space. This is almost certainly not the case. Black radiation in free space differs from the equilibrium radiation in an opaque solid, and only in case κ/λ is constant as stated above, has this equilibrium radiation the same spectral distribution as the natural radiation from the ultimate sources. Assuming the constancy of κ/λ and thus for the natural radiation the same spectral distribution as for equilibrium radiation, it seems necessary to modify Duane's assumption (3) so as to read "*the energy radiated per hit is on the average proportional to the fourth power of the speed of the free electron and to the square of the index of refraction for the radiation emitted.* In other words,[1] *the ratio of the energy radiated per impact to the kinetic energy of the impacting electron is proportional on the average to the square of the ratio of the velocity of propagation of the radiation in the solid to that in vacuo.* On the new basis Planck's equation follows without question as to applicability.

In addition to giving certain indications regarding the application of Maxwell's law to free electrons, and pointing out the possibility of a constancy in κ/λ, the discussion shows how Duane's hypothesis, when combined with an assumption of such constancy and with conclusions arrived at independently in other lines of research, gives a satisfying physical concept of processes which may underlie the emission of radiation by its ultimate sources.

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AN INCREASE IN DENSITY IN THIN FILMS.

BY ELIZABETH R. LAIRD.

SOME phenomena noted while working with thin celluloid films seemed to indicate that the weight was not proportional to the thickness as determined by an interferometer. Since a number of observers give the thickness of similar films without details as to method of determination, it was decided to investigate the point. For this purpose it was necessary to measure the index of refraction of films of various thickness, the displacement of fringes in an interferometer, the area of the films, and their weight.

It was attempted to measure the index of refraction by a critical angle method by depositing a thin film directly on one side of a glass prism, or by using it as one side of a thin cell with carbon bisulphide as the liquid in between. As far as it went this method indicated no change in the index of refraction with increasing thinness, but in the first case the films made perfect contact with the glass only in little spots, and in the second such a small amount of light was refracted into the prism that an accurate setting with a spectrometer was impossible. The method of using the polarizing angle for this determination proved very convenient, as the same film could be used in this as in the other measurements. The index of refraction found thus showed very little change if any from thick films down to the thinnest used. The index found was between 1.50 and 1.51.

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[1] As reworded by the writer's colleague, Dr. E. Q. Adams.

The optical thickness was measured by the fringe displacement in a small Michelson interferometer by noting first the displacement of the central black fringe in white light, then changing to sodium light and noting the displacement of a number of fringes for different positions of the film in order to get an average thickness. The area of the films was found by measuring with a planimeter the hole from which they were cut. The early weighings were made on an ordinary balance sensitive to 0.05 mg., the later by observing in a tele-microscope the displacements of a glass thread clamped at one end and suitably protected from draughts, when the films were placed in a stirrup forming part of the thread. With this weighings could easily be made to 0.005 mg.

The later results were in general agreement with the earlier, and assuming the optical thickness as the true thickness, show that while the density down to a thickness of 400 $\mu\mu$ remains approximately 1.41 grams per cm.^{3}, somewhere below this it begins to increase so that in the neighborhood of 60 $\mu\mu$ it is about 2 and at 30 $\mu\mu$ about 2.5 and that it is higher still at smaller thicknesses. It is expected to continue the experiments.

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Electrical Resistance of a Rotating Coil.

By A. P. Carman.

The coil is wound on a circular disk and the disk is rotated at a high speed about its axis. The centrifugal force is thus at right angles to the wire, and if "the electric current has a true momentum" (using Maxwell's words), it might be forced to the outer part of the cross-section of the wire. The experiment is made to determine if this cross-centrifugal force produces any change in the electrical resistance of the coil. The experiment was made in 1913–1914,[1] but gave no results because of a lack of a satisfactory means of making electrical connection with the rotating coil. A year ago a successful method of connecting with such a moving coil was devised;[2] this was described in a paper before this Society at the preceding, Chicago, meeting. From the center of each end of the shaft a fine wire is stretched in the line of the axis of the shaft extended. The wire is about 25 centimeters long and ends in a small swivel and a spring to keep the wire straight. The wire can thus rotate with the shaft, and even when the shaft is totating at 7,000 r.p.m. for considerable time, there is little twist in this axial connecting wire. The wire runs through a mercury trough, passing loosely through end corks, and connection to the outside circuit is made by means of the mercury. To avoid thermo-electromotive forces, connection to the coil was not made through the shaft, but through an insulated tapered plug, and then by an insulated wire which was carried through a hole along the axis of the shaft. Potentiometer tests

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[1] Thesis of P. L. Bayley, June, 1914, MS. in University of Illinois Library.

[2] Thesis of C. C. Schmidt, 1921.