

TABLE OF CONTENTS

Personnel	vii
Publications and Reports	xv
Introduction	xviii

GENERAL PHYSICS

I.	Molecular Beams	1
	Neutrality of Atoms (Atomic Beam Method)	1
	Low Temperature Helium Beam Experiment	1
	High-Resolution Measurements of the 3-3 Inversion Transition in Ammonia	3
II.	Microwave Spectroscopy	7
	Observations of Incoherent Phonon Propagation in X-cut Quartz	7
III.	Radio Astronomy	17
	Measurements of the Microwave Spectrum of Venus near 1-cm Wavelength	17
	Observations of Microwave Emission from Atmospheric Oxygen	20
	Matrix Formulation of Radiative Transfer	24
	Five-Millimeter Radiative Transfer in the Upper Atmosphere	34
IV.	Optical and Infrared Spectroscopy	41
	Analysis of Reflection Spectra by Means of a Fit with a Classical Dispersion Formula	41
V.	Ultrasonic Properties of Solids	49
	Order-Disorder Lambda Transition in Ammonium Chloride at High Pressures	49
VI.	Geophysics	53
	Plasma Diffusion in a Magnetic Field	53
	Observations of the Upper Atmosphere by Optical Radar in Alaska and Sweden during the Summer 1964 (Part II)	53
VII.	Gravitation Research	59
	Research Objectives and Project Status	59

CONTENTS

VIII.	Magnetic Resonance	65
	Self-Diffusion in Liquid Ethane	65
IX.	Physical Acoustics	67
	Response of Lead Zirconate Titanate Ceramics to Temperature Fluctuations	67
	Spontaneous Instability in Parallel Flows	76
	Dispersion Relation for Ultrasound in Gyrotropic Quantum Plasma	79
	Diffusion Waves	84

PLASMA DYNAMICS

X.	Plasma Physics	91
	On the Ambipolar Transition	91
	Ion Cyclotron Resonance in a Radiofrequency Discharge	109
	Electron Cyclotron Absorption in the Cesium Afterglow	112
	Radiofrequency Cyclotron Confinement	118
	Definition of the "Ray Refractive Index" and Its Role in the Radiation in Anisotropic Plasmas	122
	Application of Parallel Plate Geometry to the Reflection of Guided Waves from a Magnetized Plasma	129
XI.	Plasma Electronics	137
	Ion-Plasma Oscillations	137
	Dispersion Diagrams for Hot-Electron Plasmas	141
	Instabilities in Electron Streams in Crossed Electric and Magnetic Fields	144
	Instabilities in Transverse Waves along B_0 for Beam-Type Distributions	149
	Hot Plasma Waveguides and Resonators	153
	Emission Processes by an Oscillator Moving at Super-Wave Velocity	156
	Electron Cyclotron Resonance Discharge	159
	New Microwave Technique for Measuring Electron Density	159
	Intensity Measurements of the Argon 4880 Å Line	162
	Fusion Blanket Research	164
	Nonadiabatic Diffusion in Toroidal Geometry	164
	Plasma Turbulence Studies	167
	Stuffed-Cusp Plasma Facility	168
	Motion in Nonadiabatic Fields	171

CONTENTS

Determining the Electron Distribution Function from Scattered Light II	176
Thomson Scattering Diagnostics of a Hollow-Cathode Arc Plasma	181
Pulsed Langmuir Probe Measurements on a Hollow-Cathode Discharge	188
Electron Transport in Three-Component Plasmas	192
Problems in the Theory of Optimal Control of Nonlinear Systems	202
XII. Plasma Magnetohydrodynamics and Energy Conversion	205
Experiments with a Liquid-Metal Magnetohydrodynamic Waveguide	205
Hall Parameter-Conductivity Instabilities in Magnetogasdynamic Flow	208
Nonlinear Effects of Fluctuations on Magnetohydrodynamic Performance	211
Hartmann Flow Friction Factors – Present and Future	214
Magnetohydrodynamic Induction Machine with Laminar Fluid Flow	218
Behavior of Dry Potassium Vapor in Electric and Magnetic Fields	232
Bonding Mechanism of Alkali-Metal Atoms Adsorbed on Metal Surfaces	238
COMMUNICATION SCIENCES AND ENGINEERING	
XIII. Statistical Communication Theory	245
A Special Class of Quantizer-Input Signals	245
Optimum Homomorphic Filters	247
A Singular Maximization Problem with Applications to Filtering	259
On the Relation between Integral and Differential Characterization of Nonlinear Systems	264
Useful Expressions for Optimum Linear Filtering in White Noise	268
An Application of Volterra Functional Analysis to Shunt-Wound Commutator Machines	273
XIV. Processing and Transmission of Information	277
Lower Bounds on the Tails of Probability Distributions	277
Error Bounds for Gaussian Noise Channels	293
XV. Speech Communication	305
Detection of DSB Signals Occupying the Same RF Spectrum	305
Cues Used in Speech Perception and Production by Children	310

CONTENTS

XVI.	Mechanical Translation	315
	Revised Proof Procedure Program	315
	Constituent Structure and Word-Order Rules for German	317
XVII.	Cognitive Information Processing	323
	Cognitive Processes	323
	Interlingual Transfer of Reading Skill	323
	Picture Processing	325
	Optimum Scanning Direction in Television Transmission	325
	Bounds on Two-Element-Kind Impedance Functions	331
	Sensory Aids	335
	Approximate Formulas for the Information Transmitted by a Discrete Communication Channel	335
XVIII.	Communications Biophysics	343
	Summary of Research – Publications	343
	Motion of Middle-Ear Joints	346
	Dependence of Efferent Inhibition of Auditory Nerve Responses on Intensity of Acoustic Stimuli	347
	Correlation Analysis of EEG and Tremor Activity	354
	Active and Compensatory Visual-Oculomotor Tracking in Relation to the Vestibular System	367
XIX.	Neurophysiology	383
	New Methods for Testing Camera Lenses (Part II)	383
	Quantum Theory of Measurement in Relation to a General Theory of Observation and Control	390
XX.	Neurology	399
	Microsaccades and the Velocity-Amplitude Relationship for Saccadic Eye Movements	399
	Human Horizontal Eye-Movement Mechanism	402
	Hospital Information Systems: An Automated Tumor Registry	413
	Interpretive and Diagnostic Matrices for Computer Diagnosis of Electrocardiograms	416
XXI.	Network Synthesis	423
	An Additional Realization Cycle for LC Impedances	423
	Author Index	428