and cannot be removed by acceptable changes in the parameters.

At very high pressures, not collisions, but intermolecular perturbations, should be used in considering spectral line shapes, and a statistical type of theory should be employed. A crude form of this theory has been devised. The long-range perturbations partially developed by Margenau and Warren[3] suggested averaged perturbations that led to an expression for a statistical absorption coefficient α_s. This α_s differed from the Van Vleck-Weisskopf absorption coefficient α_i only in the shape factor term. The dispersion form in α_i was replaced by a triangular form in α_s.

The line widths in the expression for α_s were estimated from the r.m.s. perturbations, using intermolecular distances equal to the radius of the volume per molecule sphere.

At intermediate pressures the actual line shapes should depend on both statistical and impact processes. The behavior of the impact theory expression when a finite collision duration was introduced together with the assumption that the statistical processes are of importance only when the molecules are closer than the collision distance, suggested that in general the absorption coefficient at any pressure might be written as

$$\alpha=\alpha_i \exp(-ap)+\alpha_s[1-\exp(-ap)];$$

(ap) was taken to be the ratio of the volume of the collision sphere to the volume per molecule.

The absorption computed in this manner shows no substantial improvement over the impact theory itself, unless the Bohr frequencies used in α_s, and in α_s only, vanish. The circles in Fig. 1 are calculated on this basis. It should be pointed out that none of the parameters used in this computation were adjusted to fit the observed absorption. While calculations have not been carried out in detail, the above theory appears to be in agreement with published observations at shorter wave-lengths.[2, 4, 5, 6]

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On the Use of Nuclear Plates in a Magnetic Field

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SINCE present nuclear plate techniques do not allow direct determination of the sign of particles investigated and individual mass measurements are not very accurate magnetic deflection methods assume considerable importance in the study of cosmic rays. Powell and Rosenblum[1] have proposed that if two parallel emulsion surfaces separated by an air gap are placed perpendicular to a magnetic field, the curvature of a particle's path in air can be obtained from the tracks in the emulsions on either side. We have been using a similar arrangement, differing in several particulars from their method, to determine meson masses at balloon altitudes. Under Pb absorbers we have, in collaboration with J. J. Lord, obtained on our plates meson densities great enough to make measurements on such flights practicable.

In viewing the plates after development, accurate measurements can be made only if the two emulsions are exactly juxtaposed. With ordinary commercial plates, this involves viewing through the glass backing of 1 mm thickness, so that high magnification is impossible with refracting microscopes. Powell has therefore had to use a specially constructed reflecting microscope[2] with a large working distance. In our experiments, we have re-coated the original emulsions on very thin glass plates (150 microns and even down to 50 microns). Besides enabling the use of an ordinary microscope, this method has the additional advantage that if thin plates are coated with emulsion on both sides, several such plates separated by air gaps can be stacked as a "sandwich," and more than one curvature measurement made on the same particle as it crosses successive air gaps. Emulsions coated on thin plates, or on acetate film-backing, will be commercially obtainable in the near future.

The magnetic deflection can be measured by projecting as a straight line the last segment of a track as it leaves the top plate, and determining the distance from this line to the point at which the particle enters the lower emulsion. An independent deflection measurement is obtained by similarly projecting back the first segment of the lower track. Scattering very near the surface may introduce uncertainty in the direction of the projected line which would result in an error in the measured deflection proportional to the path length in air. Since, however, the magnetic curvature produces a deflection proportional to the square of the path length, a greater air gap will reduce the percentage error. Our air gap is 2000 microns wide. For a path length of 10,000 microns in air and our field of 12,500 gauss, the theoretical deflection of a 200 m_e meson of energy 4.5 Mev is 625 microns; for 1.2 Mev, 1250 microns, etc. Events with path length longer than this can readily be recorded, the only limit being the correct matching of tracks in the two emulsions caused by the same particle. The direction of an emergent track and its "dip angle" with the plane of the emulsion are found, and tracks in the lower emulsion in the region where the particle might be expected to strike are noted. We are simplifying this procedure by the use of a projection microscope, a tilting stage to measure dip angles, and a magnifying pantagraph attached to the stage with which the location and orientation of tracks can be traced on a large sheet of paper. Matching is checked by the equality of (a) the two deflection measurements obtained by projecting the upper and lower tracks, respectively, as indicated above; (b) the angles of dip, and (c) the grain densities, above and below. With proton tracks obtained by cyclotron bombardment and with plates exposed on balloon flights we are able to get good matching of tracks between the two emulsions.

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