

Contents

Introduction	v
Personnel	vi
Publications and Reports	viii
Research Projects	
I. Physical Electronics	1
A. Electron Emission Problems	1
1. Thermionic Emission from Sintered Cathode of Thoria and Tungsten Mixture	1
2. Studies on Oxide-Coated Cathodes. Correlation of Pulsed and D-C Emission and Decay of Pulsed Emission	2
3. Work Functions and Conductivity of Oxide-Coated Cathodes	2
4. Thermionic Emission from Oxide-Coated Cathodes under Retarding and Accelerating Fields	2
5. Determination of the Thermionic Emission Properties of Single Tungsten Crystals by a Photometric Method	3
B. Gas Discharges	3
1. Langmuir Probe Measurements in the Mercury Arc Operating in the Transition Range between Low and High Pressures	3
C. Experimental Techniques	4
1. Spectral Emissivity of Tungsten	4
2. Ionization Gauge	6
II. Microwave Gaseous Discharges	7
III. Solid State Physics	13
A. Properties of Matter at Low Temperatures	13
1. Helium Liquefiers	13
2. Surface Impedance of Tin	13
3. Resistivity of Normal Conductors	15
4. Investigation of Second Sound in Liquid Helium II	16
5. Mechanical Excitation of Second Sound in Liquid Helium	27
6. Theory of Liquid Helium	27
B. Properties of Matter at Ultrasonic Frequencies	28
C. Phase Transitions	28
D. Ultrasonic Absorption in Liquids	29
IV. Radio-Frequency Spectroscopy	30
A. Molecular-Beam Research	30
1. Hyper-fine Structures and Nuclear Quadrupole Moments of the Halogens, and Na ²²	30
2. The Generation and Detection of a Beam of Aluminum Atoms	30
3. The Third Molecular-Beam Apparatus	30
4. Theory of Nuclear Effects in Microwave Spectra	31
B. Magnetic Nuclear Resonance	32
1. Measurements of Nuclear Magnetic Moments	32
2. Studies of Phase Transitions by Means of Magnetic Nuclear Resonance Phenomena	34
3. Circuit Improvement	39
C. Paramagnetic and Ferromagnetic Resonance Absorption	39
D. Microwave Spectroscopy	40
V. The Linear Accelerator Program	44

VI.	Magnetron Development	44
	A. Ten Megawatt Magnetron	46
	B. Ceramic Windows	47
	C. Thoria Cathodes	47
	1. Physical Research	47
	2. Design	47
	D. Mode Stability	47
	E. Noise Generation in the Pre-oscillating Magnetron	51
	F. Static Space-Charge in the Plane Magnetron and Cylindrical Magnetron	52
VII.	Traveling-Wave Tubes	53
	A. Three-Cm Traveling-Wave Amplifier Tubes	53
	B. Seven-CM Traveling-Wave Oscillator	54
VIII.	Communications Research	55
	A. Multipath Transmission	55
	1. Speech and Music	55
	2. Broadbanding of the Bradley Detector	58
	3. Television	58
	B. Microwave Modulation Techniques	59
	C. Statistical Theory of Communication	59
	1. Autocorrelation Function: Electronic Correlator	60
	2. Probability of Distributions	63
	a. Random Noise	63
	b. Instantaneous Amplitude Distributions of a Continuous Time Function in the Frequency Range between 50 and 10,000 Cycles/sec	65
	c. Amplitude and Conditional Probability Distributions of a Quantized Time Function	65
	3. Optimum Prediction	68
	4. Theory of Transmission of Information	70
	5. Pulse Modulation Studies	70
	6. Effects of Transit Angle on Shot Noise in Vacuum Tubes	71
	D. Transient Problems	73
	1. Envelope Studies	73
	2. Transient Theories	74
	3. Theory of the Synthesis of Networks for a Specific Transient Response	74
	4. Response of Networks to Frequency Transients	74
	E. Active Networks	75
	1. General Theory	75
	2. Broadbanding of Amplifiers by the Use of Active Elements in the Interstage	75
	F. Higher Mode Problems	76
	1. Steady-State Propagation of Electromagnetic Waves along Cylindrical Structures	76
	2. Transmission through Large Metallic Waveguides	79
	G. Locking Phenomena in Microwave Oscillators	79
IX.	Miscellaneous Problems	80
	A. Electronic Differential Analyzer	80
	B. An Impedance Function Analyzer	82
	C. Proton-Velocity Meter	84
	D. Electronic Potential Mapping	84
	E. Physical Limitations of R-F Radiating Systems	85
	F. Mathematical Problems _{wacnet}	85
	G. Scattering of Electronic Waves. Matrix Methods	86
	H. A D-C Amplifier	86