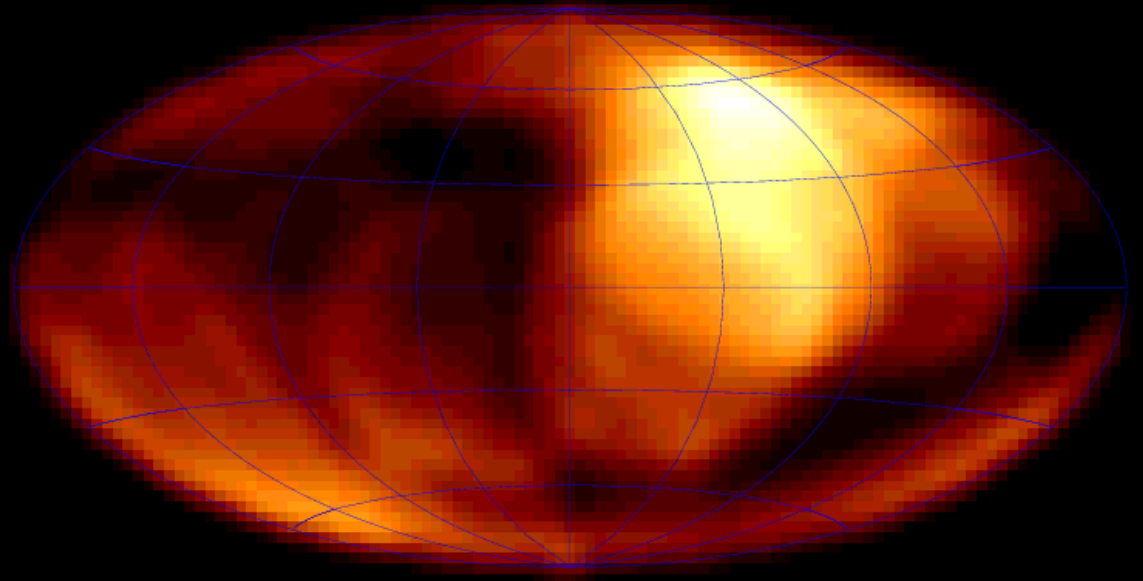


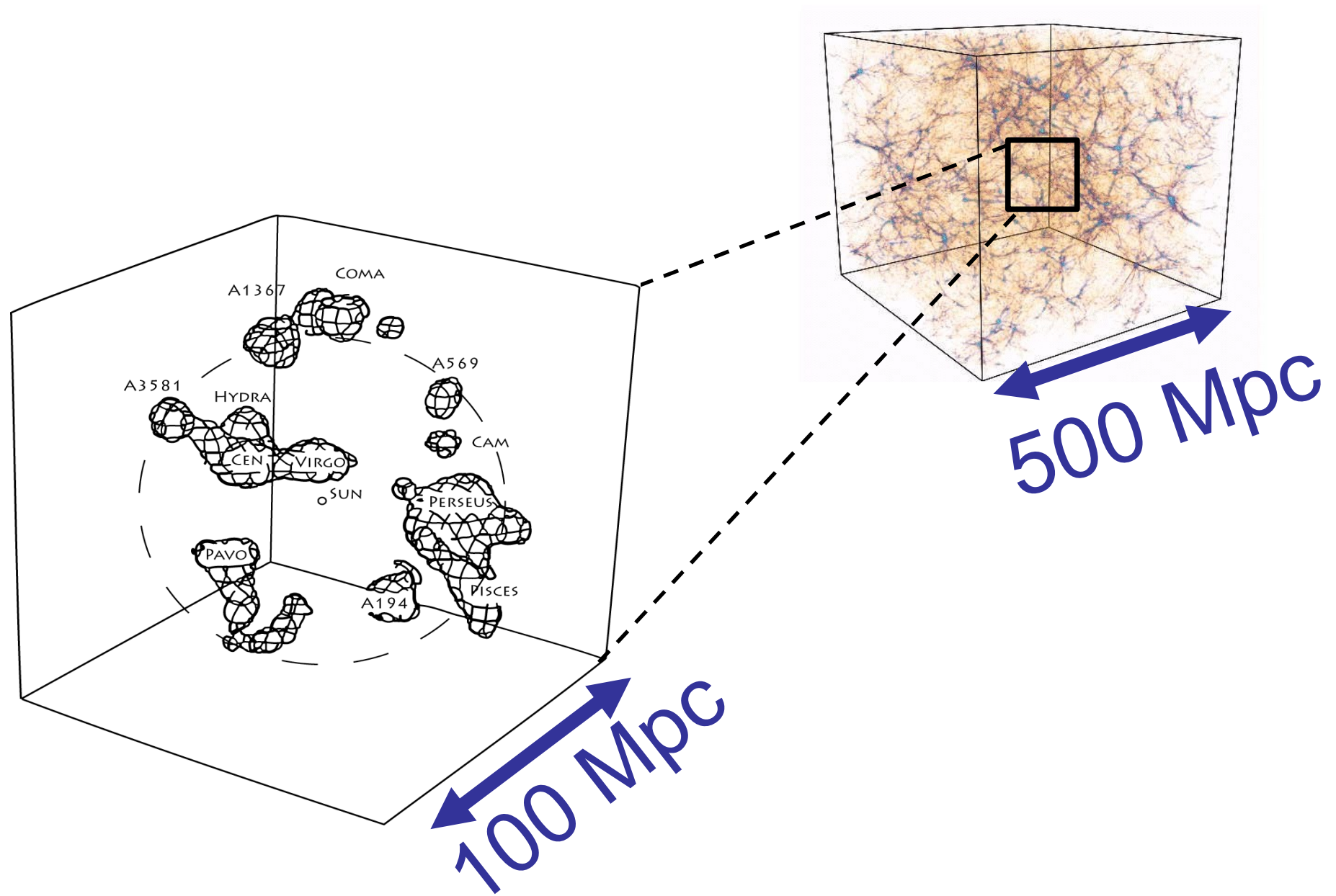
# Large Scale structure of the local Universe traced by hard X-ray emitting AGNs



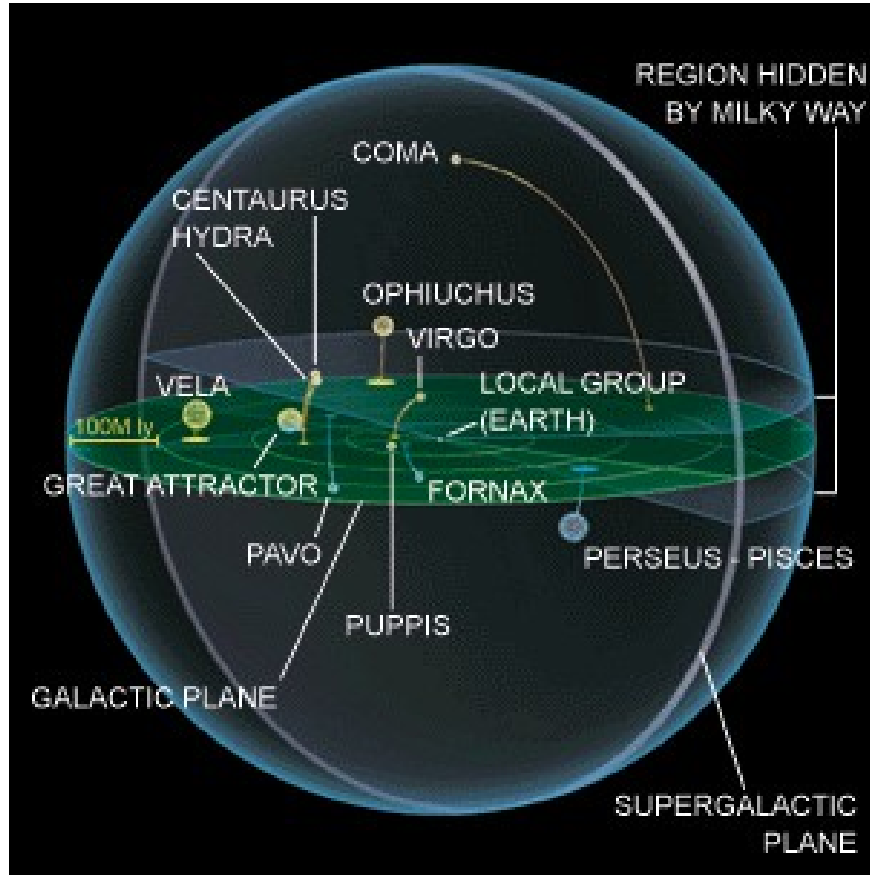
**R.Krivosos, M.Revnivtsev,  
S.Sazonov, E.Churazov, R.Sunyaev**

**MPA, Garching, Germany  
IKI, Moscow, Russia  
Excellence Cluster Universe, Garching, Germany**

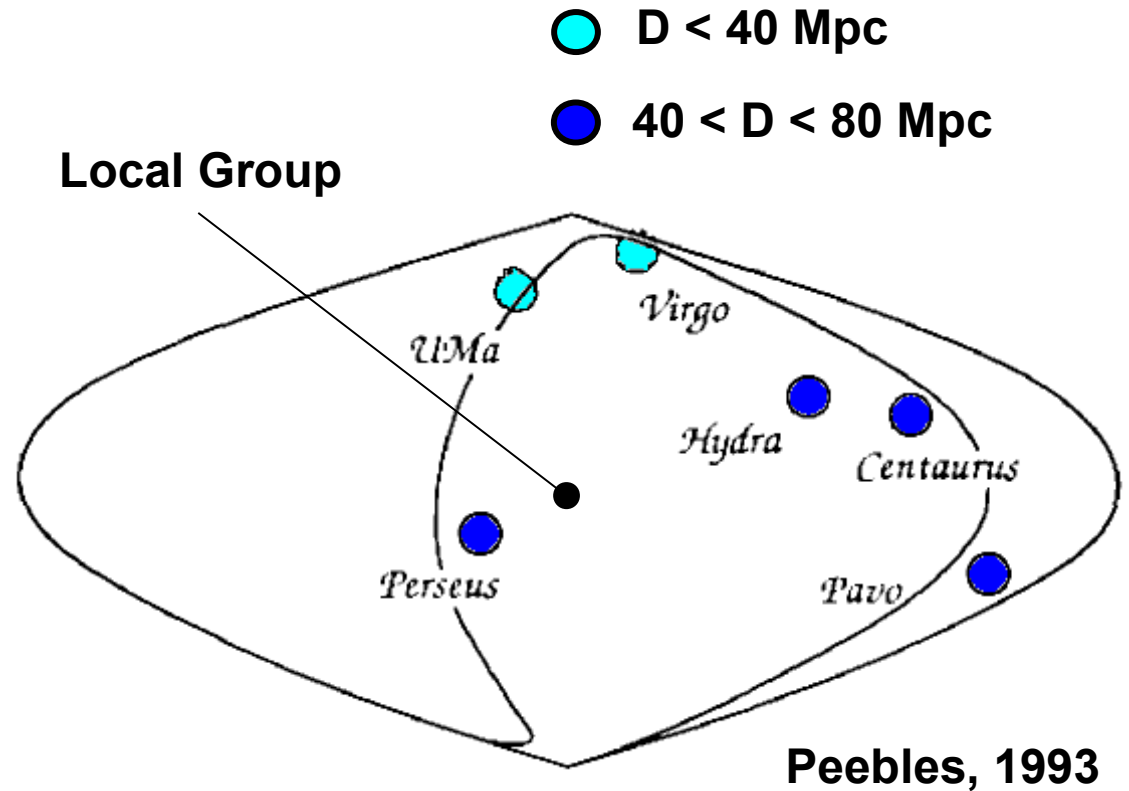
# Large Scale Structure of the Local Universe



# Large Scale Structure of the Local Universe



Kraan-Korteweg & Lahav, Sci. Am. 1998



# Do X-rays trace the mass?

X-Ray AGN bias factor:

$$b = \delta\rho_{\text{AGN}} / \langle \rho_{\text{AGN}} \rangle : \delta\rho_{\text{m}} / \langle \rho_{\text{m}} \rangle$$

Measurement	Reference	Scale (Mpc)	$b$ ( $\Omega_0 = 1$ )
X-ray cluster dipole	PK98	10-100	4
X-ray AGN dipole	MB90	1000	3-6
XRB-galaxy CCF		10-100	$< 2$
XRB dipole vs bulk motions	S99	1000	2-7
XRB multipoles vs bulk motions	T98	100-1000	1-2
Clustering of distant AGN	C98	10-100	1-2
Clustering of nearby AGN	APG99	100	2-3

TABLE 4. Bias parameters as inferred from various measurements. references are: PK98 Plionis & Kolokotronis (1998); MB90: Miyaji & Boldt (1990); S99: Scharf et al (1999); T98: Treyer et al (1998); C98: Carrera et al (1998); APG99: Akylas, Plionis & Georgantopoulos (1999).

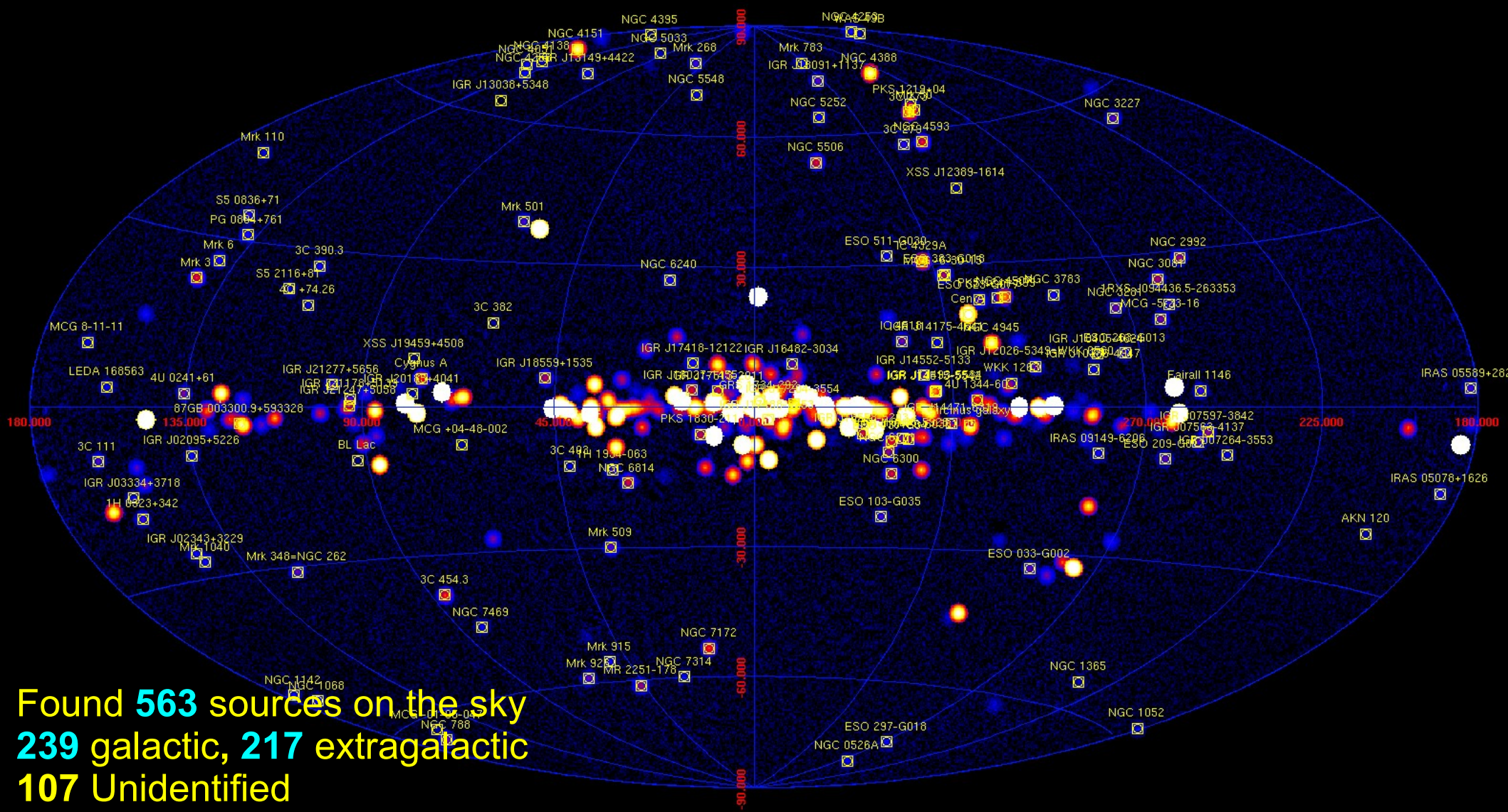
Barcons et al., 2001

# INTEGRAL



- Large FOV  
~30x30 deg<sup>2</sup>
- point source  
localization  
~ few arcmins
- High sensitivity  
(17 - 100 keV)

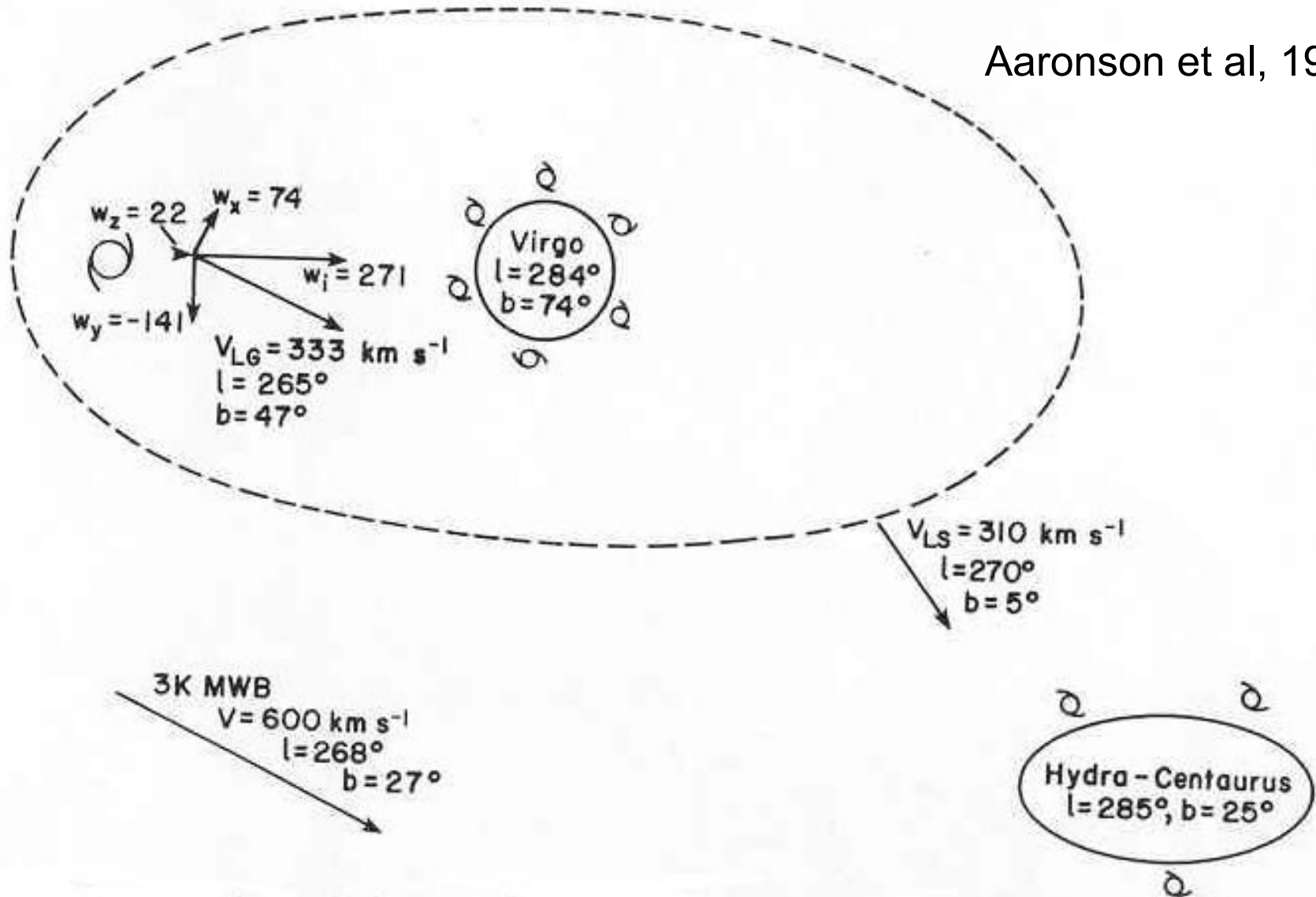
# All-sky survey 17-60 keV (Krivonos et al. 2007)



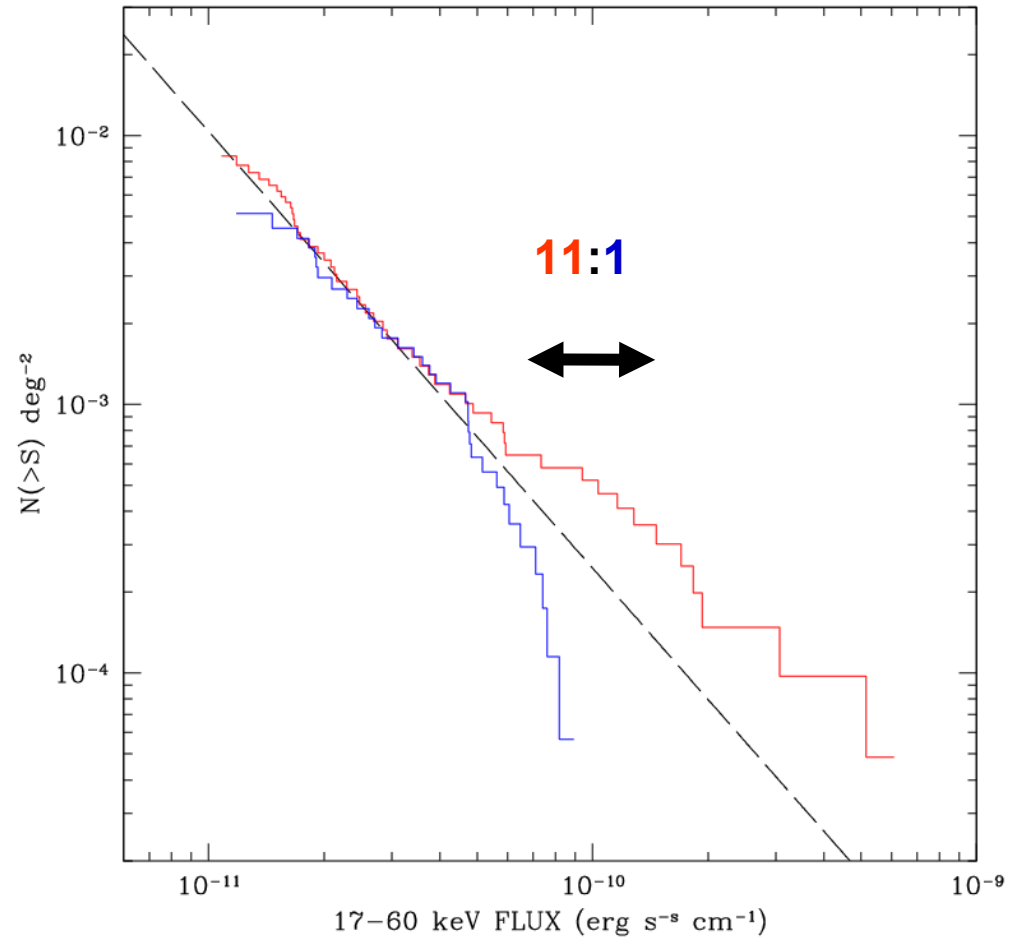
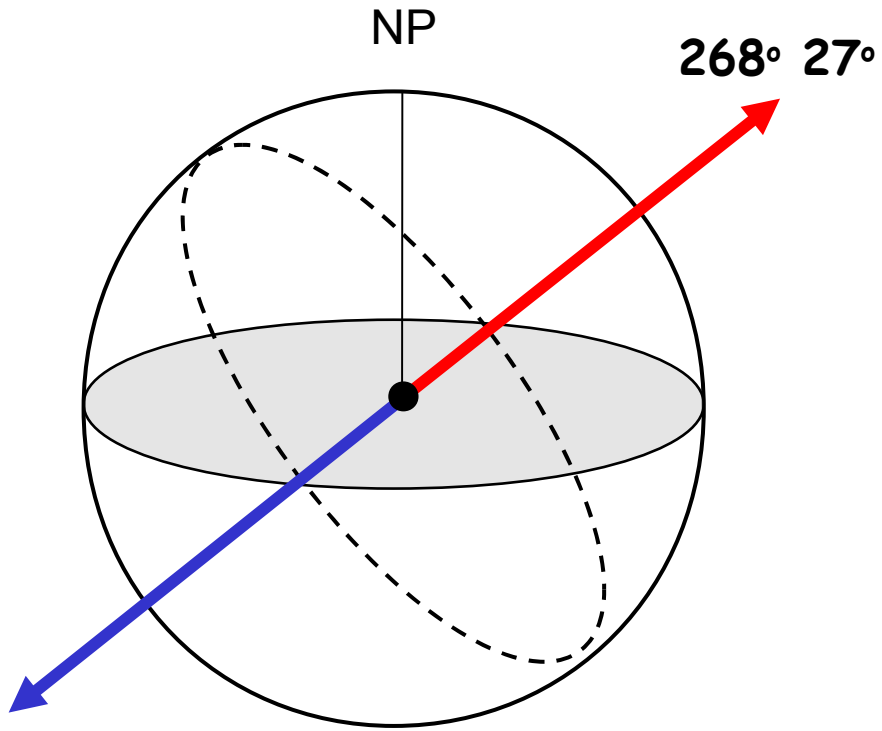
*Effective “depth” of the survey 200-300 Mpc for a source with typical luminosity  $10^{43}$  erg/s*

# Local Group motion

Aaronson et al, 1986

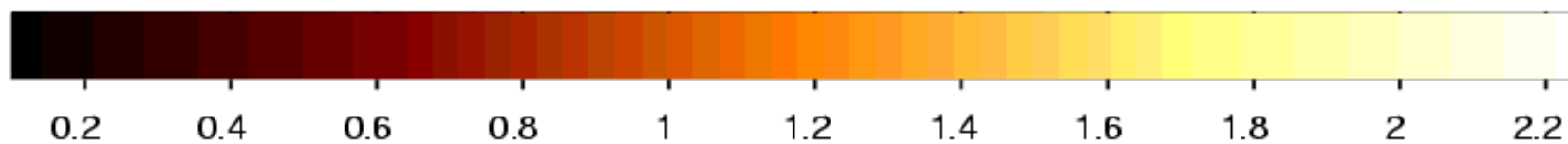
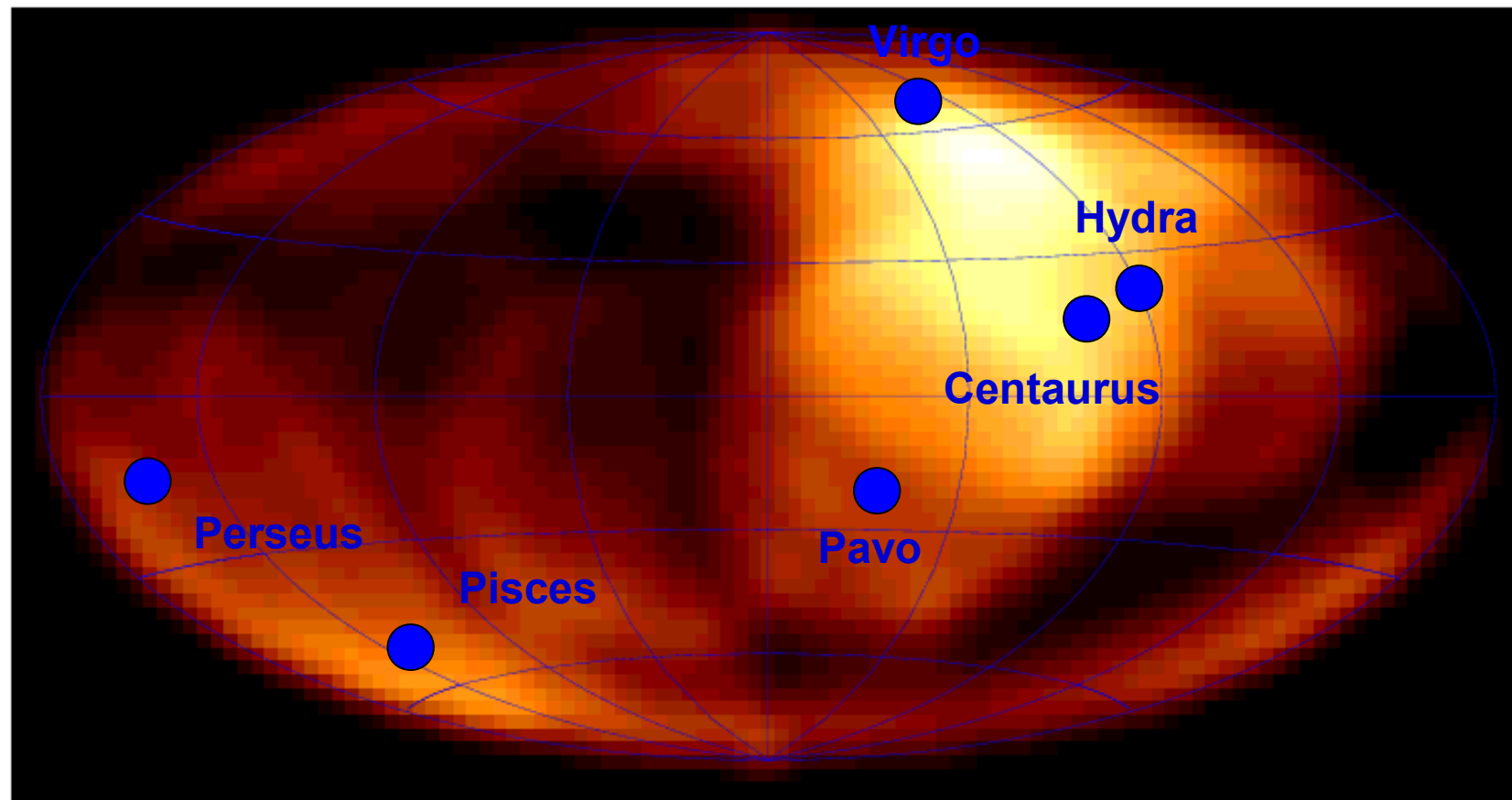


# AGN surface density contrast





# AGN volume density ( $D < 70$ Mpc)

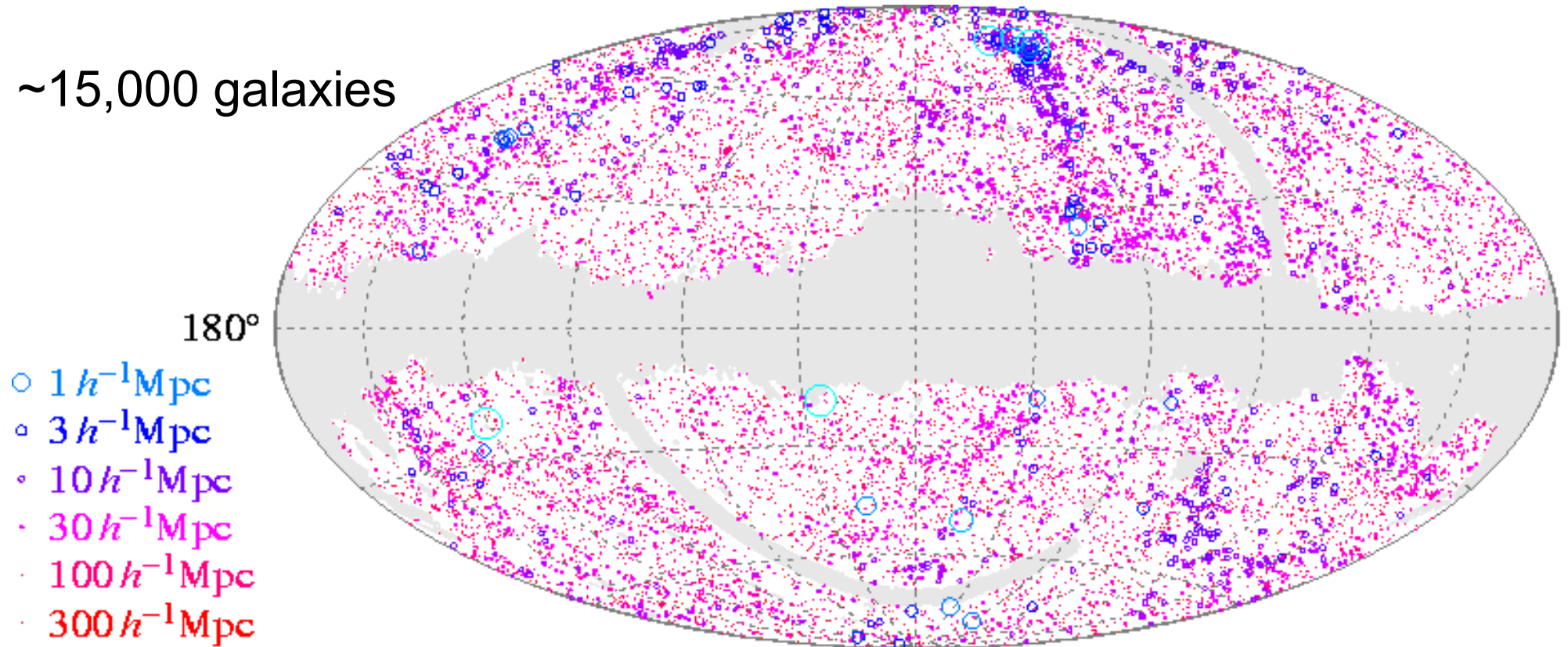


40 AGNs

$n = 1.4 \times 10^{-3} / \text{Mpc}^3, L > 10^{41} \text{ erg/s}$

# IRAS PSCz survey as matter tracer ( $b_{\text{IR}} \approx 1$ )

~15,000 galaxies

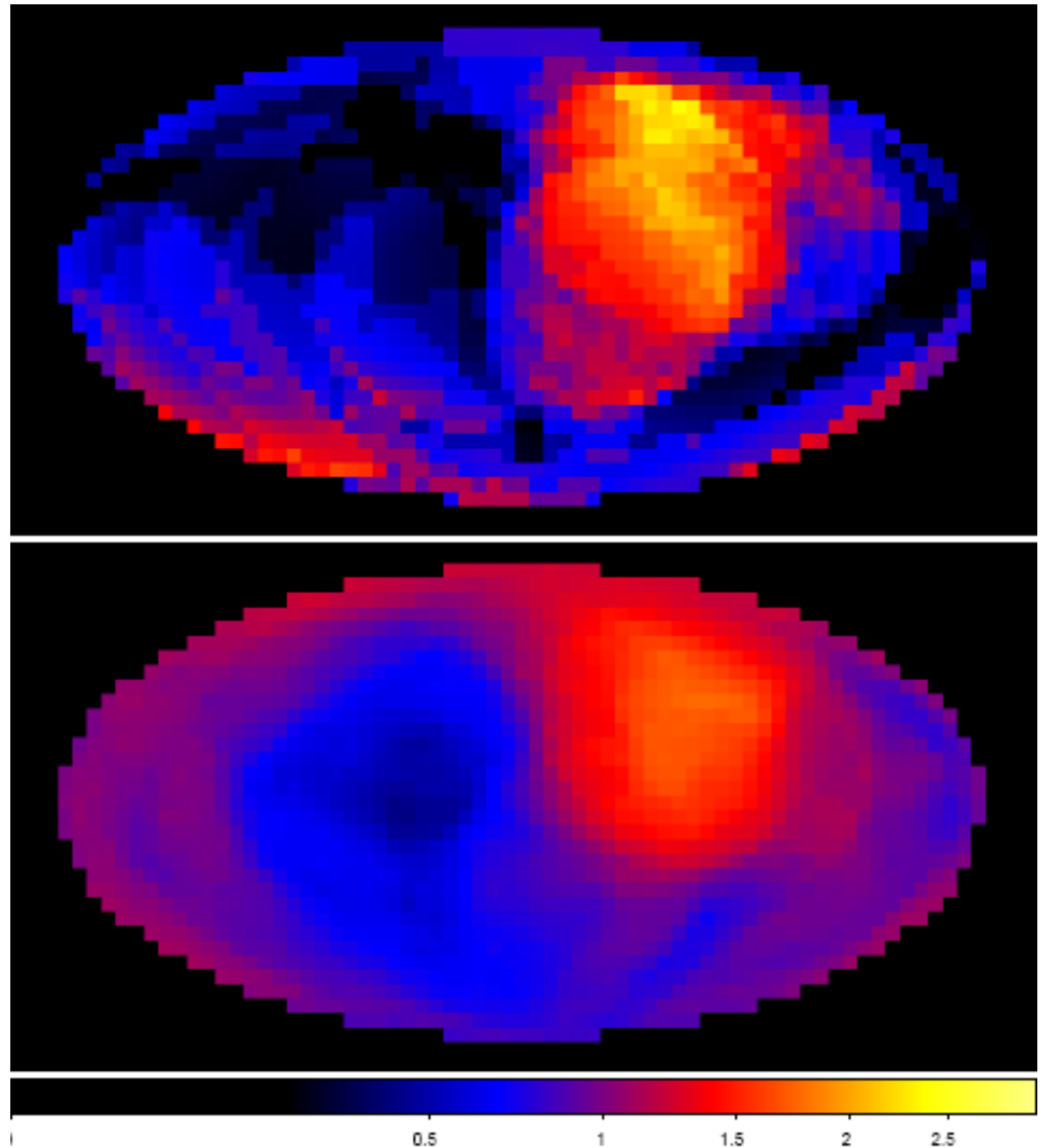


Saunders et al.,

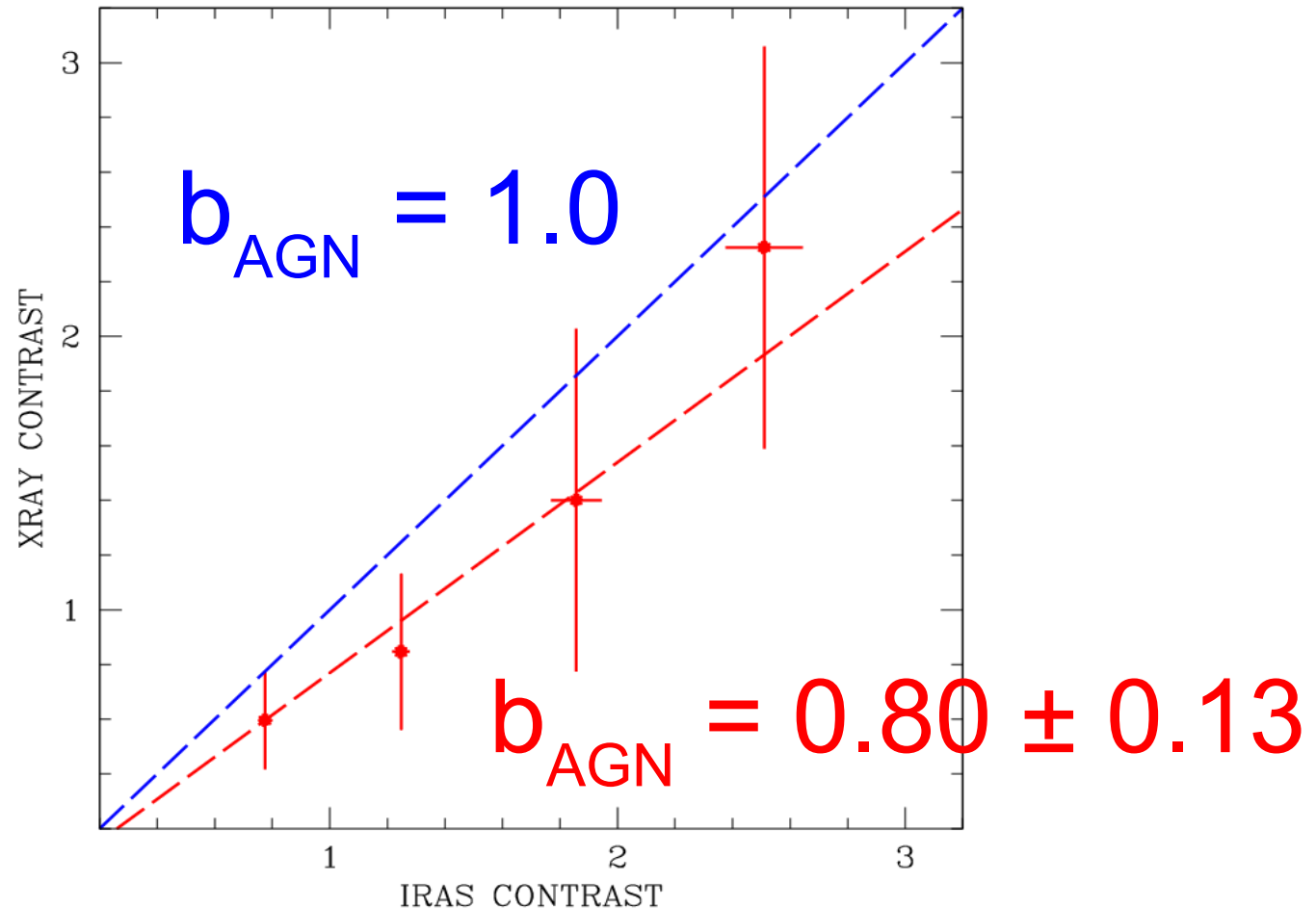
# Volume density excess of nearby (<70 Mpc)

40 AGNs:  
(*INTEGRAL* survey)

~5,000 IR galaxies:  
(*IRAS PSCz* survey)



# X-Ray AGN bias factor



- => AGNs – good matter tracers on 10-70 Mpc scale
- => SMBH activity independent from density of galaxies

# Summary

=> **b~1** Density fluctuations of matter can be linearly translated into the density fluctuation of Hard X-ray emitting AGNs at zero redshift.

=> SMBH activity independent from density of galaxies on scales 10-70 Mpc