MEASUREMENT OF THE 3 K COSMIC BACKGROUND NOISE IN THE FAR INFRARED

G. Dall'Oglio[1], P. de Bernardis[2], S. Masi[2] and F. Melchiorri[2]

[1]Institute for Atmospheric Physics, CNR, Rome
[2]Institute of Physics, Rome

1. ABSTRACT

Quantum fluctuations of the cosmic background have been measured in the 900 to 2000 micron range (H.P.B.W.) by means of a balloon-borne correlator operating between 5 and 150 Hz. Preliminary results indicate an upper limit $\sqrt{<dP^2>} \lesssim 2.1 \times 10^{-17}$ watt/(cm^2 srad Hz)$^{1/2}$, corresponding to the noise of a blackbody at a temperature $T \lesssim 3.1$ K at 1σ.

2. THE CORRELATOR

The instrument consisted of two Germanium Composite Bolometers operating at 0.3 K, a mylar beamsplitter and Cassegrain optics at 1.8 K. The electrical NEP was 8×10^{-16} watt/Hz$^{1/2}$ and the throughput was 0.05 cm^2 srad with a field of view of 2 deg. Anisotropy measurements were alternated to noise measurements by wobbling the secondary mirror for half the observing time. The intrinsic, uncorrelated noise of the two detectors has been subtracted by using an analog multiplier followed by an integrator. The expected noise is shown in Figure 1.

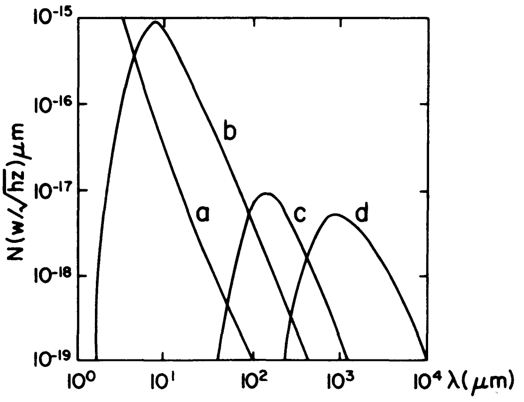


Figure 1.
Expected noise scenario in the 1 to 10^4 μm band. Lines a, b, c and d are:

a) Zodiacal light (scattered)
b) Zodiacal light (thermal)
c) Galactic dust (12 K)
d) C.B.R.

Power is computed for unitary throughput.

G. O. Abell and G. Chincarini (eds.), Early Evolution of the Universe and Its Present Structure, 135–137.

https://doi.org/10.1017/S0074180900038821 Published online by Cambridge University Press

The balloon was launched August 8 from Milo, Sicily. The correlated noise is plotted versus elevation in Figure 2. The secant law fit has been done by disregarding the point at highest elevation. We used the relation:

$$\sqrt{\langle dP^2 \rangle} = 2.77 \times 10^{-18} \left[T^5 \tau \int_{x(2000\ \mu m)}^{x(900\ \mu m)} \frac{(e^x - 1 + \tau)\ x^4\ dx}{(e^x - 1)^2}\right]^{1/2} \mathrm{W/cm^2\ srad\ Hz)^{1/2}}$$

with $x = h\nu/kT$ and τ = efficiency of the system estimated to be about 0.2. We get an upper limit of 3.1 K for the temperature of the Cosmic Background Radiation at 1σ.

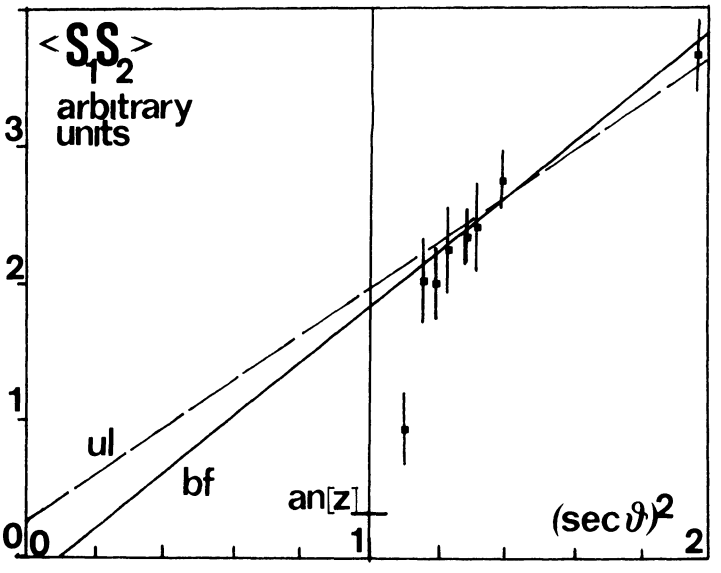


Figure 2. Signals at different tipping angles are plotted. The right side of the figure shows the extrapolation to sec θ = 0; bf is the best fit secant law; ul is the upper limit at 1σ; an(z) is the expected atmospheric noise at the zenith (T = 250 K, emissivity = 5×10^{-4}).

ACKNOWLEDGMENTS

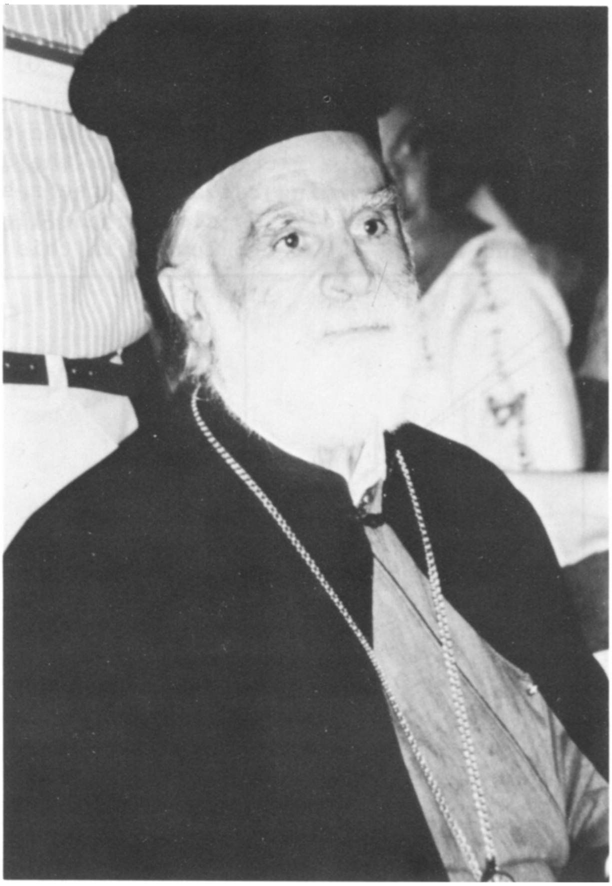
This work has been made possible with the help of the Italian and French teams at the balloon base of Milo. Our warm thanks are due to Dr. Cosentino and Dr. A. Soubrier. The work has been supported by Servizio Attività Spaziali del CNR, Roma.

DISCUSSION

Wright: Do you measure the cross correlation function versus lag to get the cross power spectrum, or do you measure only the correlation at zero lag? If the latter, how do you know you are not seeing dewar temperature fluctuations?

de Bernardis: Up to now we measured only the mean square value of the correlated signal (zero lag). Since the temperature of the dewar is lower than 3 K and the fluctuations in the dewar add quadratically to fluctuations in incoming radiation, the result is a little offset to the measure. We measured it by closing the liquid helium section of the dewar and fixing the "zero level" in this way.

https://doi.org/10.1017/S0074180900038821 Published online by Cambridge University Press



Bishop Irineos, Metropolitan of Kissamos and Selinos. *(Courtesy, K. Brecher)*