

# **Are Recent Velocity Surveys Consistent?**

**An Attempt...  
To Find an Answer...**

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# Agenda



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- Background Revisited: Motivation



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- The Formalism of Our Analysis



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- Overview of the surveys
- Results
- Conclusion: Future Prospects

**“Not everything that can be counted counts,  
*and*  
Not everything that counts can be counted.”**

Albert Einstein



# Background

- The overall expansion of a homogeneous and isotropic universe is described by the Hubble law

$$cz = H_0 r$$

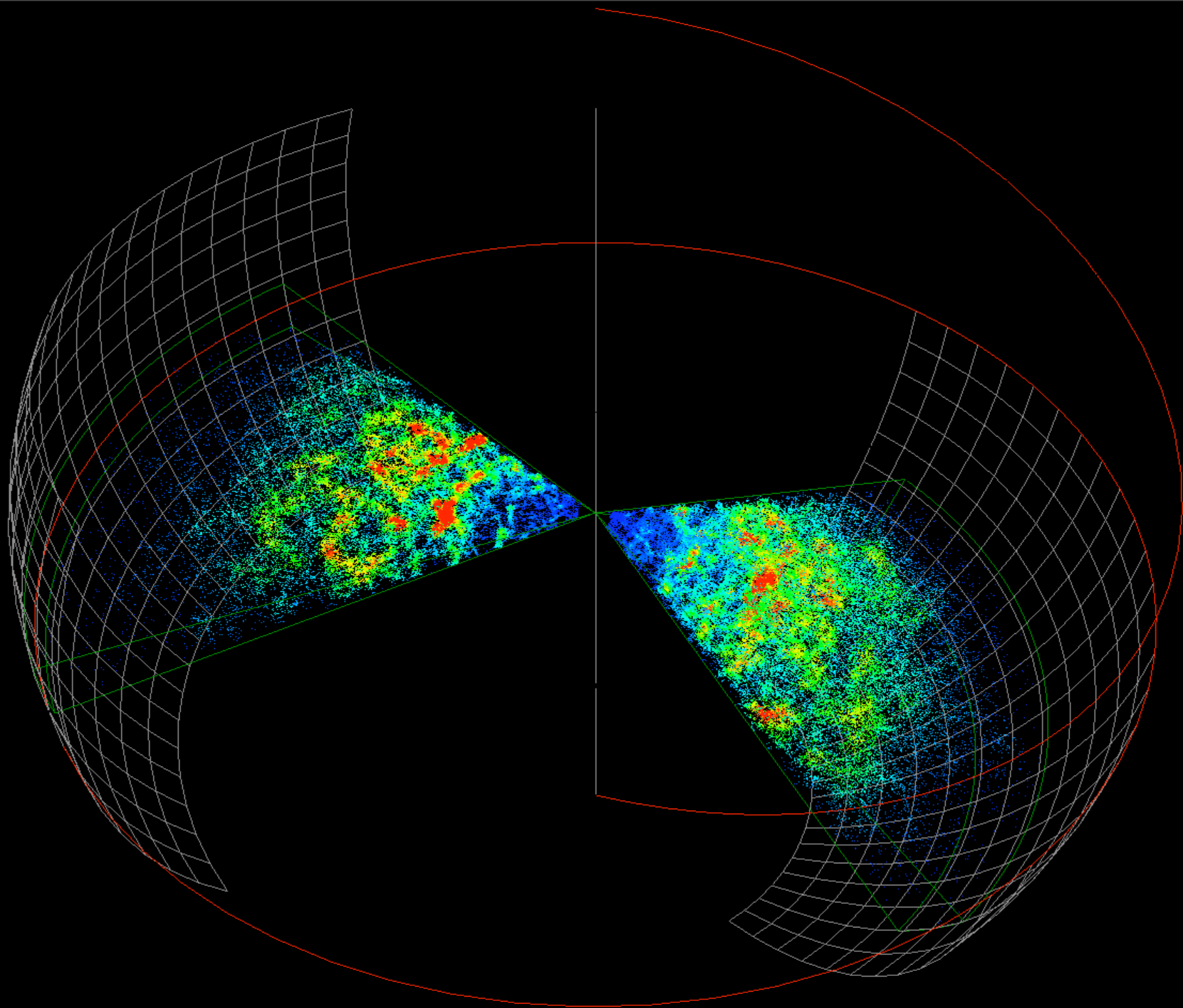


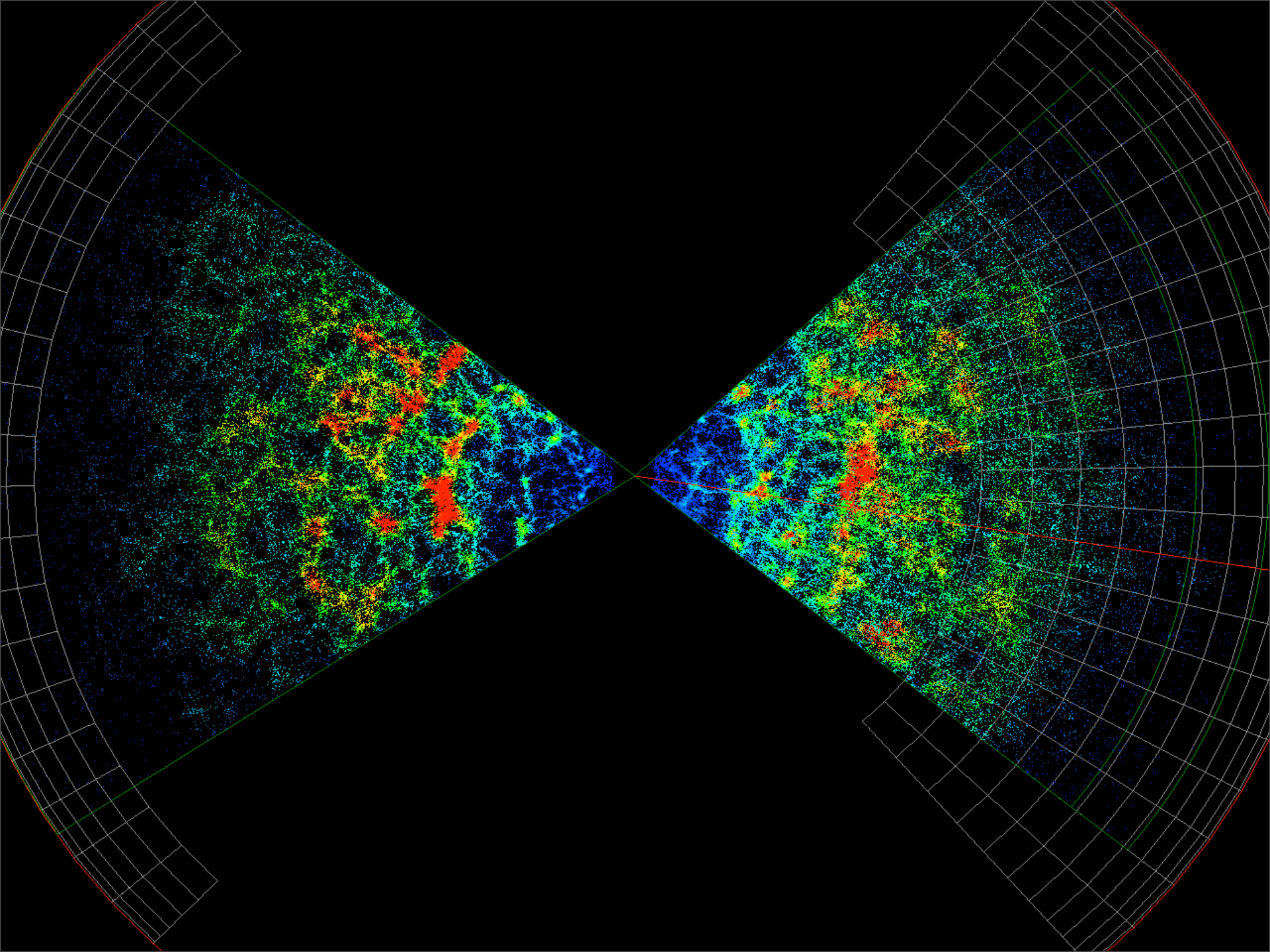
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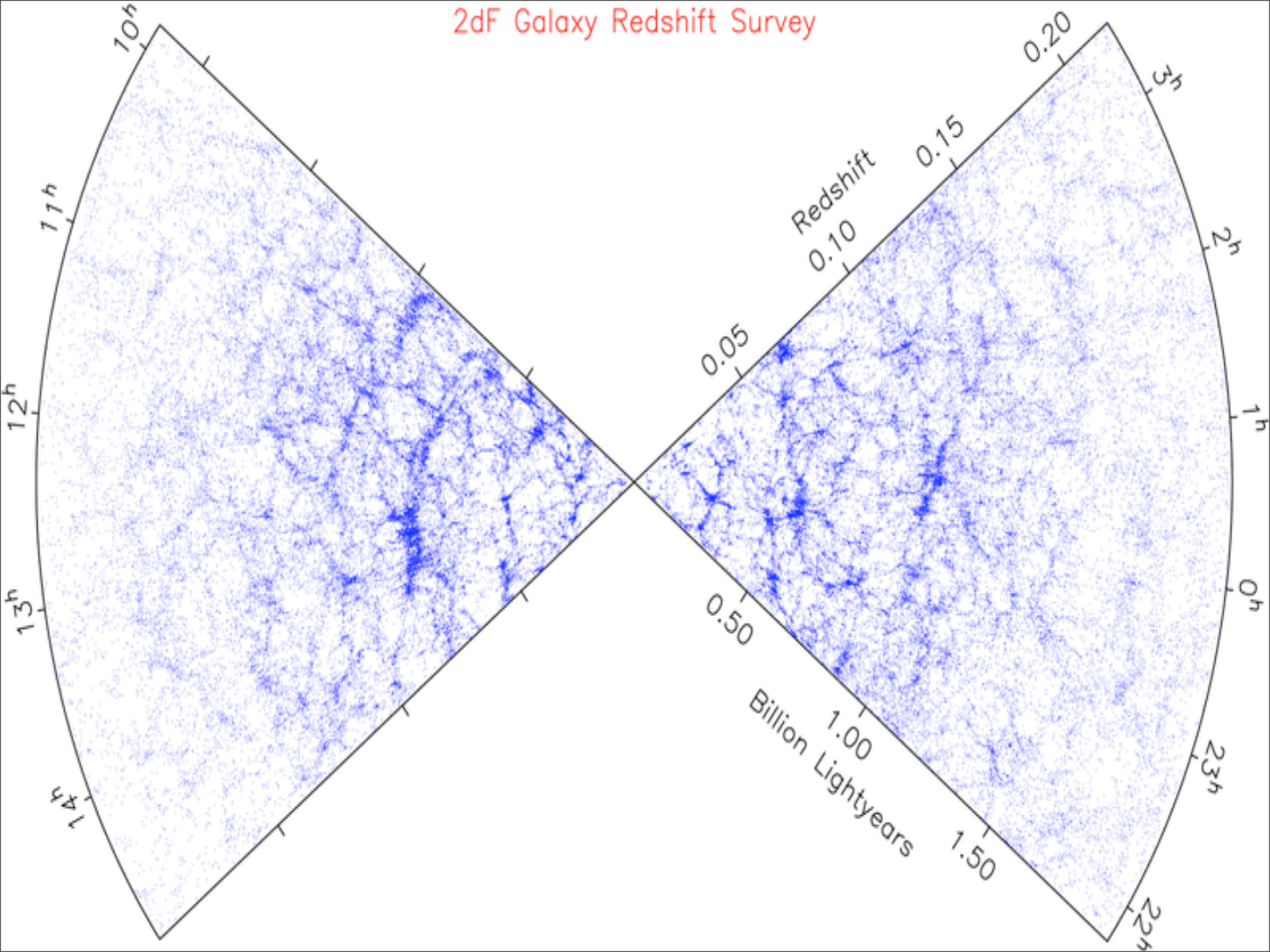
$$cz = H_0 r$$

- Now, what do observations tell us about the structure of our universe?





# 2dF Galaxy Redshift Survey

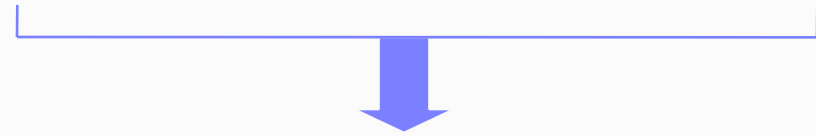




## Background (cont'd...)

- Modified Hubble Law:

$$cz = H_0 r + \hat{\mathbf{r}} \cdot [\mathbf{v}(\mathbf{r}) - \mathbf{v}(0)]$$



$$v(r)$$

Line-of-Sight component  
of  
Peculiar Velocity



## Background (cont'd...)



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$$\nabla \cdot \mathbf{v}(\mathbf{r}) \propto \frac{\rho(\mathbf{r}) - \rho_0}{\rho_0}$$



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&



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&

$$\mathbf{v}(\mathbf{r}) \propto -\nabla \phi$$



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- Unique method to probe the distribution of mass in local universe
- Effective method to constrain  $\Omega_m$
- Effective method to constrain  $\sigma_8$
- For a fair comparison of the results obtained from different surveys, it is important to know whether they are **consistent** with one another



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*Kaiser, N. 1988, MNRAS, 231, 149*



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Gaussian

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## Modeling the Observational Data

- For a given power spectrum, the **correlation** between the estimates of the bulk flows of any pair of catalogs (A,B) is

$$C = \frac{\langle U_i^A U_i^B \rangle}{\left( \langle U_l^A U_l^A \rangle \langle U_m^B U_m^B \rangle \right)^{1/2}}$$

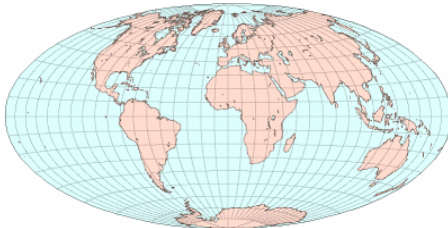
*Watkins, R. and Feldman, H. A., 1995, ApJ, 453, L73*



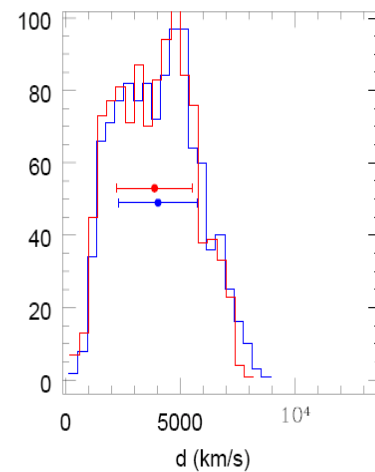
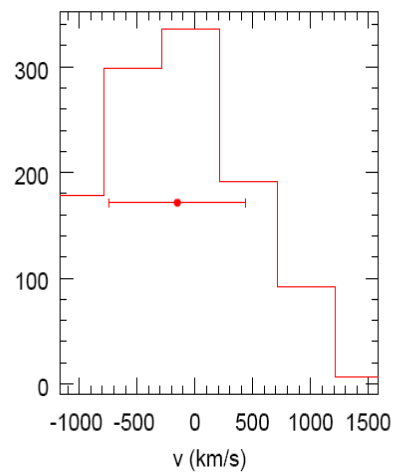
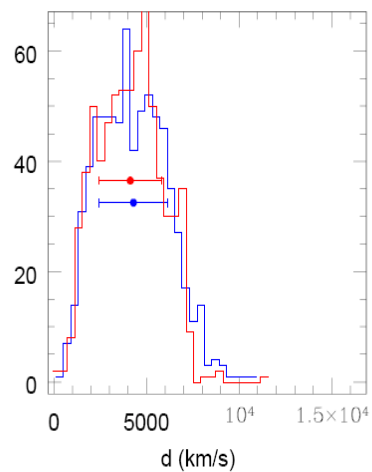
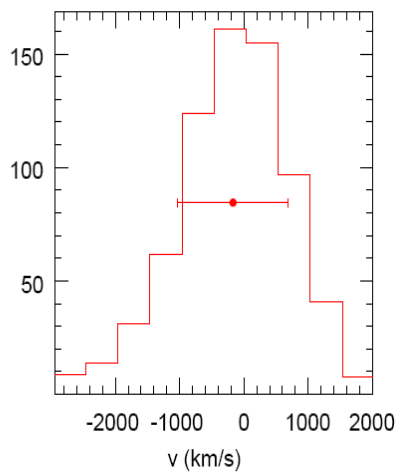
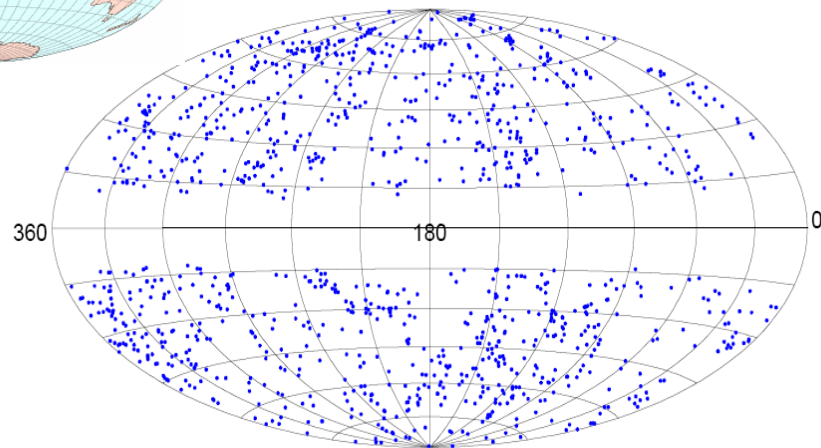
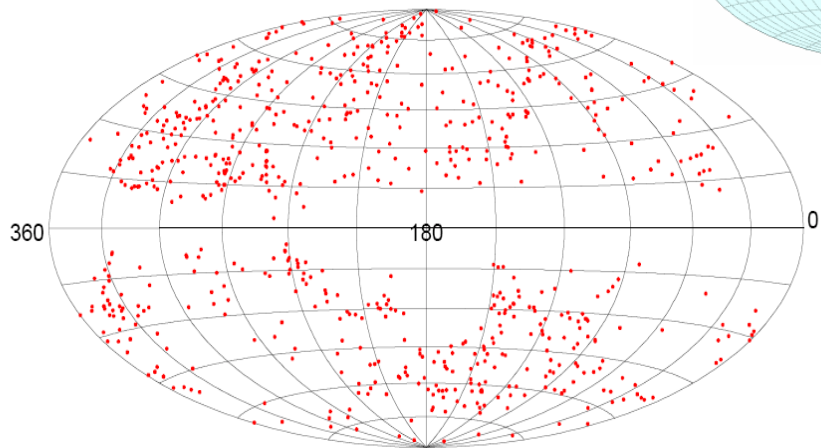
# Surveys

- **Nearby Early-type Galaxy Survey (ENEAR)**
  - All sky survey with  $D_{n-\sigma}$  measured distances
- **Spiral Field I-Band (SFI)**
  - All sky survey with I-Band TF distance indicators
- **Surface Brightness Fluctuation (SBF)**
  - Employs I-Band surface brightness fluctuation tech.
- **Revised Flat Galaxy Catalog (RFGC)**
  - HI line widths, TF distance indicators

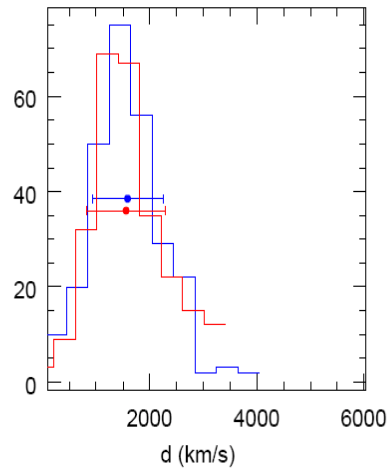
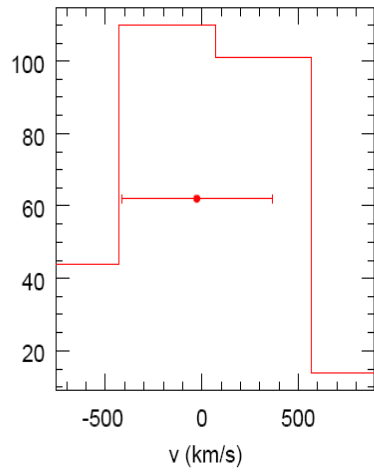
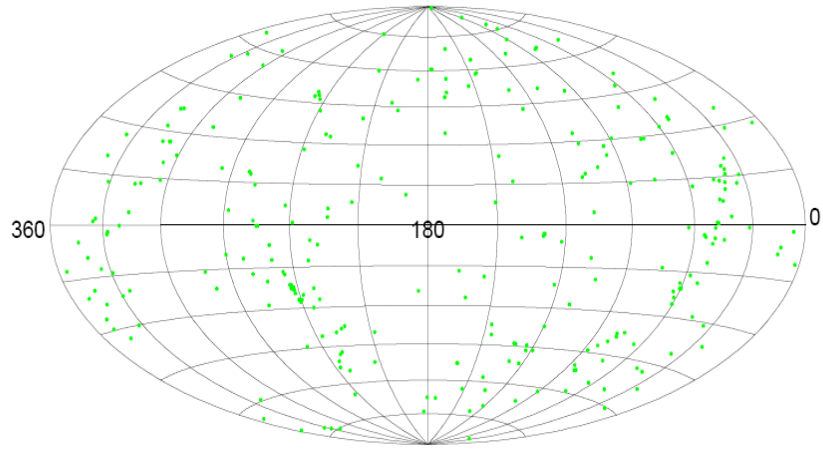
ENEAR Survey (702 Elliptical Galaxies)



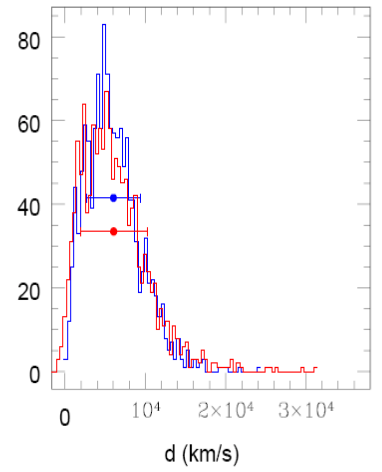
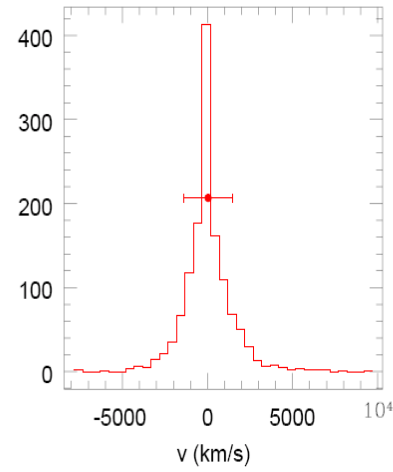
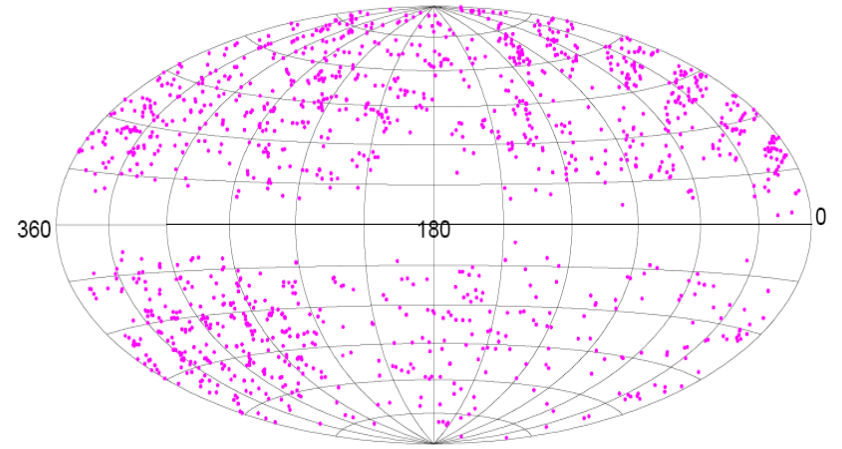
SFI Survey (1104 Spiral Galaxies)



SBF Survey (269 Late Time Galaxies)



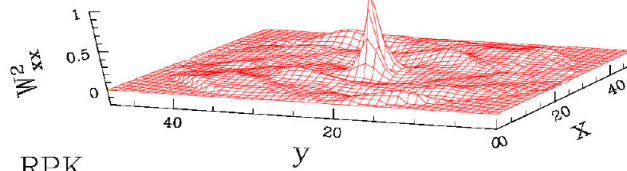
R FGC Survey (1326 Edge-on Spiral Galaxies)



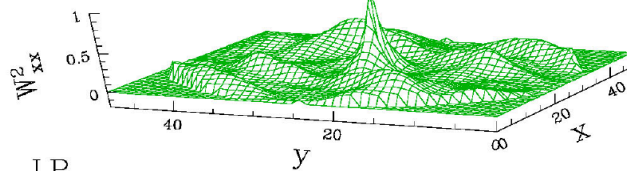


# Results: Window Functions

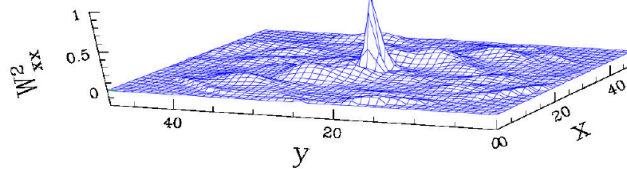
BOTH



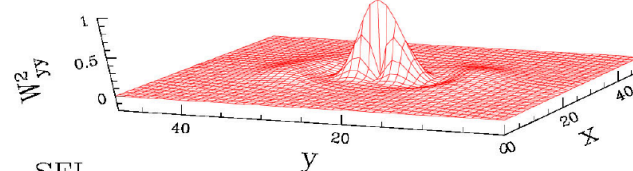
RPK



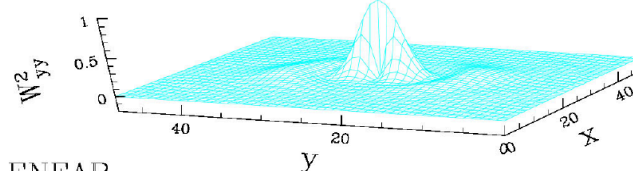
LP



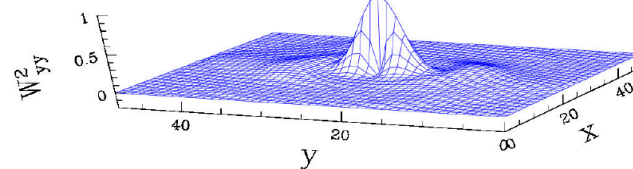
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SFI

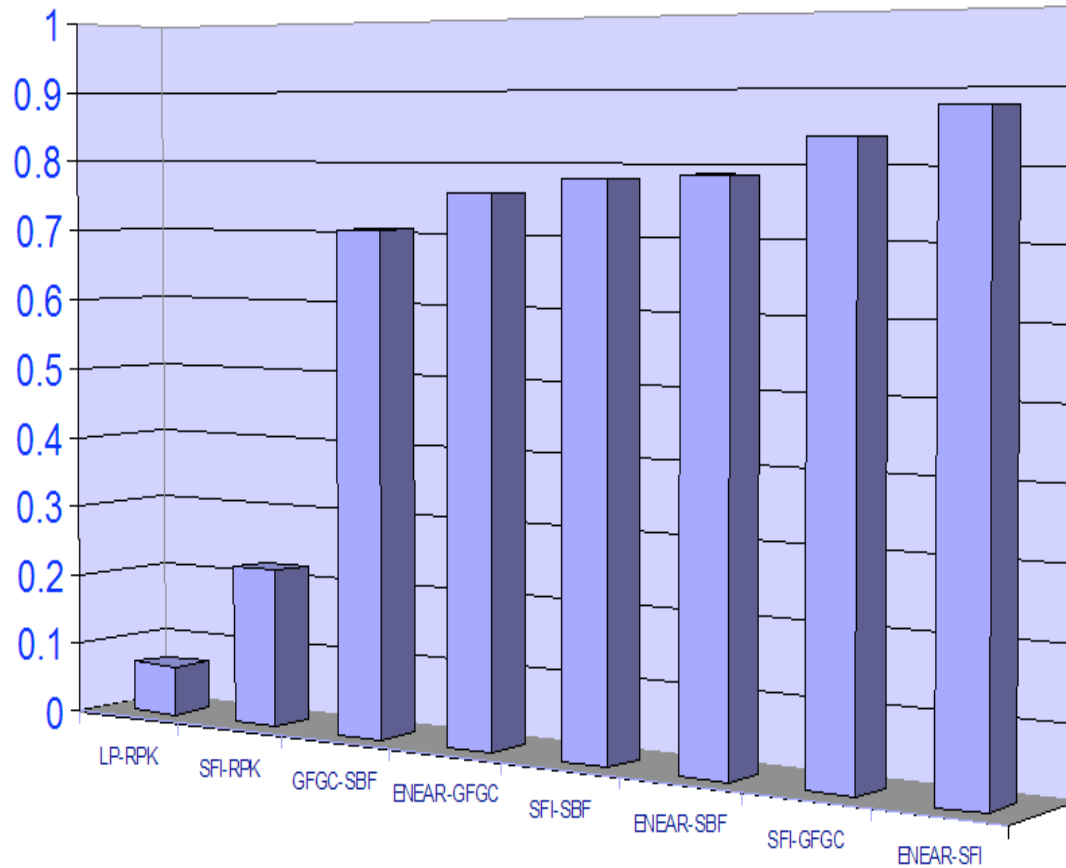


ENEAR





# Results: Correlation Coefficients





# Conclusion



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- High degree of correlation between the bulk flow vectors of all the surveys
- No statistically significant differences between the velocity fields mapped by spiral and elliptical galaxies
- Consistent results are obtainable from independent distance indicators
- With further improvement of observational techniques, better constraints can be obtained

***“Ars Longa, Vita Brevis”***

***Velocity Fields Forever!***

• Poster presented at the APS Meeting in April 2005:

<http://mactania.phsx.ku.edu/images/Posters/2005-APS-WF.gif>