



Meson Creation

There is good experimental evidence that a substantial part of the soft electronic component of cosmic radiation originates in events high in the atmosphere that involve the collision of primary cosmic rays with air nuclei. These events are fundamentally nuclear in origin and involve neutrons, protons, and the heavy mesons that are intimately associated with nuclear forces. It is surprising therefore that electrons or gamma rays, which are normally not regarded as being very strongly coupled to nuclear particles and mesons, should be emitted in this type of process. Up to the present time the most plausible explanation for these events is J. R. Oppenheimer's assumption of a neutral meson, produced in nuclear collisions, that decays in a very short time into two or more gamma rays. While some experimental evidence that may bear on this point has recently been discovered in experiments with the Berkeley cyclotron, the situation is far from clear and no definite conclusions can as yet be drawn. It is therefore of interest to consider alternative mechanisms that might account for the production of electrons or gamma rays in nuclear collisions.

One such mechanism, examined in the present paper, concerns the radiation of electromagnetic waves or gamma rays by a meson when it is accelerated as it is being created in a nuclear collision. As usually calculated, not very much radiation is given off in this way, and the total amount increases only as the logarithm of the energy of the meson at high energies. This result follows both from a classical treatment and from the quantum mechanical treatment of scalar mesons (spin zero) and Dirac mesons (spin $\frac{1}{2}$). It turns out, however, as is shown in the present paper, that the creation of vector mesons (spin one) produces much more radiation, the amount increasing as the fourth power of the energy of the meson for high energies. This would give a substantial amount of radiation for energetic primary cosmic rays, and would probably explain at least a large part of the soft component actually observed if the heavy or pi mesons of cosmic radiation were to have spin one. While it is fairly well established that these mesons have either spin zero or spin one, no decision between these possibilities can now be made. Further examination of cosmic ray data in the light of the present calculations would help to determine the spin of the pi meson.

L.I.S.

Radiation Accompanying Meson Creation. By L. I. Schiff. *Phys. Rev.* 76: 89, July 1, 1949.

Science and Music

The twentieth anniversary meeting of the Acoustical Society of America gave opportunity for papers indulging in prospect and retrospect. One of these discussed the contributions of acoustics to music and the other

sounding arts, and to the art of architecture. The broad general research and measurement programs instituted under college and industrial sponsorship have benefitted music in many ways. Instrumental and vocal spectra have been determined, the mechanism of hearing studied, and greatly improved forms of sound recording and reproducing developed. Traditional musical instruments still persist, however, and are likely to continue, because of the shortcomings of electronic instruments as developed to date.

One notes a growing appreciation on the part of acousticians of such aesthetic factors as the vibrato and the type of attack and release of tones. The importance of pitch and agogic "fringes" for satisfactory ensemble effects is becoming evident. In the use of sacred music and liturgy very long reverberation times are found to be desired. In the minds of some worshippers, particularly in large churches, such long reverberation, indefinitely localized except in the upward direction, becomes symbolic of the omnipresence of the Holy Spirit. The symbolism may not rise to the level of consciousness, and yet the resulting contribution to the sense of awe and reverent worship may be of more value than the ability to understand every word of the sermon!

One also notes on the part of musicians a growing sympathy with the spirit and the instrumentation of science. Musicians, more decibel-conscious than formerly, grow less suspicious of analytical methods as applied to art.

W.T.B.

The Contributions of Acoustics to the Arts. By Wilmer T. Bartholomew. *J. Acous. Soc. Am.* 21: 311, July, 1949.

Large Cloud Chamber

One method of increasing the probability of observing interesting cosmic ray events, which are not subject to the control of the observer, is to build a very large cloud chamber. The difficult problem of illuminating a large chamber has been ingeniously solved by Carl D. Anderson and Seth Neddermeyer in the construction of a chamber nearly three feet in diameter.

The back of the chamber, the movable piston, and the front plate are constructed of transparent discs of "Tuflex" glass so that light may pass completely through from the rear of the chamber to the side facing the cameras. The lights are arranged behind the chamber in such a manner that direct rays are screened from the cameras, but the alcohol droplets forming the tracks in the chamber need deflect only slightly the light striking them for the rays to enter the cameras. Because the spherical droplets scatter many times more light through a small angle than through a large angle, such rear illumination requires only a small fraction of the energy for lighting demanded by the more conventional system of lighting from the sides of the chamber.

This chamber has recently been placed in the cabin of a B-29 airplane and flown at altitudes ranging up to forty-three thousand feet. Many more questions have been raised than answered by the thousands of tracks obtained in the pictures taken at high altitude. Some of these questions may possibly be answered in the future