



Focusing Sound

In his investigations on the scattering of energy from objects small compared to the wavelength, Lord Rayleigh often applied his results interchangeably to sound waves and electromagnetic waves. With this in mind, several artificial dielectric lenses originally designed for microwave use were experimented with and found to focus acoustic energy of similar wavelengths. As a result, two novel types of sound refracting media have been developed, both delay mechanisms. One is an obstacle type in which the advancing wave is retarded by rigid objects—spheres, disks, or strips—arrayed in an open lattice-work. The other utilizes a path-delay principle, the wave being forced by tilted guide plates resembling a venetian blind to travel a longer path than that normally taken in free space.

The frequency dispersion inherent in the obstacle array allows a prism of this type to be used as a sound spectrum analyzer. The path-delay construction, however, is nondispersive so that convergent lenses exhibit sound-beaming directional effects over very broad frequency bands. On the other hand, divergent lenses are diffusers of sound, and, when placed in front of loud speakers that are too directional, provide more uniform angular distribution of energy, especially at the high frequencies.

The exchange of information between the acoustic and electromagnetic areas continues to grow. For example, acoustic tests on some microwave lens and prism structures have provided information on their microwave characteristics.

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Refracting Sound Waves. By W. E. Kock and F. K. Harvey. *J. Acous. Soc. Am.* 22: 471, September, 1949.

Motion in a Magnetic Field

Classically a charged particle in a constant magnetic field moves in a circle whose plane is perpendicular to the magnetic field. The center of this circle, which remains constant throughout the motion, is determined independently of the energy by the initial conditions.

The present paper is concerned with finding the analogue, in both nonrelativistic and relativistic quantum theory, of this simple description. It turns out that quantities corresponding to the center of the circle can be introduced which are constant and independent of the energy. These quantities satisfy uncertainty relations peculiar to the quantum theory. As a result, although the particle can be said to describe a circle, in contrast to classical theory, the center of the circle can no longer be located exactly.

The remainder of the paper is devoted to the mathematical details of various solutions. Well-known techniques are applied based upon the resolution of circular into simple harmonic motion. General solutions for the nonrelativistic and relativistic equations are found from which forms given by other authors can be obtained by specialization. The emphasis, in the present treatment, on the quantities representing the center of the circle, greatly simplifies the physical interpretation of the mathematical formulas.

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Motion in a Constant Magnetic Field. By M. H. Johnson and B. A. Lippmann. *Phys. Rev.* 76: 828, September 15, 1949.

Skin Heat

Knowledge of skin temperature is important because the heat lost from the body is determined by the rate of temperature change between the deep body tissues and the body surface. The thermal gradient between the skin and the external environment determines how much heat will be lost by convection, conduction, vaporization, and radiation. Also, the sensations of heat, cold, and even burning pain depend upon the skin temperature, and a knowledge of these factors is essential in understanding the mechanisms of the control of body temperature in health and disease. Further, it has been seriously proposed that the level of average skin temperature be used as the most dependable index of comfort for air-conditioning purposes.

The temperature of any surface is measured with difficulty and this is particularly true when measuring skin temperature. If a thermometer is placed against a surface, the temperature of the surface is altered by the flow of heat into the thermometer and by the interruption locally of the passage of heat into the normal environment of the surface. For skin, which is warmed by the flow of blood from the interior of the body, there is also interference with the supply of heat to the surface.

Many types of thermometers have been developed for measuring skin temperature, including ordinary clinical thermometers rolled on the skin under a notched cork, mercury thermometers with flattened bulbs, thermocouples, resistance thermometers, and low temperature radiation pyrometers (radiometers). All of these instruments, except the radiometer, require contact with the skin. As the skin (white or black) has been proved to be almost a perfect black body for infraradiation, the radiometer can be used as a precise instrument for skin temperature measurement, and is generally accepted as such. Fine wire thermocouples under carefully standardized conditions agree closely with the radiometer. Any skin thermometer which has much mass or which covers much of the skin surface gives quite misleading readings.

Comparison of the various skin thermometers was carried out under a variety of conditions (simulating the out-of-door environment) against a leather surface of known temperature. It was found that the radiometers gave the