SEARCH FOR PRIMORDIAL PERTURBATIONS OF THE UNIVERSE: OBSERVATIONS WITH RATAN-600 RADIO TELESCOPE

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All kinds of primeval perturbations of the Universe should result in fluctuations of the microwave background radio emission. Here we report our latest upper limits to these fluctuations on scales 5' to 3°. Using the new 600-m Soviet Radio Telescope we obtained a mean temperature profile of the region from 08^h to 15^h in R.A., centred at the declination of the Coma Cluster. 20 good records of this region were used in the final reduction of the data. After "normalization" of these data by filtering out low-frequency atmospheric noise and "bursts" which exceed the 4σ level we calculated an upper limit to the fluctuations of the microwave background radiation.

The following formula was used:

$$\sigma(T_B) = \frac{\eta_1 \eta_2}{n^{\frac{1}{4}}} \left(u_p + \sqrt{n}\, r \right)^{\frac{1}{2}} \sigma(T_A)$$

Here $\sigma(T_A)$ is the observed dispersion of the antenna temperature (on a given angular scale);
$\sigma(T_B)$ is the dispersion of the intensity of the microwave background radaition;
η_1, η_2 are the instrumental correction factors (spillover effect and finite beam size effect);
n is the number of independent points in the scan;
r is the mean correlation coefficient of two independent sets of measurements;
u_p is the quantile of the distribution of deflections of the measured antennna temperature from the mean.

The results of these calculations are shown in Table 1.

All values of $\sigma(T_B)/T$ are lower than the predictions. The smoothness of the microwave background radiation is amazing and needs to be explained.

M. S. Longair and J. Einasto (eds.), The Large Scale Structure of the Universe, 315-316. All Rights Reserved.

Table 1

Scale (arcmin)	$\sigma(T_A)$ ($\times 10^{-4}$ K)	$\sigma(T_B)/T$ (2σ-level)
5	5	$< 0.8 \times 10^{-4}$
10	3.5	$< 4 \times 10^{-5}$
20	2.4	$< 3 \times 10^{-5}$
50	1	$< 2.4 \times 10^{-5}$
75	0.8	$< 1.9 \times 10^{-5}$
125	0.6	$< 1.8 \times 10^{-5}$
150	0.4	$< 1.3 \times 10^{-5}$

DISCUSSION

Boynton: What do you do about discrete sources below the 4σ level (i.e. the level above which discrete sources are removed)? You might expect to be limited by such discrete sources at this wavelength?

Parijskij: We now have a new programme for finding discrete sources. The source density which we find at about 1 mJy or less is about 10^4-10^5 sr^{-1} which is consistent with the extrapolation from source counts at higher flux densities. There has been some misunderstanding about how discrete sources affect our previous results. I may comment on this later in the general discussion.

Davis: Have you performed an F test on your data to determine whether the null hypothesis (i.e. no excess noise above receiver noise) is acceptable?

Parijskij: F test is not the best method in our case. We have checked the statistics of the deflections by a χ^2 test and shown also that the correlated part of the observed fluctuations in different sets of observations is uncorrelated, the correlated part of the noise being $\lesssim N^{-1/2}$ on a relative scale, N being the number of independent samples.

Zeldovich: What is the beam-shape of the telescope with which you made the observations?

Parijskij: About 2' x 20" arc at 4 cm wavelength. In both directions the beam is roughly Guassian.