## Contents

1 **Introduction** ........................................ 1  
References .................................................. 4

2 **Background Physics** ................................. 7  
  2.1 Itinerant Electron Systems ............................. 7  
      2.1.1 Non-interacting Electron Theory ................. 8  
      2.1.2 Magnetic Field Effects .......................... 12  
      2.1.3 Electric Transport .............................. 17  
      2.1.4 The Fermi Liquid ............................... 18  
      2.1.5 Beyond the Fermi Liquid ....................... 20  
  2.2 The Physics of the Ruthenate Family .................. 24  
      2.2.1 Crystal Structure and Synthesis ................. 24  
      2.2.2 Thermodynamic Properties and Magnetic Phase  
          Diagram ........................................... 25  
      2.2.3 Electronic Structure Properties ................. 34  
  2.3 Summary ............................................. 41  
References .................................................. 42

3 **Thermodynamic Measurements of Entropy** .......... 45  
  3.1 General Considerations on Thermodynamics in  
      Magnetic Fields ..................................... 46  
      3.1.1 The Laws of Thermodynamics for Magnetic Systems  
          .................................................. 46  
      3.1.2 Phase Transitions ............................... 49  
  3.2 Experimental Consequences ............................ 50  
      3.2.1 Principle of Specific Heat Measurements ......... 51  
      3.2.2 Magnetocaloric Measurements .................... 56  
References .................................................. 63

4 **Design and Characterisation of Novel Experimental Setup** .... 65  
  4.1 Measurement Environment and Sample Holder .......... 65
4.2 Design of Experimental Setup
  4.2.1 Design Goals and Experimental Realisation
  4.2.2 Sample Platform and Thermal Bath
  4.2.3 Thermometer
  4.2.4 Heater
  4.2.5 Estimates of Thermal Performance
4.3 Thermometry
  4.3.1 Physical Properties of Thermometers
  4.3.2 Thermometer Calibration
4.4 Characterisation Run With Sr2RuO4
  4.4.1 Sample
  4.4.2 Specific Heat in Field
  4.4.3 Specific Heat at Zero Field
  4.4.4 Magnetocaloric Oscillations
4.5 Characteristics and Details of Measurements on Sr3Ru2O7
  4.5.1 Sample Selection
  4.5.2 Thermal Link
  4.5.3 Specific Heat
References

5 Experimental Results and Discussion
  5.1 Caloric Studies of Magnetic Phase Transitions in Sr3Ru2O7
    5.1.1 Evolution of Entropy across Phase Transitions as a Function of Field
    5.1.2 Specific Heat Signature of Phase Transitions
    5.1.3 Discussion
  5.2 The Low and High Field States of Sr3Ru2O7
    5.2.1 The Low Field Fermi Liquid State
    5.2.2 The High Field Fermi Liquid State
    5.2.3 Discussion
References

6 Conclusions and Future Work
References

7 Appendices
  7.1 Appendix A: Material Properties
  7.2 Appendix B: Angular Dependence of the Magnetocaloric Signal
    7.2.1 Study at 19°
    7.2.2 Study in the ab-Plane
References
Magnetothermal Properties near Quantum Criticality in the Itinerant Metamagnet Sr3Ru207
Rost, A.W.
2010, X, 145 p., Hardcover
ISBN: 978-3-642-14523-0