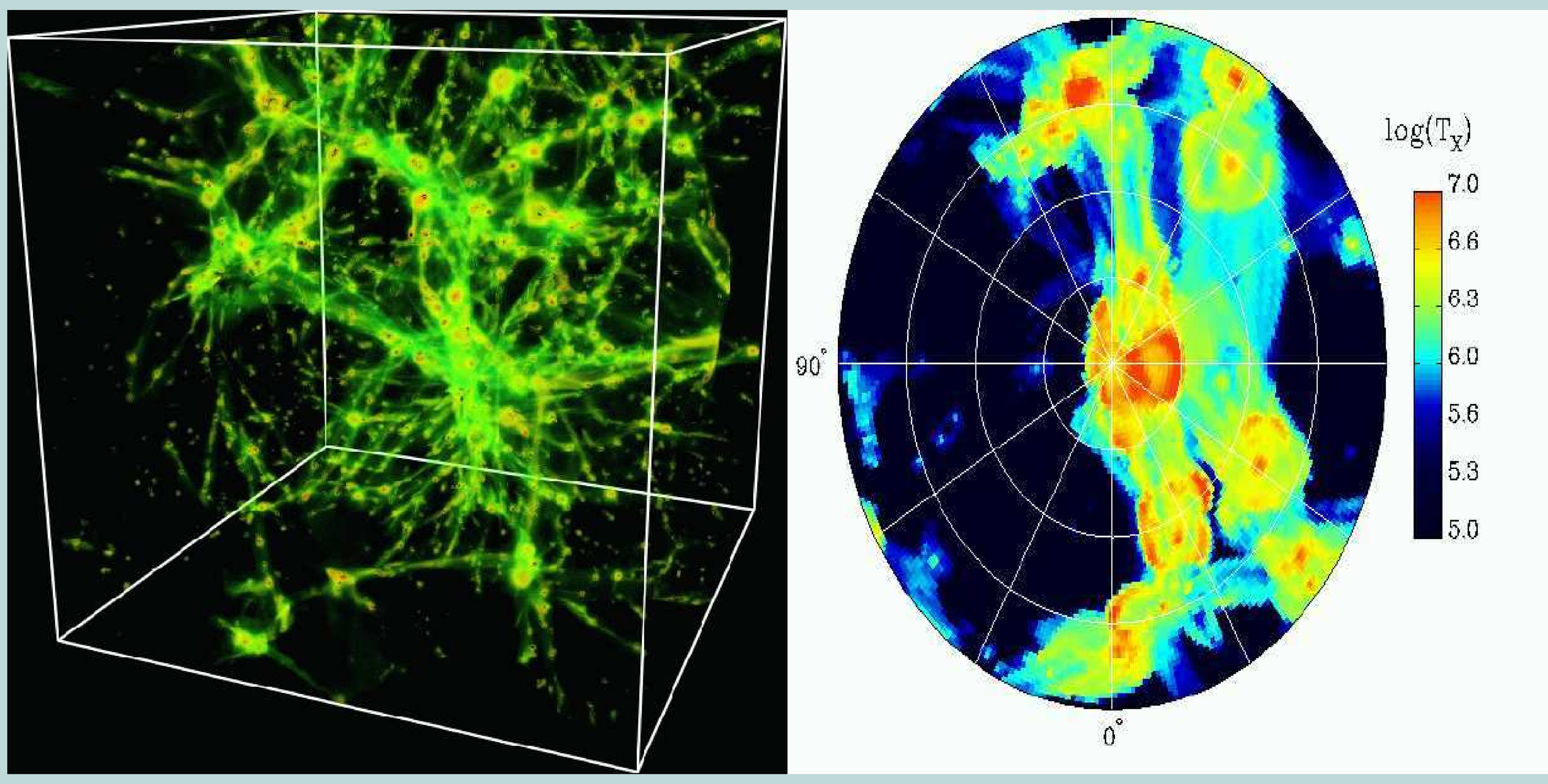
Does the cosmic web contribute to the CMB anisotropies?

F. Atrio-Barandela[1] and Jan P. Mücket[2]

The intergalactic gas is highly ionized up to $z <\approx 6$. At high redshifts ($z > 2$) almost all baryons reside in the Lymanα clouds at temperatures $T \approx 4 \cdot 10^4$K. At low redshifts ($z < 0.3$), besides the still high fraction of Lyα clouds hydrodynamical simulations predict that 20-40% of all baryons are in a phase called Warm Hot Intergalactic Medium (WHIM), with temperatures in the range $10^5 - 10^7$ K. We estimate the electron pressure of the IGM along the line of sight and its contribution to the thermal Sunyaev-Zeldovich (SZ) component of the CMB anisotropies by modeling the non-linear baryonic density contrast as a log-normal distribution. We find that the largest contribution corresponds to scales $l \approx 2000$. The amplitude is rather uncertain and could become comparable to the contribution of clusters. The actual value depends strongly on a combination of the polytropic index γ of the gas and the amplitude σ_8 of the matter power spectrum, namely $\gamma^2\sigma_8$. With its large frequency coverage, the PLANCK satellite will be able to measure the SZ contribution from both clusters and the Intergalactic Medium (IGM).

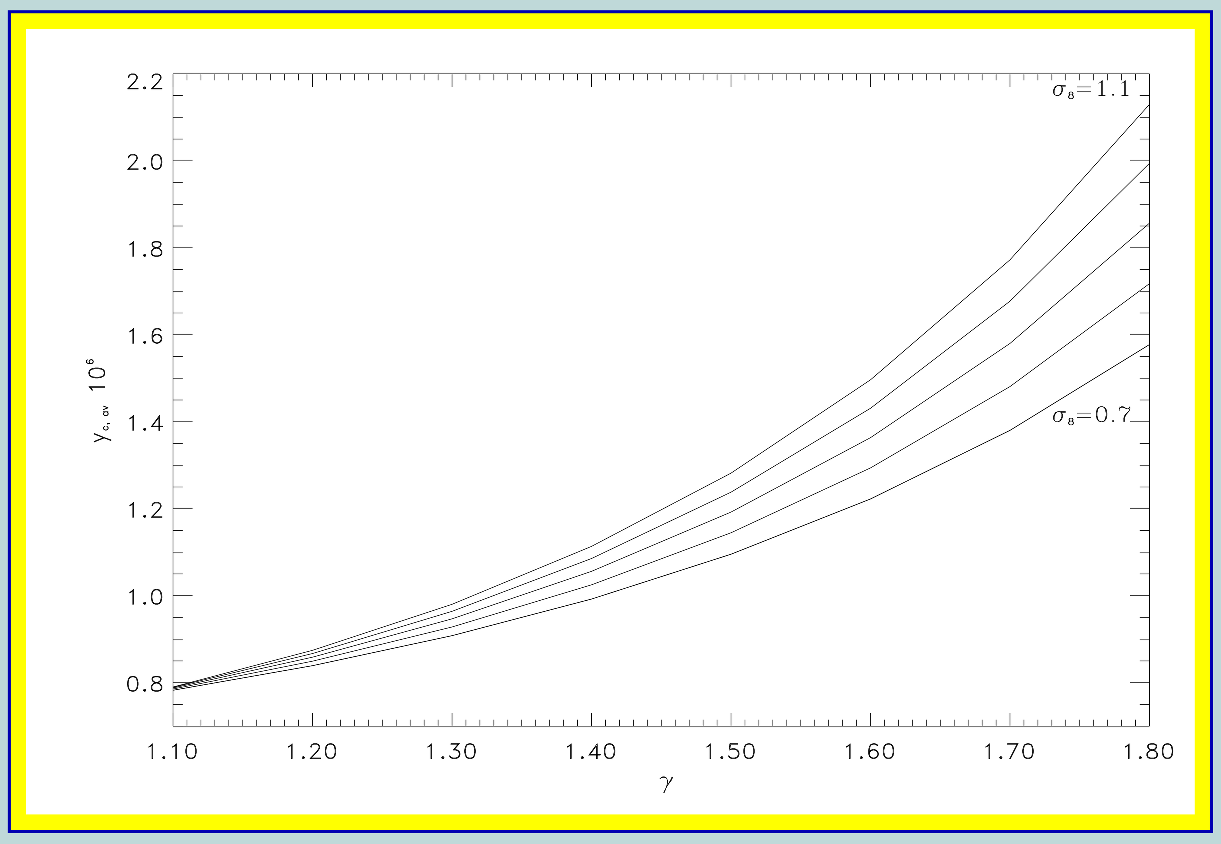


The filamentary network of the WHIM over scales of 50 Mpc (credit to R. Dave) and the local WIHM (credit to A.Kravtsov, A.Klypin & Y.Hoffmann)

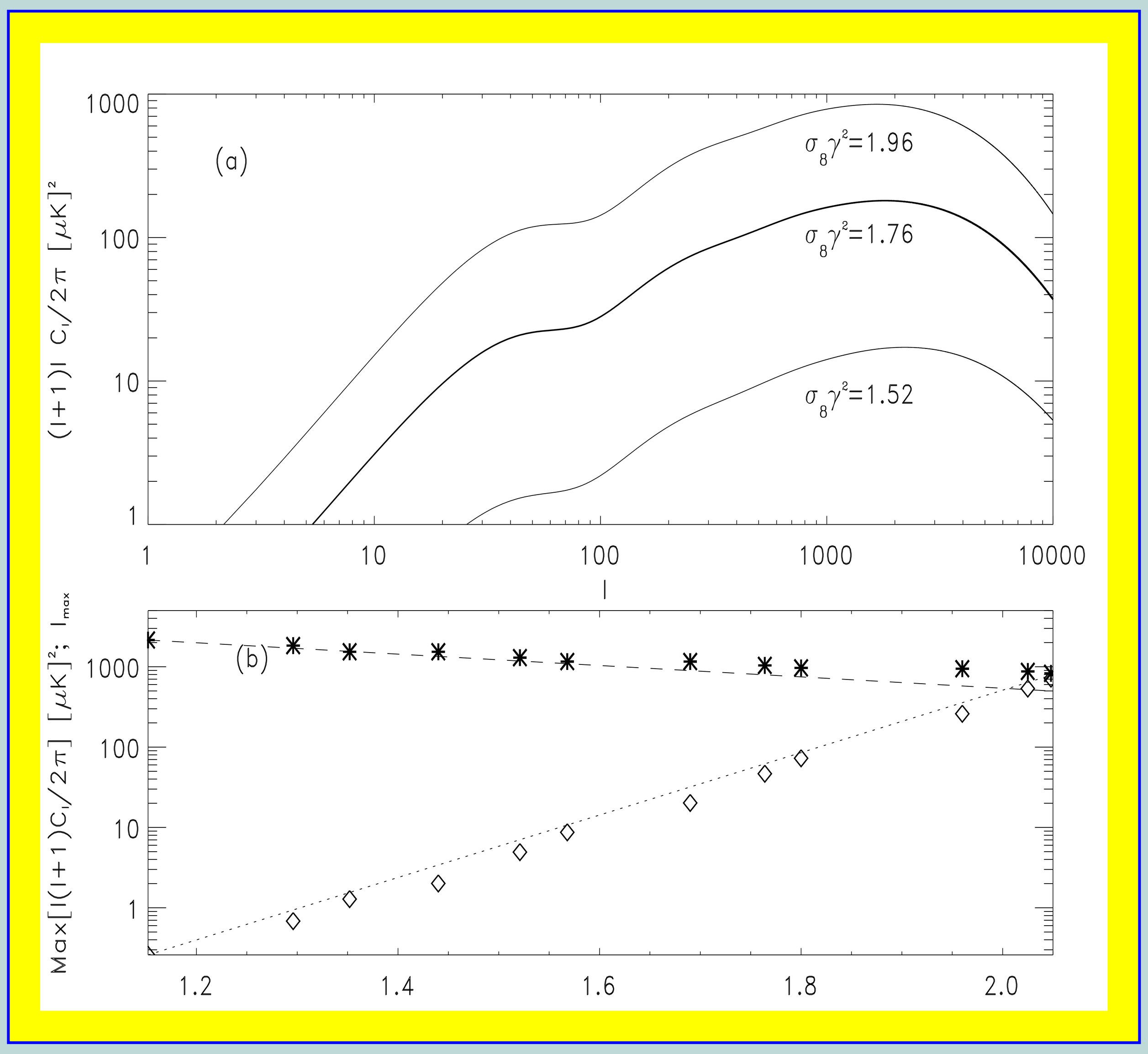
Passing hot gas, the radiation spectrum of CMB photons is distorted. The distortion is frequency dependent and is determined by the integrated electron pressure along the considered line of sight.

$$\frac{\Delta T}{T} = g(\nu) \cdot y_c = g(\nu) \frac{k_B \sigma_T}{m_e c^2} \int n_e(x) T_e(x) dl$$

The density distribution of the IGM can be considered as to be in a mildly non-linear regime. This can be well approximated by a log-normal density distribution of baryons.

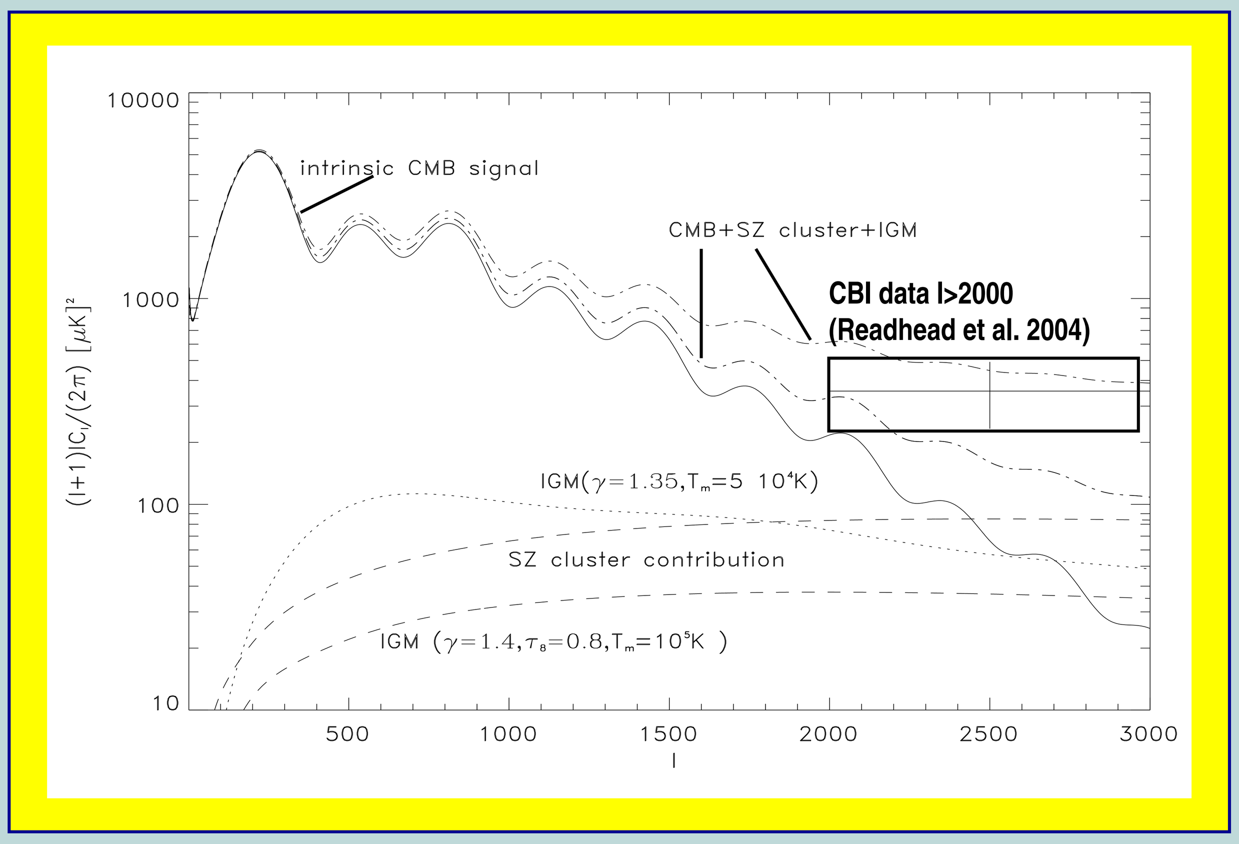


Mean distortion parameter as a function of the polytropic index. Curves correspond to different values of sig_8. From top to bottom, curves decrease in units of one tenth.



(a) CMB radiation power spectrum for different values of the parameters (sig_8, gamma).

(b) Best fit to the maximun amplitude (dashed line) and location (dotted line) of the radiation power spectrum as a function of polytropic index and cosmological parameters.
The y-axis gives the maximum value of the spectrum in muK^2 (asterisks) and the multipole l corresponding to the maximum location of the spectrum (diamonds).



Intrinsic CMB temperature anisotropies and TSZ contribution from clusters and IGM. Depending on model parameters, the IGM could become dominant beyond l=3000.

[1] Universidad de Salamanca, atrio@usal.es
[2] Astrophysikalisches Institut Potsdam, jpmuecket@aip.de

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