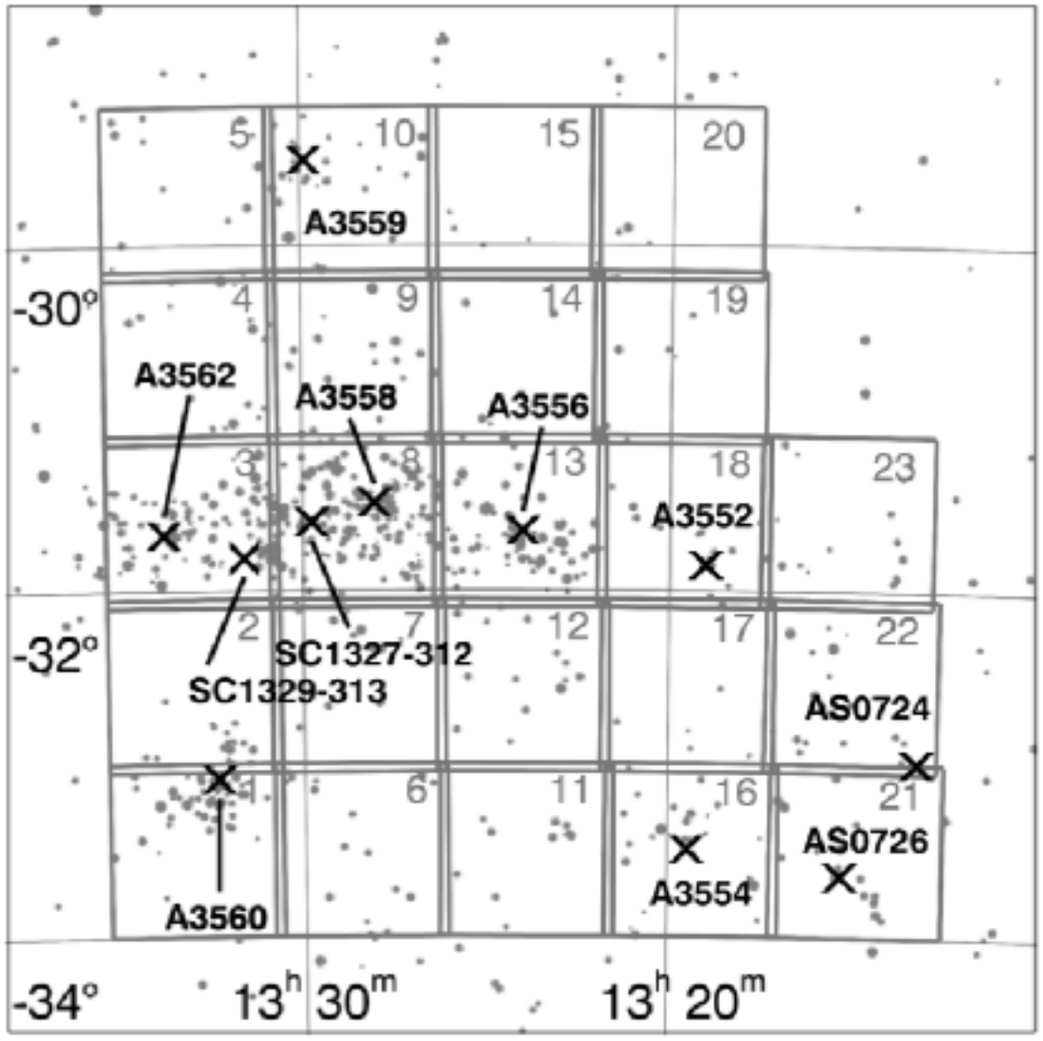
- INAF GTO survey to observe the central 23 deg^2 of the Shapley supercluster (75 hours)

- Covers 11 X-ray clusters that all lie within 1,500 km/s of the central cluster Abell 3558

- Obtain detailed morphological classifications and structural parameters to m*+6

- Identify galaxies that are being ram-pressure stripped, and interacting galaxies.

- Evolution of galaxies in a most extreme environment



	Exp time (s)	Depth (5σ)	FWHM (″)
u	2955	24.3	0.8-1.1
g	1400	24.8	0.6-1.0
r	2664	24.3	0.6-0.8
i	1000	23.2	0.5-1.0

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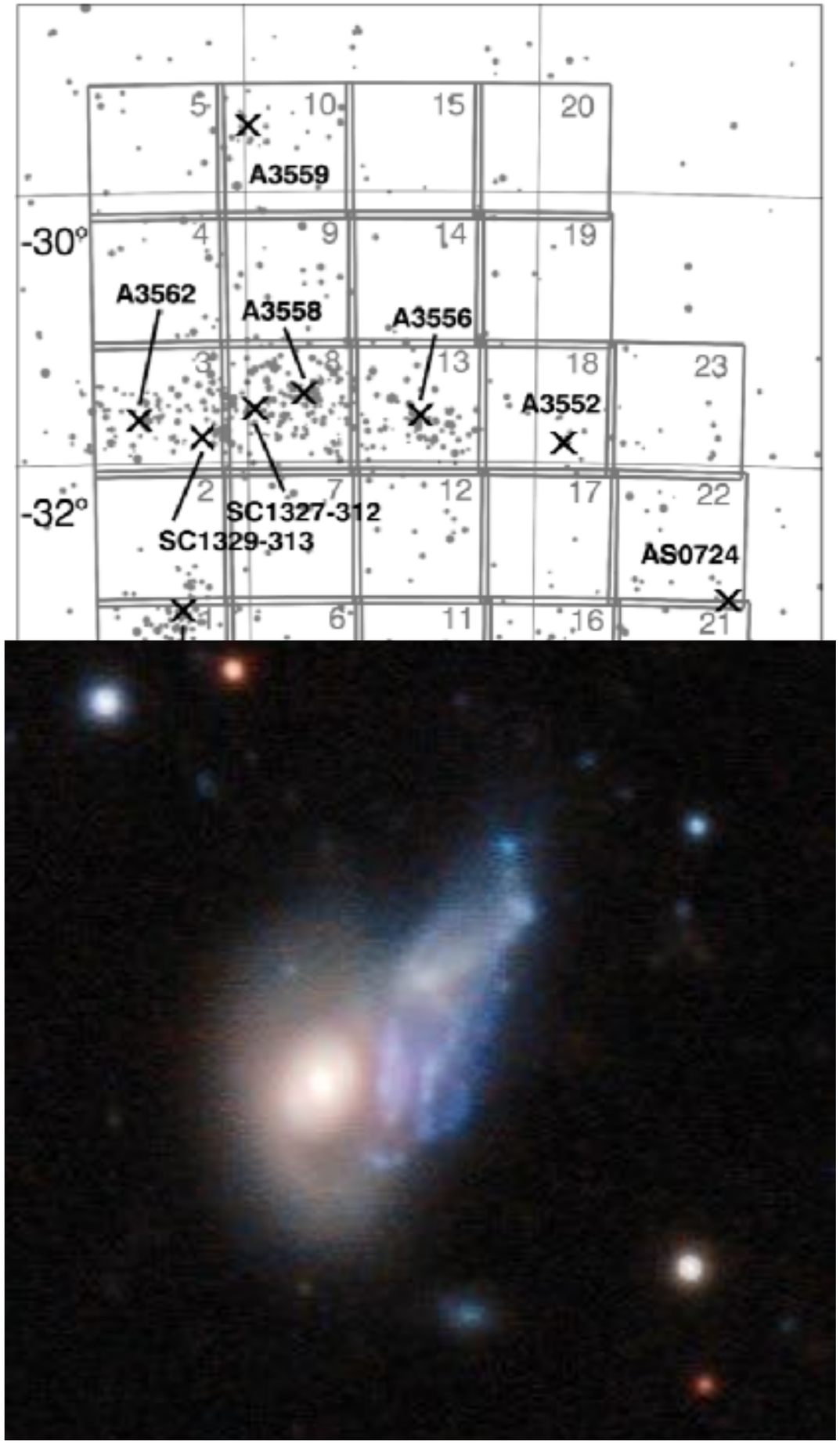
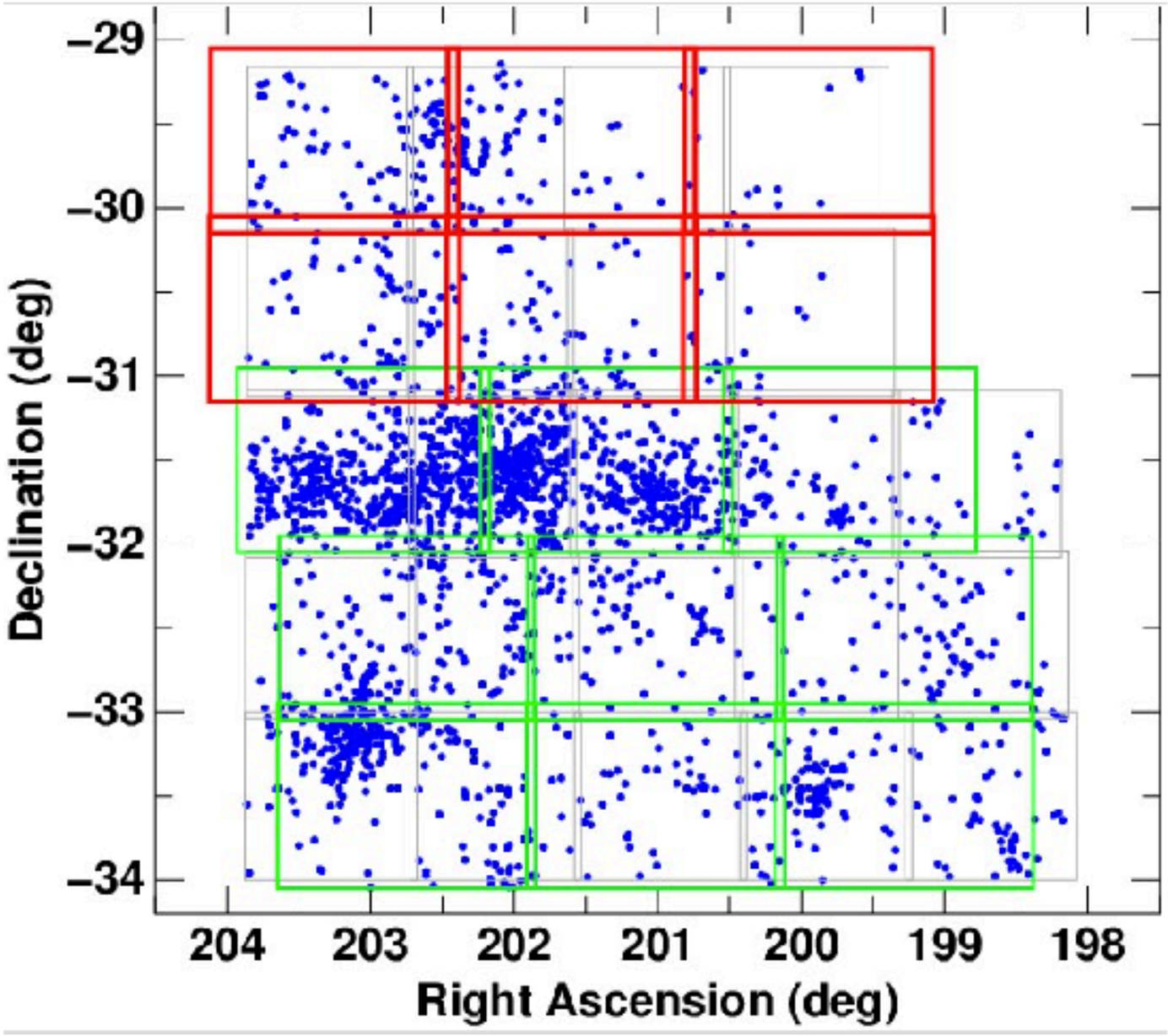


The Shapley VISTA survey

- Follow-up VISTA survey provides K-band coverage of the same 23 deg^2 region as that covered by the VST. 30 hours of observations over 2014-15.



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K	1680	20.4	0.6-1.0

The Shapley Supercluster spectroscopic survey

- Carried out redshift survey of supercluster galaxies across the VST survey region using AAOmega on the 3.9m Anglo Australian Telescope

- Aim to provide homogeneous sample of supercluster galaxies to ~L*+3.5, to study effect of supercluster environment on galaxy evolution

- Create new detailed map of the Shapley supercluster, focussing on the filamentary structures connecting the 11 clusters

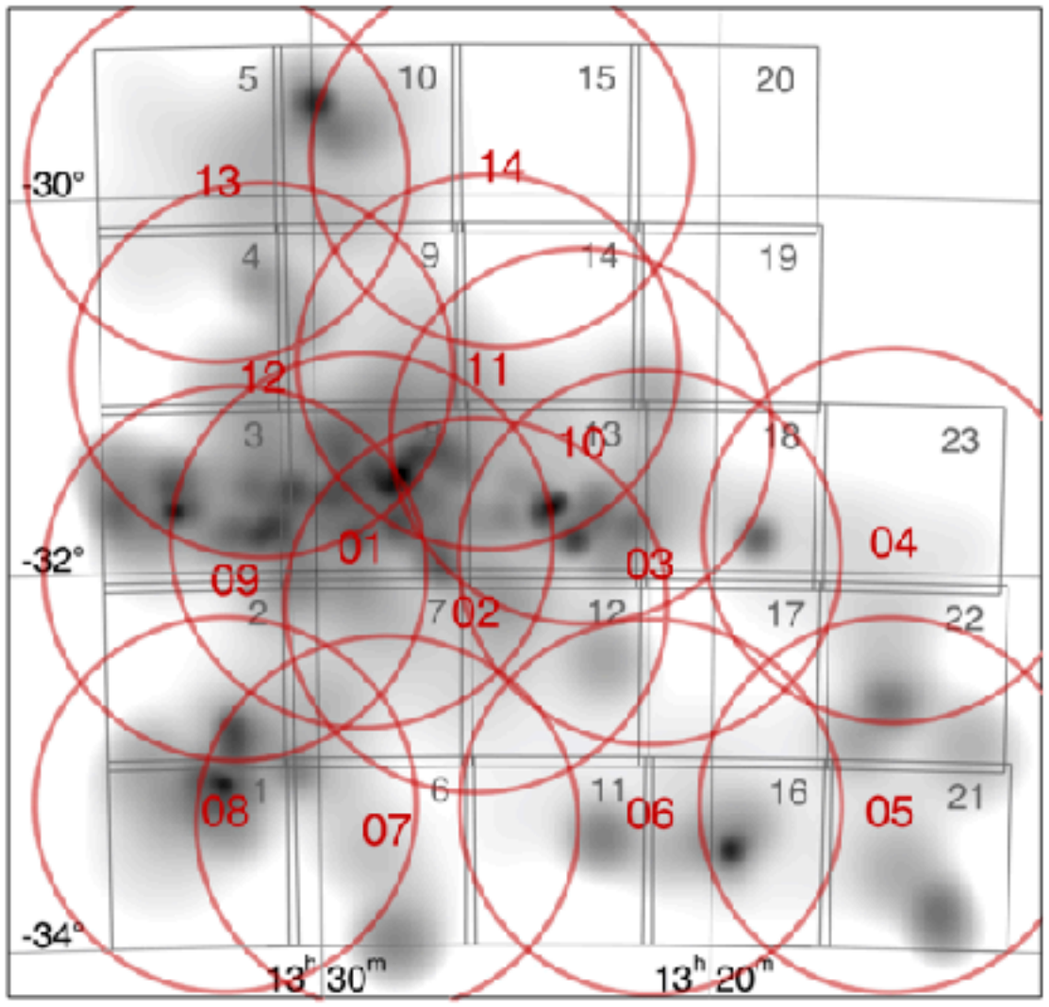
- Place galaxies in the supercluster, enabling us to focus on identifying interesting member galaxies for follow-up observations, and characterise the local environment for each galaxy.

AAOmega target selection

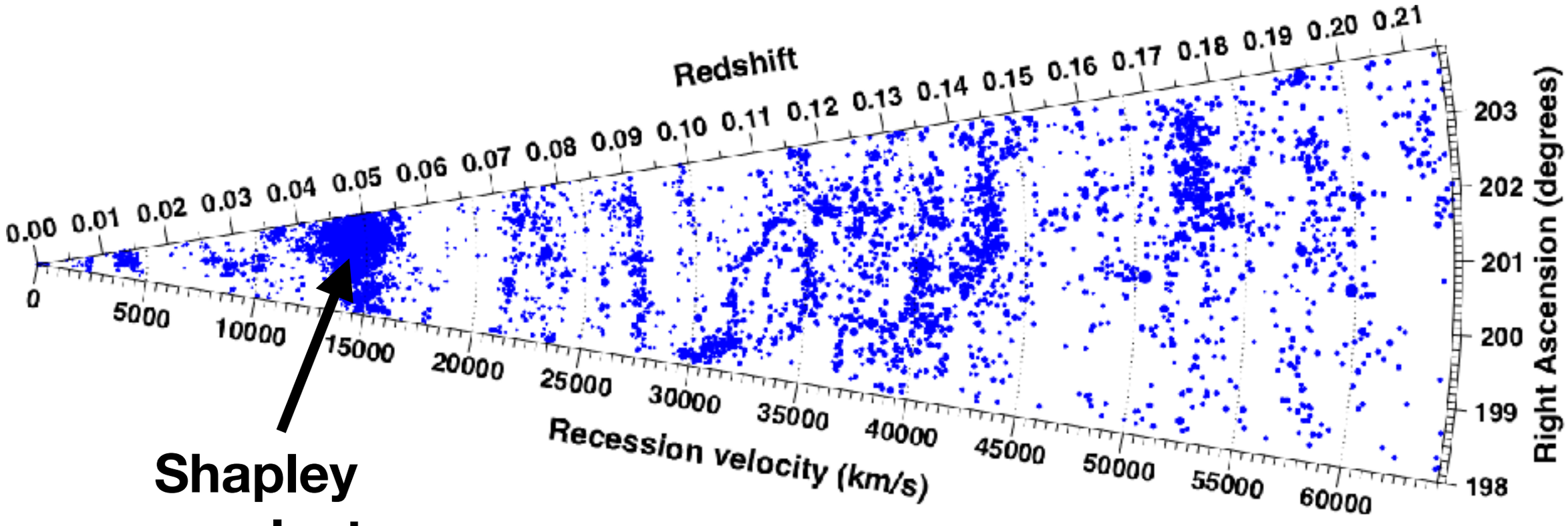
- AAOmega targets selected from VST images as galaxies brighter than i=18 mag (~i*+3.5).
- Additional selections using WISE near-IR photometry to provide effective stellar mass and SFR limited samples.
- W1(3.4μm) < 15.5 mag => $M^* > 2.7 \times 10^9 M_\odot$ {2nd cut}
- W3 (12μm) < 10.5 mag => SFR > 0.45 $M_\odot$/yr {higher priority}
- W1 closely matches K-band photometry, enabling us to produce VISTA K-band selected samples of supercluster galaxies
- W3 prioritisation has enabled us to obtain complete samples of obscured star-forming supercluster galaxies and mid-IR selected AGN.
- Many previous redshift surveys of the Shapley supercluster core: either much shallower (e.g. 6dFGRS), or targeted specific clusters (e.g. WINGS). AAOmega survey aims to produce homogenous deep redshift survey over the whole region, enabling the connecting filaments to be mapped reliably.

AAOmega and VST coverage

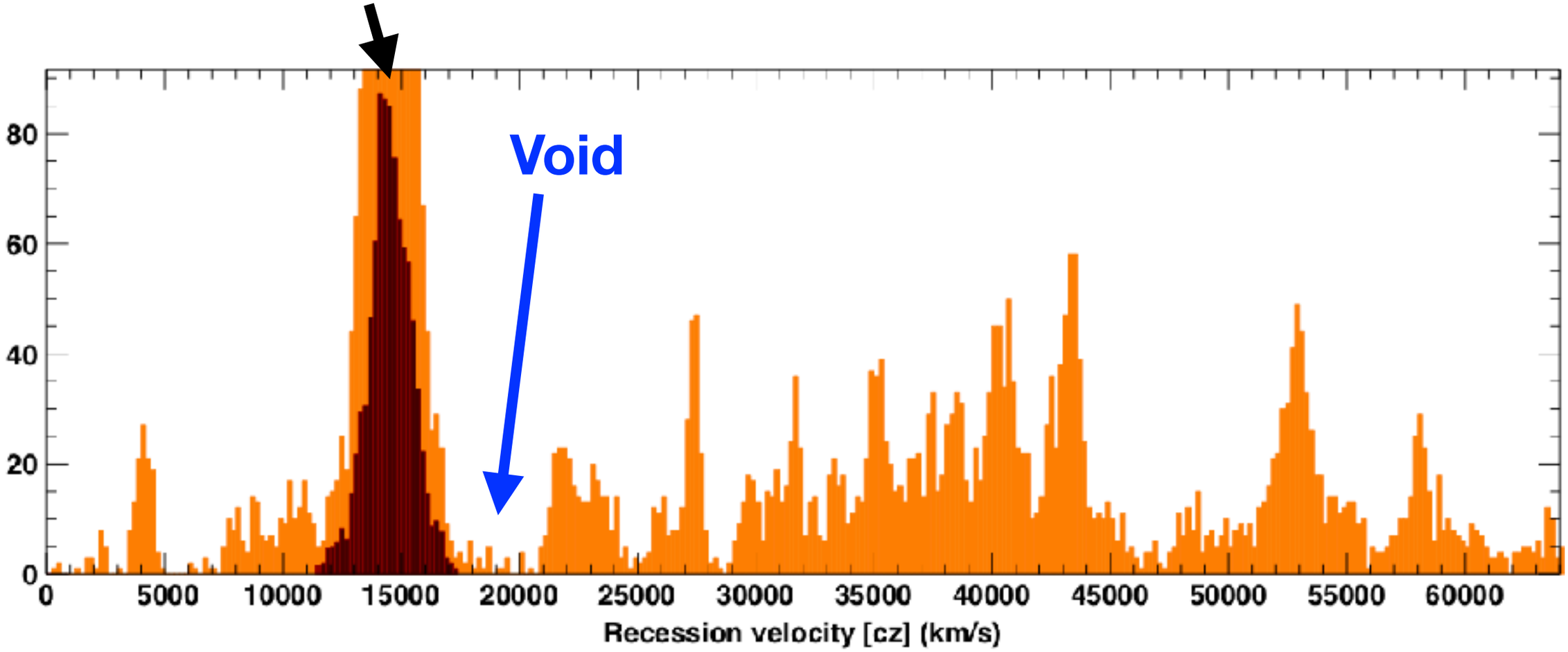
- We observed 14 AAOmega configurations over 4 nights on the 3.9-m AAT in May 2013.
- 90 mins exp time per pointing
- Final sample of 4027 galaxies with reliable redshifts
- Reliable redshifts obtained for 98% of targets observed, with mean uncertainty of 51 km/s.
- Combined with redshifts from the literature, there are now reliable redshifts for 95% of i<18, W1<15.5 galaxies over the full ShaSS region.



The 14 AAOmega pointings and 23 VST fields

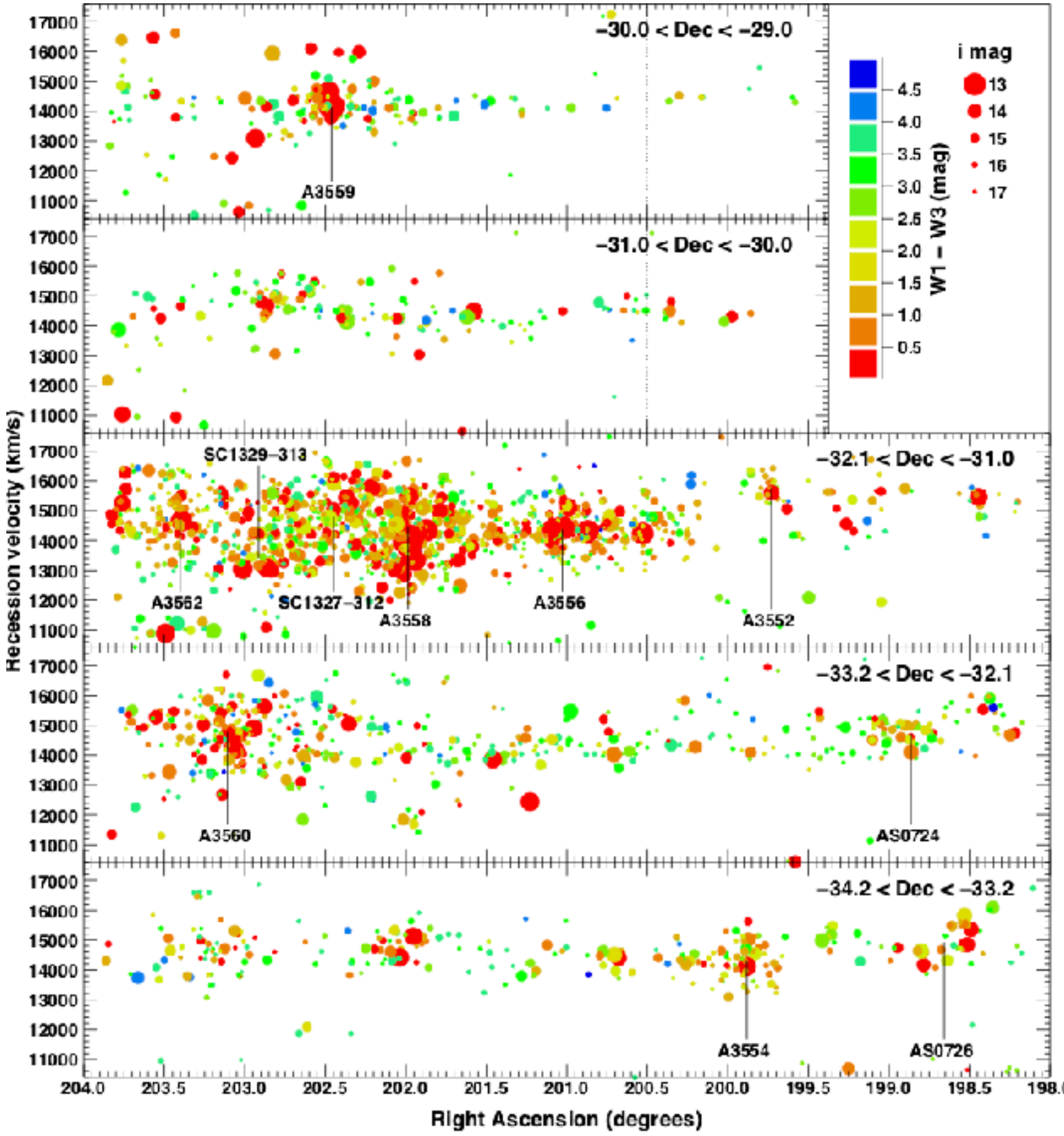


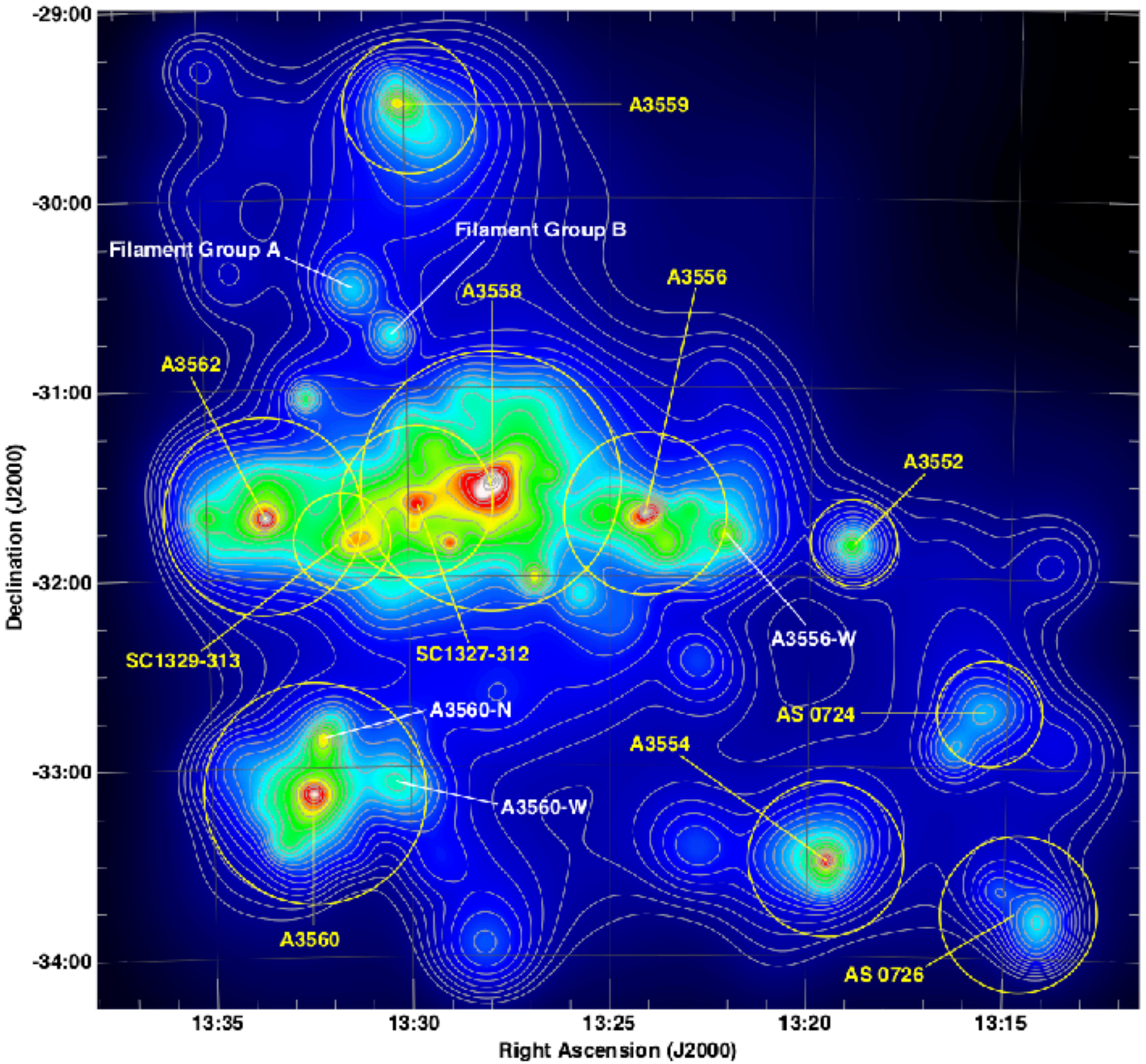
Shapley supercluster



A coherent sheet of galaxies

- Throughout the whole survey region, a well-defined ribbon of galaxies at 14,500km/s is seen
- No gaps or holes in this coherent sheet
- σ_v~200 km/s away from the clusters
- Ribbon of galaxies bound by voids => caustics. The entire region is bound and collapsing inwards toward A3558

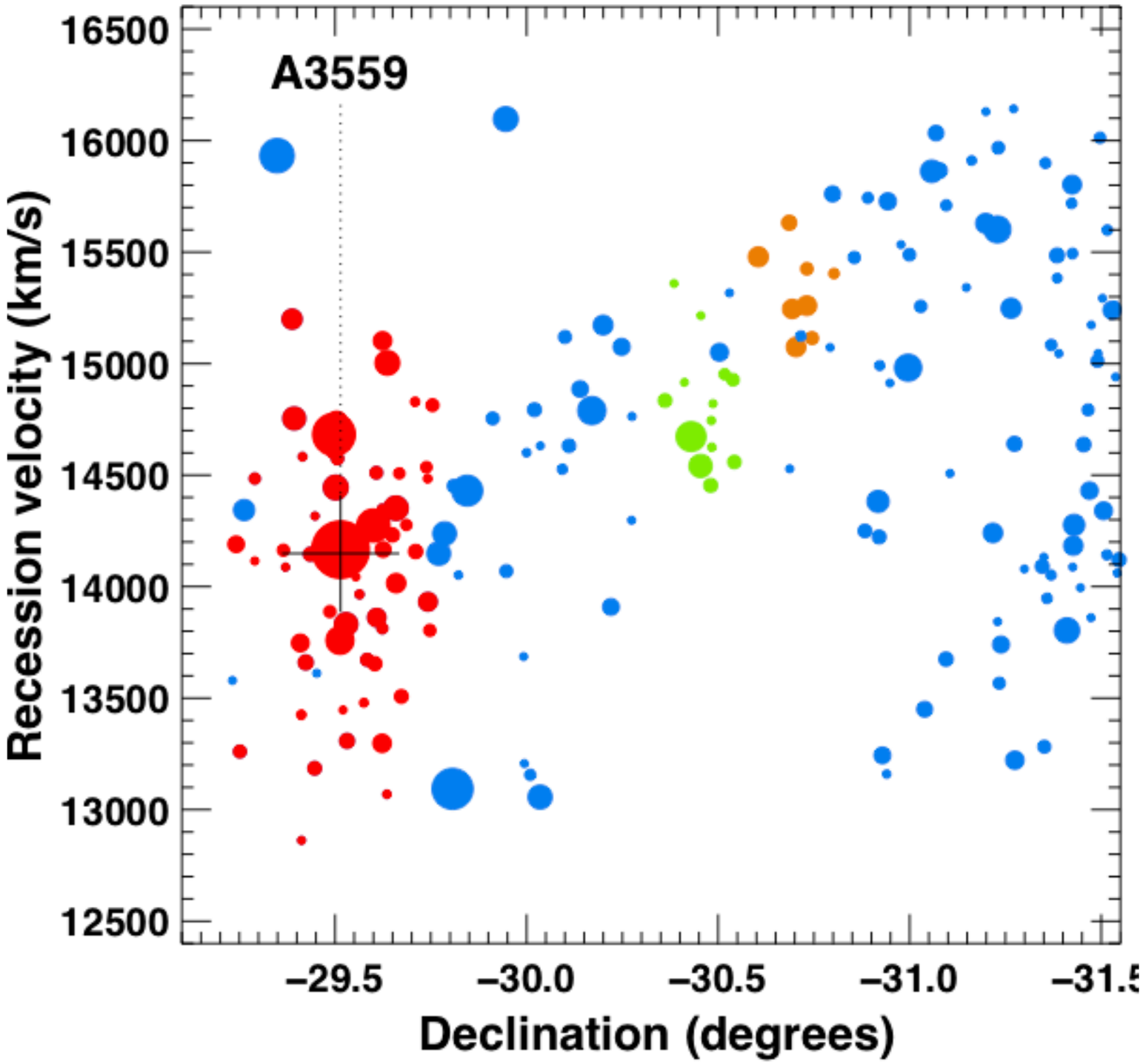




Number density of i<18 supercluster members

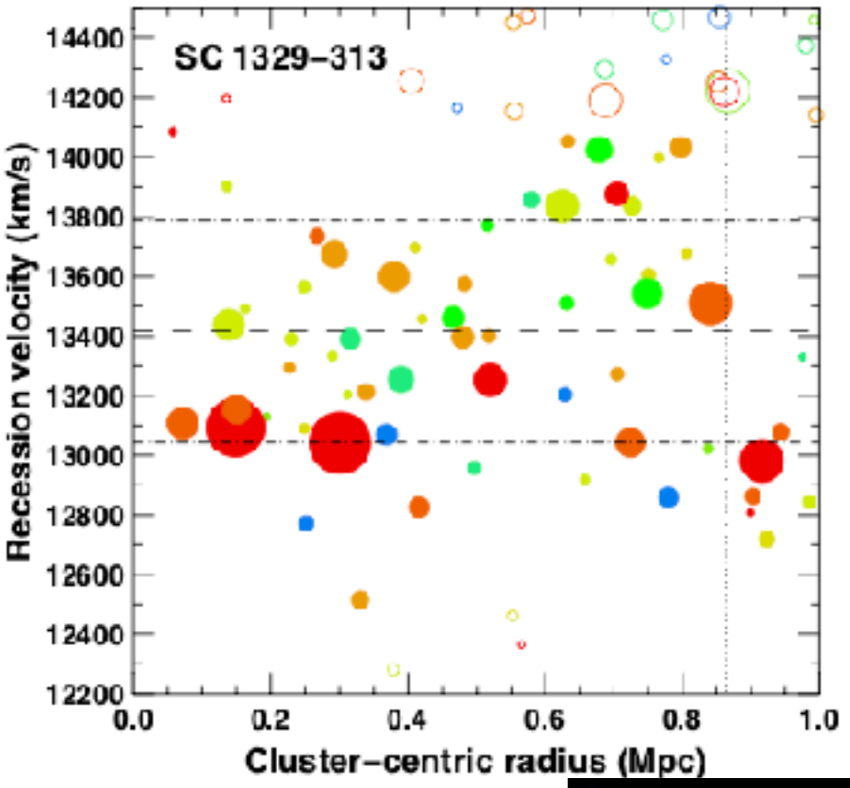
A filament connecting A3559 to the SSC

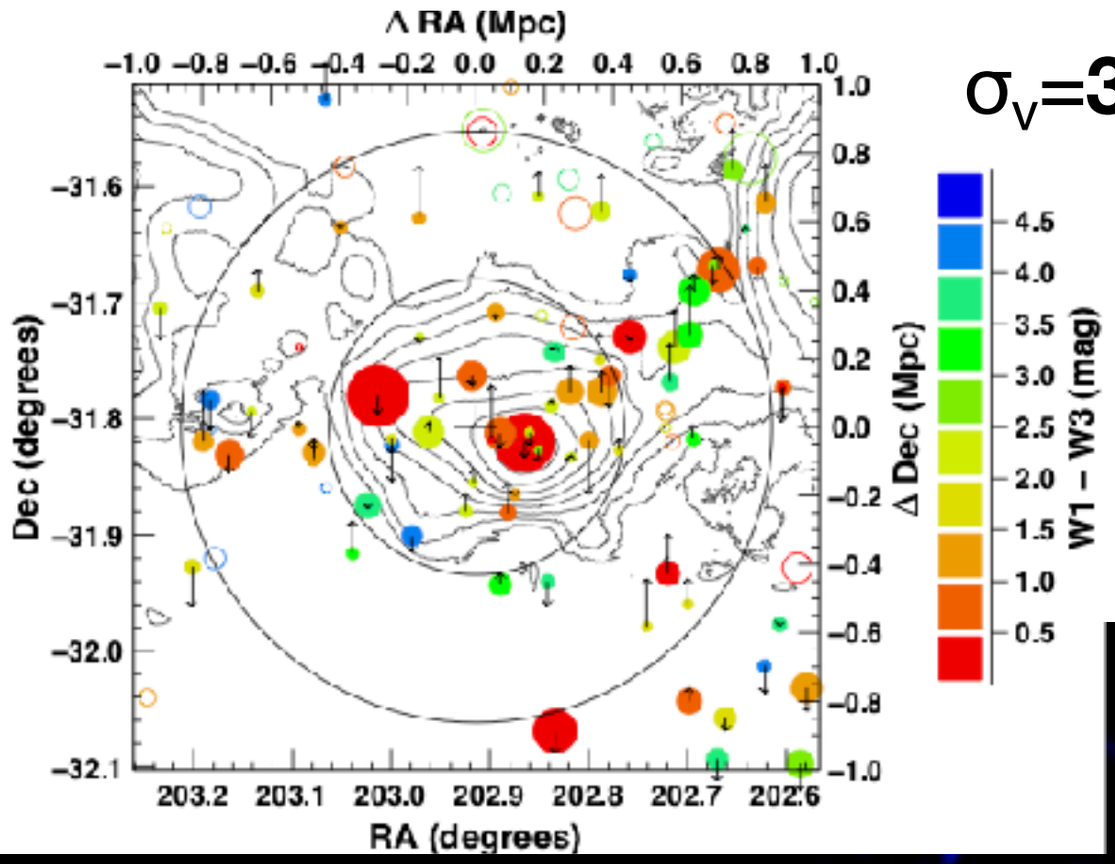
- Filament of galaxies found connecting A3559 with the core of the Shapley supercluster
- Velocity gradient indicates that A3559 is on near side. Galaxies in the filament attain infall velocities of ~2,000km/s as they approach SSC
- Two groups embedded in this filament

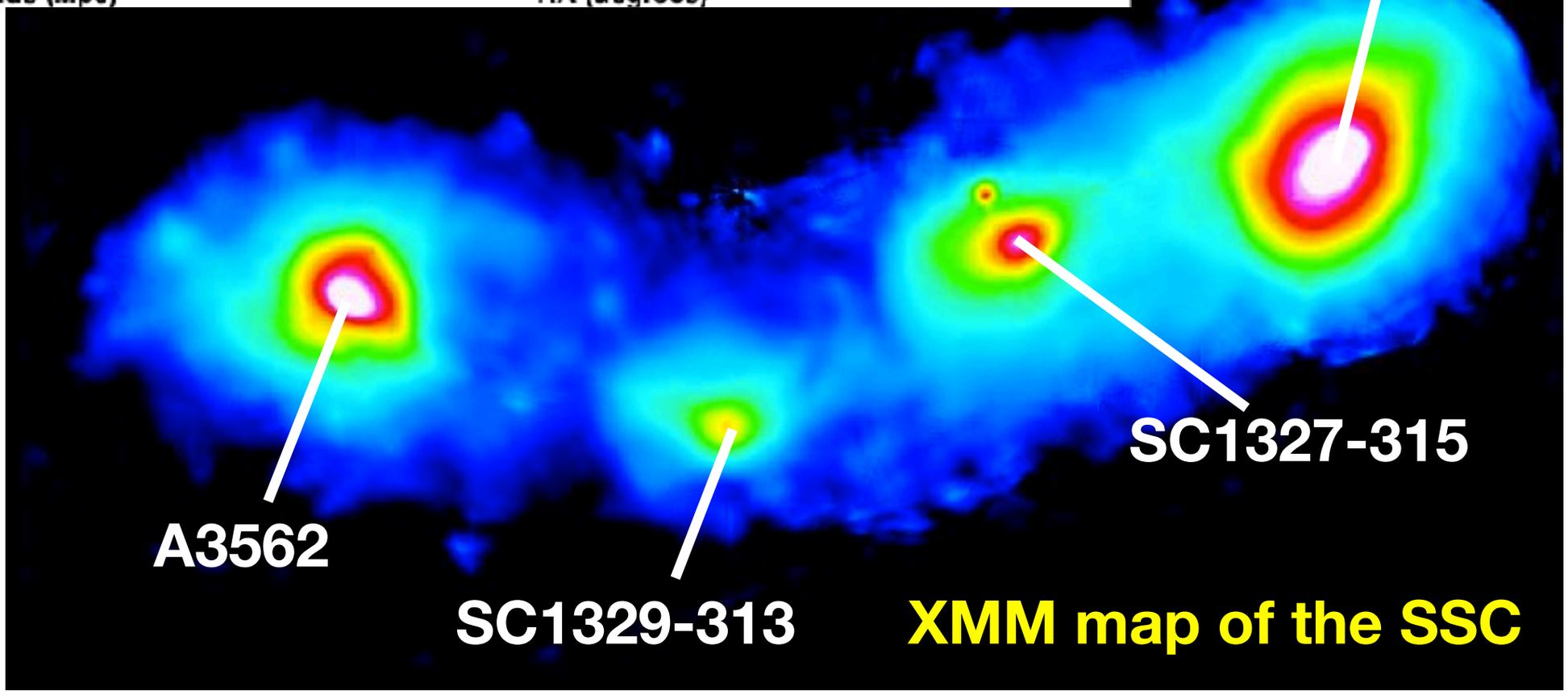


The dynamics of SC 1329-313

σ_V=373±28 km/s







Summary

- VST survey: high-quality *ugri* imaging of a 23 deg^2 region of the Shapley supercluster at z=0.048, the most massive structure in the local Universe

- VISTA K-band survey, plus WISE W1-W3 to determine stellar masses.

- Follow-up spectroscopic survey with AAOmega, obtaining redshifts for 4027 galaxies down to i=18 mag, W1=15.5 mag

- New updated map of the Shapley Supercluster, shows the 11 clusters embedded in a coherent sheet of galaxies across the full survey region.

- Identified numerous interesting galaxies in the supercluster for follow-up detailed IFU observations (Paola Merluzzi's talk).

- Shapley supercluster Survey: **Merluzzi et al. (2015), MNRAS, 446, 803**

- AAOmega redshift survey: Haines et al. (2018), coming very soon.