Contents

Preface **2**

List of Figures **7**

List of Tables **9**

1 Introduction **10**

1.1 *COBE FIRAS* Data Overview 10

1.2 Pass 4 Improvements In Data Products 11

1.3 Explanatory Supplement Organization 11

2 Instrument Description **13**

3 Mission Profile **16**

4 Pre-Calibration Data Processing **21**

4.1 Ingest 21

4.2 Quality Checking 22

4.3 Sorting 25

4.4 Coaddition 29

5 Calibration of *FIRAS* Data **36**

5.1 Apodization and Padding 36

5.2 Channel Specific Items 38

5.3 Instrument Calibration 39

5.3.1 Electronics Transfer Function 40

5.3.2 Bolometer Parameters 40

5.3.3 Emissivities 42

5.3.4 Temperature and Phase Corrections 43

5.4 Temperature Scale Calibration 46

5.4.1 Frequency Scale Calibration 46

5.4.2 Temperature Calibration 46

5.5 Calibration Performance 47

5.6 Application of Calibration Models 48

6 Destriping of *FIRAS* Data **52**

6.1 Destriper Model 52

6.2 Observation Weights 53

6.3 Destriper Model Functions 54

6.3.1 Special Time Period (Tophat) Functions 55

6.3.2 Time Functions 59

6.3.3 Source Gradient Functions 60

6.3.4 Moon Contamination 62

6.3.5 Dihedral Functions 62

6.3.6 Bolometer Functions 64

6.3.7 Vibrations 65

6.4 Algorithmic Considerations 67

6.5 Destriper Project Data Sets 68

7 Errors and Uncertainty Estimation **69**

7.0.1 Sensitivity 69

7.0.2 Formal Calibration Uncertainty 69

7.1 The Detector Noise 70

7.1.1 The D Matrix 70

7.1.2 The C Matrix 71

7.2 The Emissivity Uncertainty . . . 74

7.2.1 The Destriper and P_0EP_0 Offset Errors . . . 74

7.2.2 β Uncertainties . . . 76

7.2.3 Gain Uncertainties . . . 77

7.3 The Bolometer Model Uncertainties . . . 77

7.3.1 *JCJ* Offset . . . 79

7.3.2 *JCJ* Gain . . . 79

7.4 The Temperature Noise . . . 82

7.4.1 Resistor Noise . . . 83

7.4.2 Calibration Noise . . . 83

7.4.3 Resulting Noise . . . 84

7.4.4 Hot Horns . . . 84

7.4.5 Recommended PUP . . . 85

7.5 The Temperature Uncertainty . . . 85

7.6 Full Uncertainties . . . 86

7.7 χ^2 Distributions of Combined Skymaps . . . 87

7.8 "*FIRAS* Extra Factor" Errors . . . 90

7.8.1 The Destriper Model . . . 90

7.8.2 Channel Consistency . . . 98

7.9 Unmodeled Systematic Errors . . . 99

7.9.1 Vibration . . . 99

7.9.2 Phase Corrections . . . 99

7.9.3 Pointing Errors . . . 100

7.9.4 The Beam Profile . . . 101

7.10 Propagation of Errors . . . 102

8 Modeling *FIRAS* Spectra **106**

8.1 Zodiacal Emission Model 106

8.2 CMBR Determination 107

8.2.1 Temperature Maps 107

8.2.2 Considerations When Modeling Cosmological Parameters 110

8.3 Galactic Dust Parameter Maps 111

8.4 Spectral Lines 114

8.4.1 Generating Line Profiles 114

8.4.2 Modeling Spectral Lines 118

9 Reference Data sets **122**

9.1 ASCII Format Reference Data sets 122

9.2 VAX Binary Format Reference Data sets 125

10 Reading *FIRAS* Data **127**

10.1 Reading *FIRAS* FITS Files 127

10.2 Reading *FIRAS* Native VAX Binary Format Files 127

10.3 Using Skycube Data 128

11 References **133**

12 Appendices **135**