THE MICROWAVE BACKGROUND RADIATION IN THE DIRECTION OF CLUSTERS OF GALAXIES

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The discovery of powerful X-ray sources associated with rich clusters of galaxies has led to the prediction that these clusters contain large amounts of hot gas. A necessary consequence of the existence of such gas is the Compton scattering of cosmic microwave background radiation by hot electrons (Sunyaev & Zeldovich 1972). As a result, some of the microwave photons are re-distributed with slightly higher energies and the effect may be observed as a small diminution in the background temperature. The effect is expected to be ≈ 0.5 mK for the gas clouds associated with cluster X-ray sources.

Previous attempts to detect this effect have not been successful. I present here the results of two further attempts; by Lake & Partridge using the 36' telescope at Kitt Peak, and by Gull & Northover (1976) using the 25-m telescope at the SRC Chilbolton Observatory. Both groups used similar, twin-beam systems, comparing the temperature of the background radiation in the directions of various known X-ray clusters with that at points ≈ 15 arcmin distant. In order to minimize the effect of non-thermal background sources, it is desirable to observe at the highest frequency compatible with atmospheric stability. Gull & Northover, using a frequency of 10.6 GHz, accumulated 670 hours of observations, whilst Lake & Partridge, who did not have to contend with British weather, selected the more difficult frequency of 33 GHz, but could only manage 80 hours integration.

The results are shown in Table I. Whilst the observations of Lake & Partridge are consistent with the null hypothesis, the significantly more sensitive results of Gull & Northover amount to a marginal detection of the effect at the predicted level. The latter group also included a "blank sky" observation, to guard against systematic effects, no evidence of which was found.

The present results therefore strongly suggest the presence of hot gas in clusters of galaxies and that previous Inverse-Compton interpretations can now be ruled out. Confirmation of the effect would also show directly that the microwave background is truly cosmic, and must

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have its origin beyond distant clusters of galaxies.

Table I
Change in Background Temperature for 9 Abell Clusters

Cluster	Lake & Partridge	Gull & Northover
A376	+0.54 ± 0.80 mK	-0.13 ± 0.66 mK
A401	-0.39 ± 0.61 mK	-
A478	-	+0.33 ± 0.52 mK
A576	-0.34 ± 0.51 mK	-0.71 ± 0.57 mK
A1656	+0.60 ± 0.81 mK	-1.51 ± 0.40 mK
A2076	-0.35 ± 1.24 mK	-
A2218	-	-1.94 ± 0.54 mK
A2319	+0.27 ± 0.77 mK	-0.13 ± 0.41 mK
A2666	+1.86 ± 0.86 mK	-0.27 ± 0.35 mK
Blank sky	-	-0.01 ± 0.32 mK
Weighted mean	+0.16 ± 0.27 mK	-0.63 ± 0.17 mK

REFERENCES

Gull, S.F. & Northover, K.J.E., 1976. Nature, 263, 572.
Sunyaev, R.A. & Zeldovich, Ya.B., 1972. Comments Astrophys.Space.Phys., 4, 173.

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