# Abstracts of Bell System Technical Papers* Not Published in this Journal

ANDERSON, P. W.,[1] AND P. R. WEISS[6]

**Exchange Narrowing in Paramagnetic Resonance,** Revs. Mod. Phys., **25,** pp. 269–276, Jan., 1953.

In this paper the problem of the line shape in paramagnetic resonance when large exchange interaction is present is discussed from the standpoint of a simplified mathematical model. The mathematical model can be called the model of "random frequency modulation": It is assumed that the atom absorbs a single frequency, which varies over a distribution determined by the dipolar local fields, but that this frequency varies randomly in time at a rate determined by the exchange interactions. The predicted line shape in the case in which exchange is large is of resonance type in the observable center of the line, but falls off more rapidly in the wings. This line shape has been verified experimentally in a number of cases. This conclusion seems quite independent of any assumption about the type of random frequency modulation, etc.

The quantitative conclusions are reached in the following way: It is suspected, since the exchange motion is the superposition of the effects of a number of neighbors which is not particularly small, that a good approximation to the modulation function is Gaussian noise with a Gaussian spectrum. This, of course, is what would result from the superposition of a large number of rather small effects. Under this assumption both the second moment (which is independent of exchange) and the fourth moment of the line shape can be calculated. This kind of modulation is the simplest one which does give a finite fourth moment; a Markoffian, or "jump", type of modulation, which might seem more reasonable at first, does not. These moments are then compared with the moments computed by Van Vleck [Phys. Rev. 74, 1168 (1948)] to fix the two adjustable parameters, mean square frequency, and average rate of change of frequency, of the theory.

The result as to line breadth, which is essentially

$$\Delta \cong \frac{\langle(\Delta\omega^2)\rangle_{\text{Av}}\ \text{dipole-dipole}}{\text{J/h}}$$

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if J is the exchange integral, can be compared with observed line breadths by estimating J from Curie-Weiss constants for a number of materials. The results are quite satisfactory if the theory is extended in two ways: (a) When the exchange frequency is larger than the resonance frequency, it can be shown that the off-diagonal elements of the dipolar interaction must be included, leading to a line-width larger by a factor of roughly 10/3; (b) in a number of cases hyperfine and Stark splitting is contributing importantly to the width.

The good agreement with experiment in the cases we have investigated leads us to believe that a quantitative approach to the paramagnetic resonance line breadth problem, using only the already known concepts of dipolar interaction, exchange narrowing, and fine structure splitting, will probably explain all the observed phenomena.

ANDRUS, J., see J. K. GALT.

ARNOLD, S. M., see MISS S. E. KOONCE.

BENEDICT, T. S.,[1] AND W. SHOCKLEY[1]

**Microwave Observation of the Collision Frequency of Electrons in Germanium,** Letter to the Editor. Phys. Rev., **89,** pp. 1152–1153, Mar. 1, 1953.

BIES, F. R.[1]

**Attenuation Equalizers,** Audio Eng. Soc. J., **1,** pp. 125–136, Jan., 1953.

In all systems there are components which attenuate some frequencies to a greater extent than others, and attenuation equalizers are usually required to correct the overall gain-frequency characteristic. This paper will deal with the types of attenuation equalizer that are found most useful, the performance that they display, and a chart method of computing their insertion loss.

BOZORTH, R. M.[1]

**Permalloy Problem,** Revs. Mod. Phys., **25,** pp. 42–48, Jan., 1953 (Monograph 2102).

In attempting to explain the unusual magnetic properties of the iron-nickel alloys, single crystals of alloys containing 35 to 100 per cent nickel were prepared, and measurements made of the magnetic crystal anisotropy and magnetostriction as dependent on cooling rate. It is confirmed that there is a large effect of cooling rate on the anisotropy in the region near $FeNi_3$, but the experiments show also a substantial effect between 50 and 85 per cent nickel. Two magnetostriction constants, $\lambda_{100}$ and $\lambda_{111}$, were measured on the

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same crystals. The effect of cooling rate on magnetostriction was found to be substantial only in the composition range 70 to 80 per cent nickel. When the specimens are quenched, $\lambda_{111}$ goes through zero for a nickel content just below 80 per cent nickel, a composition very close to that for highest permeability. This is understandable because the magnetostrictive strain caused by movement of the boundary between two domains, each magnetized spontaneously in a [111] direction, depends on $\lambda_{111}$ alone. The same physical picture predicts that near 45 percent nickel, where [100] is the direction of easiest magnetization and $\lambda_{100}$ goes through zero, the permeability versus composition curve should again have a maximum. Such a maximum is known to exist, and initial permeabilities as high as 15,000 have been observed. Although simple theory suggests that domain-rotation should occur in very weak fields when the crystal anisotropy is very small (75 per cent nickel in quenched alloys), nevertheless, rotation involves magnetostrictive strains which prevents $\mu_0$ from becoming infinite. Internal poles are also likely to be formed. In slowly cooled alloys the anisotropy is zero at about 63 per cent nickel; here there are random strains caused by magnetostriction and possibly also by atomic ordering. The principal changes in magnetic properties with composition are explained in terms of the crystal anisotropy and magnetostriction, and their change with heat treatment.

BOZORTH, R. M.[1]

**Behavior of Magnetic Materials,** Am. J. Phys., **21,** pp. 260–266, Apr., 1953 (Monograph 2105).

This is a review of recent work in which the atomic theory of ferromagnetism and the domain theory of magnetization are applied to new materials.

BOZORTH, R. M., see H. J. WILLIAMS.

BURNS, R. M.[1]

**Science and Scientists in Telecommunications,** Electrochem. Soc. J., **100,** pp. 90*C*–94*C*, Apr., 1953.

COLLEY, R. H., see G. Q. LUMSDEN

COY, J. A.,[1] AND E. K. VAN TASSEL[1]

**Type-O Carrier Telephone,** Elec. Eng., **72,** pp. 418–423, May, 1953.

The Type-O carrier is an economical short-haul carrier system especially suitable for use under 150 miles. It fulfills the same purpose for open-wire lines as the Type-N carrier system does in cable routes. Numerous laboratory tests have indicated that good service standards have been maintained in spite of its low cost.

[1] Bell Telephone Laboratories.

FINE, M. E.[1]

**Magnetomechanical Effects in an Antiferromagnet, CoO,** Revs. Mod. Phys., **25,** p. 158, Jan., 1953.

FINE, M. E.[1]

**Elasticity and Thermal Expansion of Germanium between −195 and 275°C,** J. Appl. Phys., **24,** pp. 338–340, Mar., 1953 (Monograph 2069).

Young's moduli (E) of the directions (100) and (111) and the shear modulus (G) for (100) were determined in germanium from −195 to 255, 275, and 140°C, respectively. From these moduli, the elastic parameters, the compressibility, and Poisson's ratio were calculated. The thermal expansion was measured from −196 to 275°C.

GALT, J. K.,[1] ANDRUS[1], J. AND H. G. HOPPER[1]

**Motion of Domain Walls in Ferrite Crystals,** Revs. Mod. Phys., **25,** pp. 93–97, Jan., 1953.

GRAY, A. N.[3]

**Development of Electroformed Copper-steel Wire,** Wire and Wire Products, **28,** pp. 166–168, 218–219, Feb., 1953.

The author traces the development and the functioning of the apparatus in the successful efforts to produce a satisfactory copper coated steel wire used for telephone drop wire.

GROTH, W. B.[1]

**Principles of Tape-to-Card Conversion in the AMA System,** A.I.E.E. Trans. Commun. and Electronics Sect., **5,** pp. 42–52, Mar., 1953.

HAYNES, J. R.,[1] AND J. A. HORNBECK[1]

**Temporary Traps in Silicon and Germanium.** Letter to the Editor. Phys. Rev., **90,** pp. 152–153, Apr. 1, 1953.

HEIDENREICH, R. D., see E. A. NESBITT.

HOGAN, C. L.[1]

**Ferromagnetic Faraday Effect at Microwave Frequencies and Its Applications,** Revs. Mod. Phys., **25,** pp. 253–262, Jan., 1953.

[1] Bell Telephone Laboratories.
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HOPPER, H. G., see J. K. GALT.

HORNBECK, J. A., see J. R. HAYNES.

HUGHES, W. T.[1] AND J. J. LANDER[1]

**Vacuum Tube Electrometer Amplifier,** Rev. Sci. Instr. **24,** pp. 331–332, Apr., 1953.

KERSTA, L. G.[1]

**Interesting Property of Certain Conductive Rubbers.** Letter to the Editor. J. Polymer Sci., **10,** pp. 447–448, Apr., 1953.

KOCK, W. E.[1]

**Acoustic Gyrator,** J. Am., Acoust. Soc. **25,** p. 575, May, 1953.

KOCK, W. E.[1]

**Acoustic Gyrator,** Arch. Elektr. Übertragung, **7,** p. 106, Feb., 1953.

A gyrator for acoustic waves is described which is the analog of the ferrite gyrator for microwaves described by C. L. Hogan. The required non-reciprocal rotation of the plane of polarization of transverse acoustic waves propagating in a tube is accomplished by rotating the tube at high speed.

KOCK, W. E.[1]

**Ähnlichkeit zwischen Vokalformanten und Formanten von Musikinstrumenten (Similarity Between Vowel Formants and the Formants of Musical Instruments),** (in German), E.T.Z., **74,** p. 166, Mar. 1, 1953.

KOHMAN, G. T., see M. C. WOOLEY.

KOONCE, MISS S. E.,[1] AND S. M. ARNOLD[1]

**Growth of Metal Whiskers.** Letter to the Editor, J. Appl. Phys., **24,** pp. 365–366, Mar., 1953.

LANDER, J. J., see W. T. HUGHES.

LUKE, C. L.[1]

**Photometric Determination of Antimony in Lead Using the Rhodamine B Method,** Anal. Chem., **25,** p. 674, Apr., 1953.

[1] Bell Telephone Laboratories.

LUMSDEN, G. Q.,[1] AND R. H. COLLEY[1]

**Review of American Standard Fiber Stresses of Wood Poles,** Standardization, **24,** pp. 114–117, Apr., 1953.

MCKAY, K. G.[1]

**Crystal Conduction Counter,** Physics Today, **6,** pp. 10–13, May, 1953.

Development of the crystal counter (essentially an ionization chamber that is solid instead of being filled with gas) has progressed in the last few years, but is still delayed for lack of better understanding of crystals and their electrical behavior.

MCMAHON, W., see M. C. WOOLEY.

MASON, W. P.[1]

**Rotational Relaxation in Nickel at High Frequencies,** Revs. Mod. Phys., **25,** pp. 136–139, Jan., 1953.

Measurements of the $\Delta E$ effect and the decrement made by Bozorth, Mason, and McSkimin and by Johnson and Rogers are compared with that expected from a calculation of domain wall relaxations for a distribution of domain sizes as determined by the optical measurements of Williams and Walker. At low frequencies the agreement is good but at high frequencies a second relaxation region is indicated. It is shown that this region is consistent with a domain rotation relaxation and introducing this effect, a good agreement is obtained between theory and experiment for the entire frequency range.

MATHY, P. T.[3]

**Clever Conveyorization Avoids Handling Headaches,** Am. Mach., **97,** pp. 140–143, May 11, 1953.

MORRISON, J.[1]

**Controlled Gas Leak,** Rev. Sci. Instr., **24,** pp. 230–231, Mar., 1953.

NESBITT, E. A.,[1] AND R. D. HEIDENREICH[1]

**Physical and Magnetic Structure of the Mishima Alloys,** Rev. Mod. Phys., **25,** pp. 322–323, Jan., 1953.

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[1] Bell Telephone Laboratories.
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PEARSON, G. L.,[1] AND M. TANENBAUM[1]

**Magnetoresistance Effect in InSb.** Letter to the Editor, Phys. Rev., **90,** p. 153, Apr. 1, 1953.

PUGH, S. G.[5]

**Southern Bell Switches to Chemical Brush Control,** Elec. World, **139,** pp. 122–123, Mar. 23, 1953.

If properly planned and executed, chemical control costs less in time and money and does a better job.

RALSTON, R. W.[4] AND B. D. WICKLINE[4]

**Television Coverage of the National Political Conventions,** A.I.E.E. Trans. Commun. and Electronics Sect. **5,** pp. 1–14, Mar., 1953, and Elec. Eng., 72, pp. 383–389, May, 1953.

The first large-scale television coverage of both national political conventions occurred last year in Chicago and this presented many new problems to the telephone company of that city. Special video conductors and amplifiers were used in eight of the 19 channels to the amphitheatre and microwave facilities for the rest.

SHIVE, J. N.[1]

**Properties of Germanium Phototransistors,** J. Opt. Soc. Am., **43,** pp. 239–244, Apr., 1953 (Monograph 2103).

This paper describes, summarizes, and compares the properties of three photoelectric devices, namely: point contact phototransistors, *p-n* junction phototransistors, and *n-p-n* junction multiplier phototransistors, which have resulted from the prosecution of the transistor program at Bell Telephone Laboratories. The first of these devices is characterized by a comparatively high dark current and a quantum yield of 3 or 4 electrons per quantum. The second has a dark current in the microampere range and a quantum yield of approximately unity. The *n-p-n* device has a sensitivity corresponding at best to a quantum yield of several hundred electrons per quantum. All these devices have long-wave thresholds around 1.8 microns. The structures lend themselves readily to miniature encapsulation.

SHOCKLEY, W., see T. S. BENEDICT.

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[1] Bell Telephone Laboratories.
[4] Illinois Bell Telephone Company.
[5] Southern Bell Telephone Company.

SLADE, F. D.[2]

**Mechanized Billing of AMA Toll Messages,** A.I.E.E., Trans. Commun. and Electronics, **6,** pp. 175–182, May, 1953.

SLEPIAN, D.[1]

**On the Number of Symmetry Types of Boolean Functions on n Variables,** Can. J. Math., **5,** pp. 185–193, 1953.

TANENBAUM, M., see G. L. PEARSON.

VAN SICLEN, H. E.[3]

**What We Did to Cut Costs of Finishing Telephone Woodwork,** Ind. Finishing, **29,** pp. 44–52, Apr., 1953.

VAN TASSEL, E. K., see J. A. COY.

WILLIAMS, H. J.,[1] AND R. M. BOZORTH[1]

**Magnetic Study of Low Temperature Transformation in Magnetite,** Rev. Mod. Phys., **25,** pp. 79–80, Jan., 1953.

WOOD, E. A.[1]

**Simple Attachment for Low Temperature Use of an X-Ray Diffraction Camera,** Rev. Sci. Instr., **24,** pp. 325–326, Apr., 1953.

WOOLEY, M. C.,[1] G. T. KOHMAN,[1] AND W. MCMAHON,[1]

**Polyethylene Terephthalate — Its Use as a Capacitor Dielectric,** A.I.E.E. Trans. Commun. and Electronics Sect., **5,** pp. 33–37, Mar., 1953 (Monograph 2125).

The steady increase in the severity of operating conditions for capacitors and the need for more diverse characteristics has spurred the search for new and better capacitor dielectrics. The synthetic plastics industry, which is the source of a number of useful dielectric materials, has recently produced a new and promising dielectric in film form known as polyethylene terephthalate or "Mylar." This material is unusually strong, has a high softening point, and is available in very thin films which makes it especially suitable for capacitor insulation. The electrical characteristics of capacitors wound

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with Mylar film are likewise promising. As compared to mineral-oil-impregnated paper capacitors, unimpregnated Mylar capacitors exhibit higher dielectric strength, higher insulation resistance, and can be operated at higher ambient temperatures. Their loss characteristics are comparable with those of impregnated paper and the capacitance stability over the usual range of ambient temperatures approaches that of mica capacitors. Mylar is relatively nonhygroscopic and tests indicate that for moderate atmospheric conditions capacitors made from it do not require additional moisture protection. The film can be metallized readily by current techniques and, when used in metallized capacitors, appears to possess advantages over metallized paper in several respects.

WRIGHT, S. B.[1]

**Higher Frequencies for Ground-Air Communications,** Air Univ. Quart. Rev., **5,** No. 4, pp. 60–70, 1952–1953.

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