

## TABLE OF CONTENTS

SYNOPSIS

ACKNOWLEDGEMENTS

### CHAPTER I            INTRODUCTION

1.	The Theory of Relativity and the Search for a Preferred Frame of Reference .....	1-1
2.	Resonance Fluorescence .....	1-3

### CHAPTER II        THE MÖSSBAUER EFFECT

1.	Cross-section.....	2-1
2.	Lattice Binding.....	2-2
3.	Debye-Waller Factor.....	2-4
4.	Transmission Line Width.....	2-7
5.	Isomeric Shift.....	2-8
6.	Electric Quadrupole Splitting .....	2-10
7.	Magnetic Hyperfine Splitting .....	2-11
8.	Thermal Shift .....	2-13
9.	Pressure Effects.....	2-14
10.	Relaxation Effects.....	2-15

### CHAPTER III      EXPERIMENTAL PARAMETERS OF THE MÖSSBAUER EFFECT

1.	Sources and Absorbers.....	3-1
2.	Transmission Spectra .....	3-3
2.1	Background Correction.....	3-4
2.2	Resonance Dip .....	3-4
2.3	Transmission Line Width.....	3-4
2.4	Shift.....	3-5

3.	Transmission Intensity .....	3-5
3.1	Unbroadened Emission and Absorption Lines .....	3-6
3.2	Broadened Lines .....	3-7
3.3	Lorentz Broadened Lines .....	3-11
4.	Recoilless Fraction.....	3-14

CHAPTER IV            THE THEORY OF RELATIVITY

1.	Introduction.....	4-1
2.a.	The Lorentz Transformation.....	4-1
2b.	Time Dilatation and the Doppler Effect.....	4-3
3.	The Aether Drift Experiment.....	4-7
3.1	Historical Considerations.....	4-7
3.2	Theory of the "Aether Drift" Experiment .....	4-10
3.3	Past Experiments.....	4-15

CHAPTER V            BUILDING OF THE ULTRACENTRIFUGE

1.	Introduction.....	5-1
2.	Rotor Structure.....	5-3
3.	Magnetic Suspension .....	5-6
3.1	General Considerations .....	5-6
3.2	Core Material .....	5-11
3.3	The Electromagnet .....	5-11
3.4	Suspension Servo Mechanism .....	5-11
3.5	Filament Safety Features.....	5-17
4.	Monitoring the Operation of the Rotor .....	5-19
5.	Damping and Positioning of the Rotor .....	5-20
6.	The Rotor .....	5-23
6.1	Shape.....	5-23
6.2	Rotor Material.....	5-26
6.3	Machining of the Rotor .....	5-26

7.	Acceleration of the Rotor.....	5-27
7.1	General Considerations.....	5-27
7.2	Experimental Considerations.....	5-33
7.3	Eddy Current Heating .....	5-39
8.	Slowing-Down Rate of the Rotor .....	5-41
9.	Safety Devices .....	5-44

CHAPTER VI                  THE AETHER DRIFT EXPERIMENT AND ASSOCIATED  
MEASUREMENTS

1.	Introduction.....	6-1
2.	Preparation of the Mössbauer Source and Absorber.....	6-1
3.	Gamma-ray Detector.....	6-16
3.1	Proportional Counter Response .....	6-19
3.2	Efficiency of the Proportional Counter.....	6-21
4.	Counter Electronics and Saturation Effects .....	6-22
5.	Principle of Operation.....	6-26
6.	Kicksorter Accumulation.....	6-28
7.	Dead Time Effects .....	6-29
8.	Alignment and Stability .....	6-35
9.	Data Display.....	6-38
10.	Running Time .....	6-40
11.	Data Analysis .....	6-41
12.	Future Improvements .....	6-55
13.	Discussion.....	6-56
14.	Emission Theories of Light Propagation .....	6-60

REFERENCES