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PRACTICABLE DISCRIMINATION OF RAPIDLY
MOVING ELECTRIC AND MAGNETIC CHARGES*

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ABSTRACT

A method of discriminating between rapidly moving electric and magnetic charges is proposed. The scheme relies on detection of the polarization of Cherenkov radiation.

It is well known that an electrically charged particle rapidly traversing a dielectric medium emits Cherenkov radiation.¹ This radiation is linearly polarized: Maxwell's equations together with rotational symmetry demand that such a photon carry polarization vector lying within the plane spanned by $\vec{k}$, the 3-momentum of the photon, and $\vec{p}$, the 3-momentum of the charged particle. Similar arguments show that Cherenkov radiation accompanying the passage of a magnetically charged particle be polarized parallel to $\vec{k} \times \vec{p}$. This fundamental difference allows a definitive discrimination between rapidly moving electric and magnetic charges.

A potentially practical instrument can be made by the simple modification of an existing device.² One merely sandwiches a linear Polaroid sheet between the Cherenkov radiator and the sheet of high speed photographic emulsion. As described by Pinsky, et al., the

device is without the Polaroid. They report seeing the expected (circular) Cherenkov signature on the emulsion for the passage of (normally incident) electric charges. Let r and θ be polar coordinates in the emulsion with origin at the point of impact and the x-axis parallel to the optical axis of the Polaroid. For an ideal instrument, the exposure intensity would be $f(r) \cos^2 \theta$ for electric and $g(r) \sin^2 \theta$ for magnetic charges normally incident. The functions f and g depend on the speed of the particle, its charge, as well as the geometry of the detector and its ϵ and μ .

It is clear that this method does not rely on such details as range-energy properties, binding properties, or stability properties of charges. The only assumptions are that the charges are sources for the electromagnetic field.

One likely source of potential confusion of the discrimination is from incidental radiation emitted by knock-on electrons, etc. Pinsky, et al. report overcoming this problem by making the Cherenkov radiator thin ($\sim 10^{-2}$ cm). This raises the problem of fitting in the much thicker Polaroid sheet. This could be accomplished by the expedient of applying a painted-on polarizing layer a few microns thick.

Recent experimental evidence³ indicates that such a device as here sketched may be of some general interest.

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I would like to thank Drs. L. W. Alvarez and E. H. Wichmann without whose encouragement I would have dropped this subject, and Dr. Y. R. Shen who brought to my attention the thin polarizing layers.

FOOTNOTES AND REFERENCES

- * This work was supported by the U. S. Energy Research and Development Agency (ERDA).
1. J. V. Jelley, Cherenkov Radiation and Its Applications (Pergamon Press, New York, 1958).
 2. L. S. Pinsky, R. D. Eandi, R. B. Rushing, L. F. Thomson, and W. Z. Osborne, Proceedings of the 8th International Conference on Nuclear Photography and Solid State Track Detectors, Bucharest, 1972, p. 526.
 3. P. B. Price, private communication.

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