

RESONANCE COMPENSATION STUDIES AT THE FNAL RECYCLER RING

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A DISSERTATION

Submitted to  
Michigan State University  
in partial fulfillment of the requirements  
for the degree of

Physics—Doctor of Philosophy

2024

## ABSTRACT

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2024

## **ACKNOWLEDGEMENTS**

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## **LIST OF ABBREVIATIONS**

<b>MSU</b>	Michigan State University
<b>FNAL</b>	Fermilab National Accelerator Laboratory
<b>RR</b>	Recycler Ring
<b>MI</b>	Main Injector
<b>RDTs</b>	Resonance Driving Terms

## CHAPTER 1

### SINGLE PARTICLE DYNAMICS

The most basic element of a particle accelerator can be thought of as a black box. This black box takes some initial transverse coordinates  $x_0, x'_0, y_0, y'_0$ , as defined in a Frenet-Serret coordinate system, and maps them to some final coordinates  $x_f, x'_f, y_f, y'_f$ . For simplicity, any longitudinal effect will not be taken into account for this analysis [1] [2] [3] [4].

#### 1.1 Basic Accelerator Elements

#### 1.2 Normal Form

#### 1.3 Resonances in Circular Accelerators

#### 1.4 Resonance Driving Terms

## **CHAPTER 2**

### **THE FNAL RECYCLER RING**

The Fermilab Recycler Ring (RR) is one of the circular accelerators located .

#### **2.1 General Specifications**

#### **2.2 Tune Diagram and Resonances**

#### **2.3 High Intensity and Tune Footprint**



## **CHAPTER 3**

### **COMPENSATION OF THIRD-ORDER RESONANCES AT LOW INTENSITIES**

#### **3.1 Global RDTs and Lattice Model**

#### **3.2 Measurement of Third Order RDTs**

#### **3.3 Compensation of RDTs**

#### **3.4 Optimization of Compensation Currents**

#### **3.5 Experimental Verification of Compensation**

##### **3.5.1 Dynamic Loss Map**

##### **3.5.2 Static Tune Scans**

## **CHAPTER 4**

### **RESONANCE COMPENSATION STUDIES AT THE CERN PS BOOSTER**

#### **4.1 General specifications**

#### **4.2 Tune Diagram and Operation**

#### **4.3 Optimization Algorithms for Resonance Compensation**

#### **4.4 Experimental Verification of Compensation**

## **CHAPTER 5**

### **HIGH INTENSITY STUDIES**

#### **5.1 Global RDTs and Intensity-Dependent Effects**

#### **5.2 Space Charge Tune Shift**

#### **5.3 Measurement of Tune Shift**

#### **5.4 Static Tune Scans at Different Intensities**

## **CHAPTER 6**

### **CONCLUSIONS AND FUTURE WORK**

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**APPENDIX**  
**YOUR APPENDIX**