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LETTER TO THE EDITOR

ON ISOTROPY OF ELECTROMAGNETIC VACUUM

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Recently, I. V. Aničin has raised the question of the isotropy of electromagnetic vacuum and proposed an experiment to check this isotropy directly[1]. In this experiment photons of a given energy are emitted from a source and are counted by a detector rigidly connected with the source. Assuming that internal states of source and detector do not change, the number of photons counted per second should not depend on the orientation of source and detector with respect to distant matter, e. g. to the galactic center, if electromagnetic vacuum is isotropic. The proposed experiment could reveal an anisotropy of the order of $4 \cdot 10^{-8}$ or would ascertain the isotropy to this limit.

In this letter we comment briefly on the existing experiments which could be interpreted as giving evidence of the isotropy of electromagnetic vacuum.

In the experiment of Partridge the power input to a microwave source radiating in free space and into a local absorber was measured to test the opaqueness of the universe[2]. The output of the diode oscillator emitting microwaves at 9.7 GHz was alternately switched at 1 kHz between a large horn antenna pointing at the zenith and an absorptive termination. The time variation of power consumption was measured using phase sensitive detection. The ratio $\Delta P/P_{mw}$, where ΔP is the change in input power and P_{mw} is the emitted microwave power, was found to be $(1.1 \pm 1.6) \cdot 10^{-9}$, i. e. consistent with zero. This result was obtained in 159 runs of 8 minutes each, spanning a time of two months. It was exploited as evidence against cosmological models which are not opaque in the future. The isotropy of electromagnetic vacuum was taken for granted.

The result of Partridge's experiment allows some conclusions regarding the isotropy of electromagnetic vacuum, though the orientation of the antenna

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with respect to the galactic center was not monitored directly during the measurement. However, the experiment spanned a time of two month and was run effectively for almost 24 hours. Any anisotropy in the opaqueness of the universe should show up in the final result, as one does not expect the opaqueness of the local absorber to have the same orientation dependence.

The anisotropy of the electromagnetic vacuum should show up at least in the standard deviation of $\Delta P/P_{mw}$. We feel that the present value of the standard deviation ensures isotropy to the order of 10^{-7} which is not very far from the expected value in the experiment proposed by Aničin. A limit of the order 10^{-8} could be obtained by reexamination of Partridg's data with regard to the orientation of the antenna with respect to the galactic center.

Less direct evidence for the isotropy of electromagnetic vacuum could be extracted from experiments devised to test the existence of unknown long range fields[3]. Drever used NMR technique to search for a symmetric second rank tensor field[4]. He found an upper limit of 10^{-22} for the anisotropy of the inertial mass. Turner and Hill looked for a vector field that would affect the rates of atomic clocks[5]. By using Mössbauer technique they found the vector anisotropy to be less than $4 \cdot 10^{-5}$. Similar experiments are due to Kündig[6] and Young[7].

In all these experiments the isotropy of the electromagnetic vacuum was taken for granted and only in this case the results can be interpreted as they were. Thus, the isotropy of electromagnetic vacuum was tested indirectly. However, a more precise statement about the accuracy to which the isotropy of electromagnetic vacuum would be established by these experiments, the proposed experiment of Aničin included, would require a detailed consideration of specific models for breaking the electromagnetic isotropy.

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