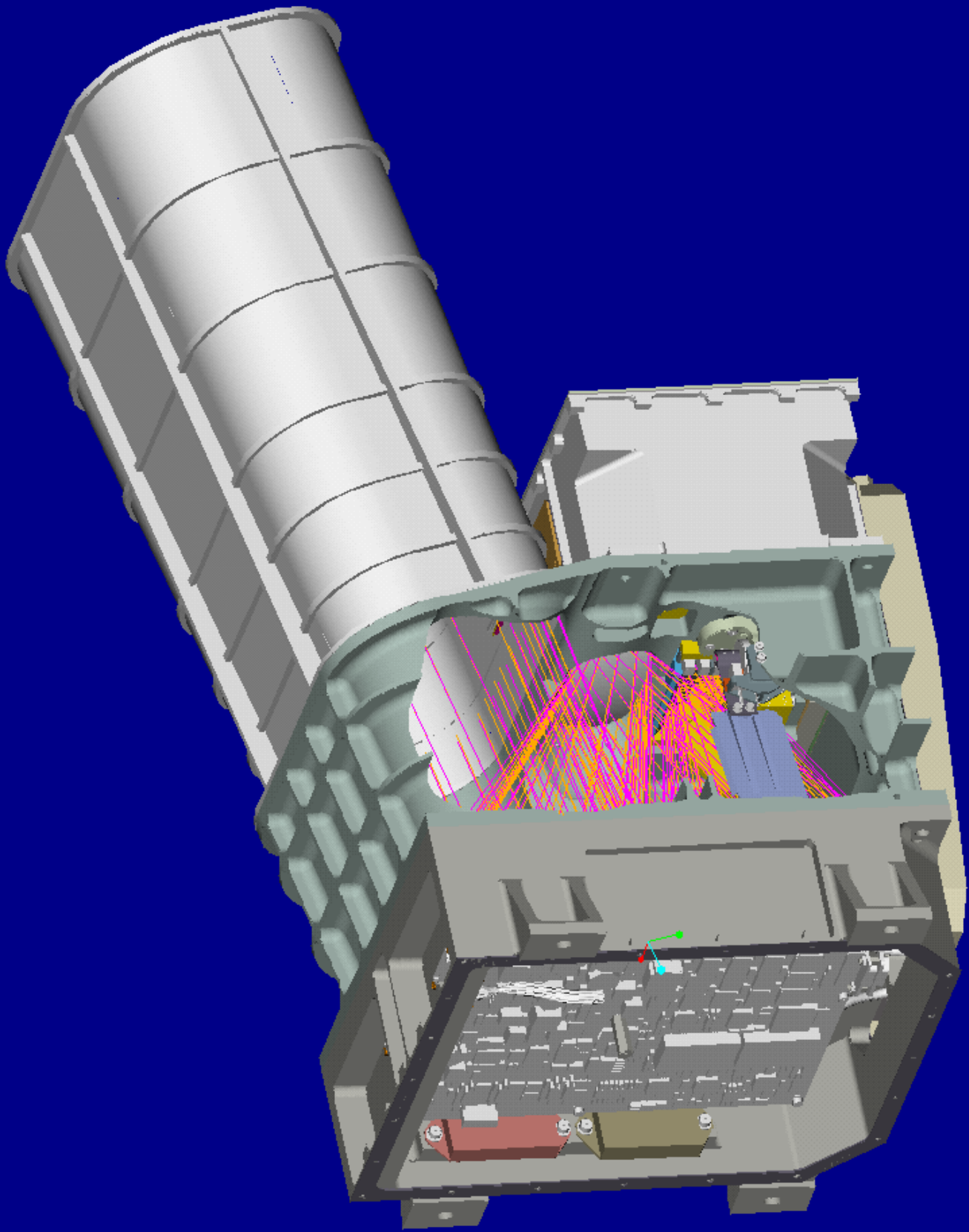


Figure 1-1a

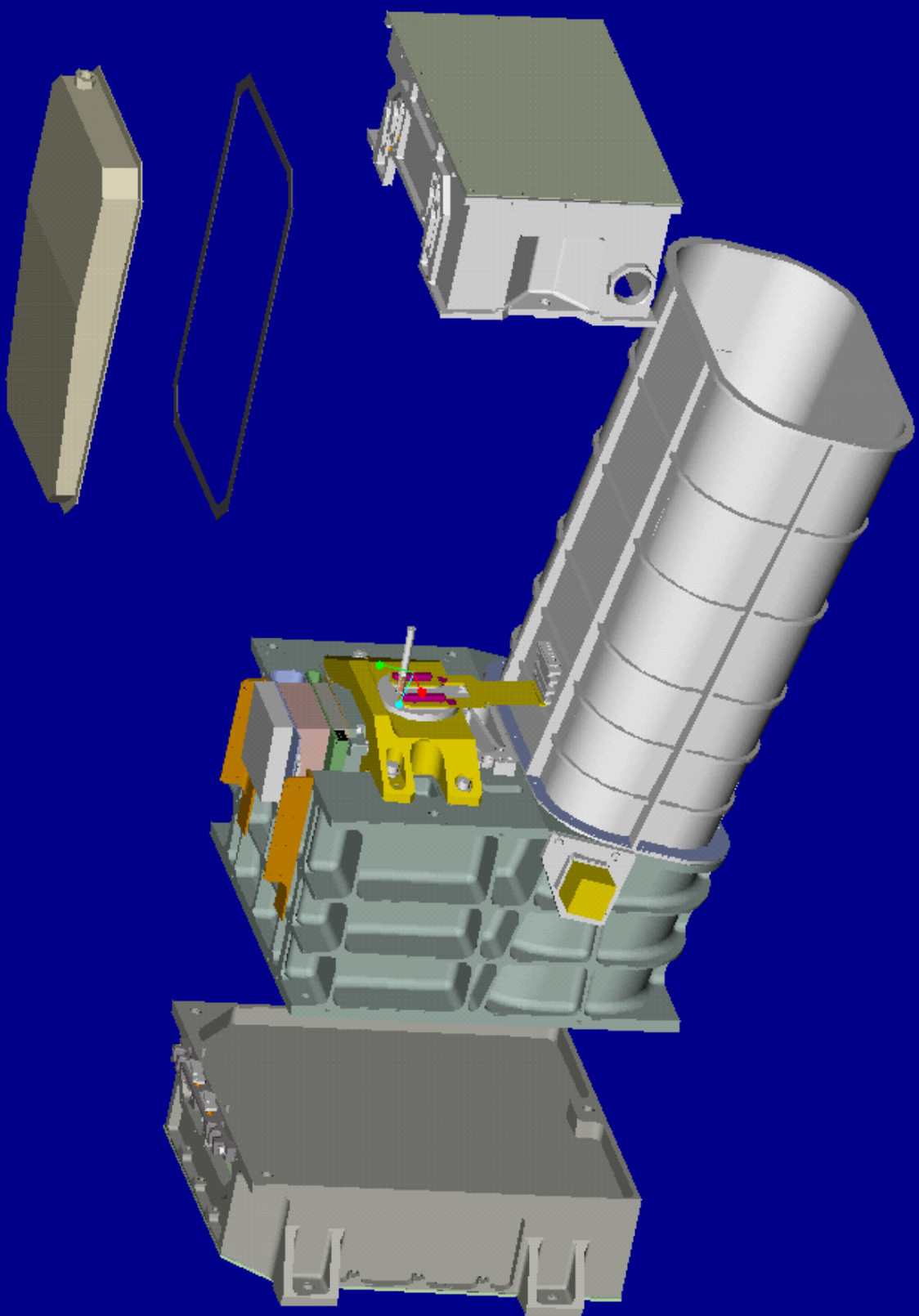


Figure 1-1b

Figure 1-2

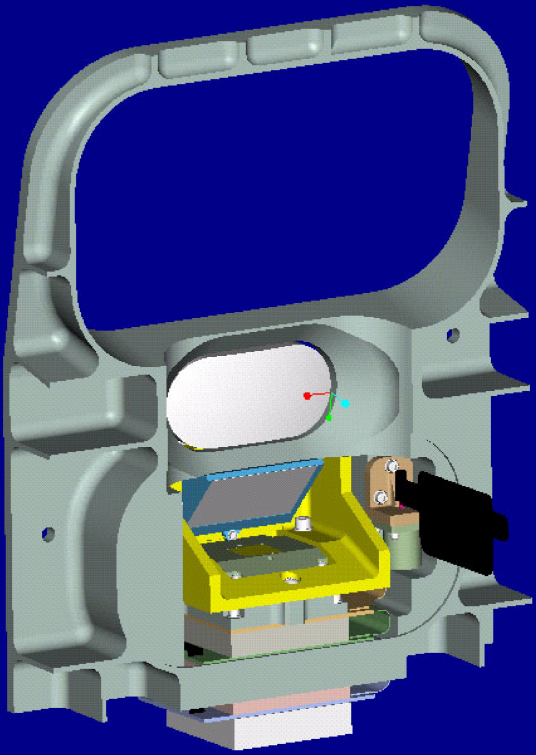


Figure 1-3

Figure 1-4

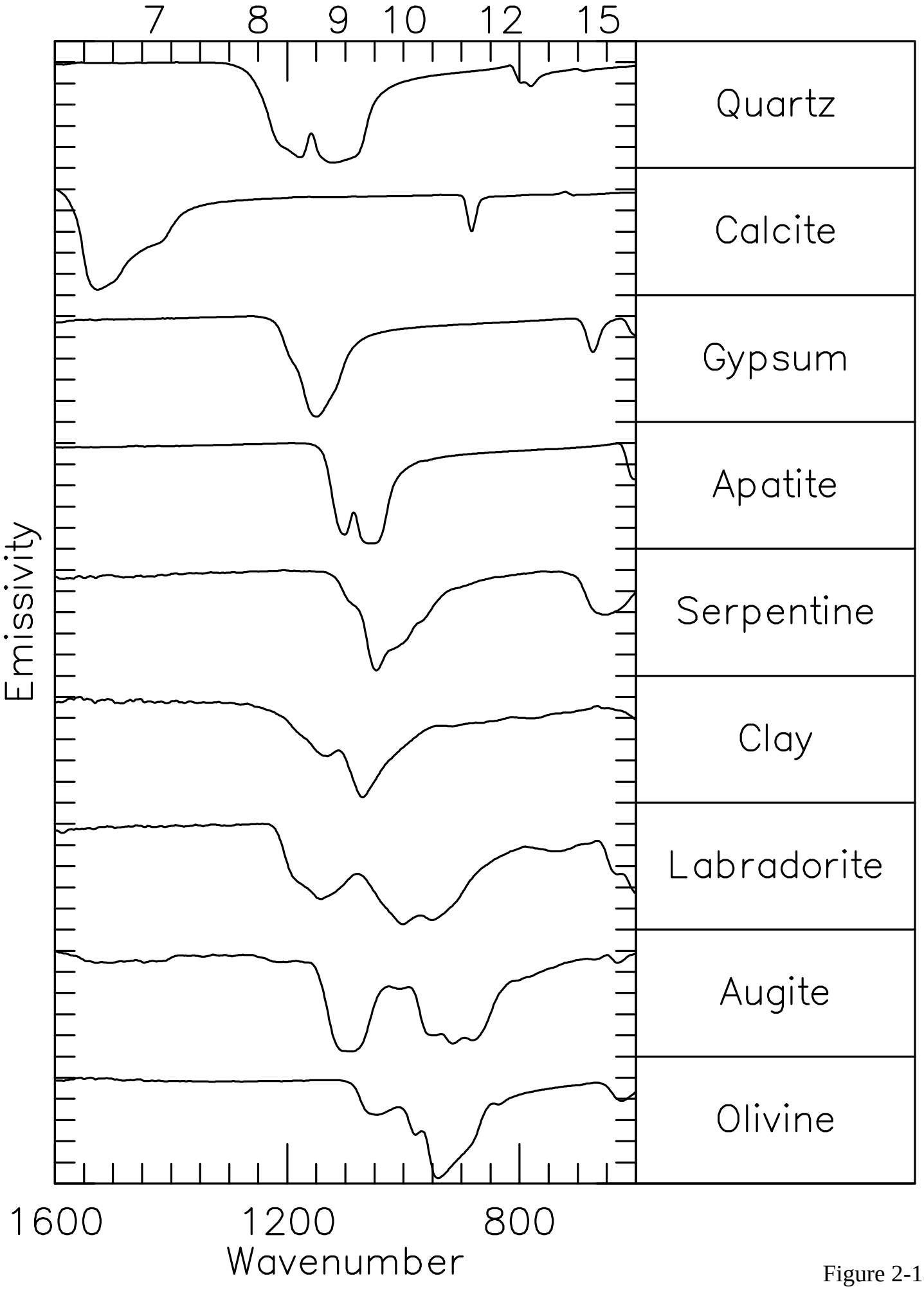

7
8
9
10
12
15
Quartz
Calcite
Gypsum
Apatite
Serpentine
Clay
Labradorite
Augite
Olivine
Emissivity
1600
1200
800
Wavenumber

Figure 2-1a

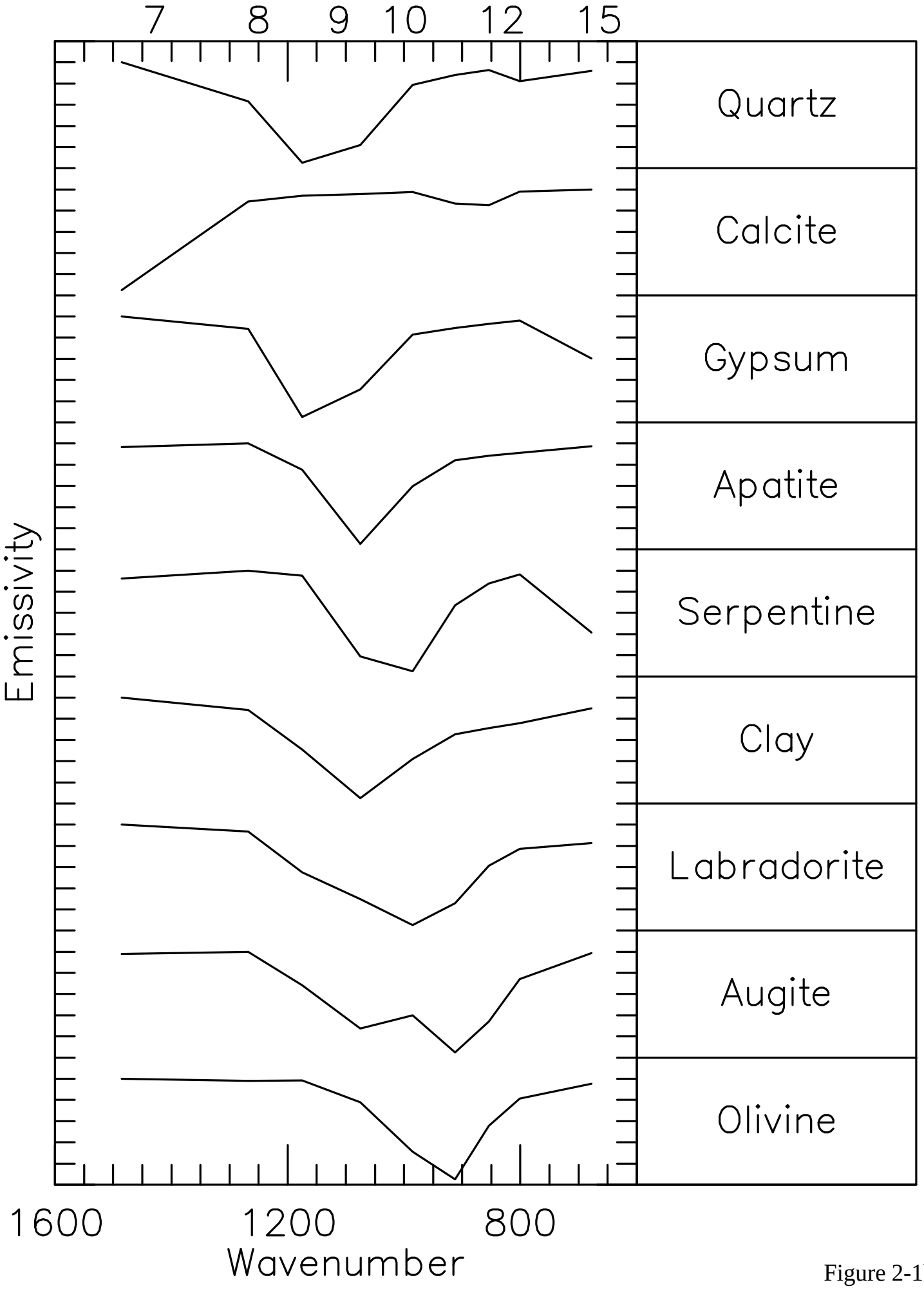
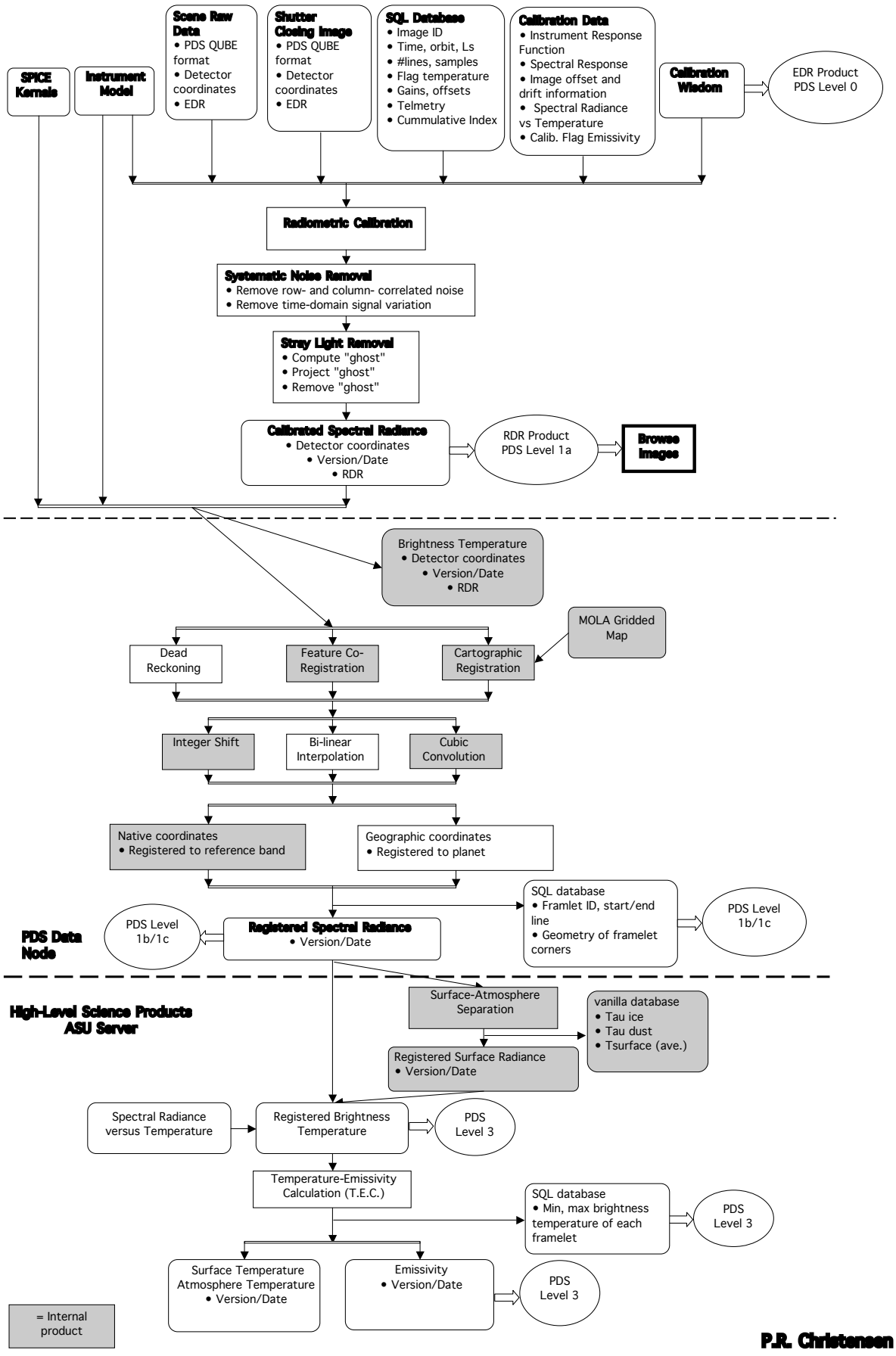

7
8
9
10
12
15
Quartz
Calcite
Gypsum
Apatite
Serpentine
Clay
Labradorite
Augite
Olivine
Emissivity
1600
1200
800
Wavenumber

Figure 2-1b

Figure 4-1

THEMIS IR Data Processing Flow



P.R. Christensen 9/6/02

Figure 3-1

THEMIS Pre-launch IR Calibration Data Collection Flow 1/5/02

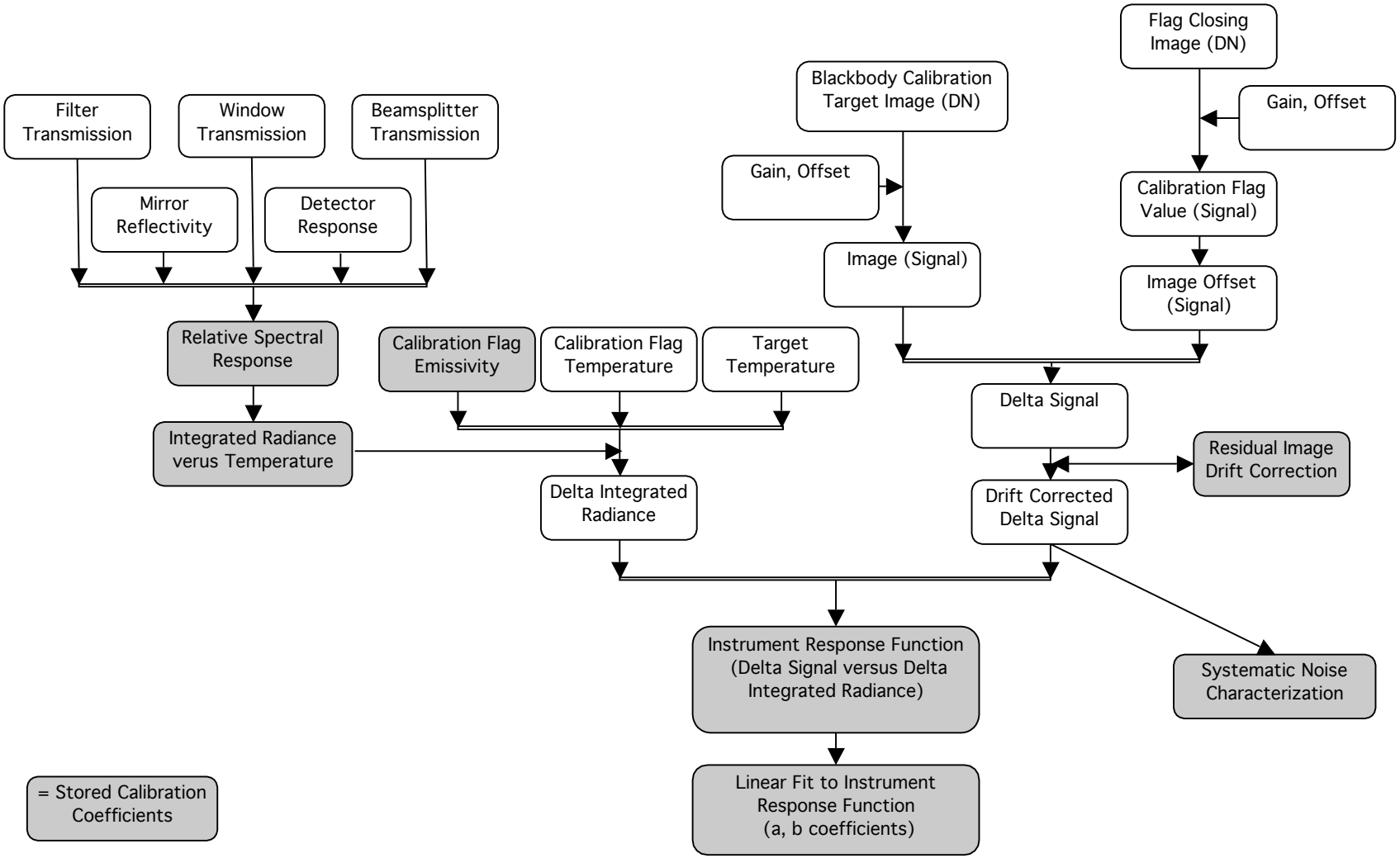


Figure 3-2

THEMIS IR Mars Data Calibration Flow

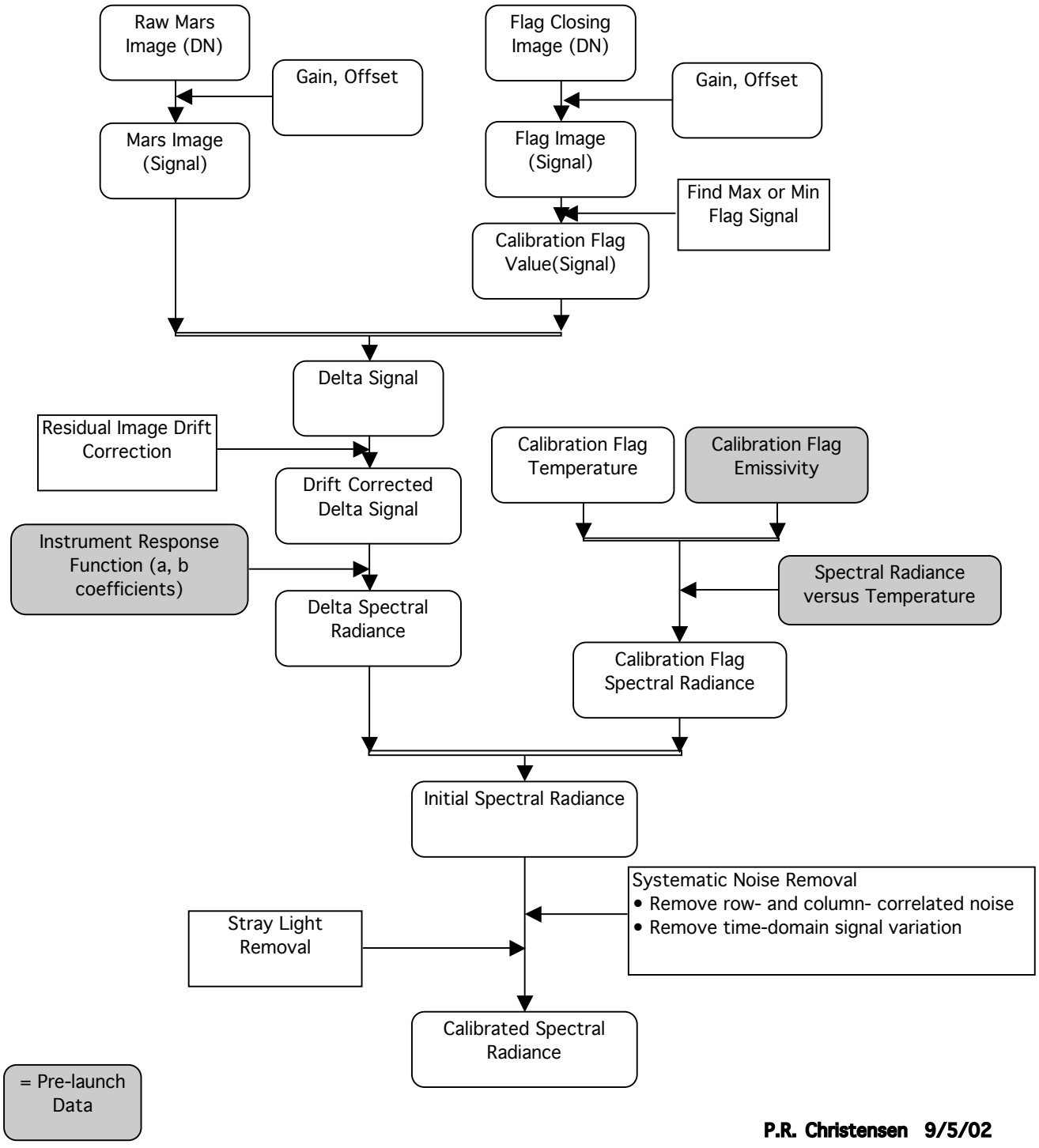


Figure 3-3

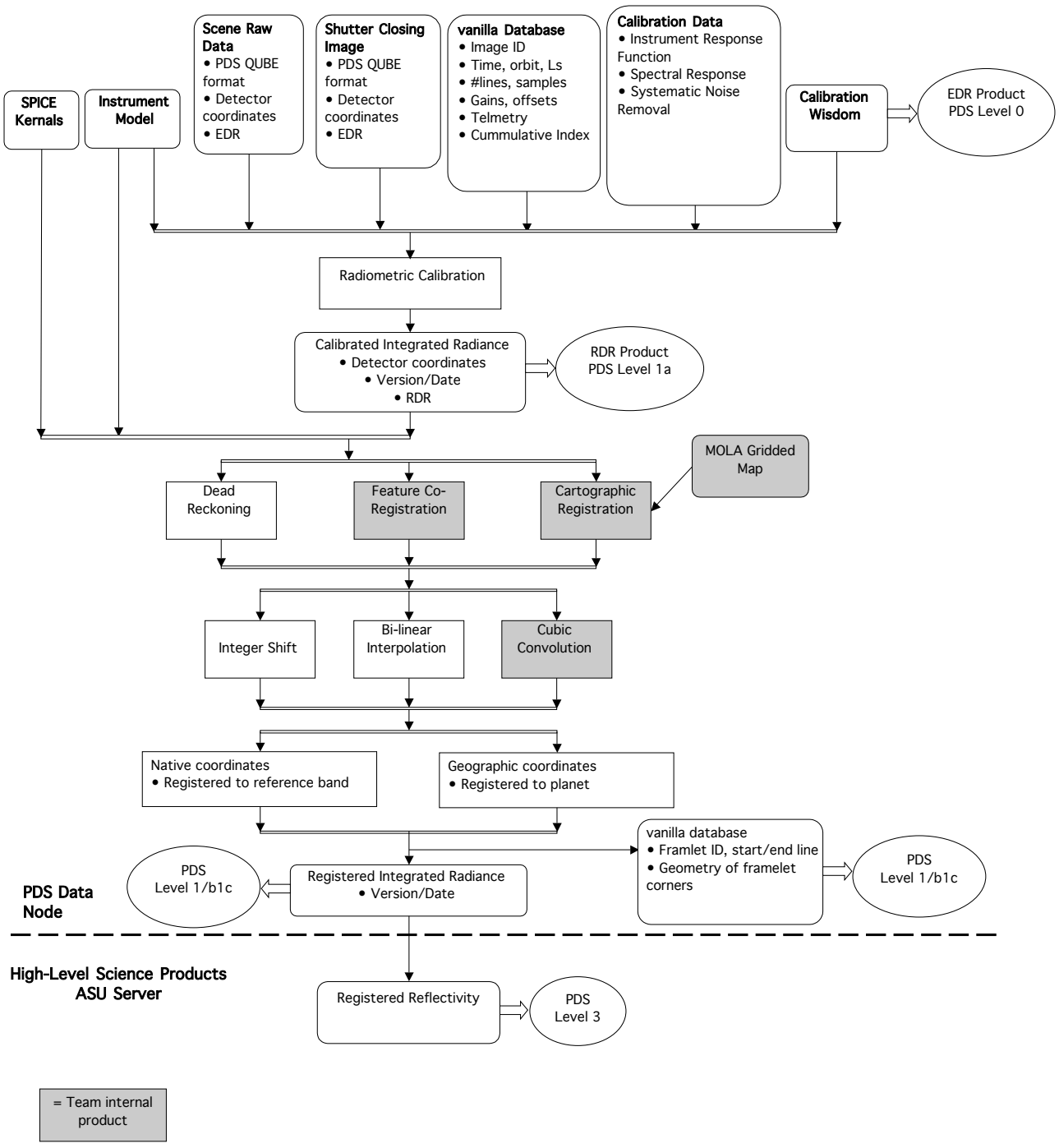

THEMIS VIS Data Processing Flow 2/16/02
SPICE Kernals
Instrument Model
Scene Raw Data
• PDS QUBE format
• Detector coordinates
• EDR
Shutter Closing Image
• PDS QUBE format
• Detector coordinates
• EDR
vanilla Database
• Image ID
• Time, orbit, Ls
• #lines, samples
• Gains, offsets
• Telmetry
• Cummulative Index
Calibration Data
• Instrument Response Function
• Spectral Response
• Systematic Noise Removal
Calibration Wisdom
EDR Product PDS Level 0
Radiometric Calibration
Calibrated Integrated Radiance
• Detector coordinates
• Version/Date
• RDR
RDR Product PDS Level 1a
MOLA Gridded Map
Dead Reckoning
Feature Co-Registration
Cartographic Registration
Integer Shift
Bi-linear Interpolation
Cubic Convolution
Native coordinates
• Registered to reference band
Geographic coordinates
• Registered to planet
vanilla database
• Framlet ID, start/end line
• Geometry of framelet corners
PDS Level 1/b1c
PDS Level 1/b1c
Registered Integrated Radiance
• Version/Date
PDS Data Node
High-Level Science Products ASU Server
Registered Reflectivity
PDS Level 3
= Team internal product

Figure 3-4

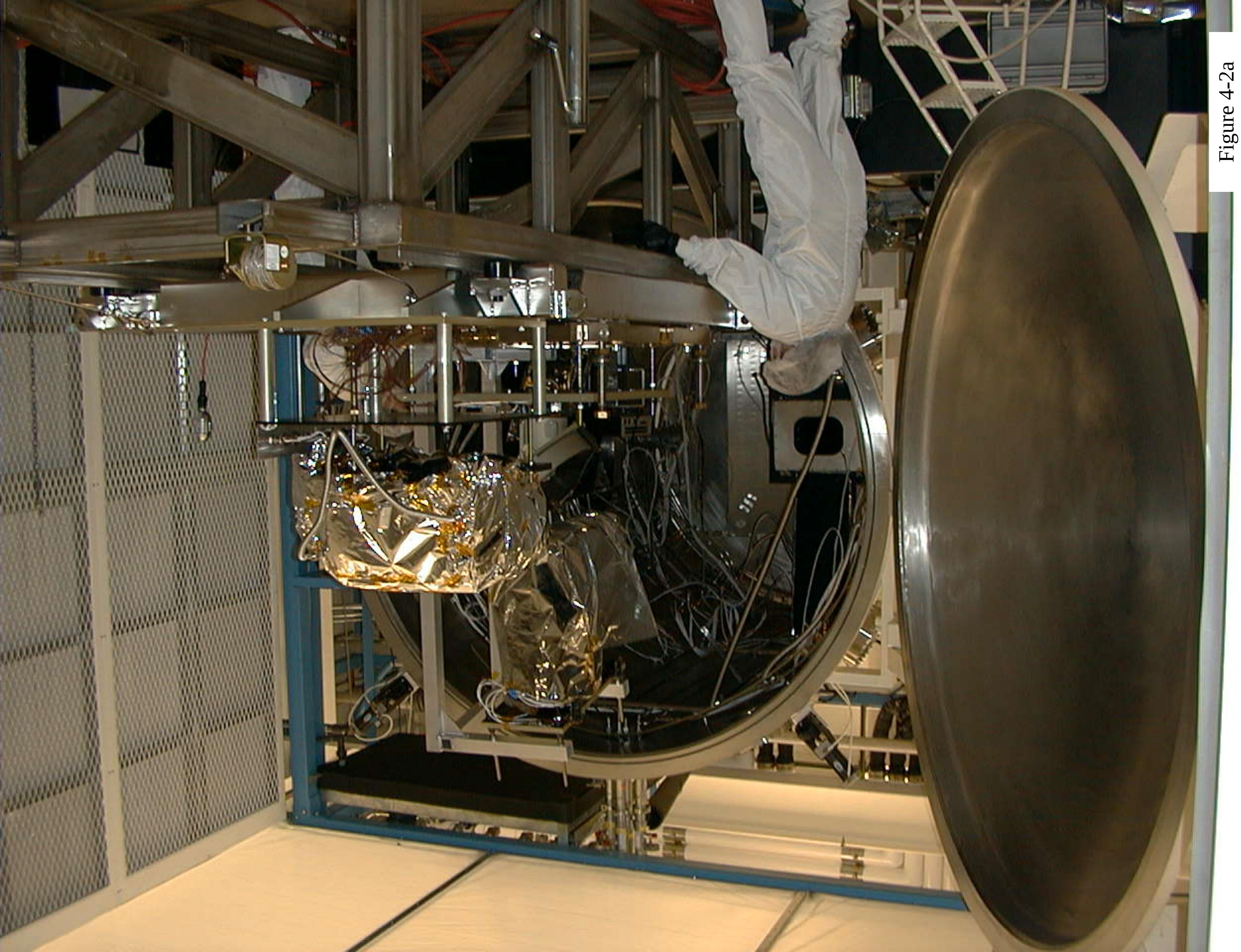


Figure 4-2a

Figure 4-2b

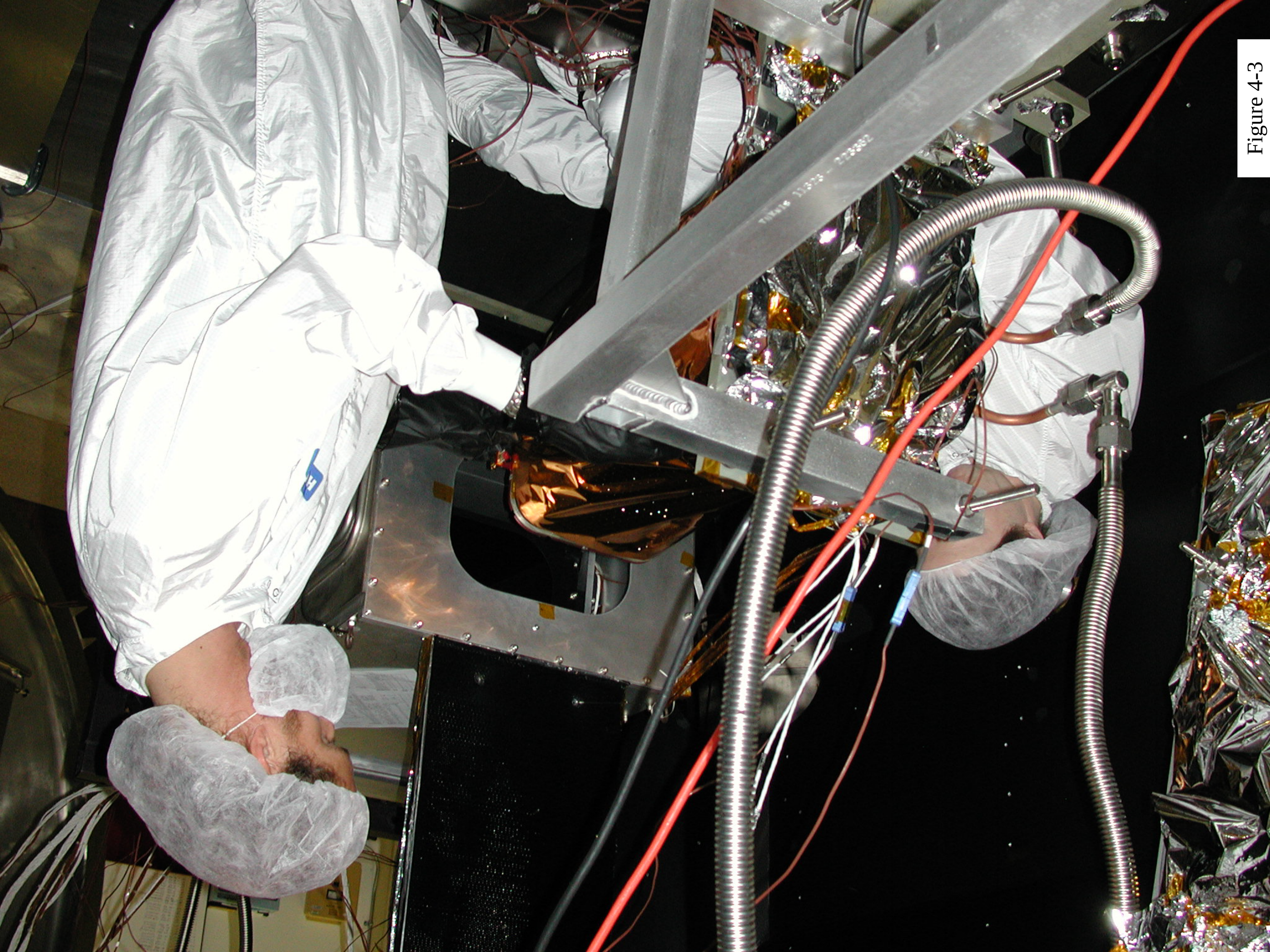


Figure 4-3

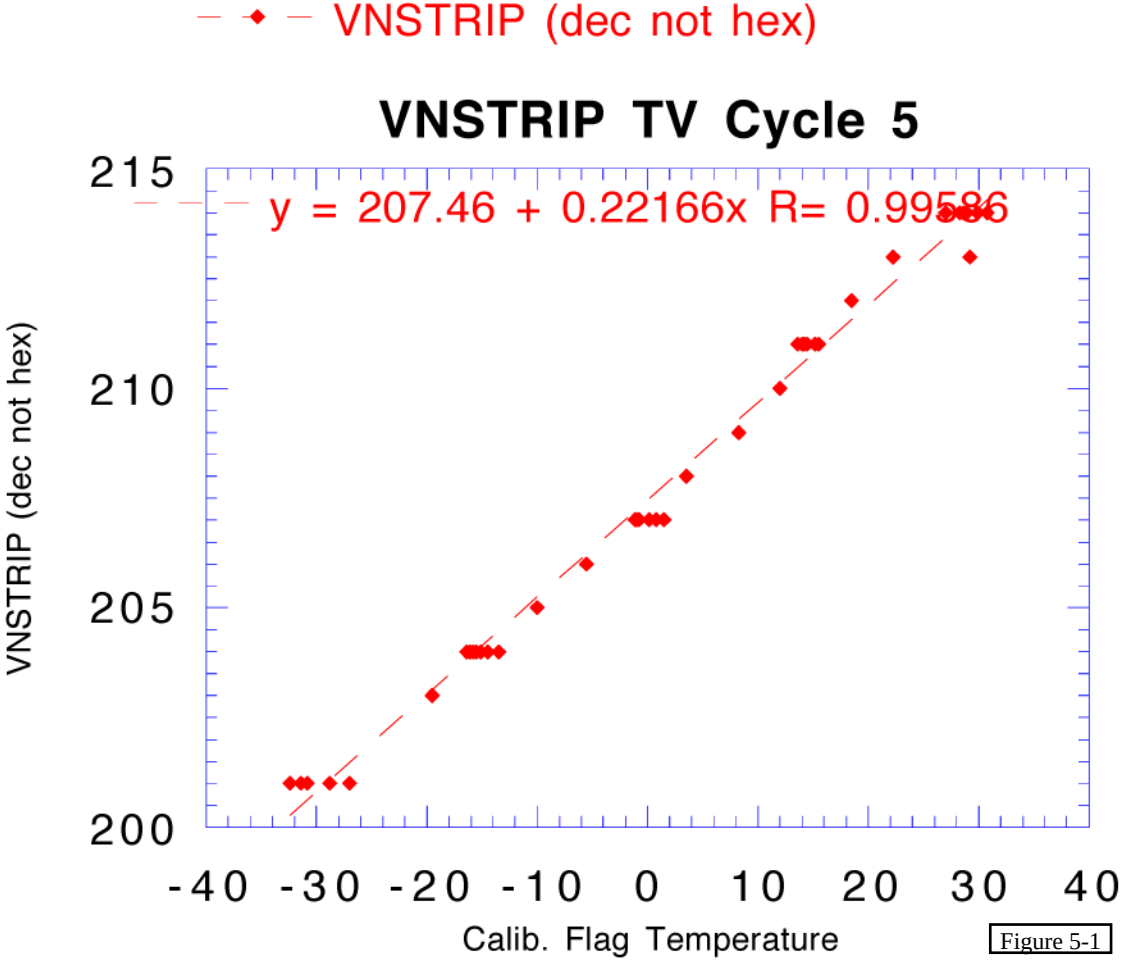

VNSTRIP (dec not hex)
VNSTRIP TV Cycle 5
y = 207.46 + 0.22166x R= 0.99586
215
210
205
200
VNSTRIP (dec not hex)
-40 -30 -20 -10 0 10 20 30 40
Calib. Flag Temperature

Figure 5-1

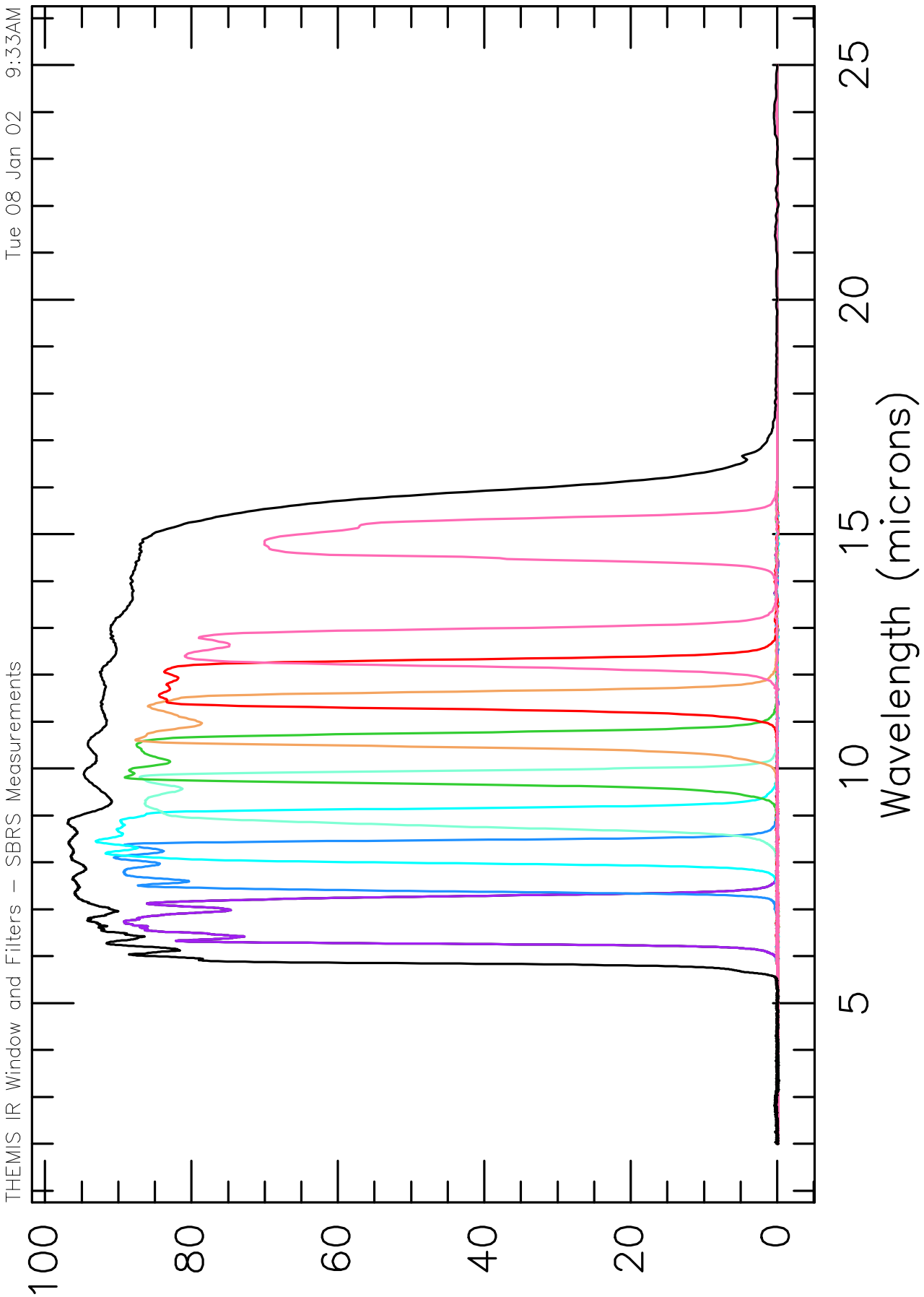

THEMIS IR Window and Filters – SBRS Measurements
Tue 08 Jan 02 9:33AM
Percent Transmission
100
80
60
40
20
0
5
10
15
20
25
Wavelength (microns)

Figure 7-3

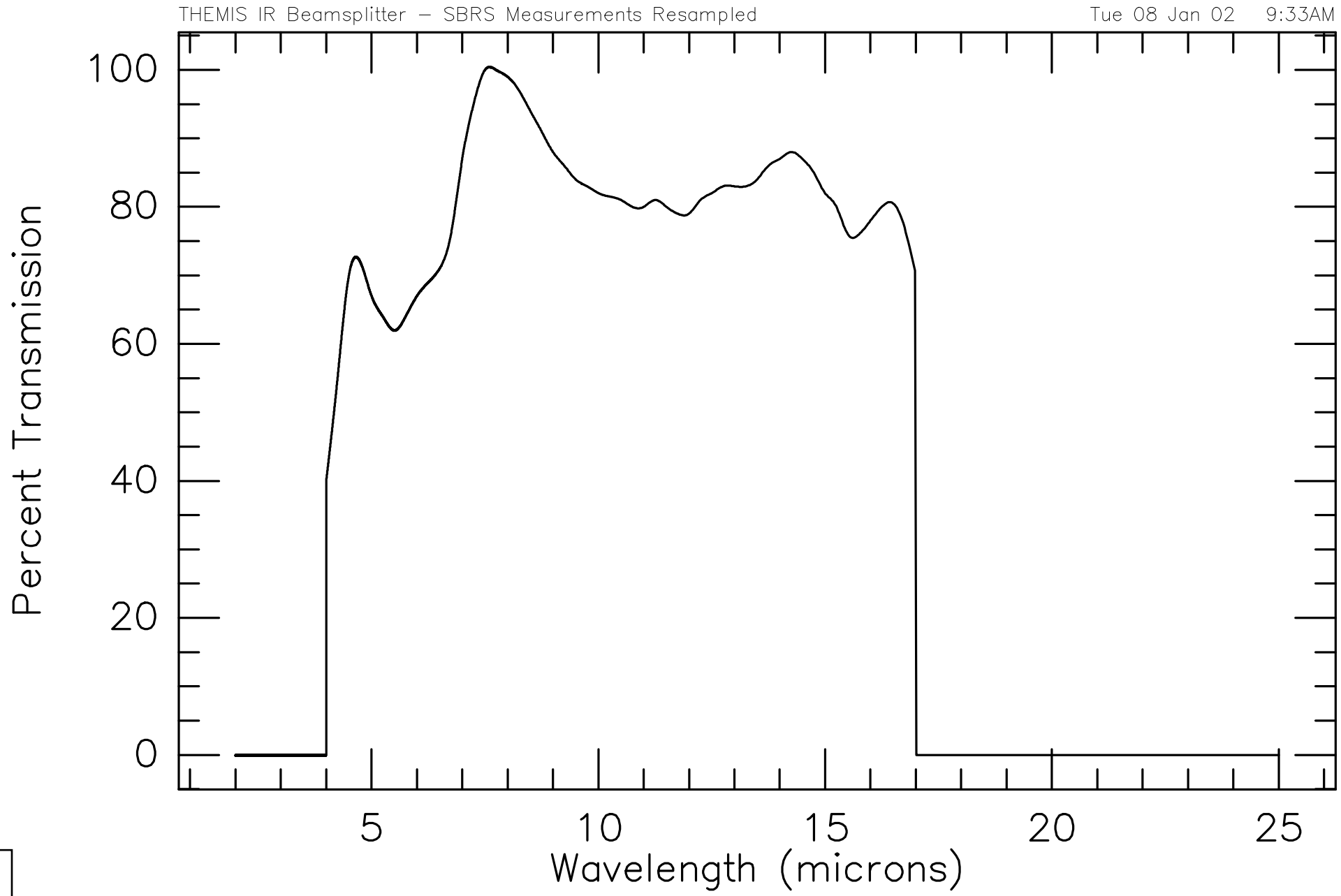

THEMIS IR Beamsplitter – SBRS Measurements Resampled
Tue 08 Jan 02 9:33AM
Percent Transmission
100
80
60
40
20
0
5
10
15
20
25
Wavelength (microns)

Figure 7-4

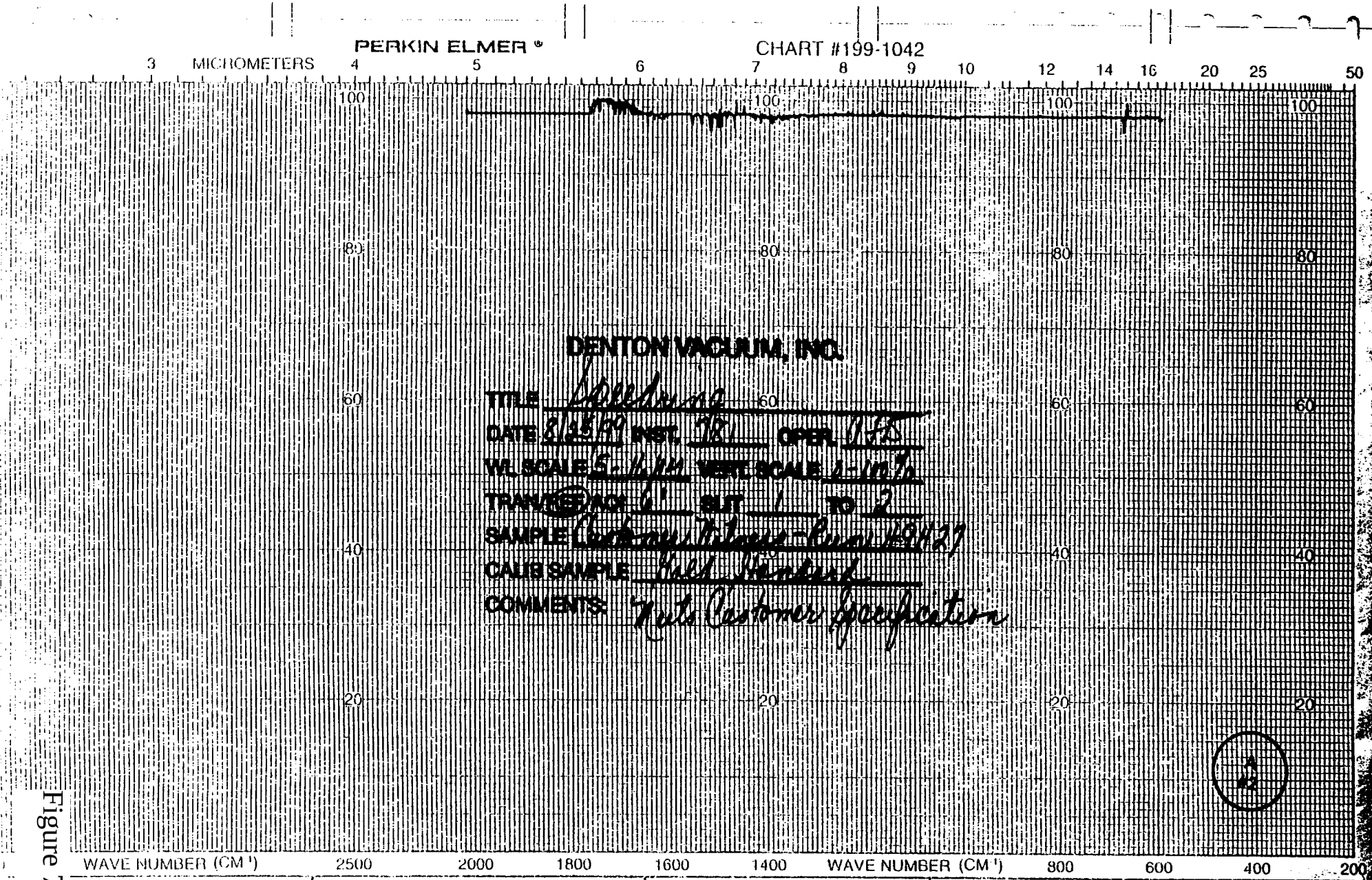


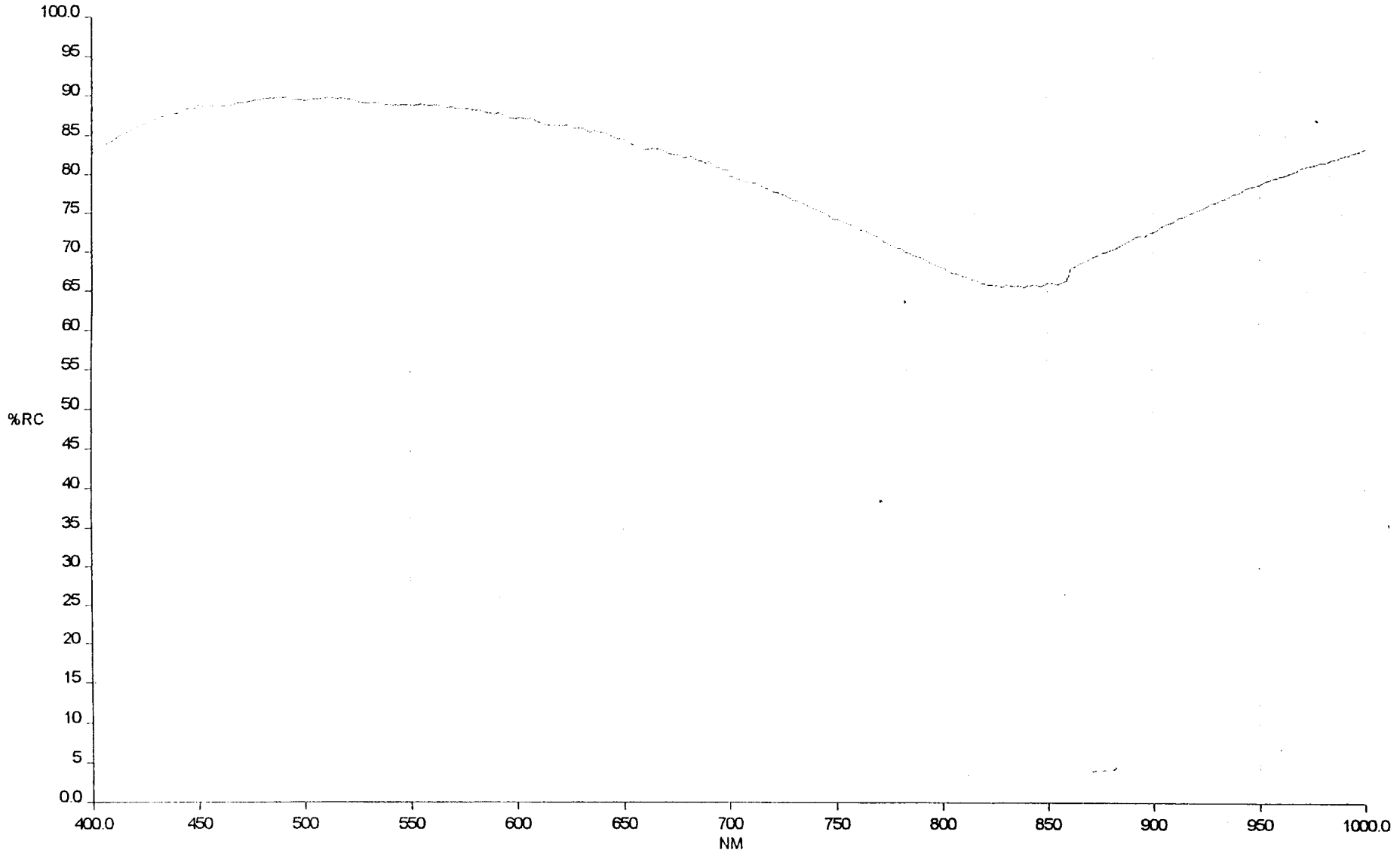
Figure 7-5a

ABSCISSA	ORDINATE	SCAN TIME	REP. SCAN / SINGLE BEAM
ON	EXPANSION	MULTIPLIER	TIME DRIVE
SSION	%T / ABS	SLIT PROGRAM	OPERATOR / DATE
SAMPLE	REMARKS	SOLVENT	CELL PATH

Date: 8/26/99

DENTON VACUUM, L.L.C.

LAMBDA 900



SPEEDRING SYSTEMS

Figure 7-5b

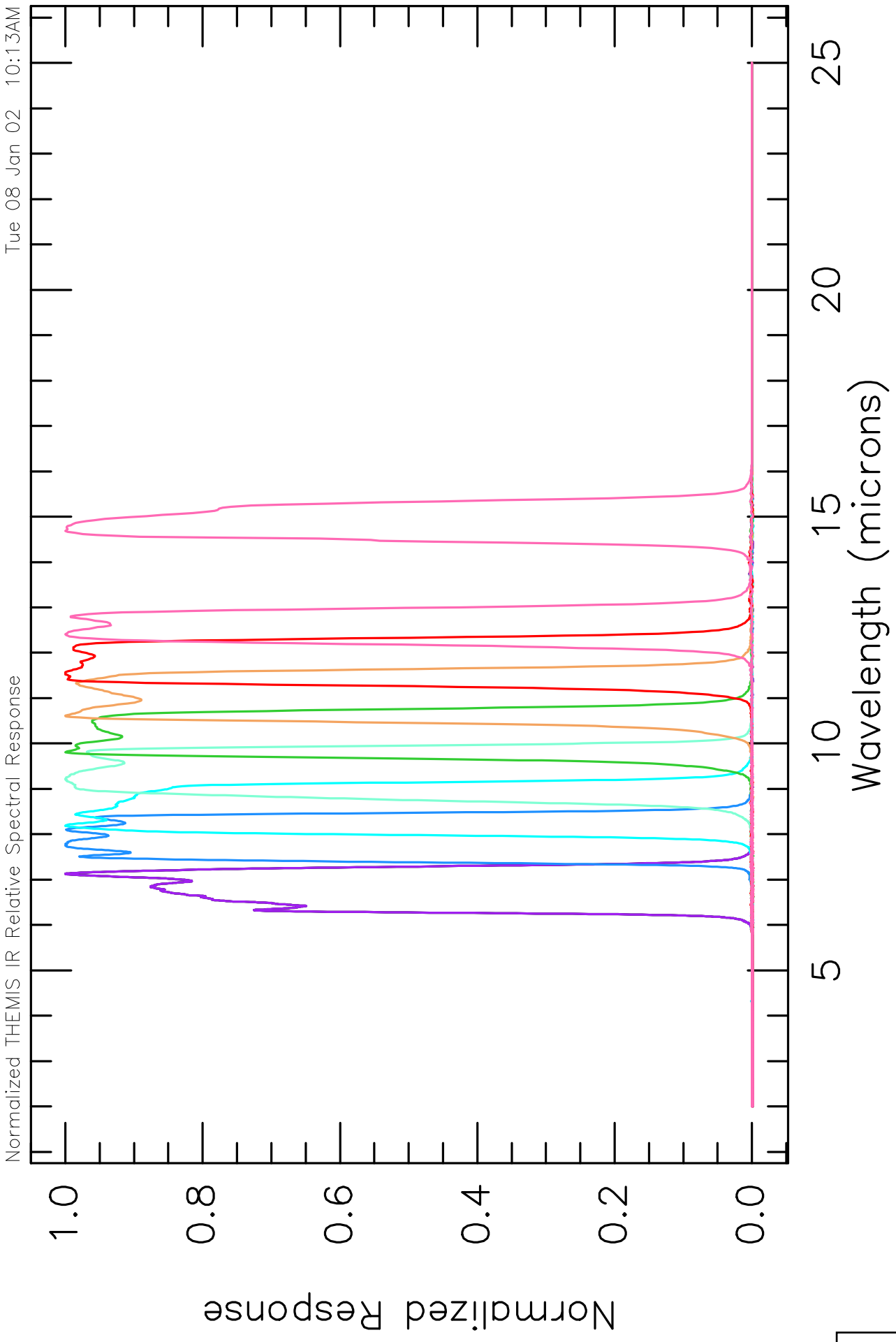

Normalized THEMIS IR Relative Spectral Response
Tue 08 Jan 02 10:13AM
Normalized Response
1.0
0.8
0.6
0.4
0.2
0.0
5
10
15
20
25
Wavelength (microns)

Figure 7-6

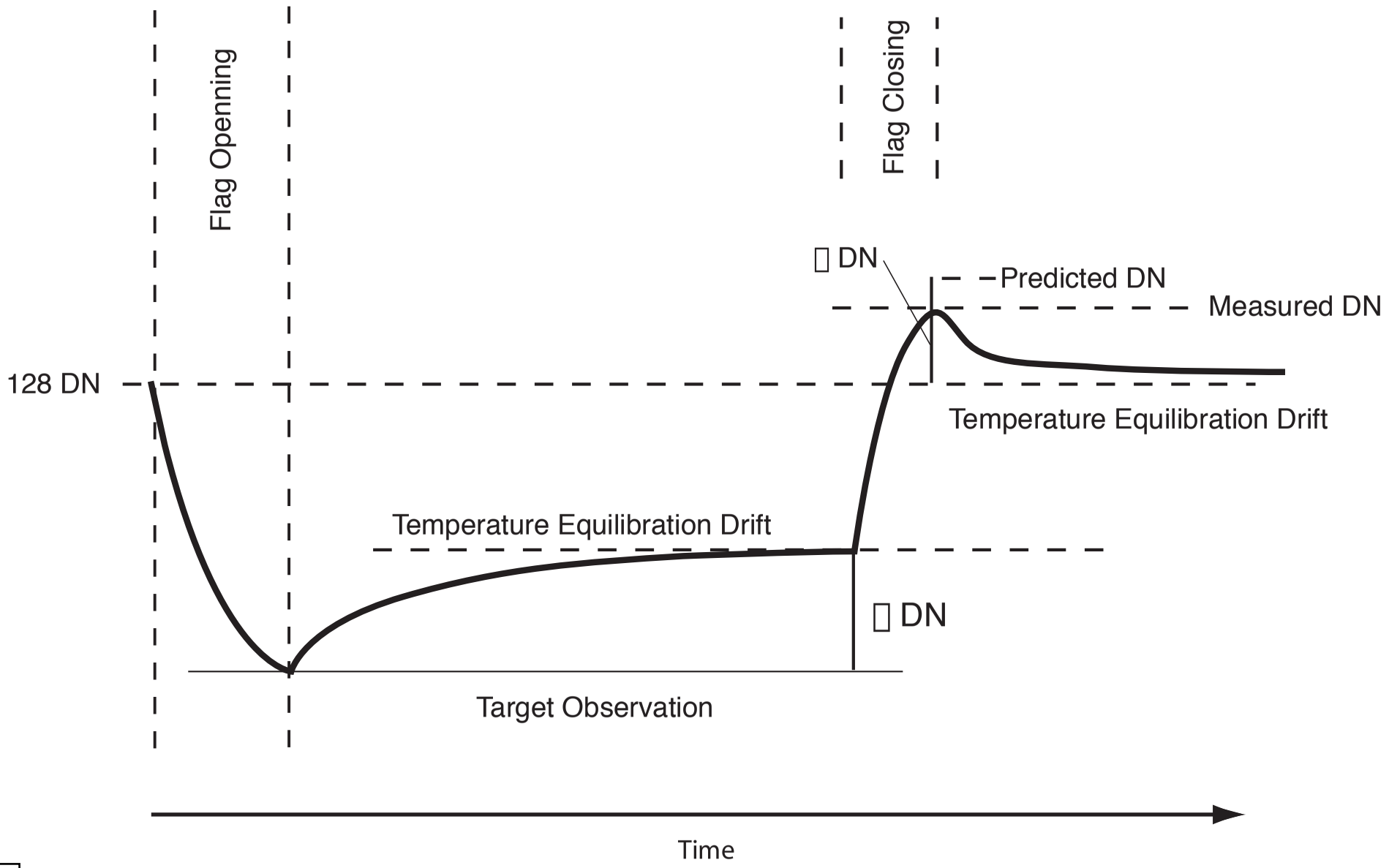

Flag Openning
Flag Closing
DN
Predicted DN
Measured DN
128 DN
Temperature Equilibration Drift
Temperature Equilibration Drift
DN
Target Observation
Time

Figure 7-7

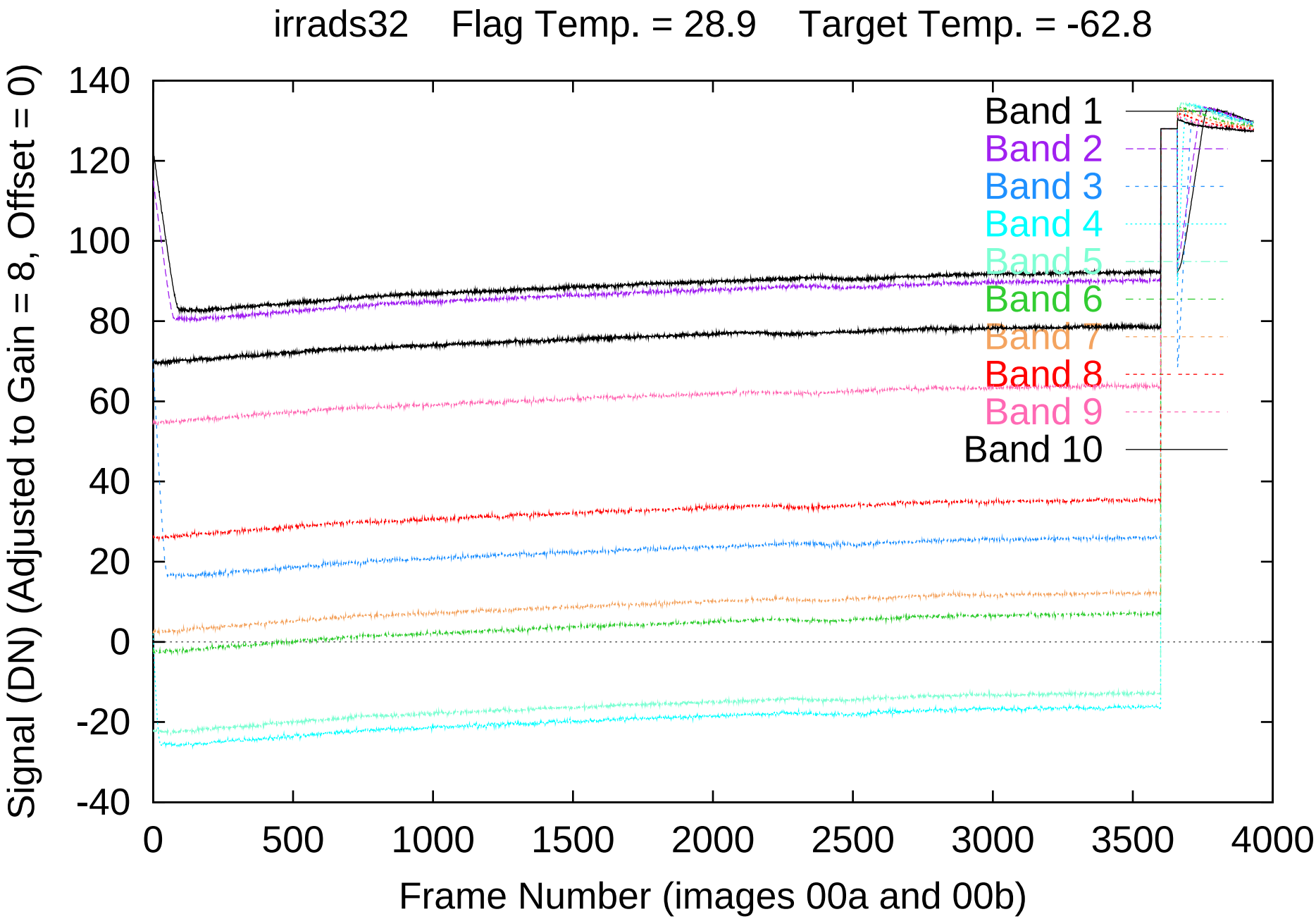

irrads32 Flag Temp. = 28.9 Target Temp. = -62.8
Signal (DN) (Adjusted to Gain = 8, Offset = 0)
140
120
100
80
60
40
20
0
-20
-40
0
500
1000
1500
2000
2500
3000
3500
4000
Frame Number (images 00a and 00b)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10

Figure 7-8

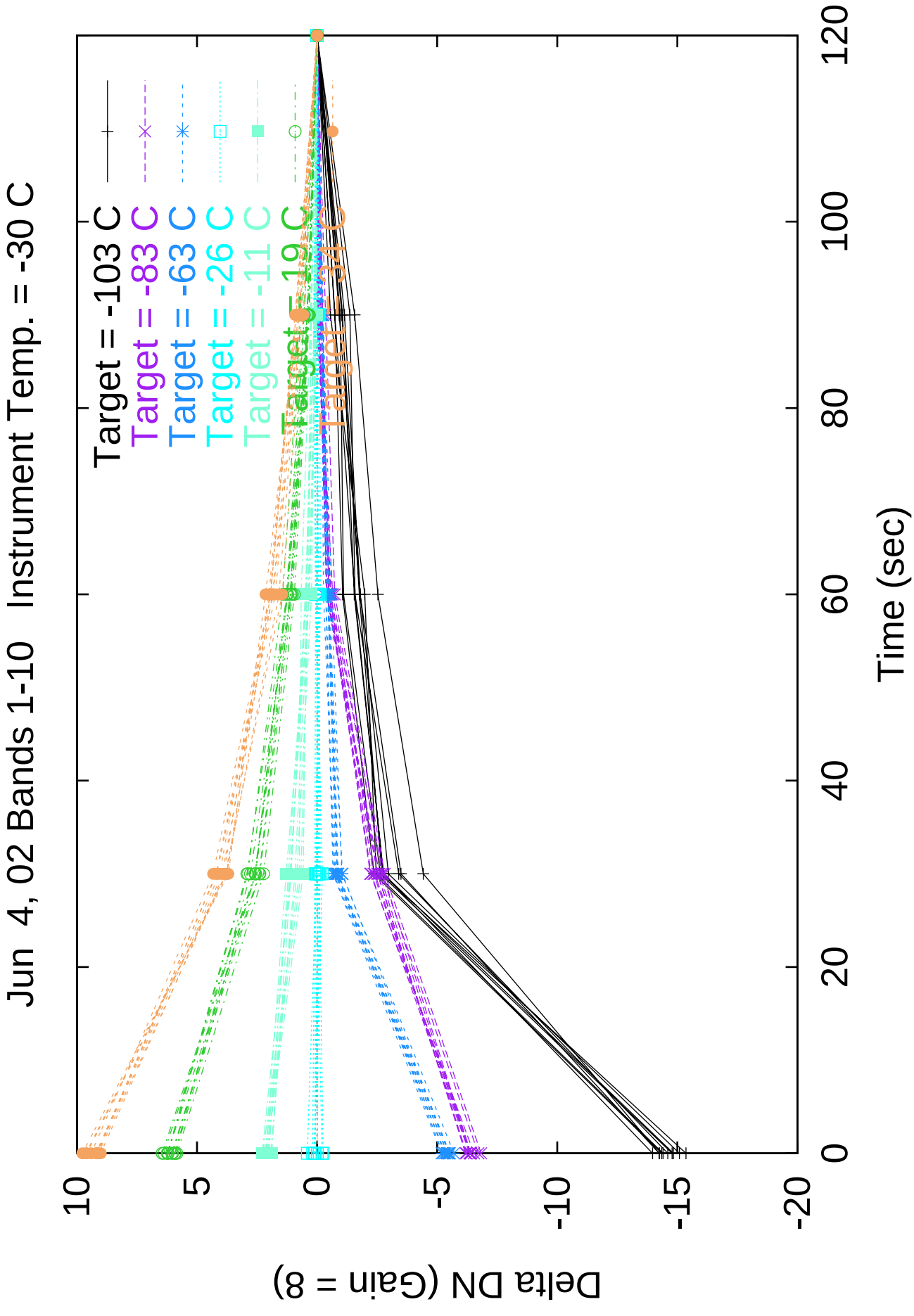

Jun 4, 02 Bands 1-10 Instrument Temp. = -30 C
Delta DN (Gain = 8)
Time (sec)
10
5
0
-5
-10
-15
-20
0
20
40
60
80
100
120
Target = -103 C
Target = -83 C
Target = -63 C
Target = -26 C
Target = -11 C
Target = -19 C
Target = -34 C

Figure 7-9a

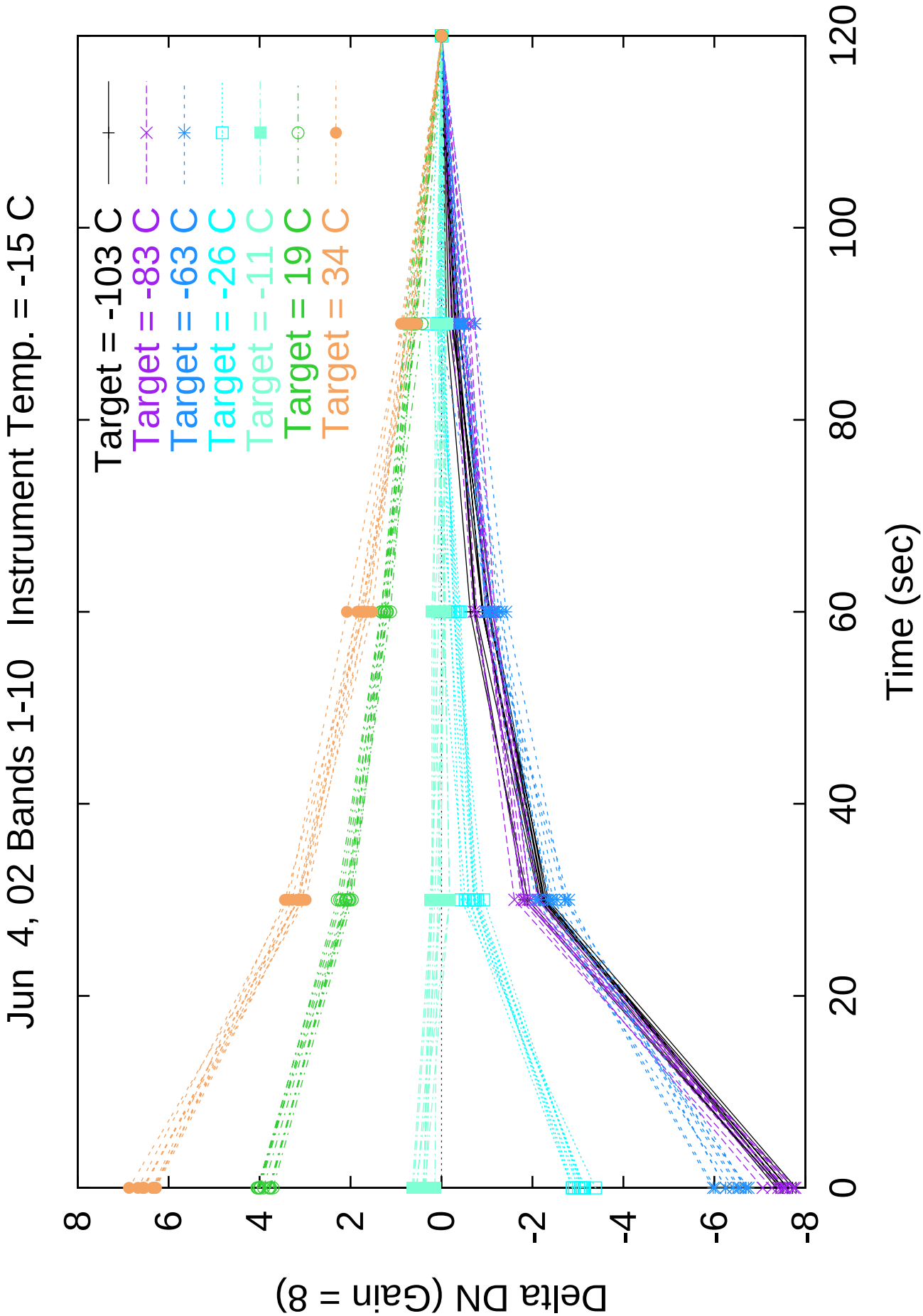

Jun 4, 02 Bands 1-10 Instrument Temp. = -15 C
Target = -103 C
Target = -83 C
Target = -63 C
Target = -26 C
Target = -11 C
Target = 19 C
Target = 34 C
Delta DN (Gain = 8)
Time (sec)
8
6
4
2
0
-2
-4
-6
-8
0
20
40
60
80
100
120

Figure 7-9b

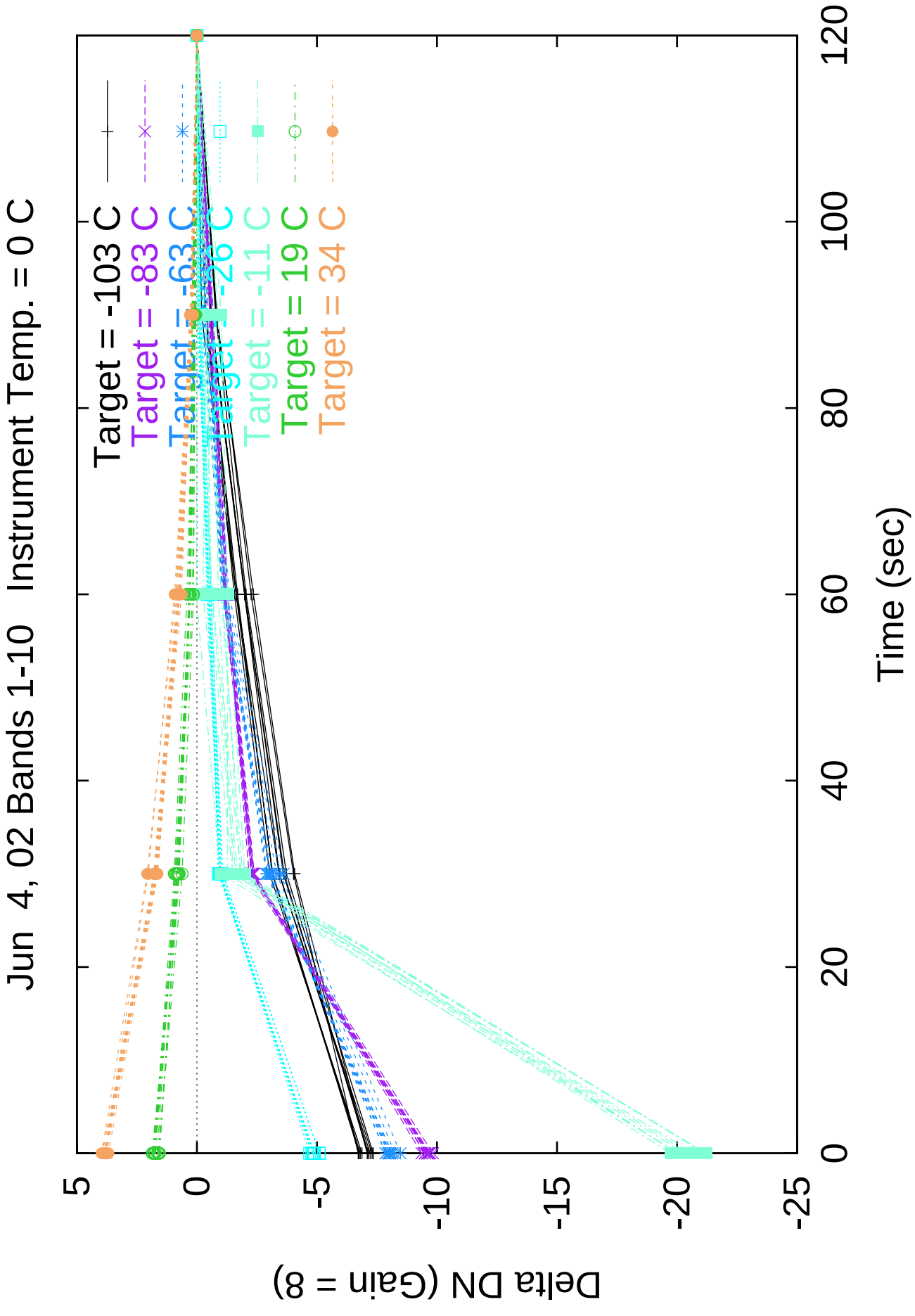

Jun 4, 02 Bands 1-10 Instrument Temp. = 0 C
Delta DN (Gain = 8)
Time (sec)
5
0
-5
-10
-15
-20
-25
0
20
40
60
80
100
120
Target = -103 C
Target = -83 C
Target = -63 C
Target = -26 C
Target = -11 C
Target = 19 C
Target = 34 C

Figure 7-9c

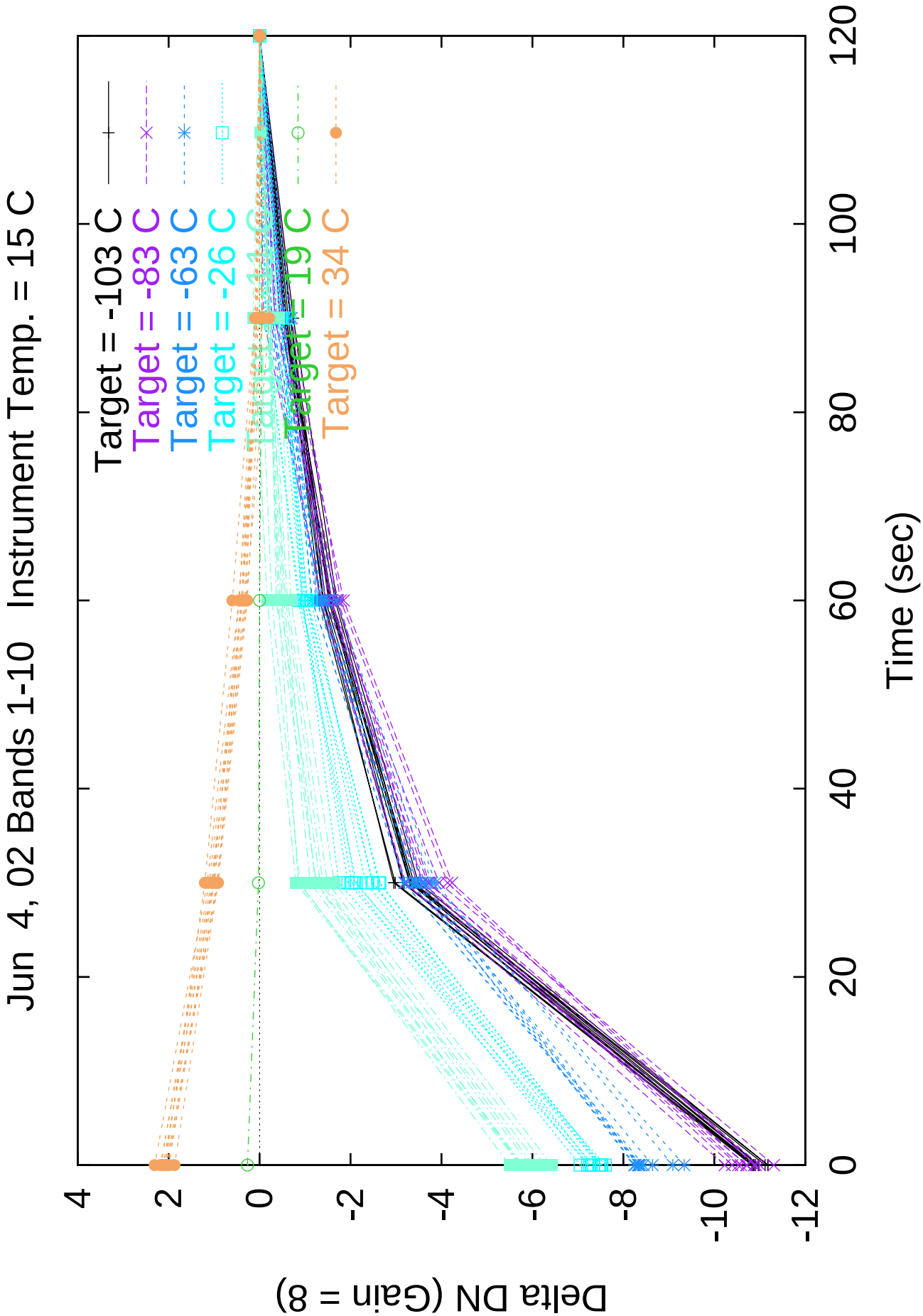

Jun 4, 02 Bands 1-10 Instrument Temp. = 15 C
Delta DN (Gain = 8)
Time (sec)
Target = -103 C
Target = -83 C
Target = -63 C
Target = -26 C
Target = -11 C
Target = 19 C
Target = 34 C
4
2
0
-2
-4
-6
-8
-10
-12
0
20
40
60
80
100
120

Figure 7-9d

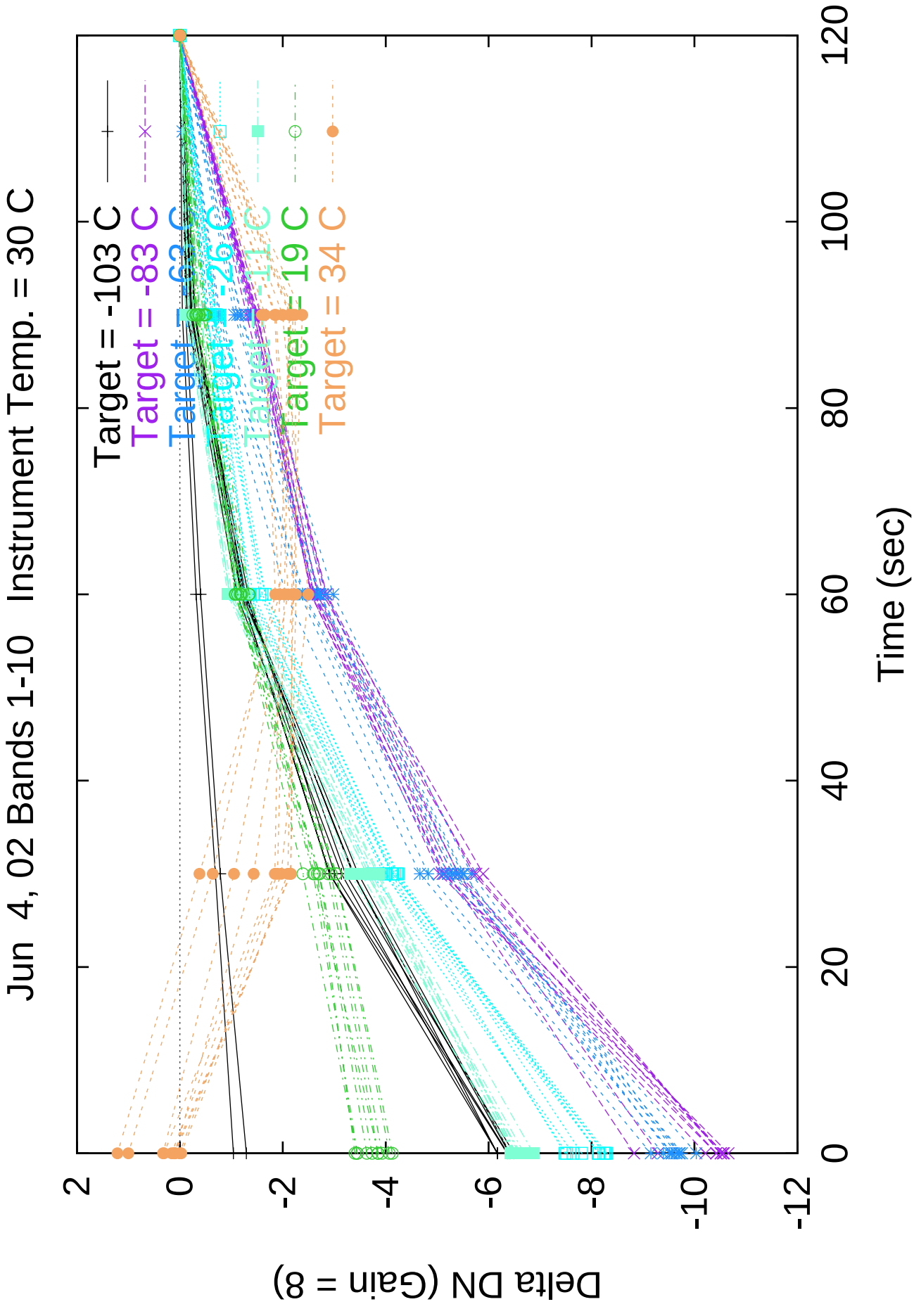

Jun 4, 02 Bands 1-10 Instrument Temp. = 30 C
Target = -103 C
Target = -83 C
Target = -63 C
Target = -26 C
Target = -11 C
Target = 19 C
Target = 34 C
Delta DN (Gain = 8)
Time (sec)
2
0
-2
-4
-6
-8
-10
-12
0
20
40
60
80
100
120

Figure 7-9e

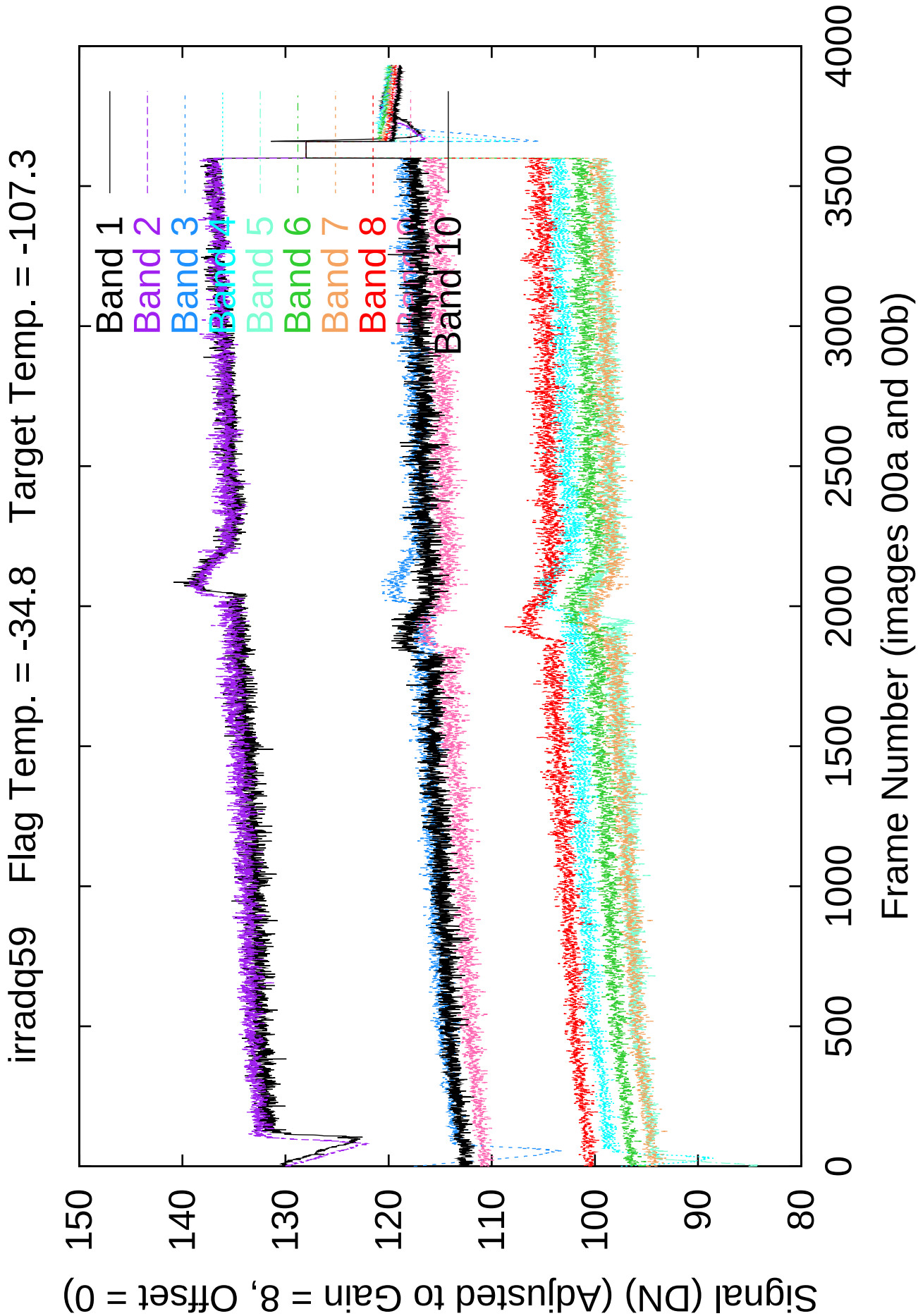

irradq59 Flag Temp. = -34.8 Target Temp. = -107.3
Signal (DN) (Adjusted to Gain = 8, Offset = 0)
Frame Number (images 00a and 00b)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 10
150
140
130
120
110
100
90
80
0
500
1000
1500
2000
2500
3000
3500
4000

Figure 7-10

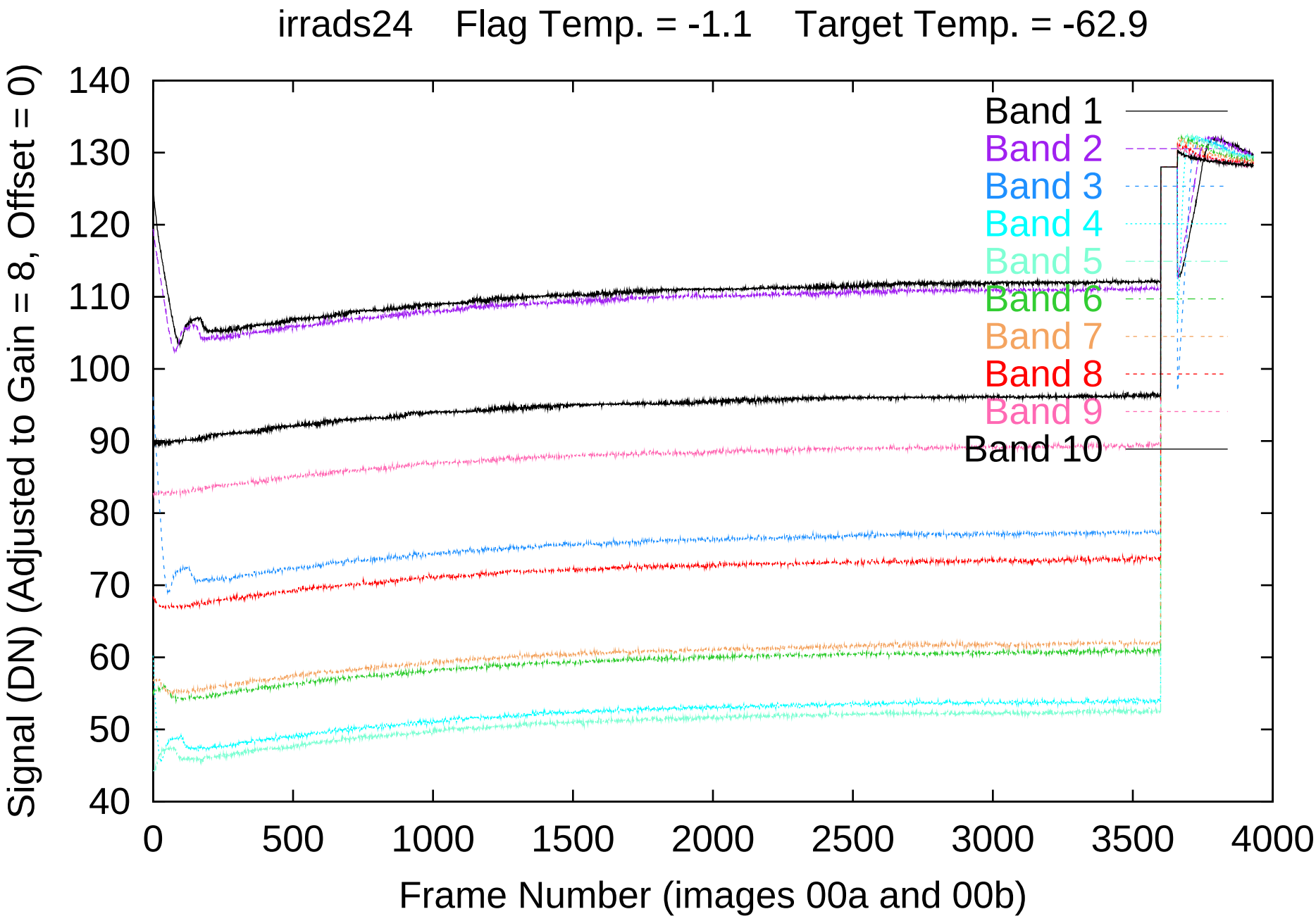

irrads24 Flag Temp. = -1.1 Target Temp. = -62.9
Signal (DN) (Adjusted to Gain = 8, Offset = 0)
Frame Number (images 00a and 00b)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10
140
130
120
110
100
90
80
70
60
50
40
0
500
1000
1500
2000
2500
3000
3500
4000

Figure 7-11

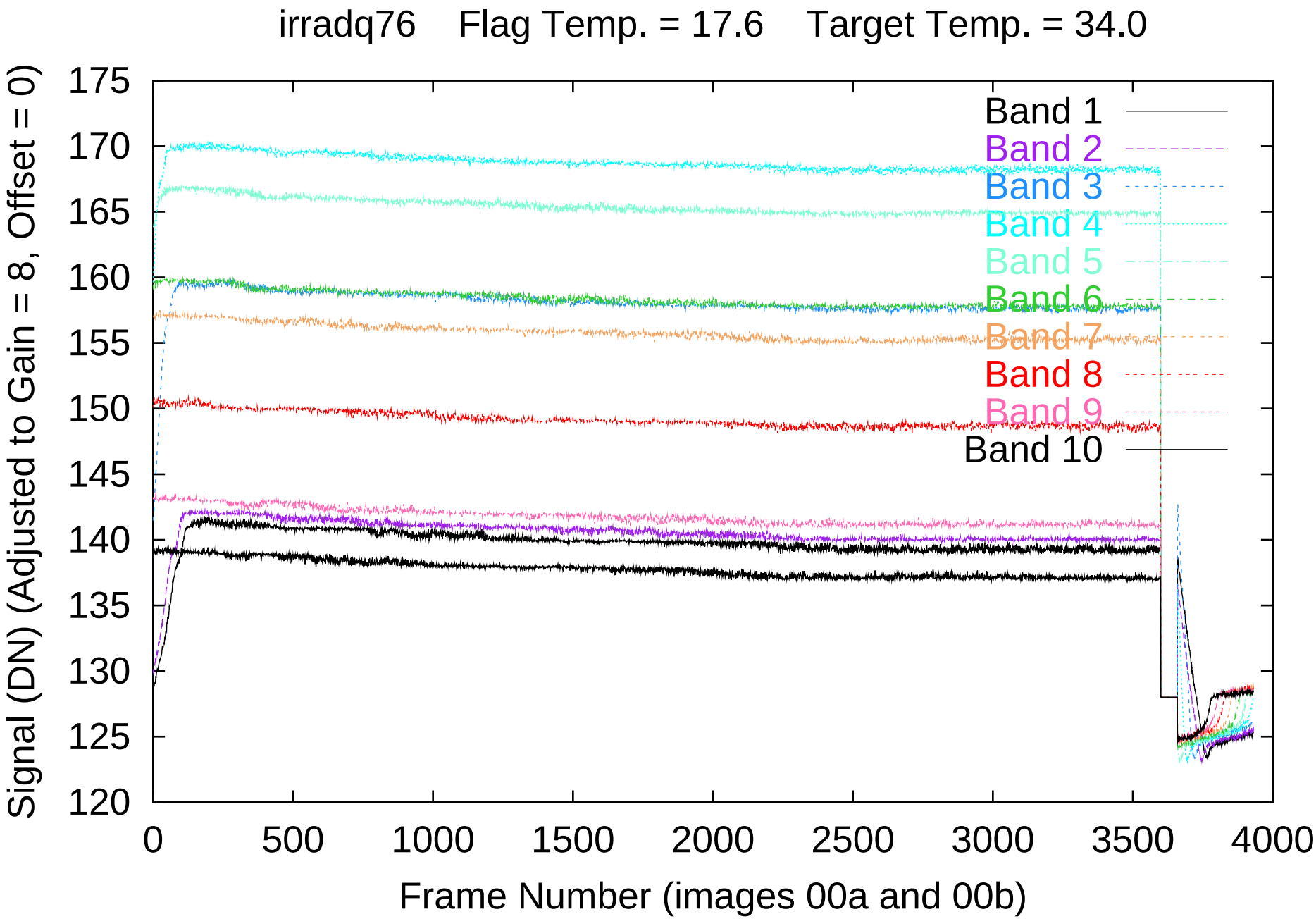

irradq76 Flag Temp. = 17.6 Target Temp. = 34.0
Signal (DN) (Adjusted to Gain = 8, Offset = 0)
175
170
165
160
155
150
145
140
135
130
125
120
0
500
1000
1500
2000
2500
3000
3500
4000
Frame Number (images 00a and 00b)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10

Figure 7-12

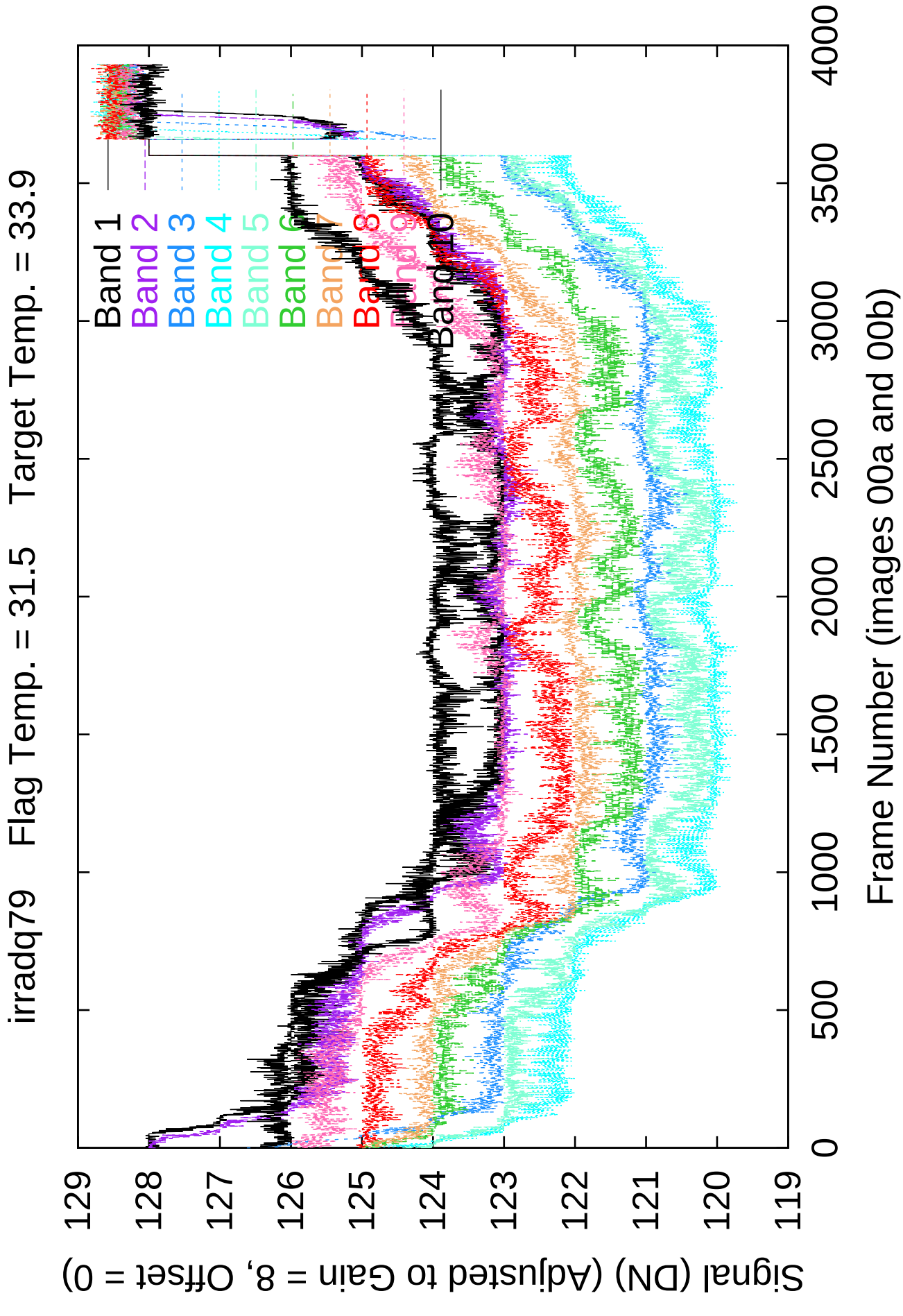

irradq79 Flag Temp. = 31.5 Target Temp. = 33.9
Signal (DN) (Adjusted to Gain = 8, Offset = 0)
Frame Number (images 00a and 00b)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10
129
128
127
126
125
124
123
122
121
120
119
0
500
1000
1500
2000
2500
3000
3500
4000

Figure 7-13

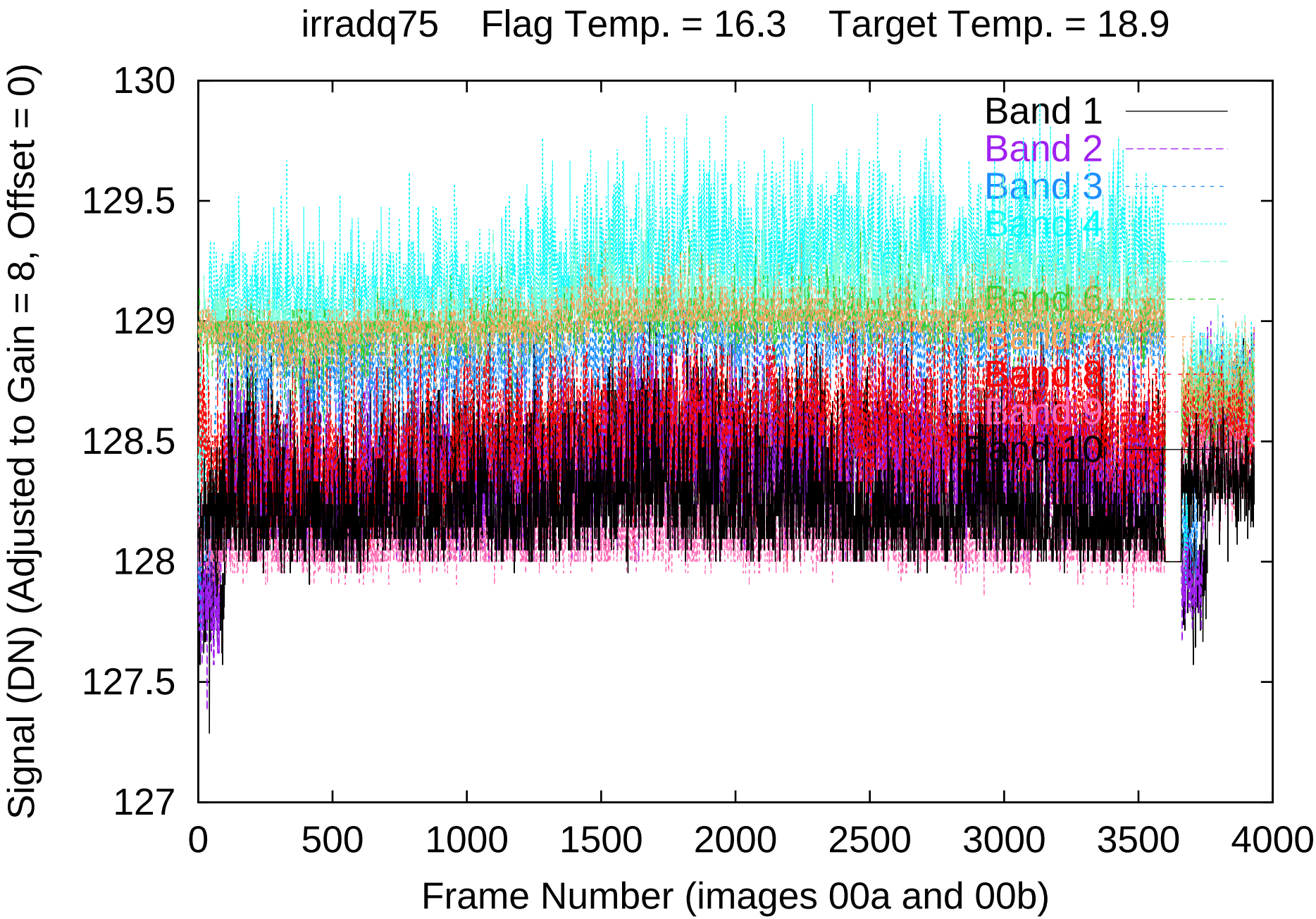

irradq75 Flag Temp. = 16.3 Target Temp. = 18.9
Signal (DN) (Adjusted to Gain = 8, Offset = 0)
130
129.5
129
128.5
128
127.5
127
0
500
1000
1500
2000
2500
3000
3500
4000
Frame Number (images 00a and 00b)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10

Figure 7-14

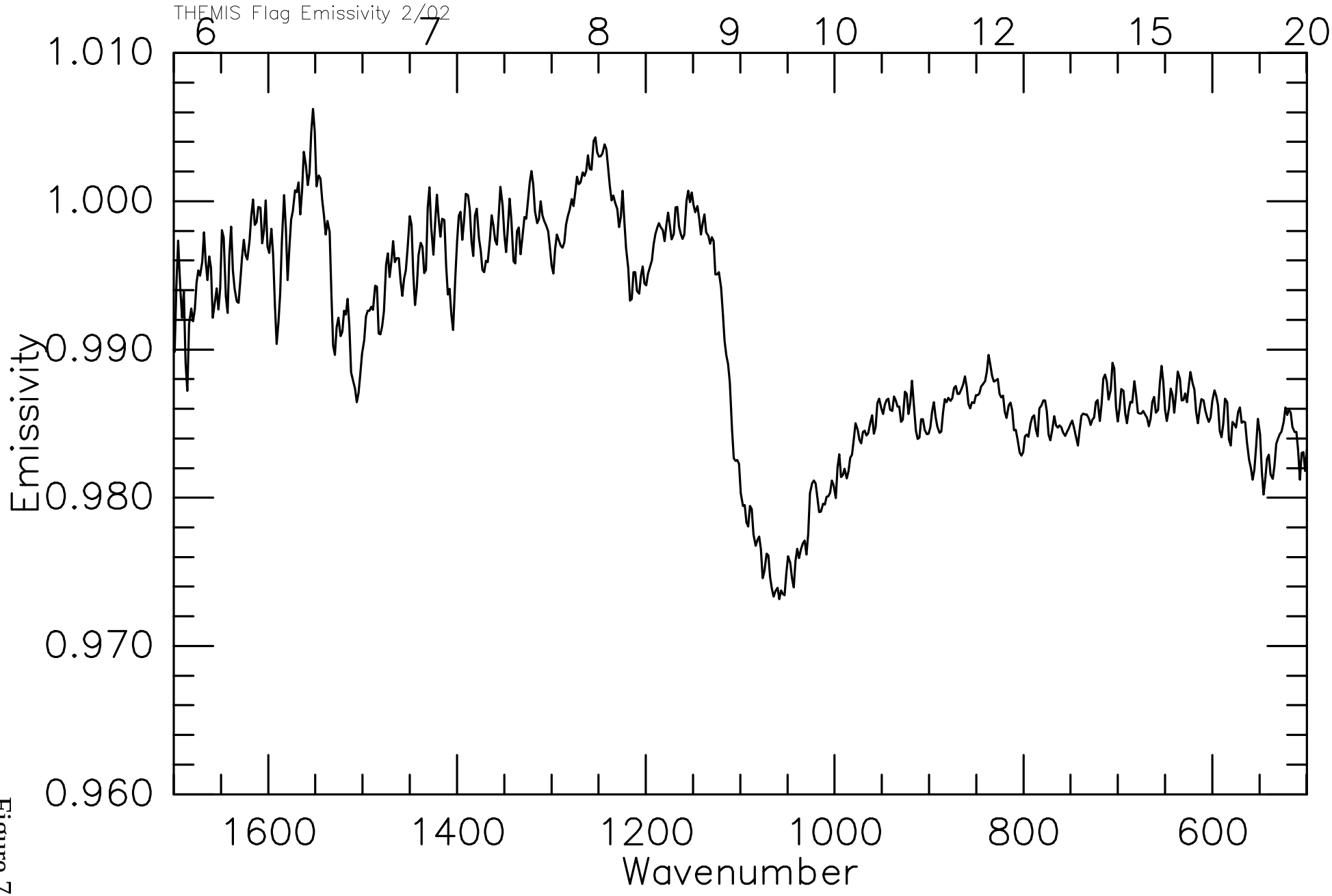

THEMIS Flag Emissivity 2/02
6
7
8
9
10
12
15
20
1.010
1.000
0.990
0.980
0.970
0.960
Emissivity
1600
1400
1200
1000
800
600
Wavenumber

Figure 7-15a

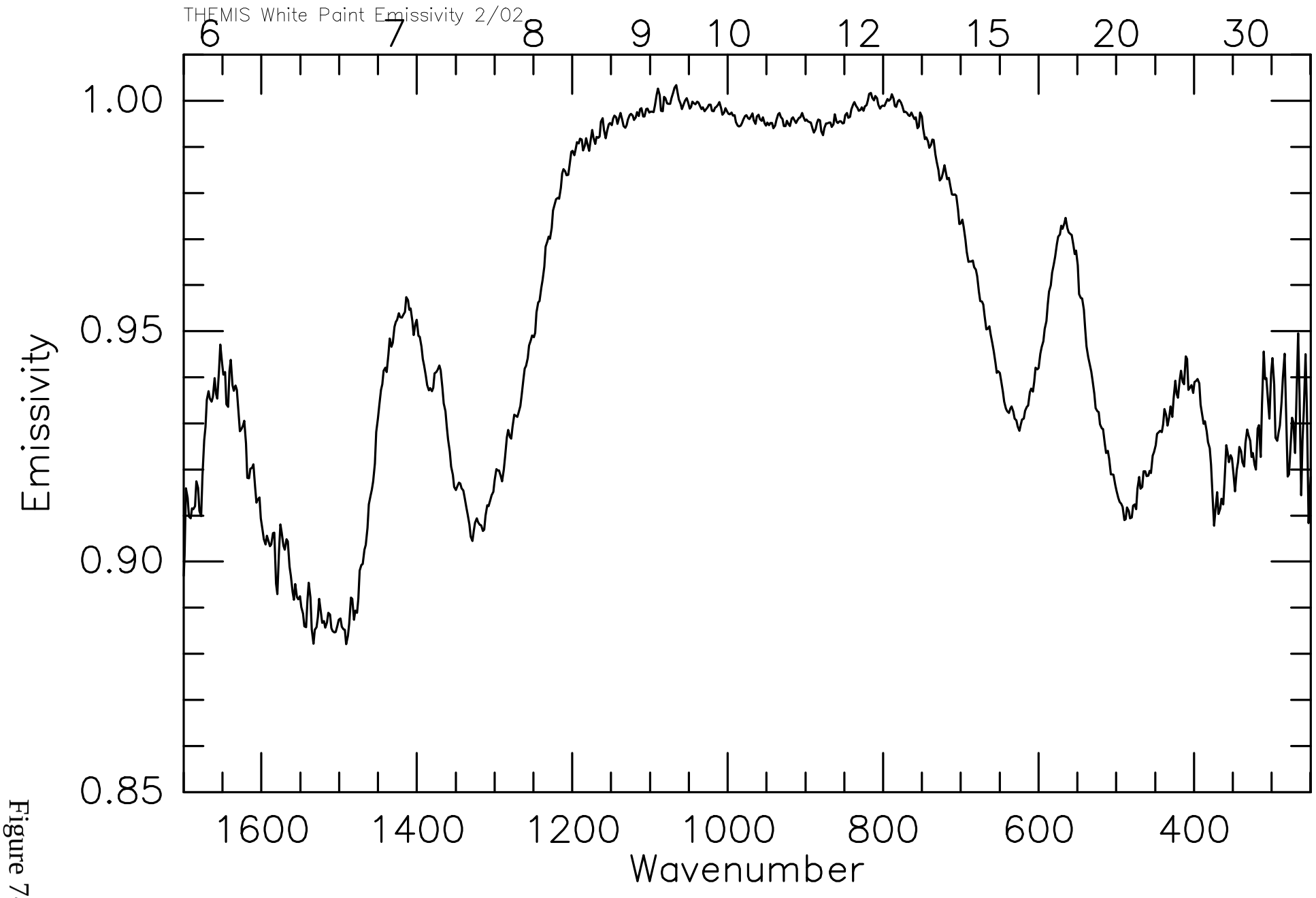

THEMIS White Paint Emissivity 2/02
6
7
8
9
10
12
15
20
30
1.00
0.95
0.90
0.85
Emissivity
1600
1400
1200
1000
800
600
400
Wavenumber

Figure 7-15b

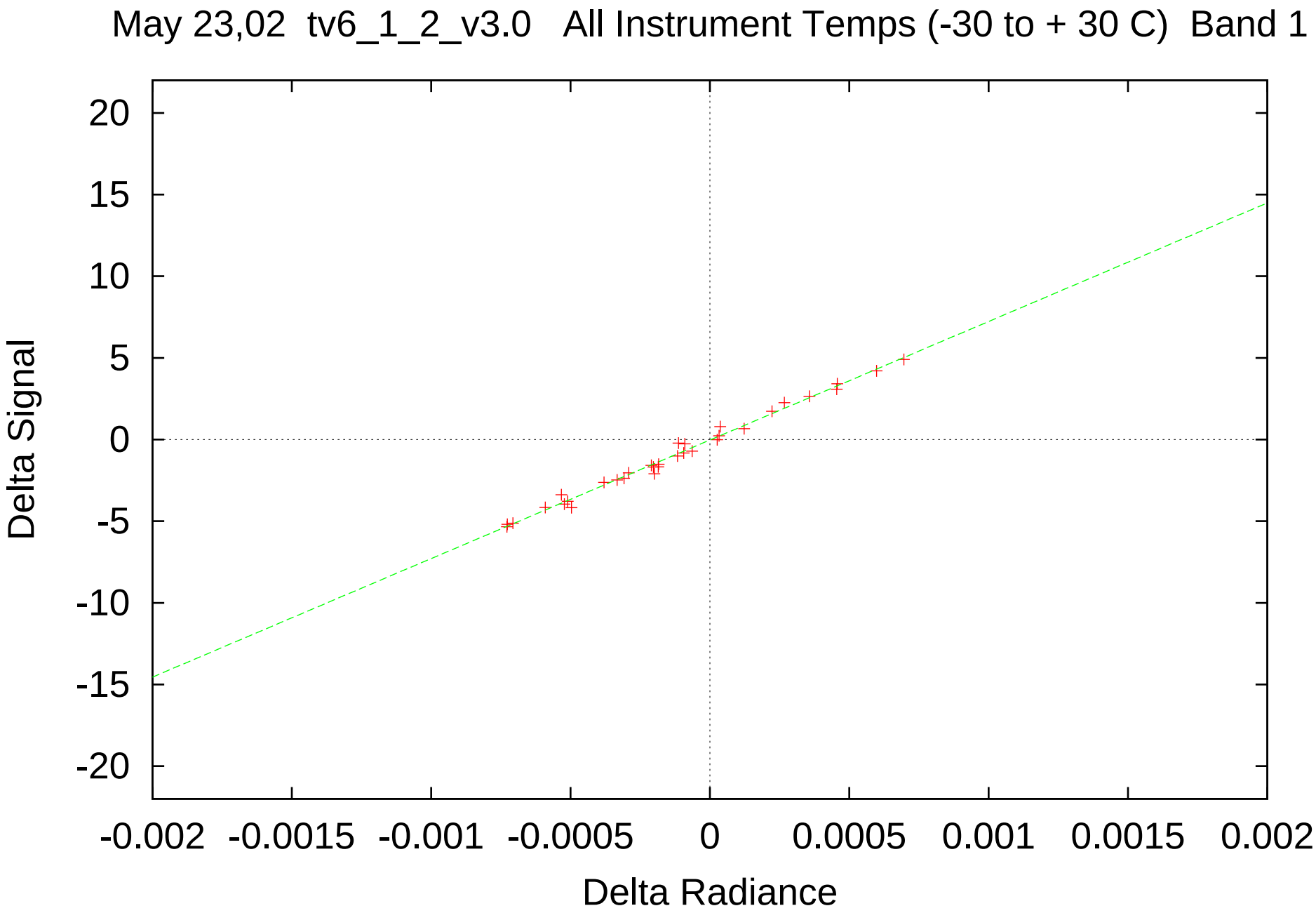

May 23,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 1
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16a

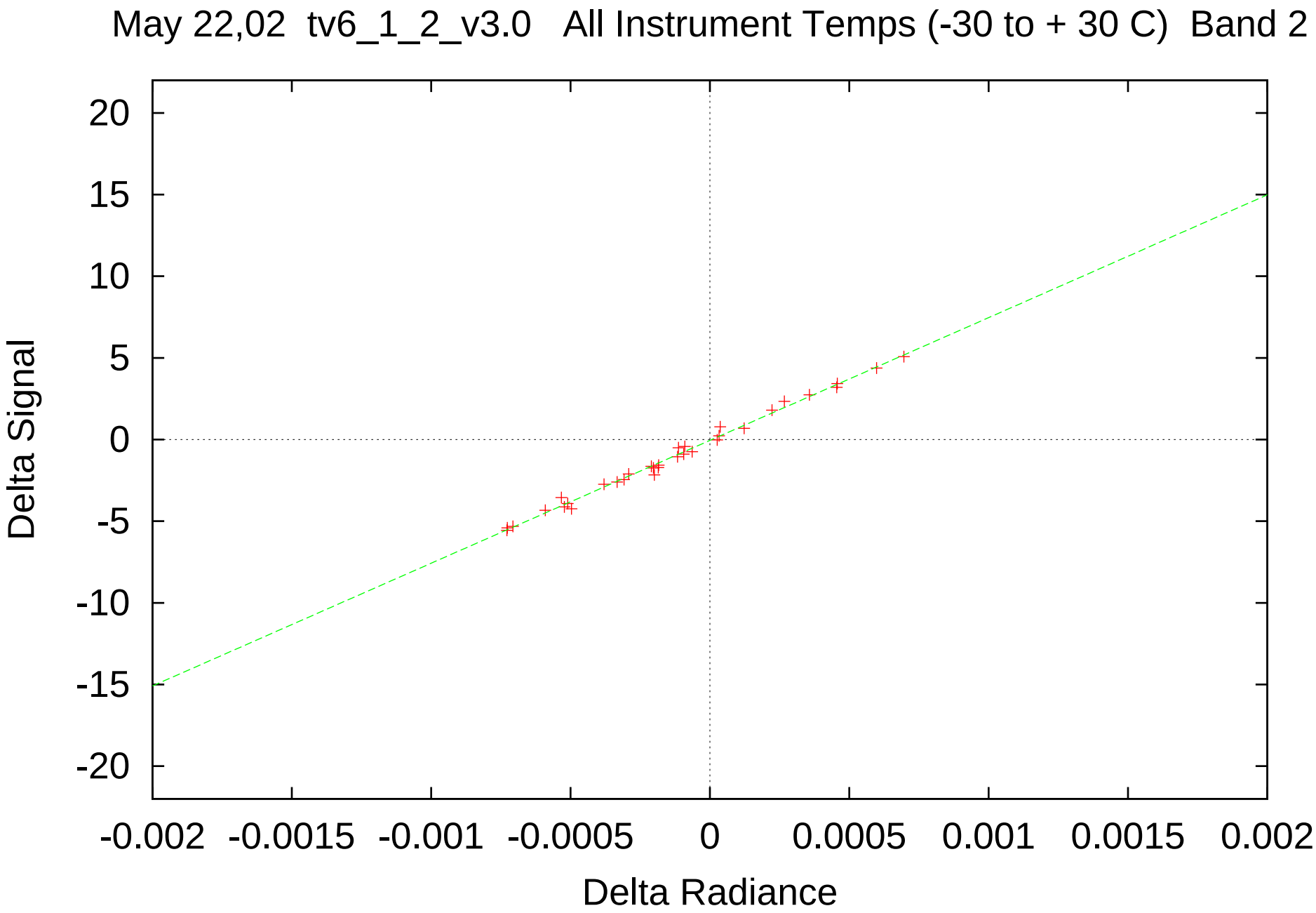

May 22,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 2
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16b

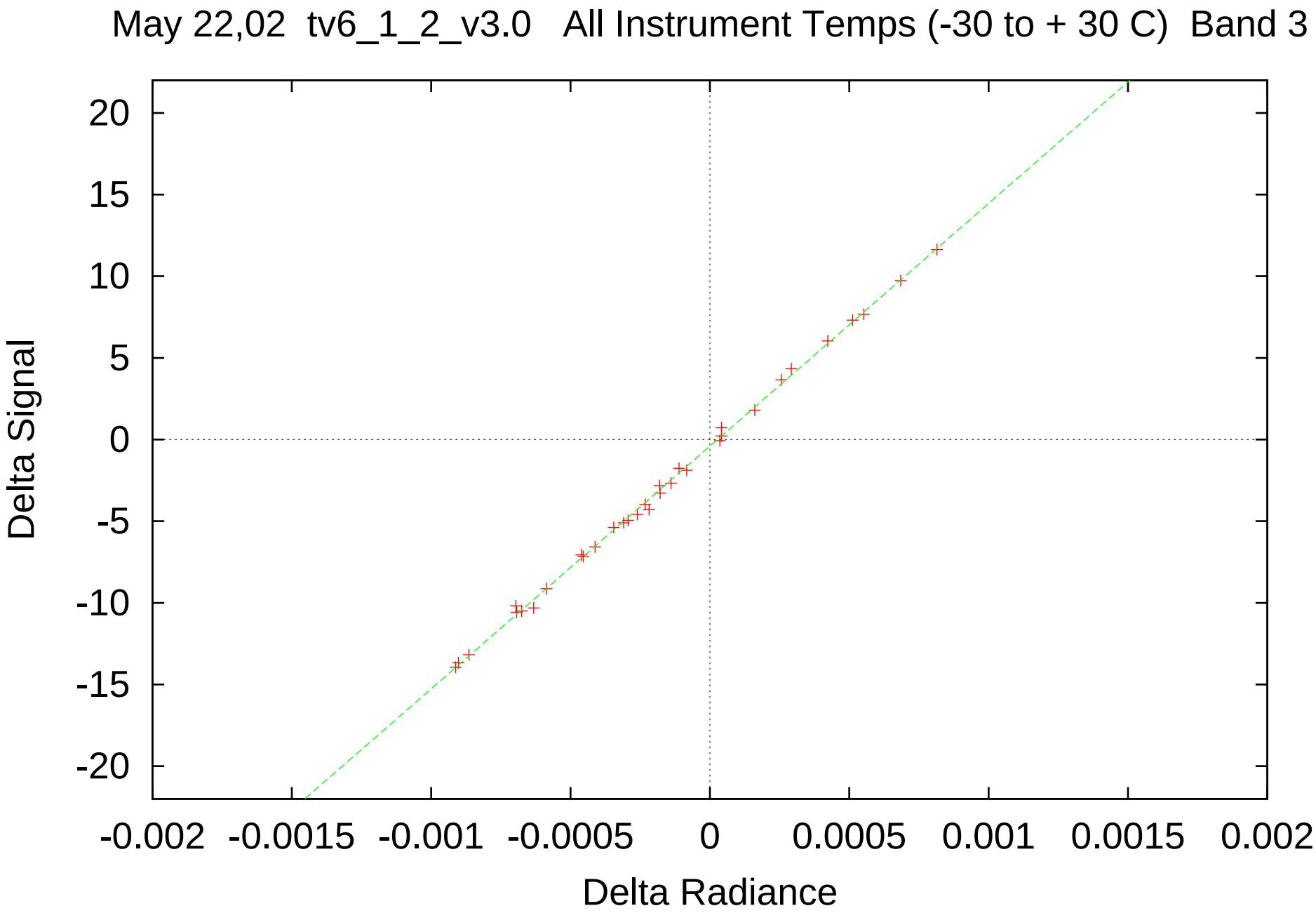

May 22,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 3
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16c

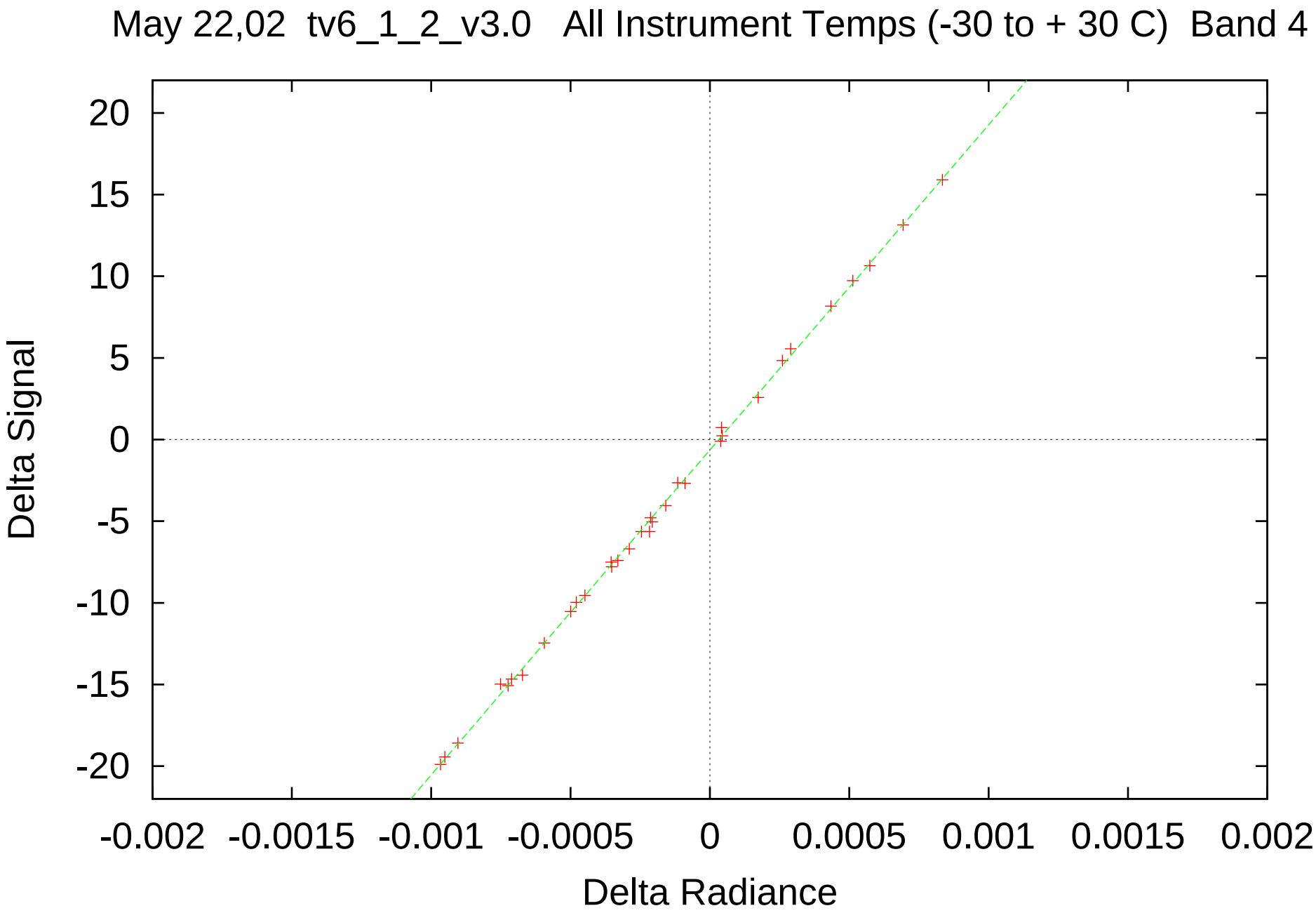

May 22,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 4
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16d

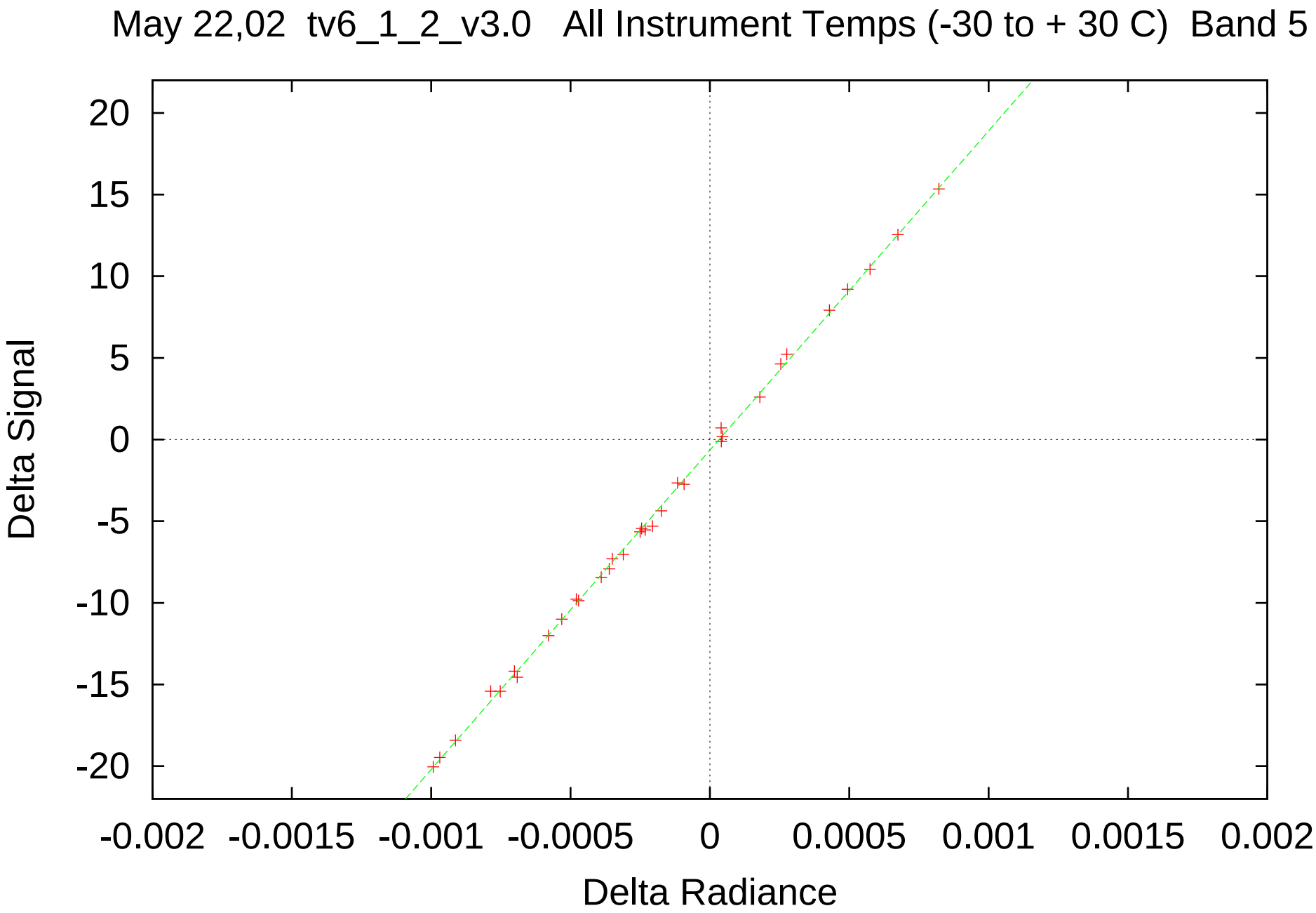

May 22,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 5
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16e

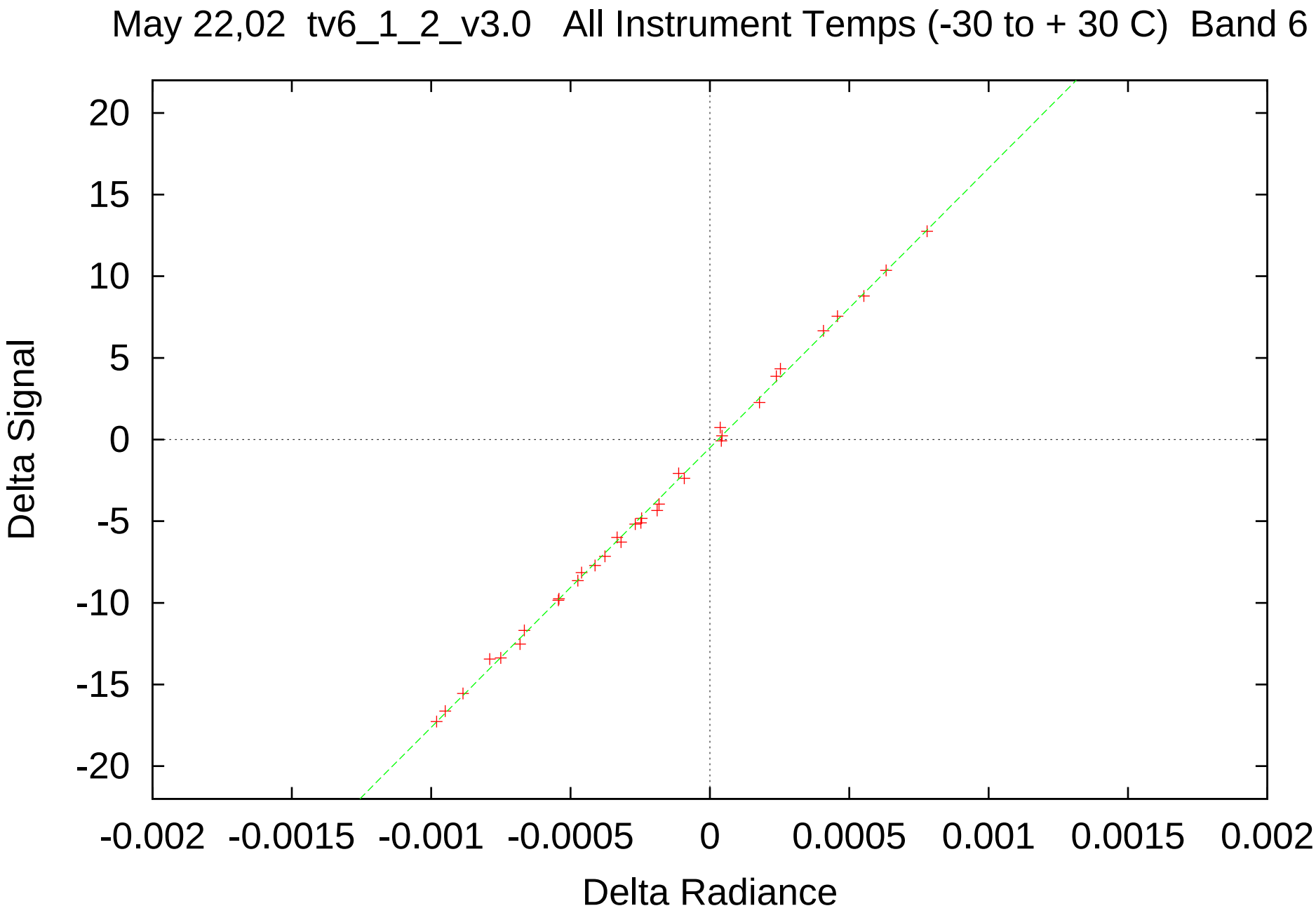

May 22,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 6
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16f

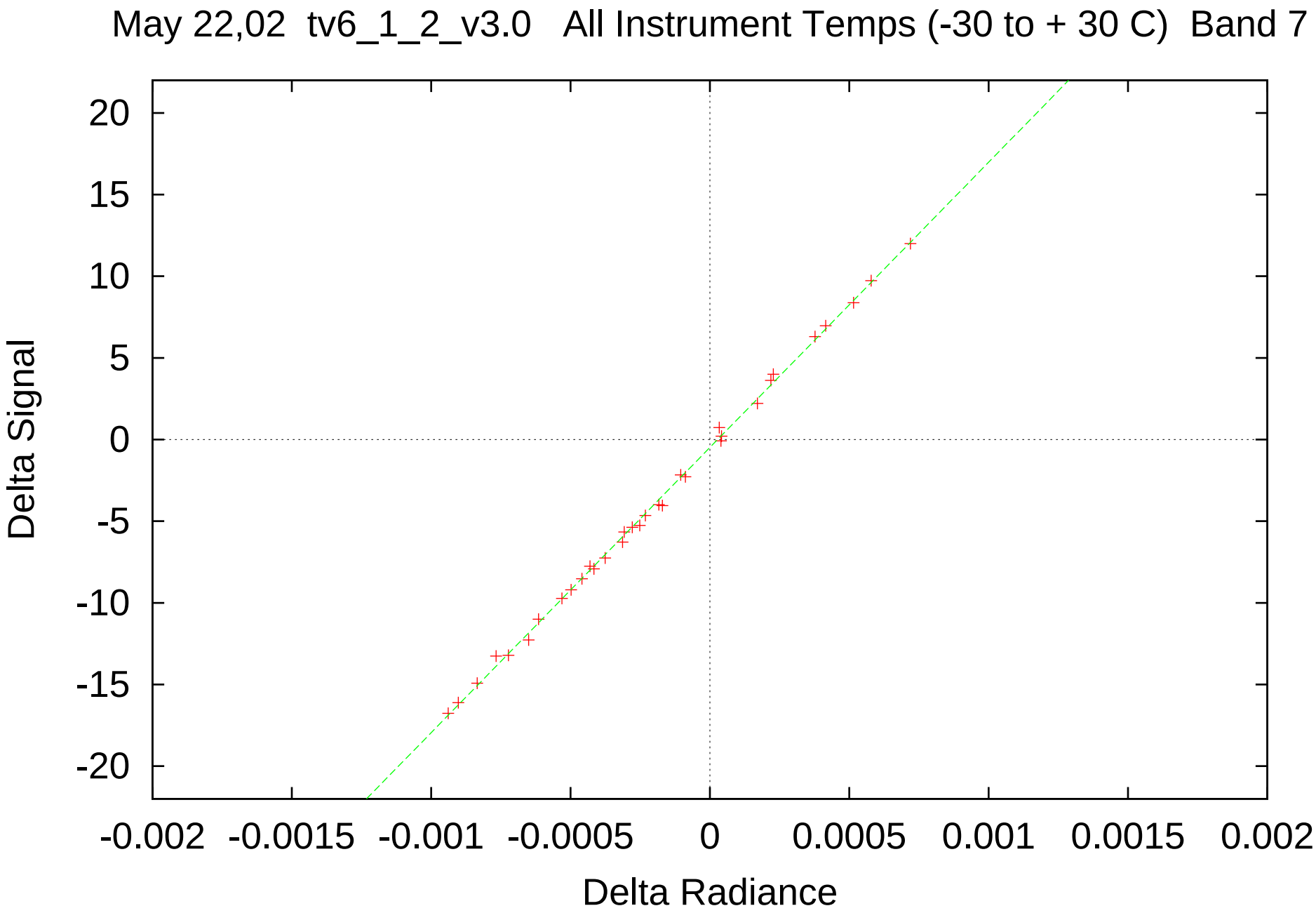

May 22,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 7
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16g

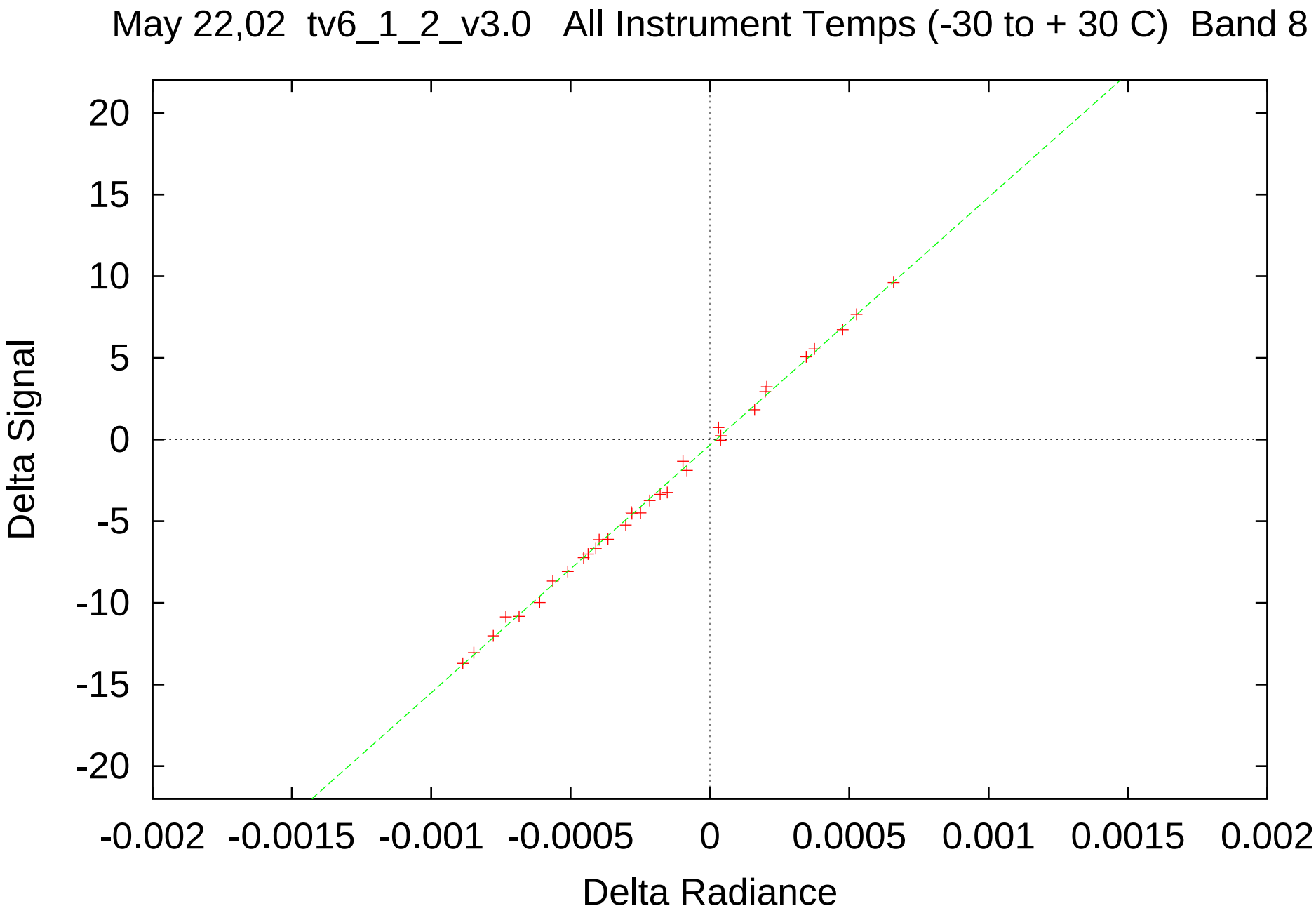

May 22,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 8
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16h

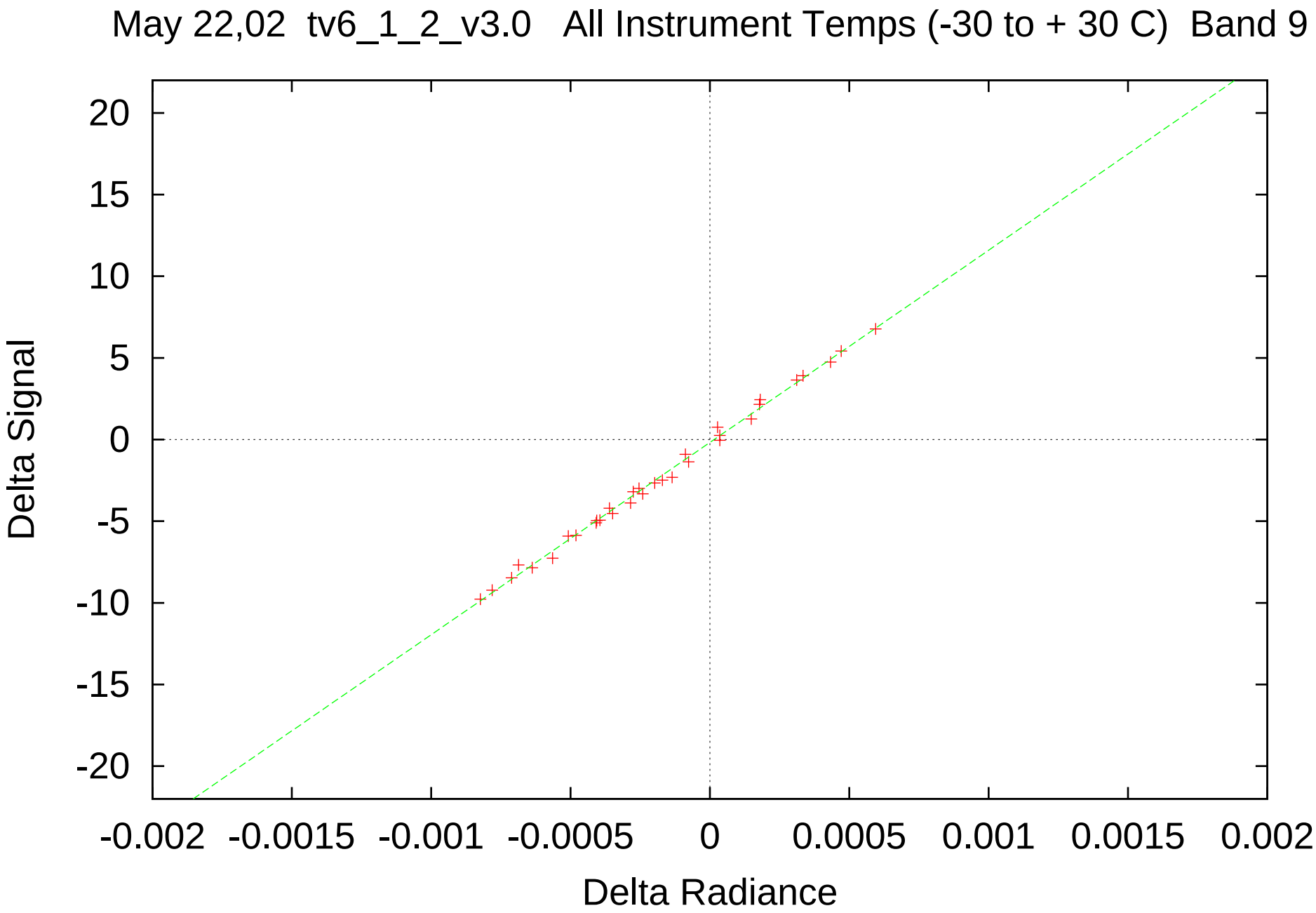

May 22,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 9
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16i

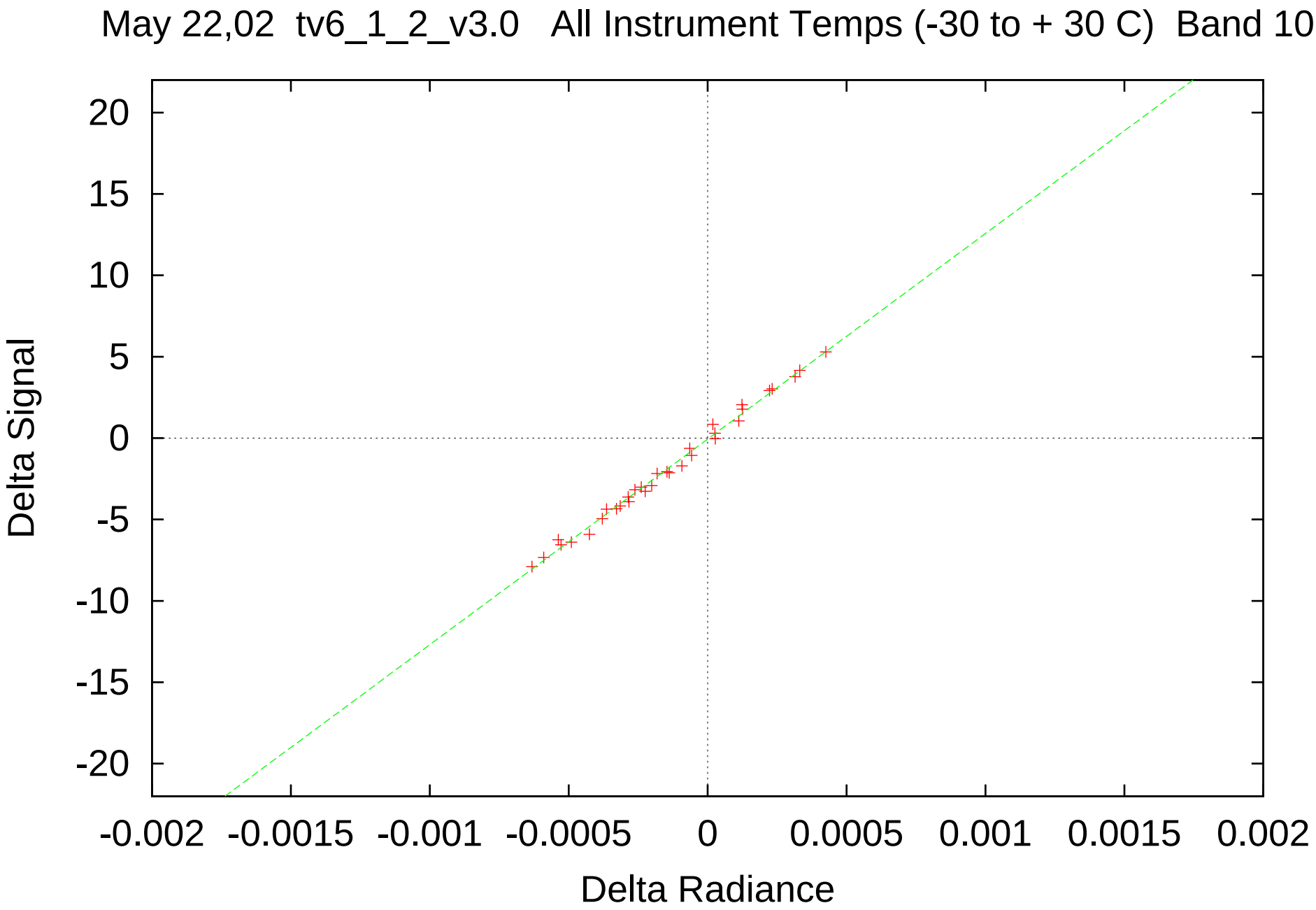

May 22,02 tv6_1_2_v3.0 All Instrument Temps (-30 to + 30 C) Band 10
Delta Signal
20
15
10
5
0
-5
-10
-15
-20
-0.002
-0.0015
-0.001
-0.0005
0
0.0005
0.001
0.0015
0.002
Delta Radiance

Figure 7-16j

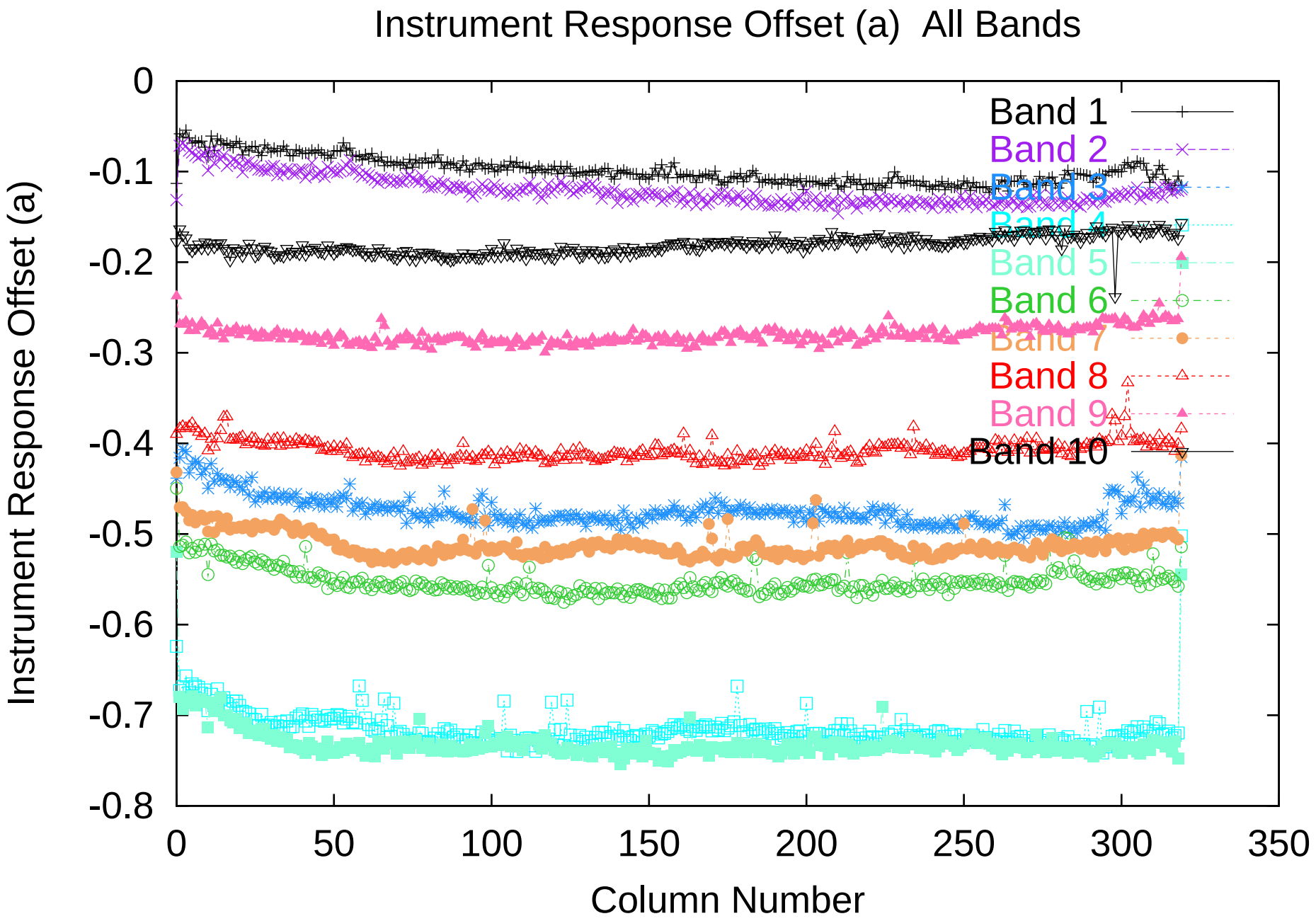

Instrument Response Offset (a) All Bands
Instrument Response Offset (a)
Column Number
0
-0.1
-0.2
-0.3
-0.4
-0.5
-0.6
-0.7
-0.8
0
50
100
150
200
250
300
350
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10

Figure 7-17a

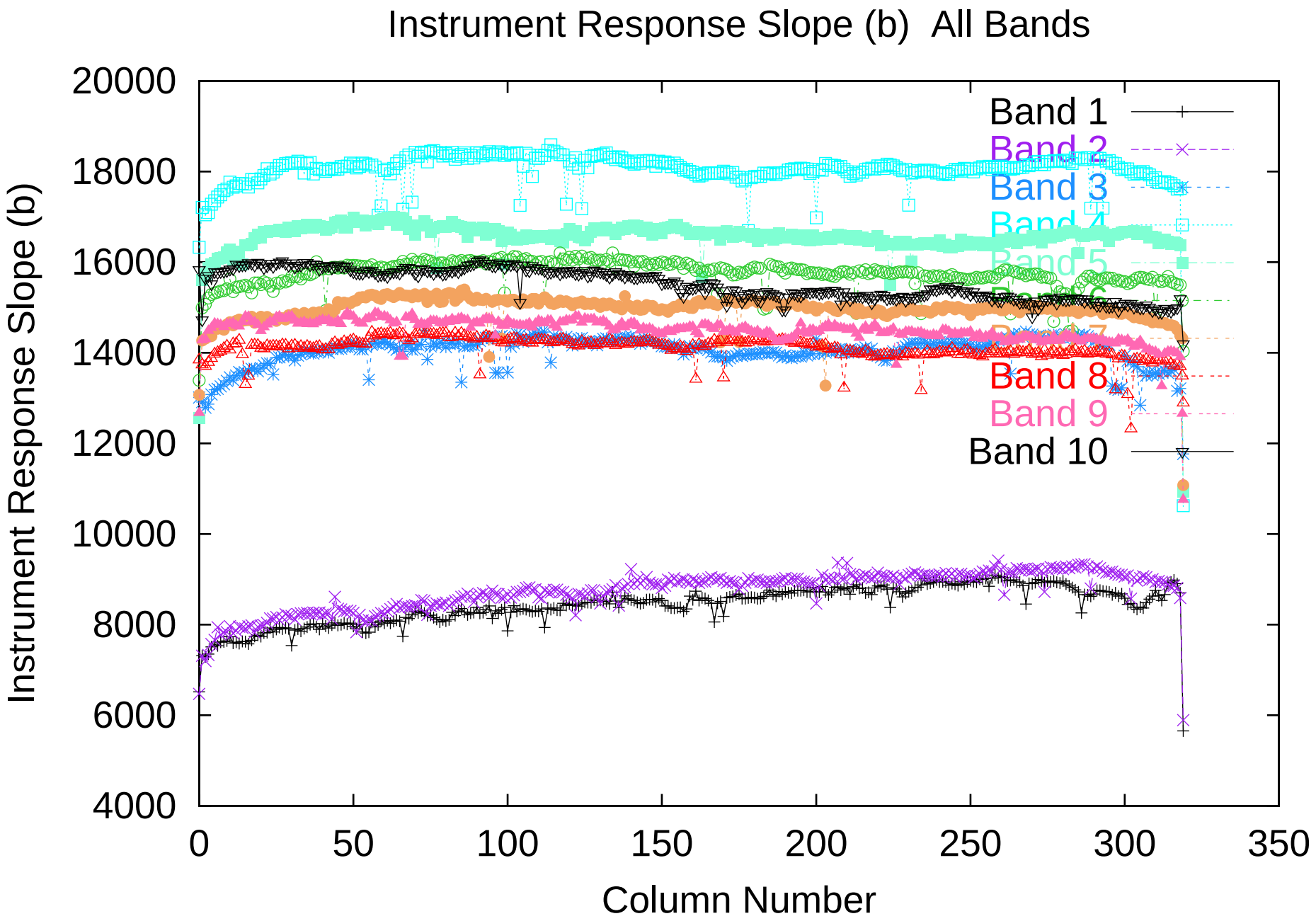

Instrument Response Slope (b) All Bands
Instrument Response Slope (b)
Column Number
20000
18000
16000
14000
12000
10000
8000
6000
4000
0
50
100
150
200
250
300
350
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10

Figure 7-17b

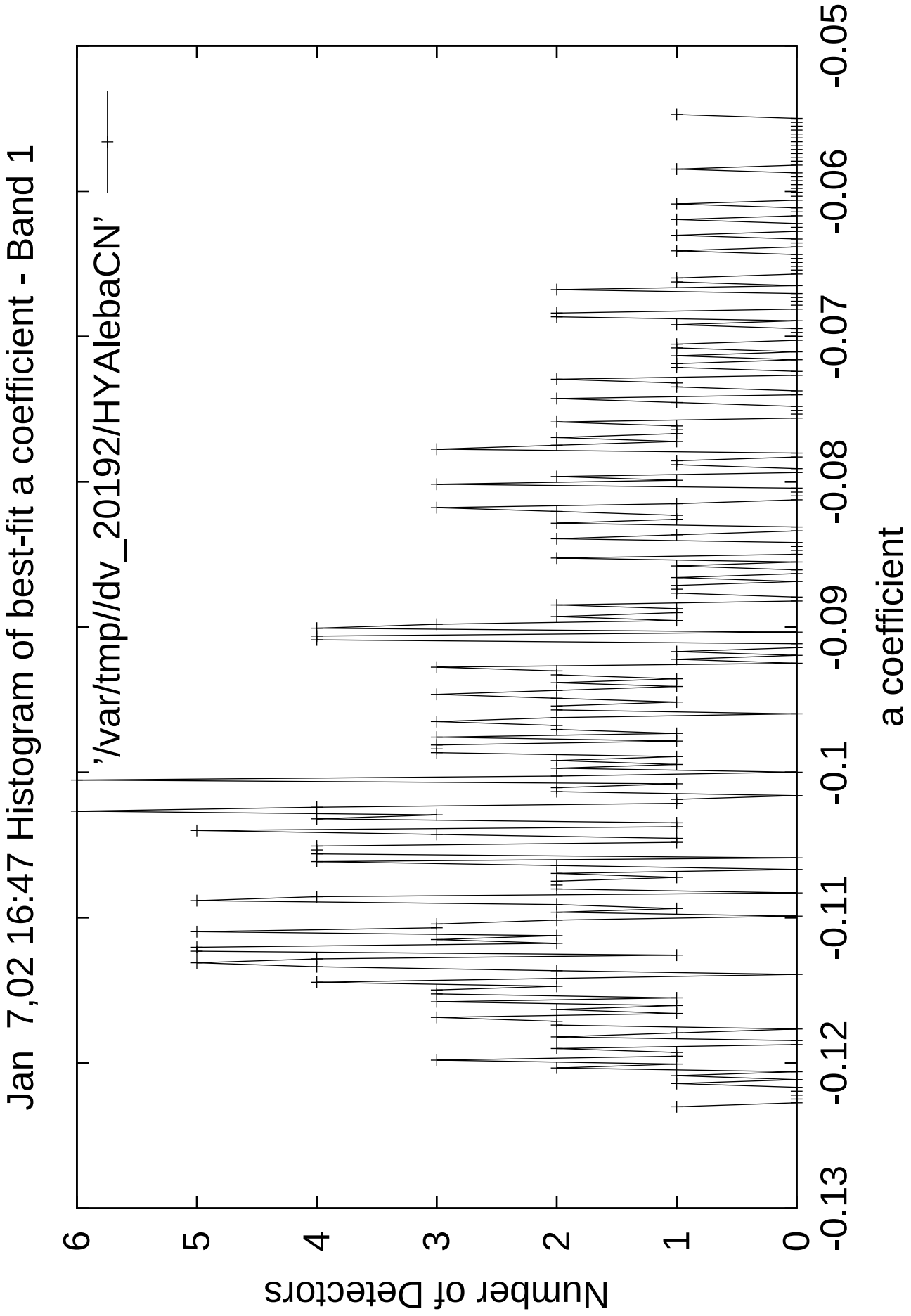


Figure 7-18-1a

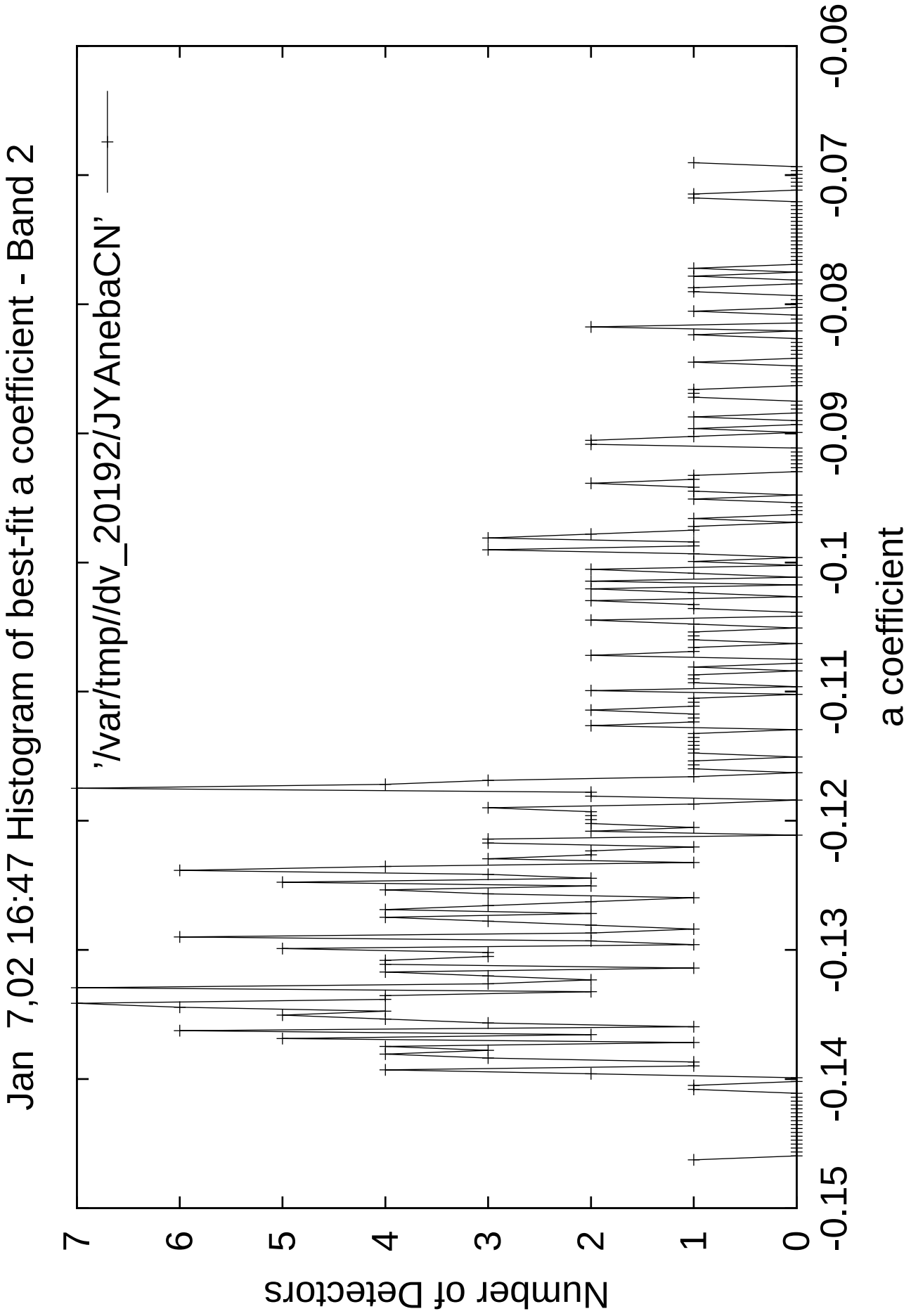


Figure 7-18-1b

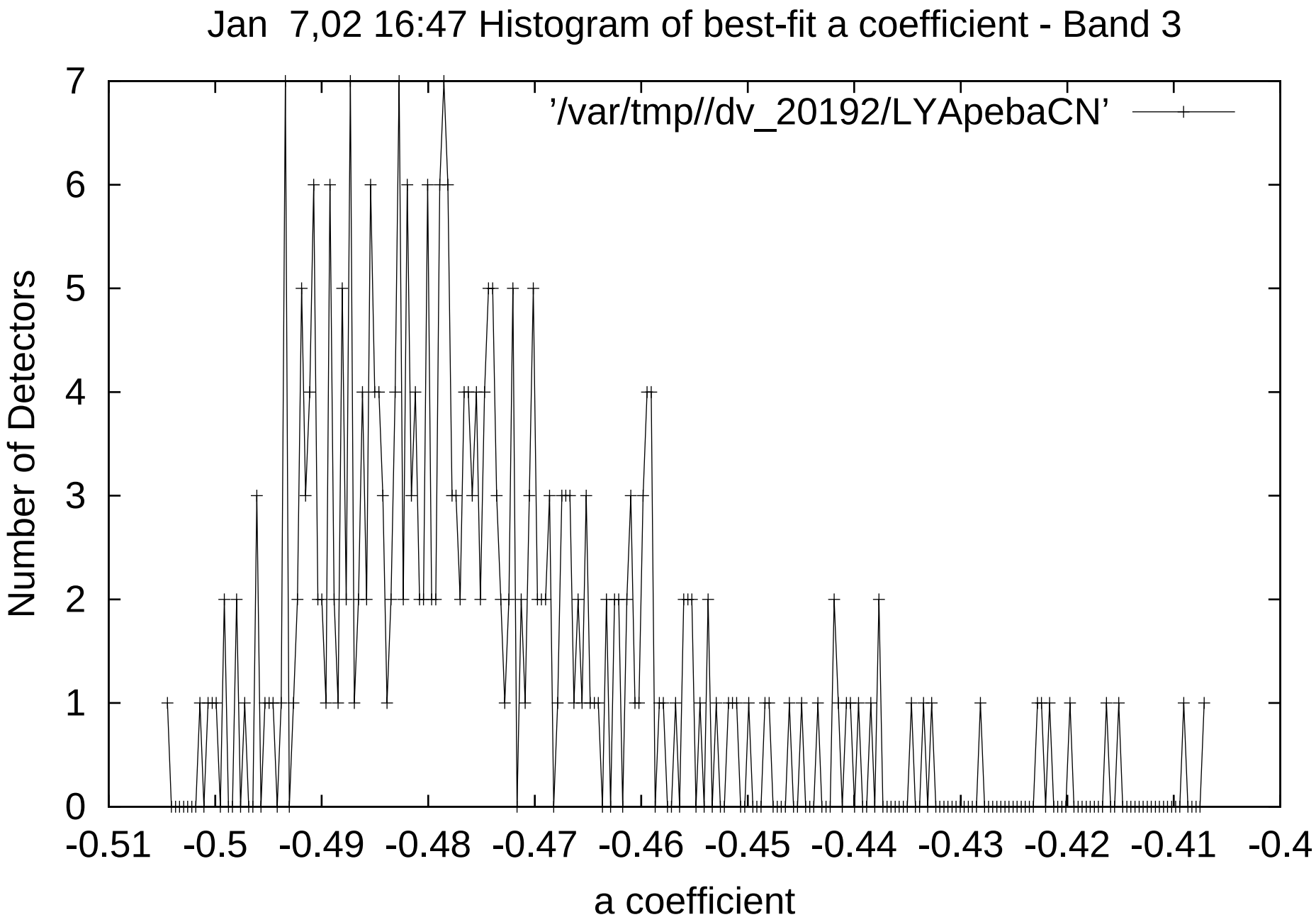


Figure 7-18-1c

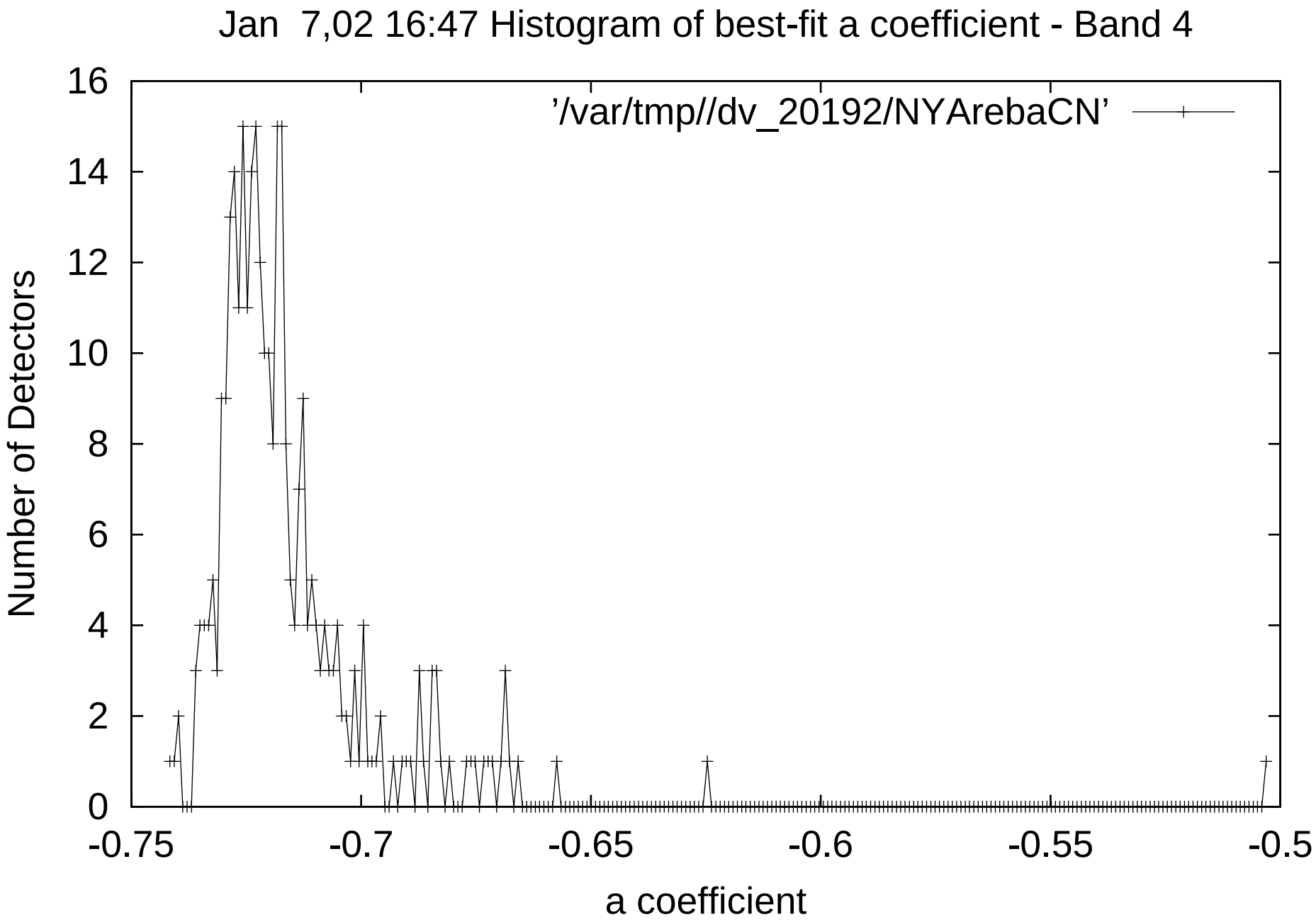


Figure 7-18-1d

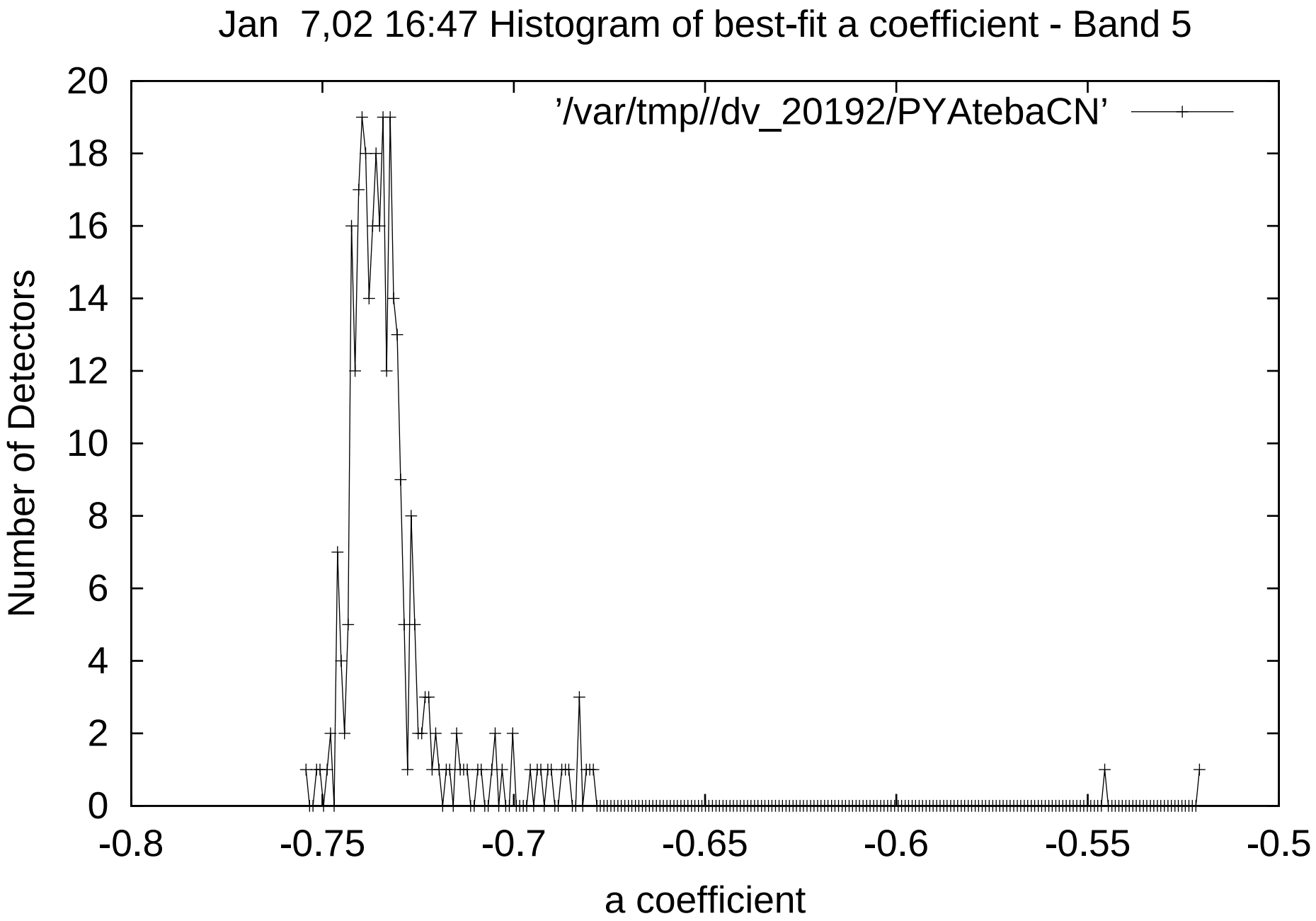


Figure 7-18-1e

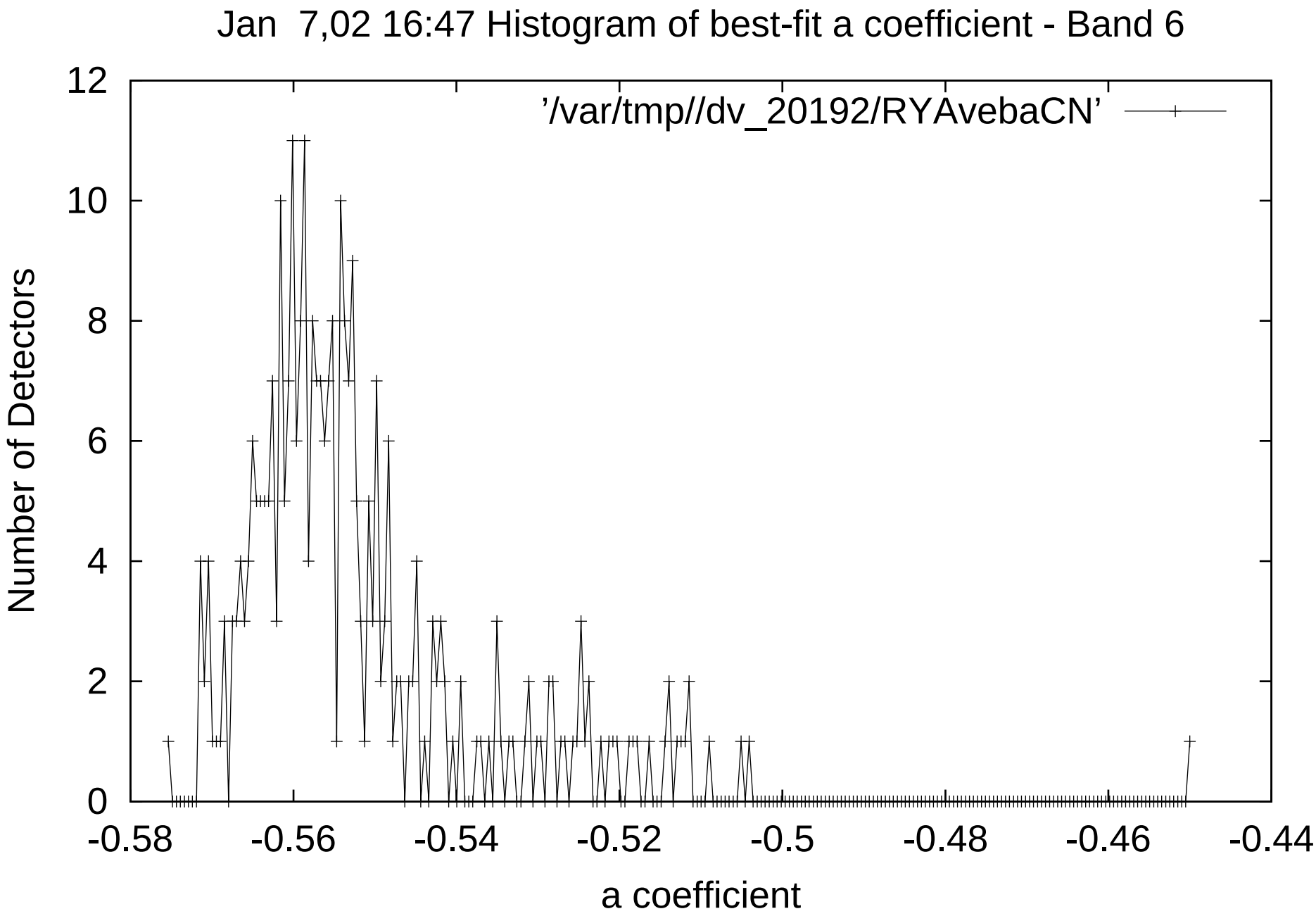


Figure 7-18-1f

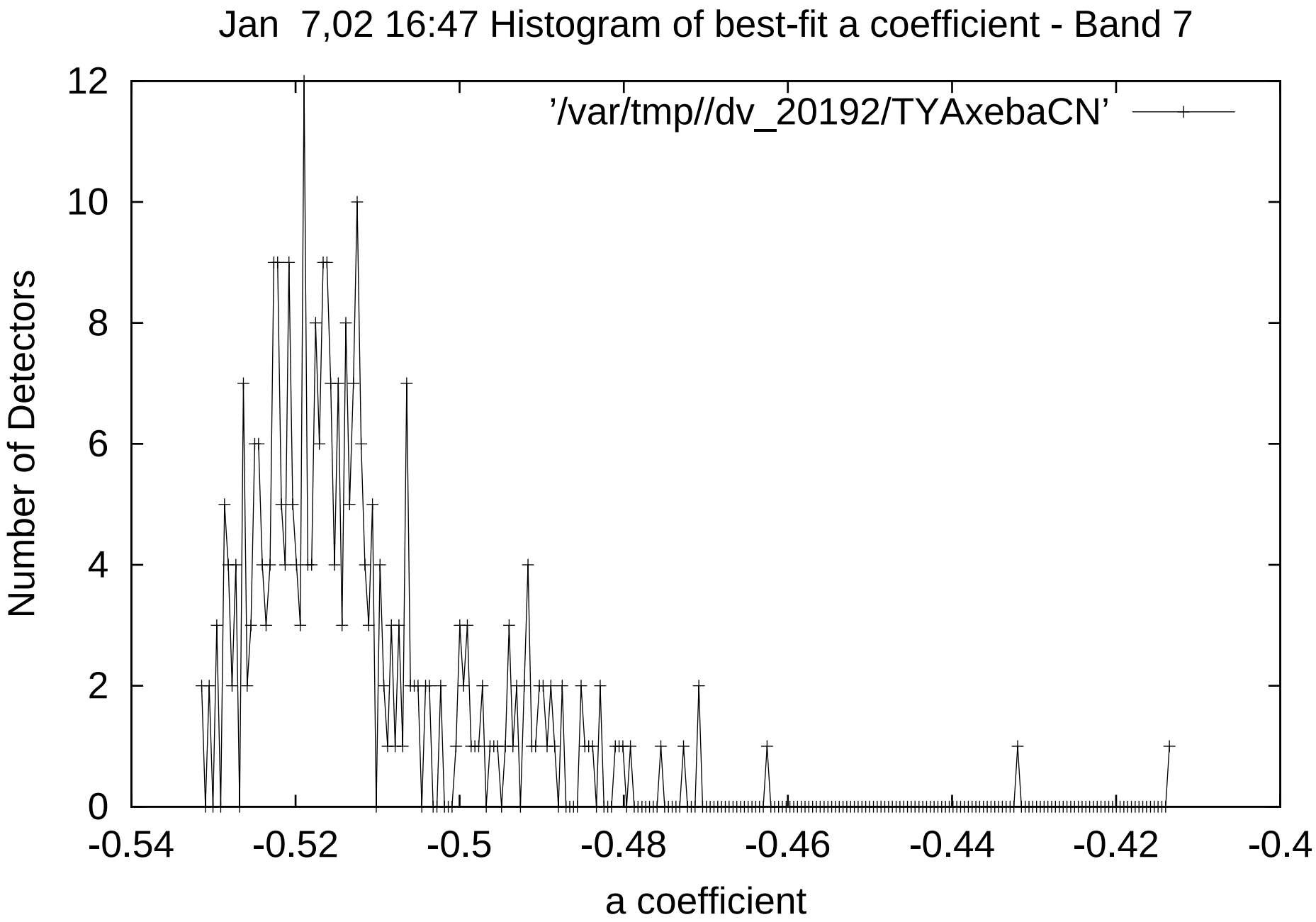


Figure 7-18-1g

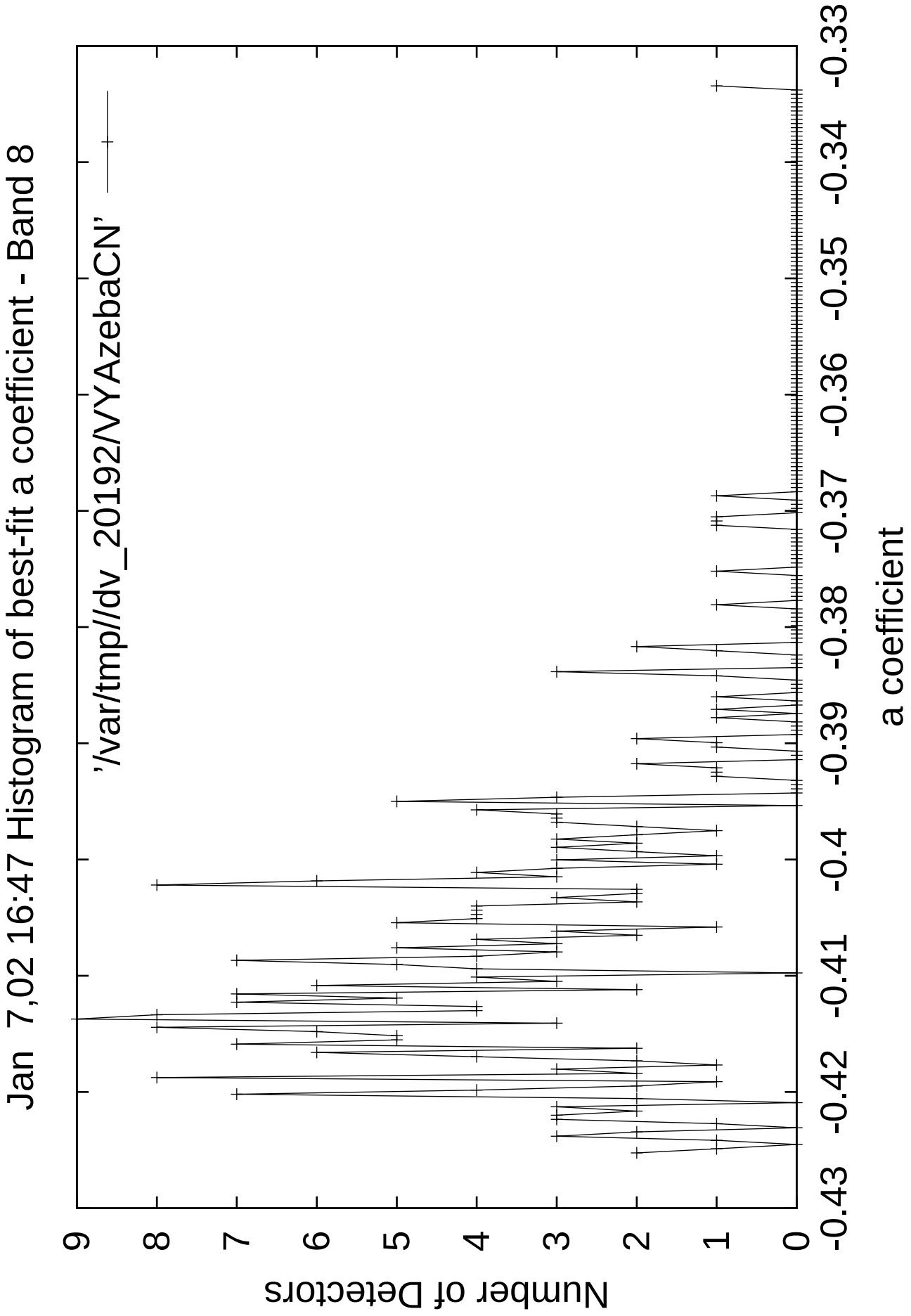


Figure 7-18-1h

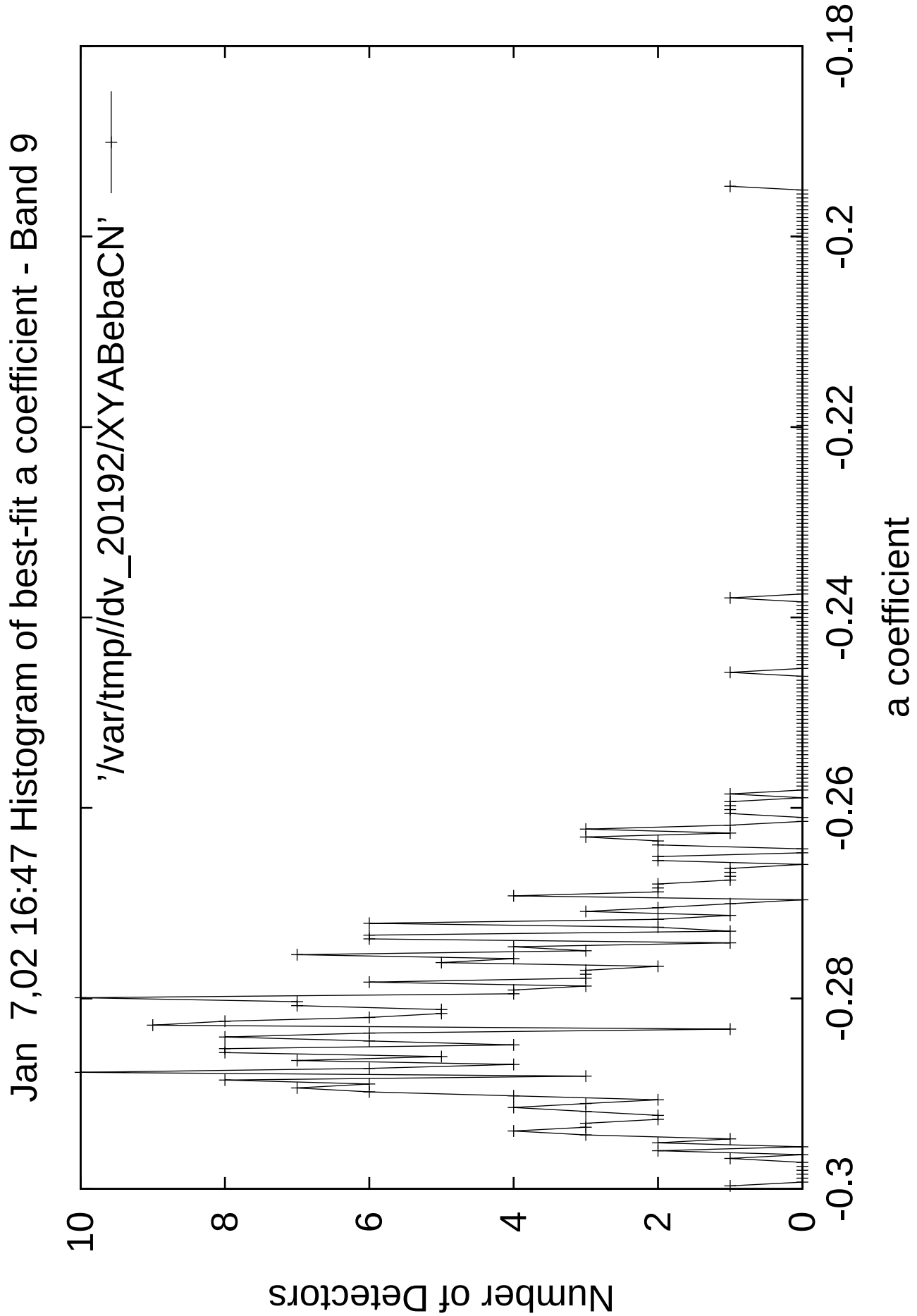


Figure 7-18-1i

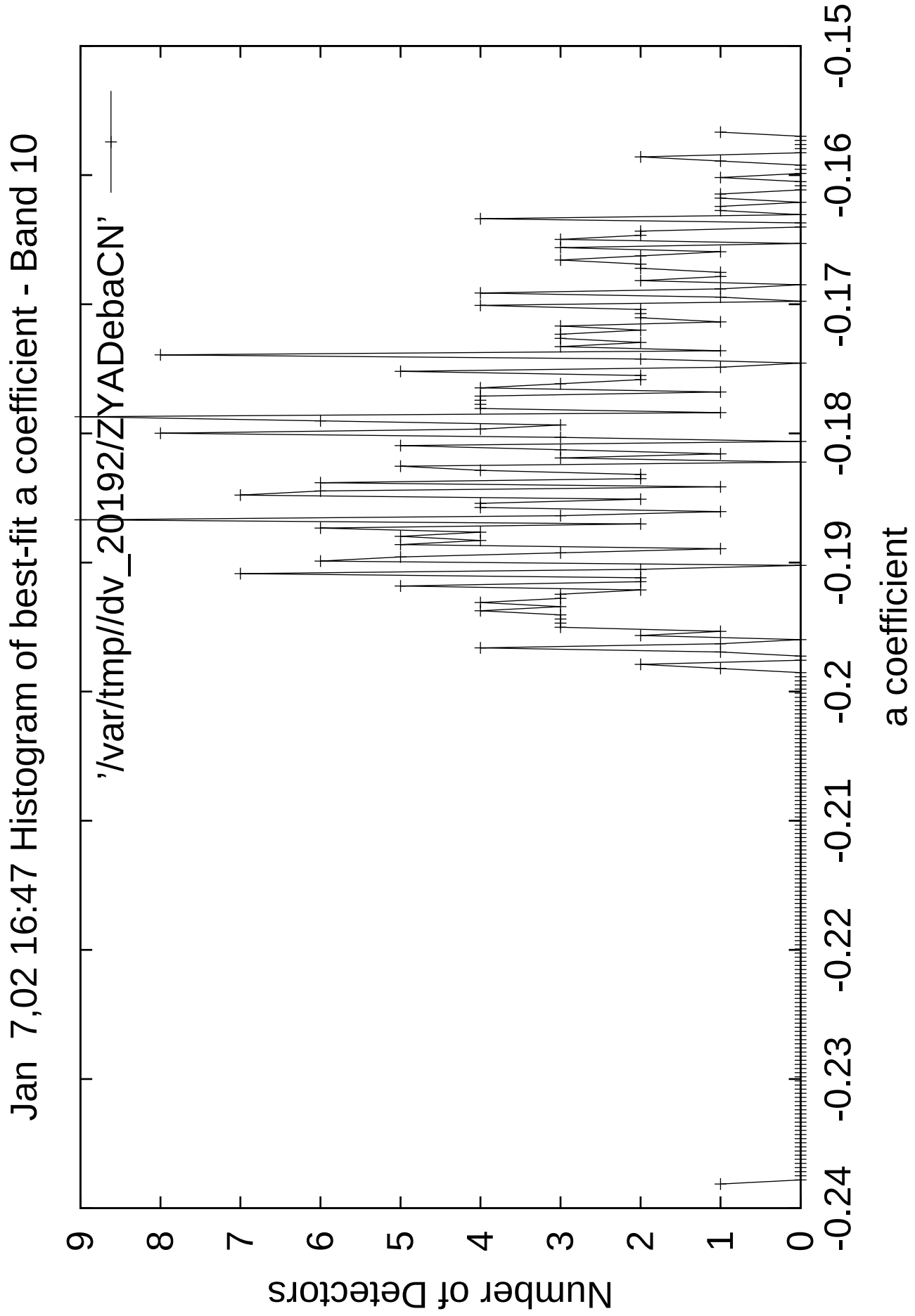


Figure 7-18-1j

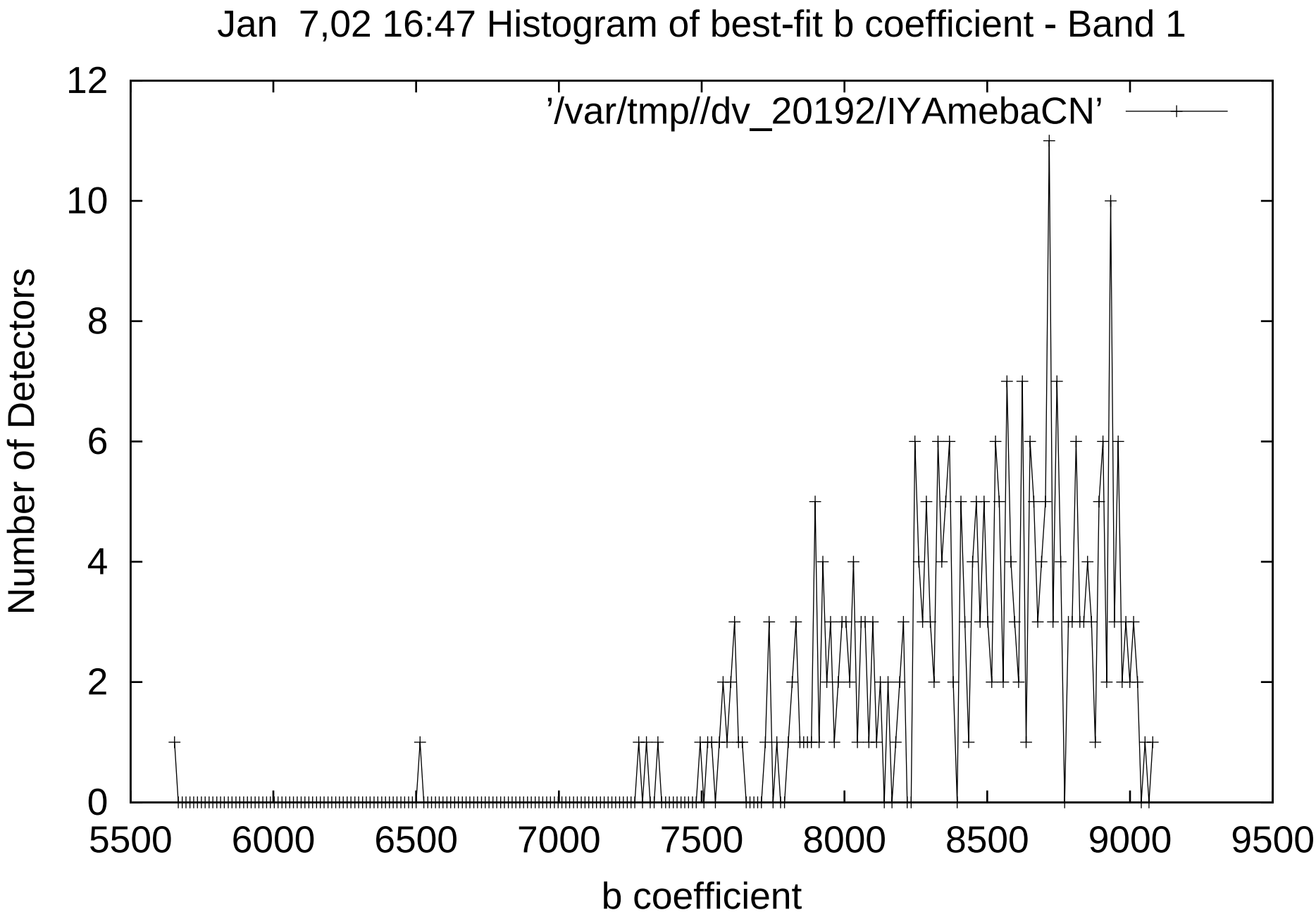


Figure 7-18-2a

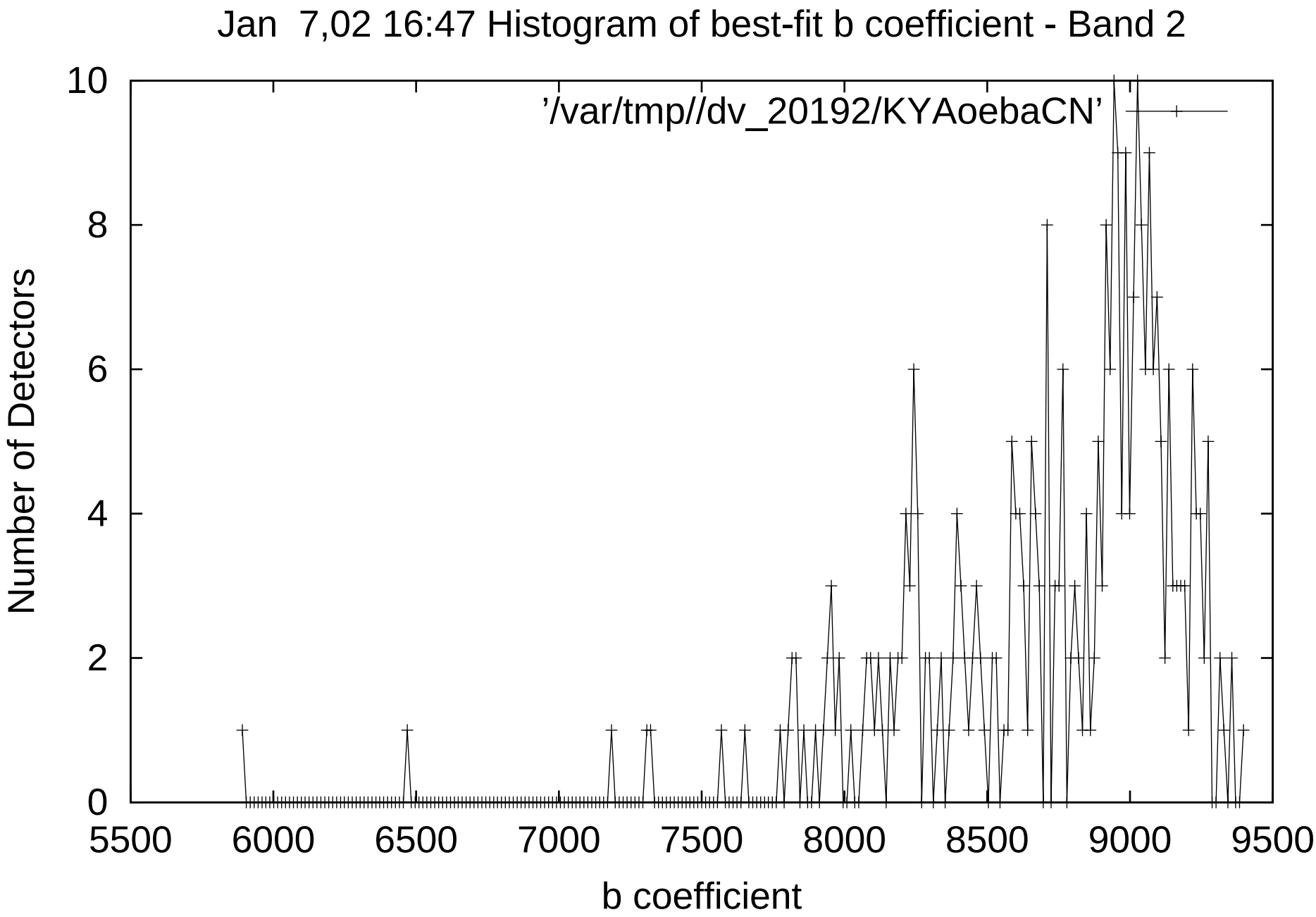


Figure 7-18-2b

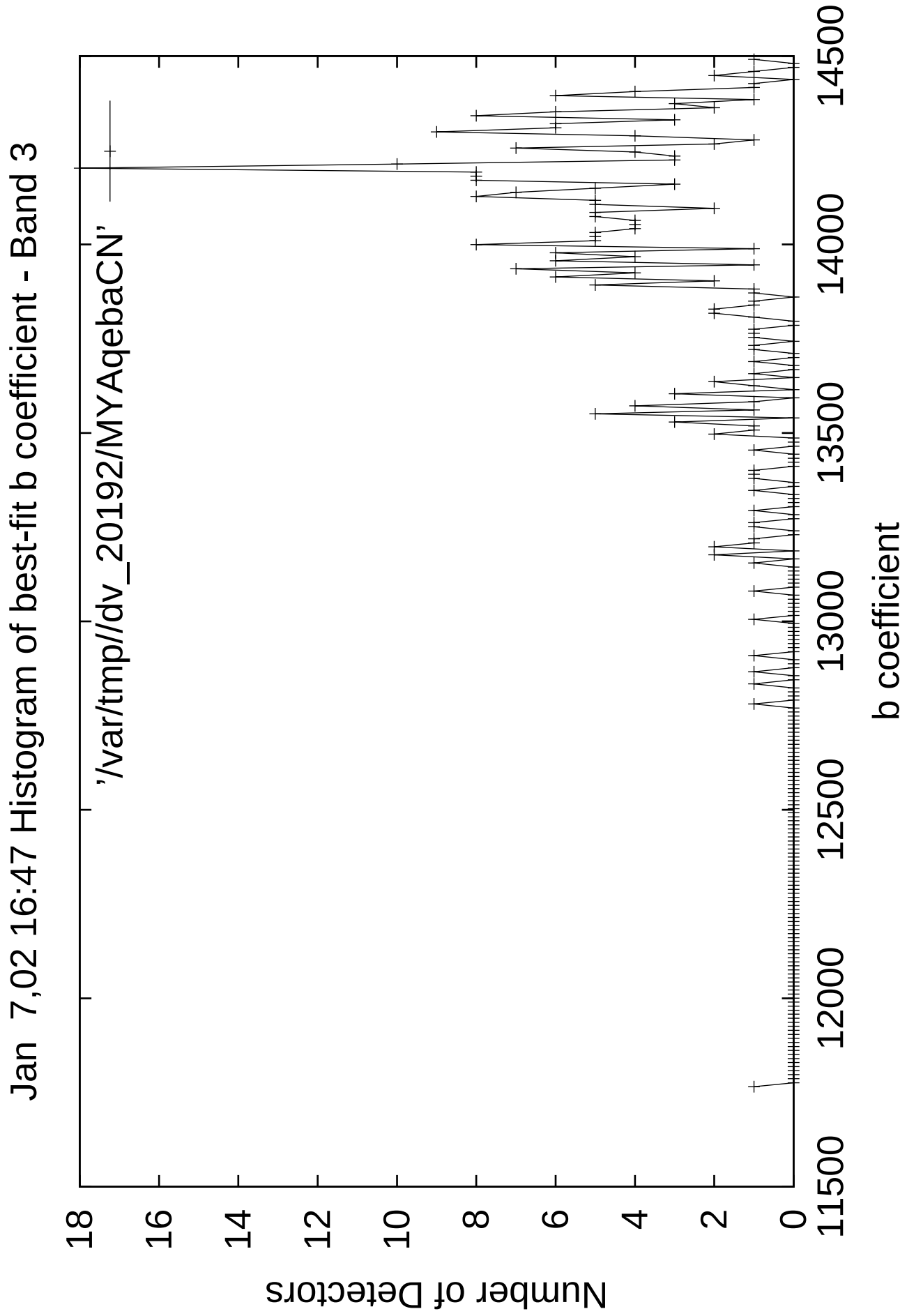


Figure 7-18-2c

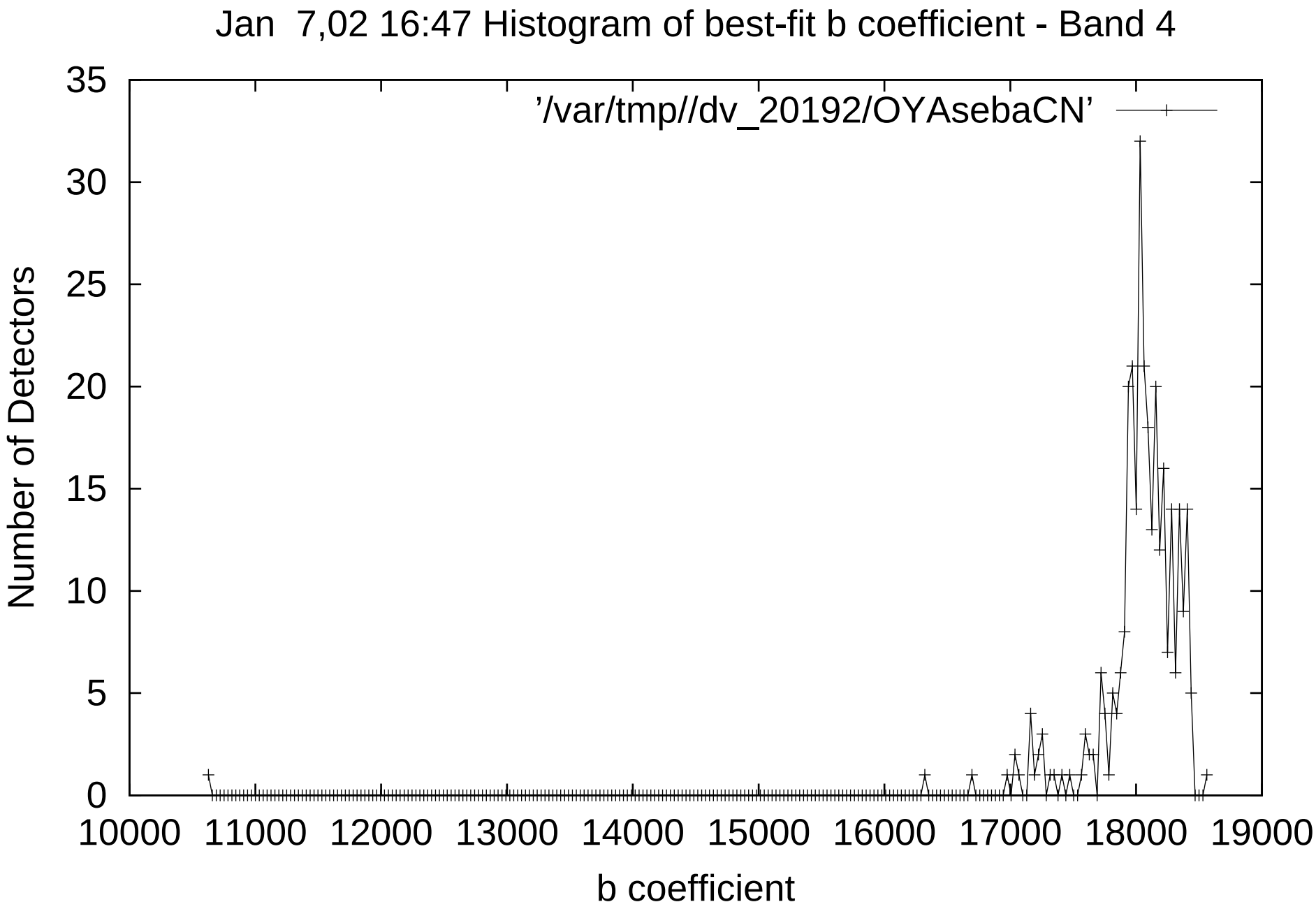


Figure 7-18-2d

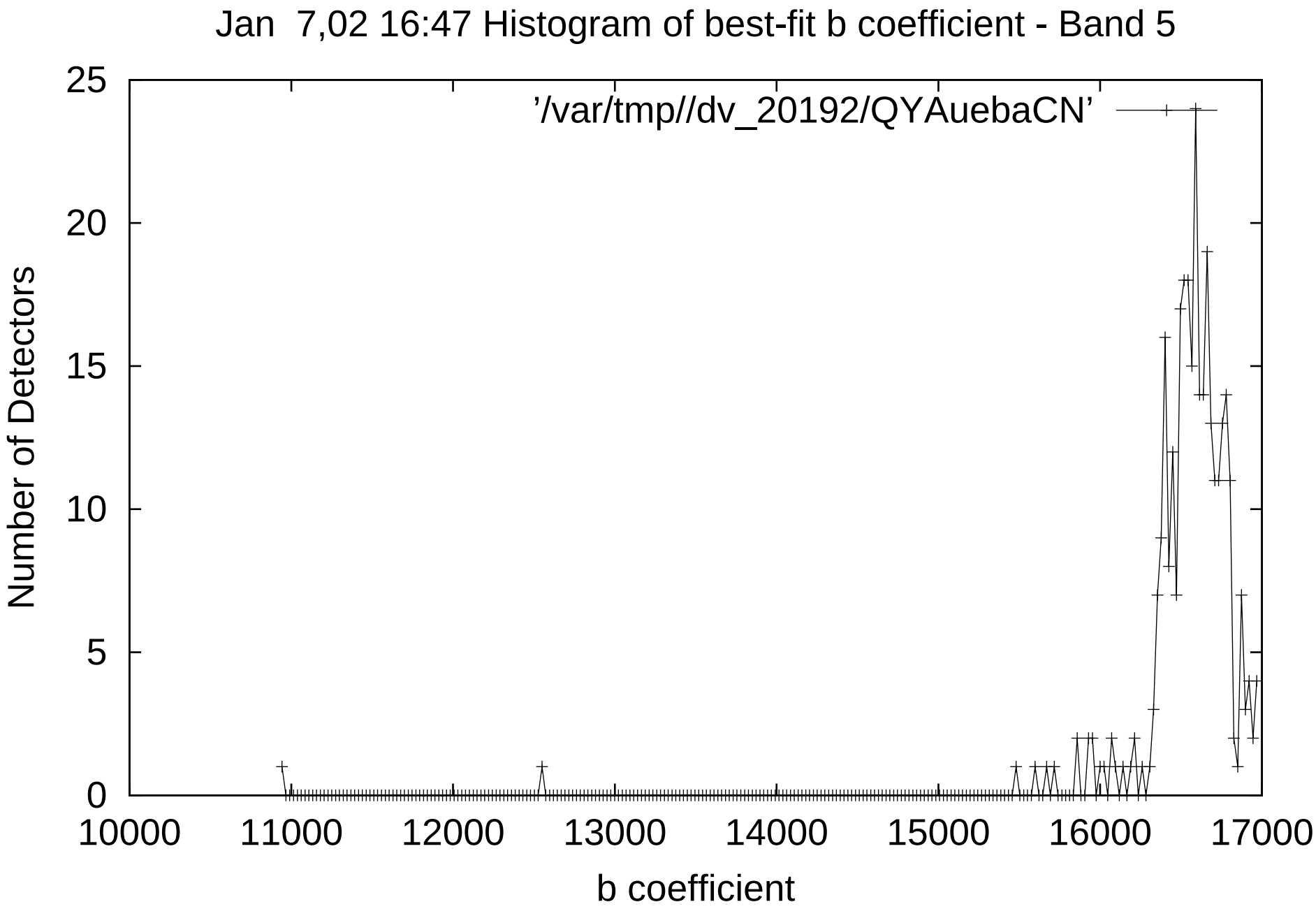


Figure 7-18-2e

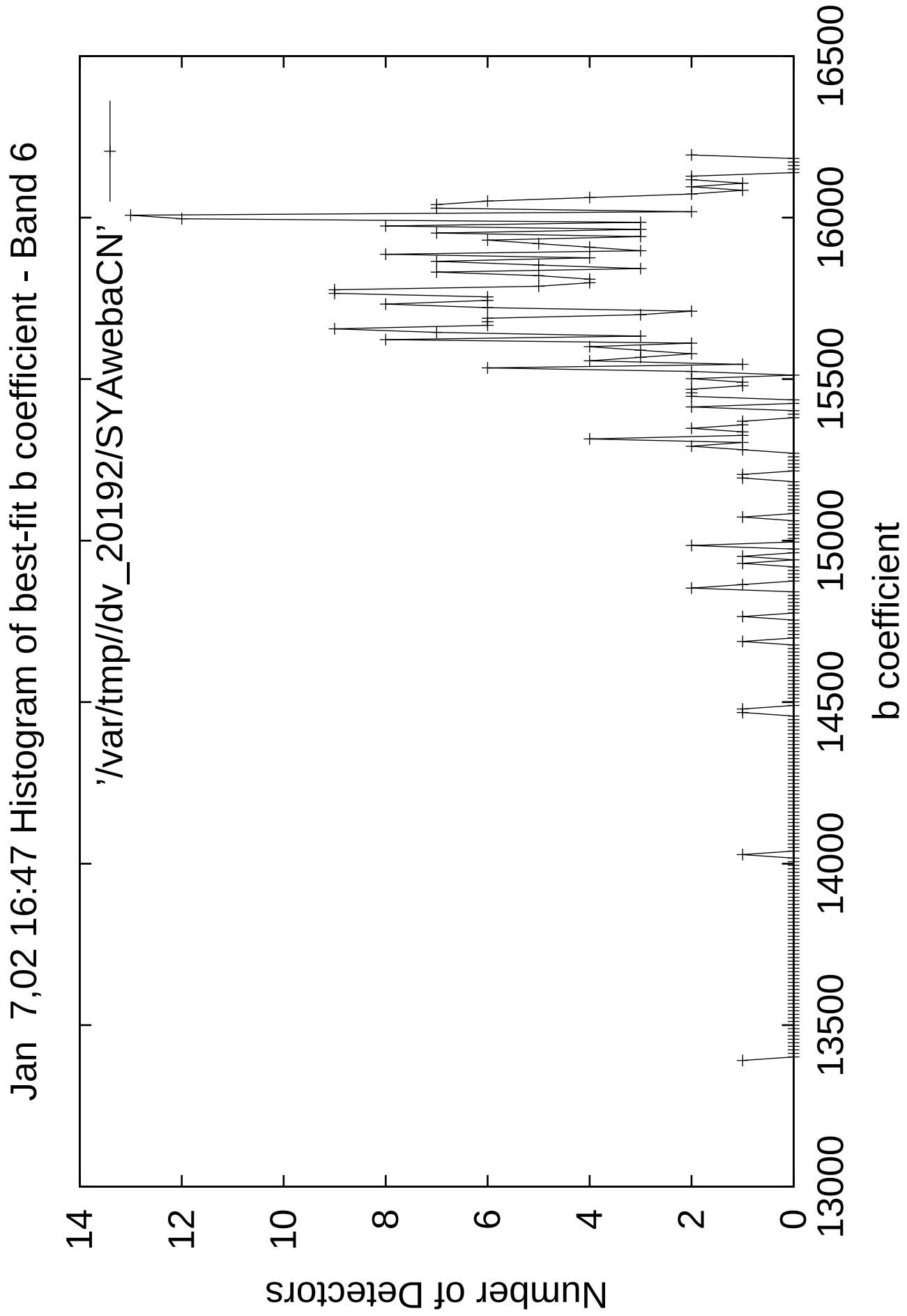


Figure 7-18-2f

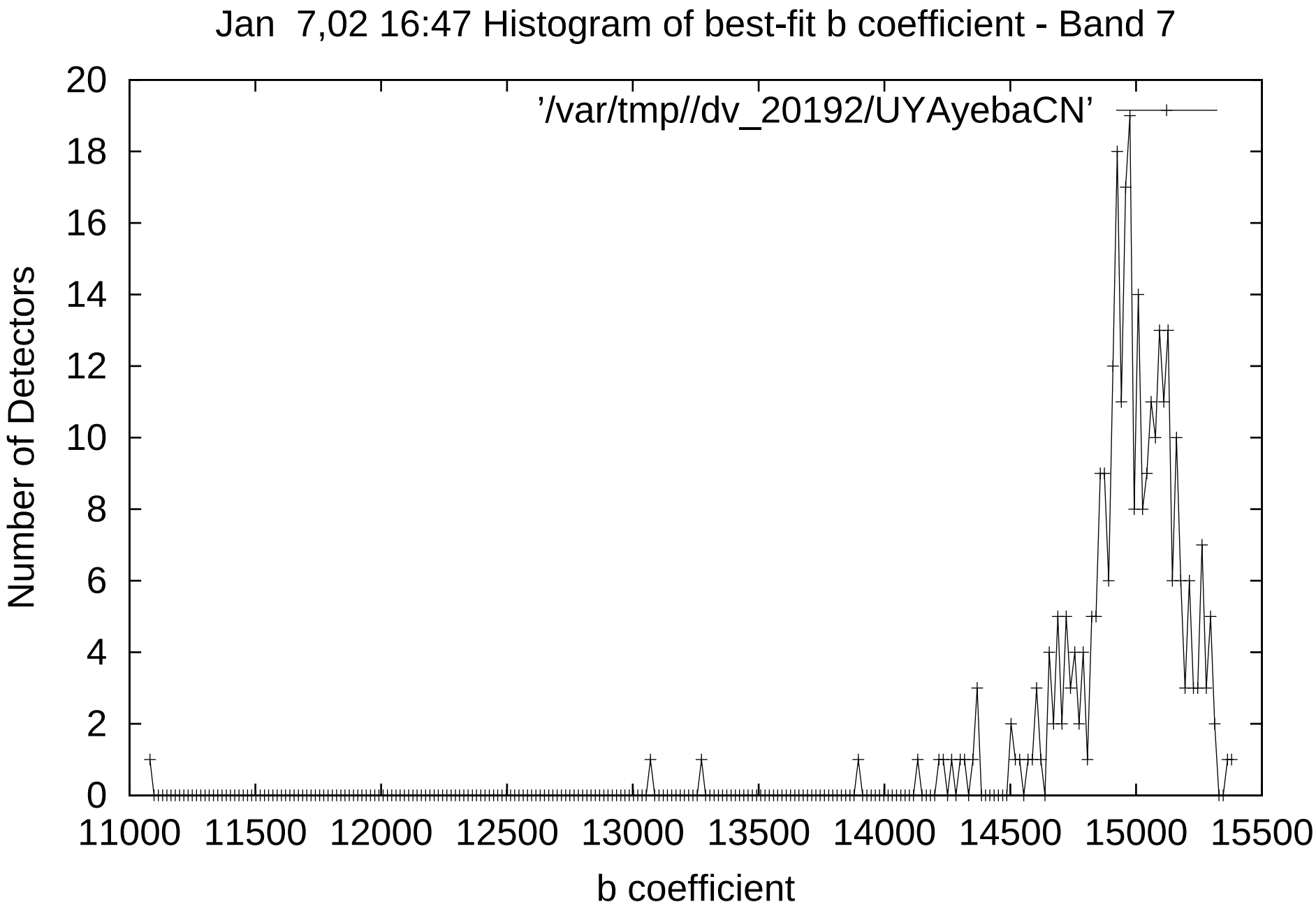


Figure 7-18-2g

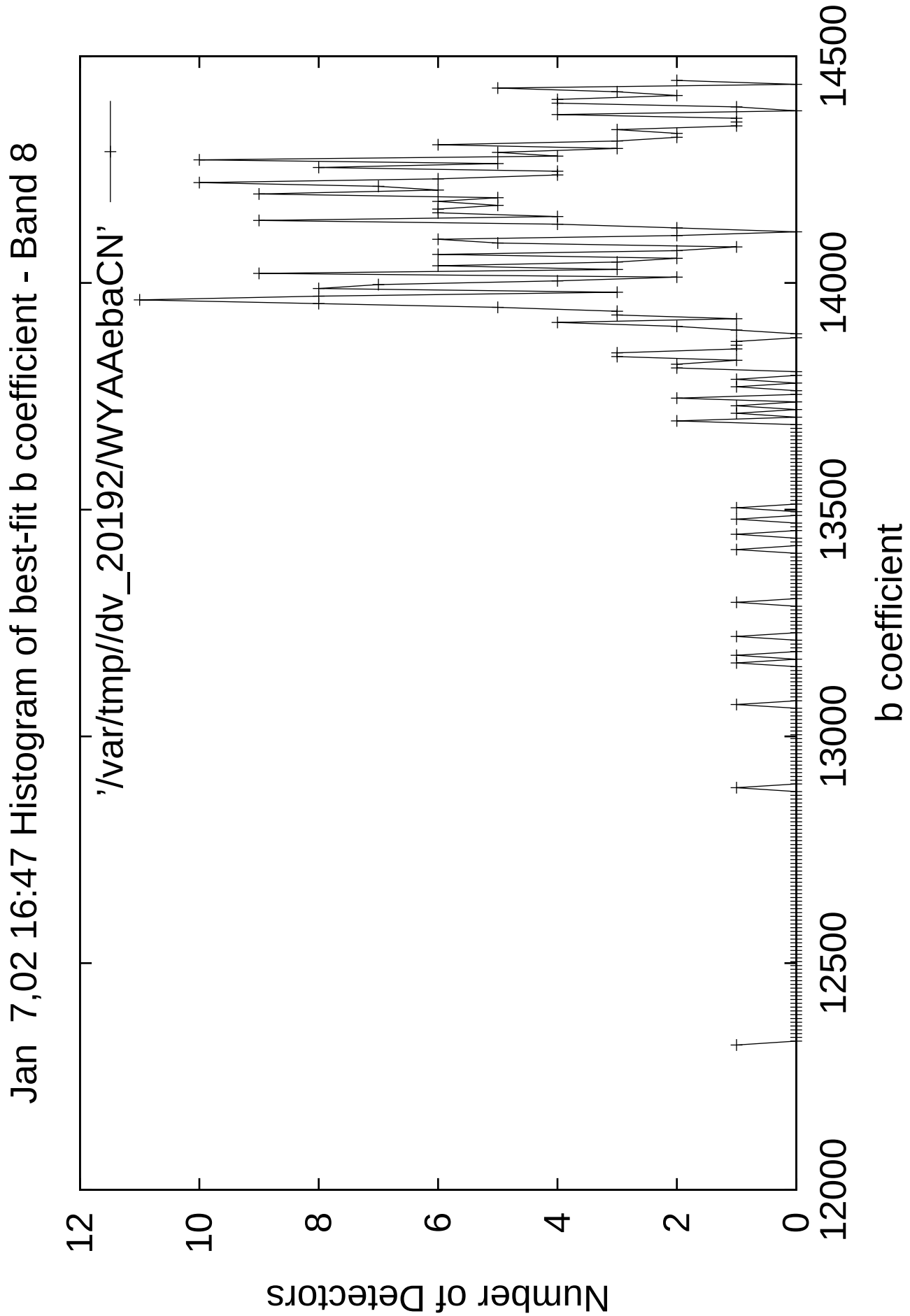


Figure 7-18-2h

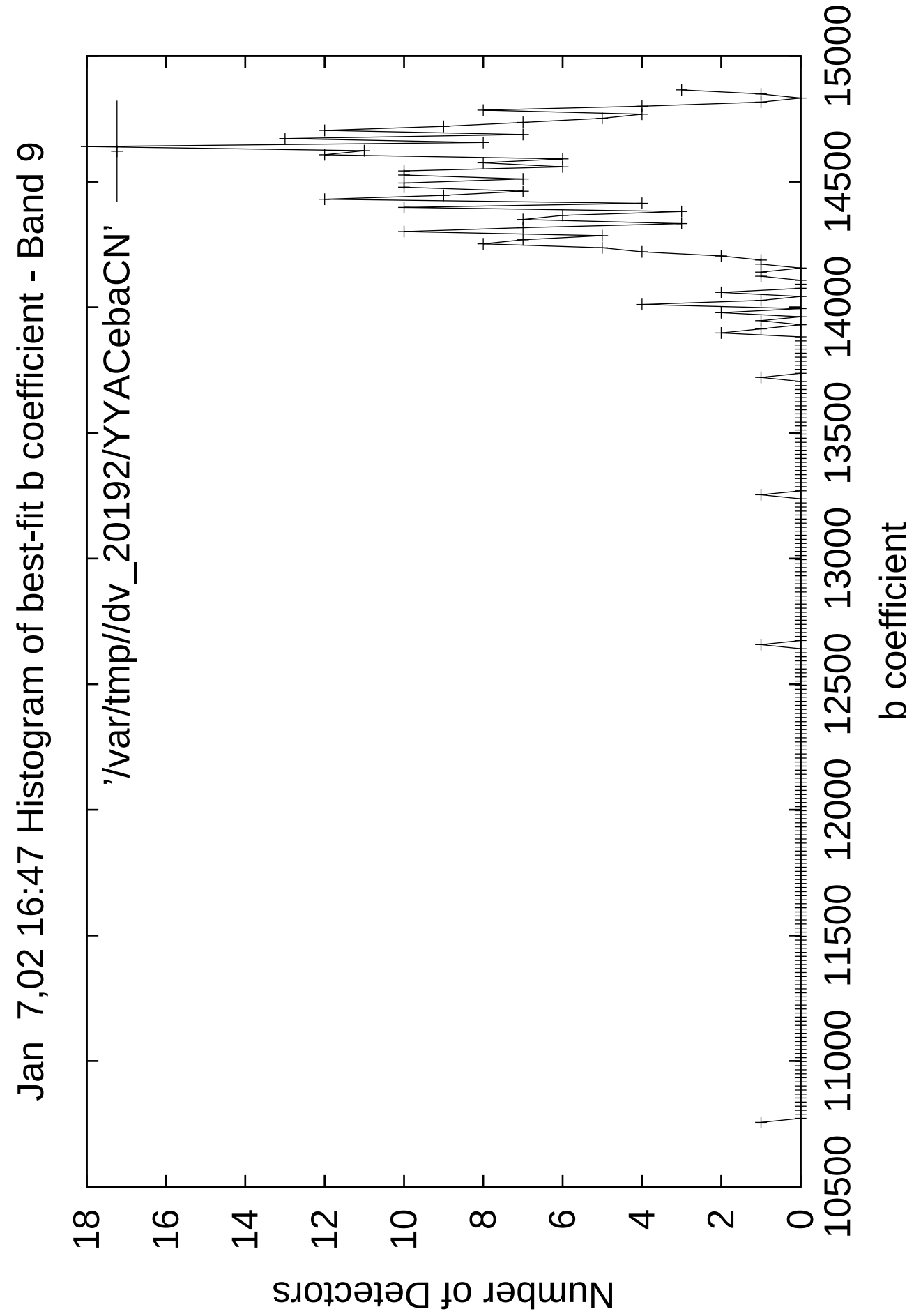


Figure 7-18-2i

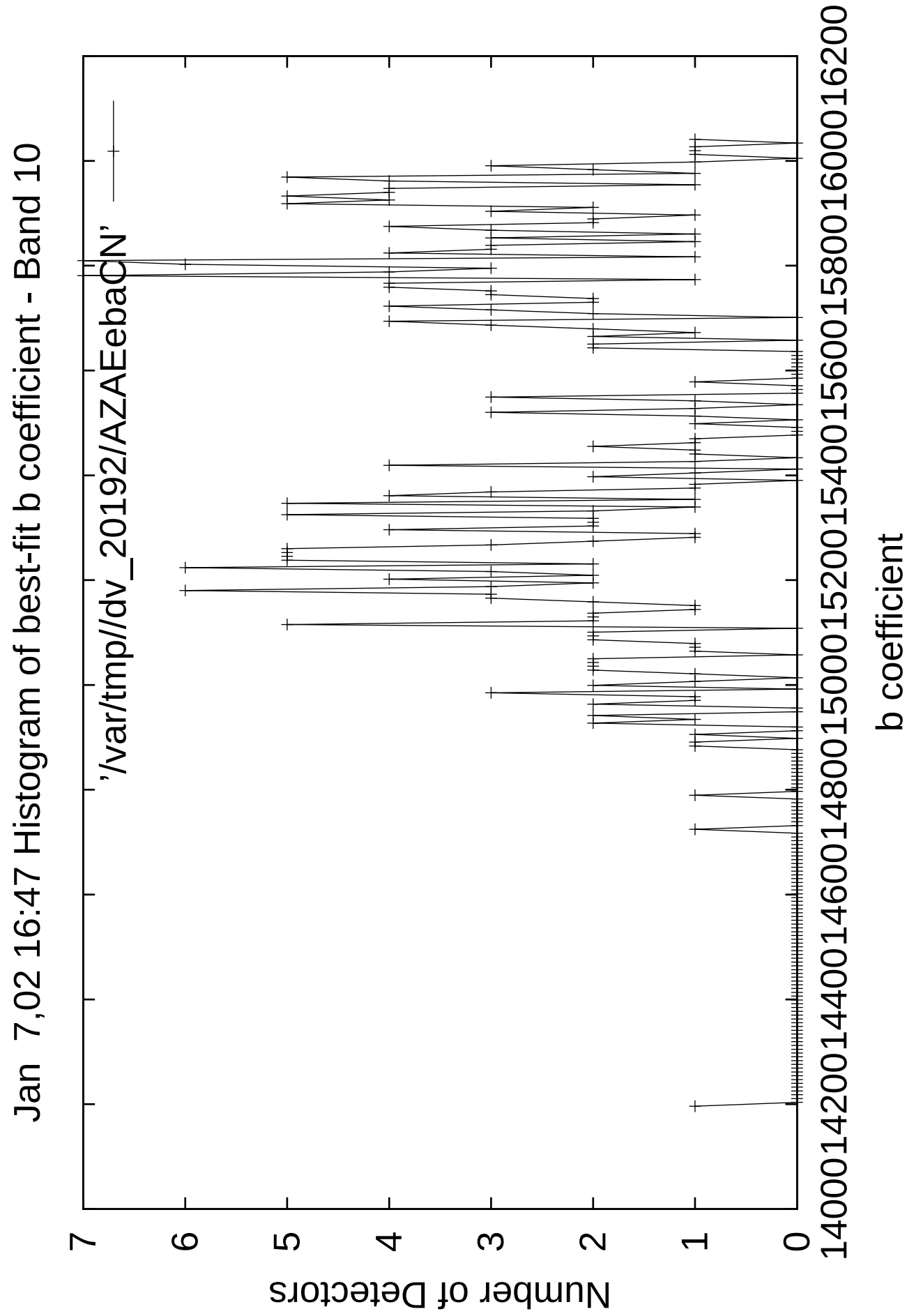


Figure 7-18-2j

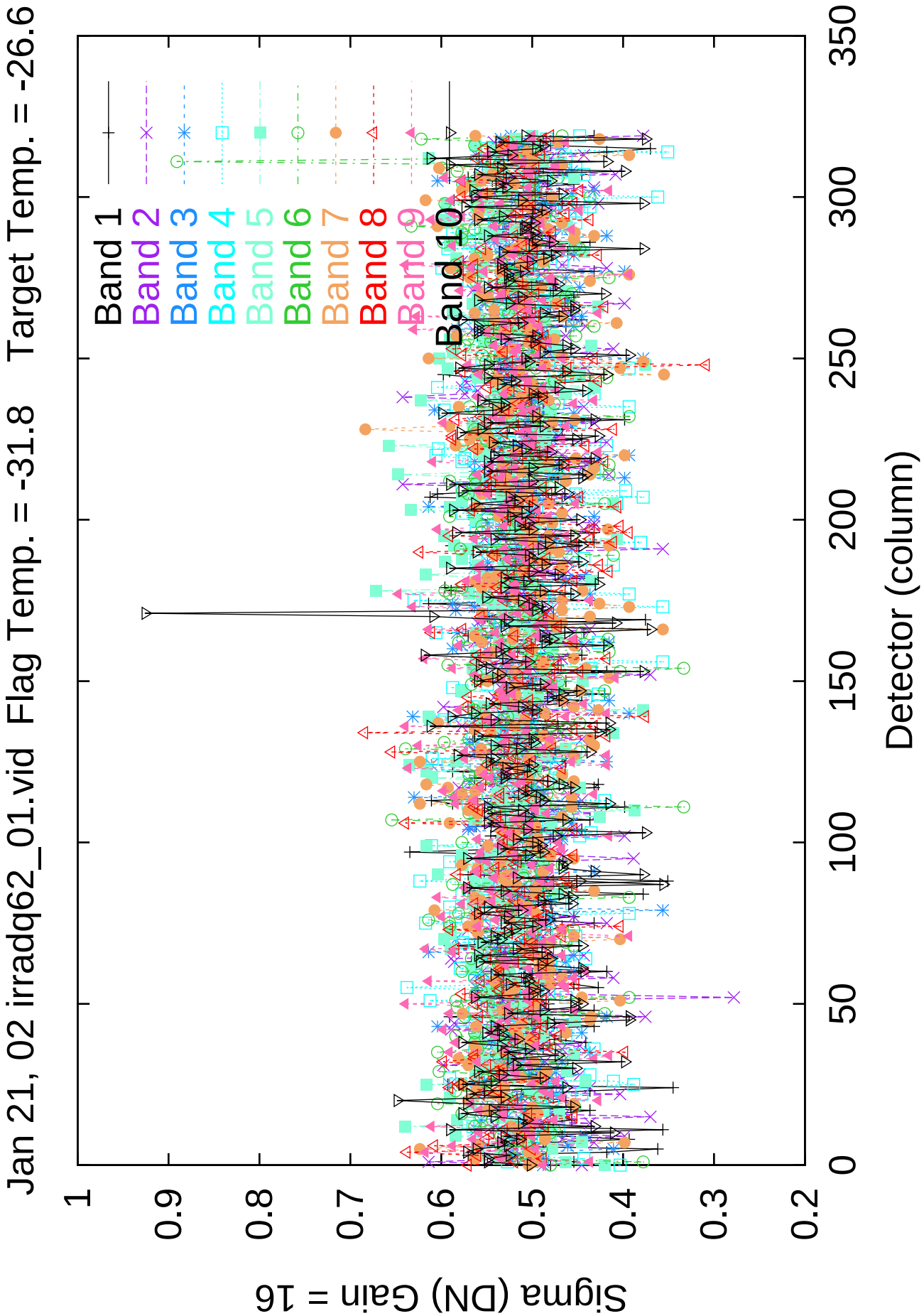

Jan 21, 02 irradq62_01.vid Flag Temp. = -31.8 Target Temp. = -26.6
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10
Sigma (DN) Gain = 16
Detector (column)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
50
100
150
200
250
300
350

Figure 7-19a

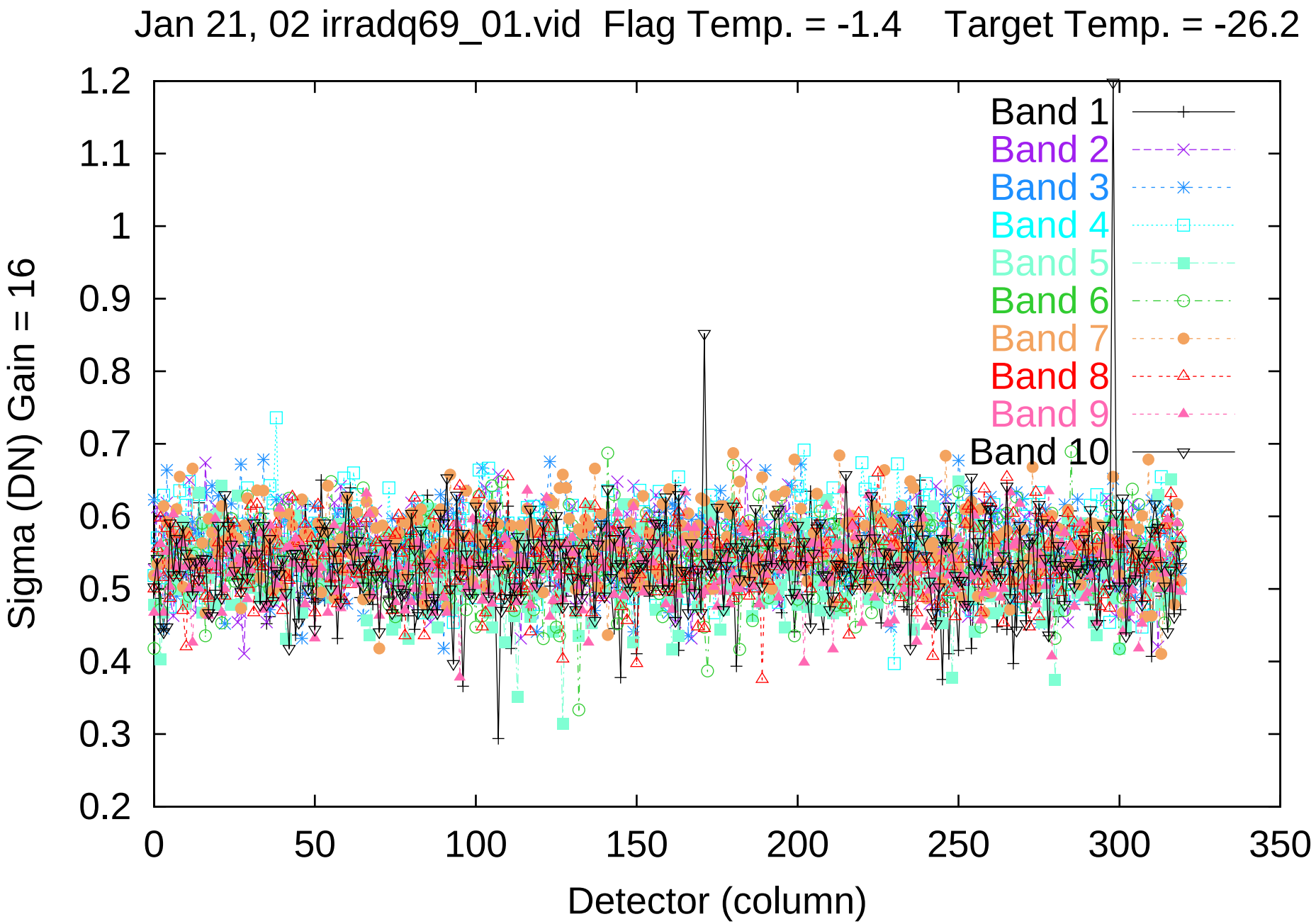

Jan 21, 02 irradq69_01.vid Flag Temp. = -1.4 Target Temp. = -26.2
Sigma (DN) Gain = 16
Detector (column)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
50
100
150
200
250
300
350

Figure 7-19b

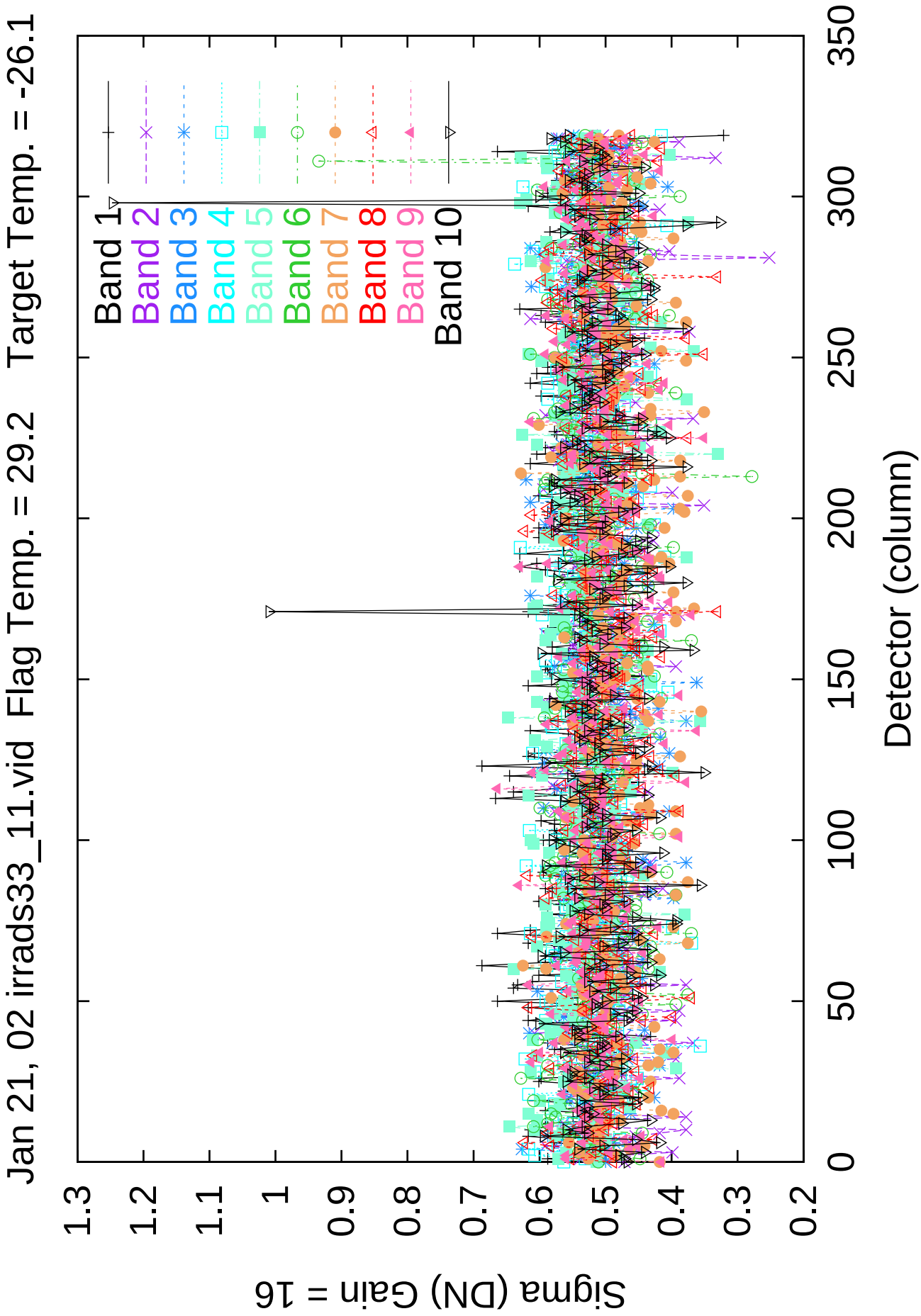

Jan 21, 02 irrads33_11.vid Flag Temp. = 29.2 Target Temp. = -26.1
Sigma (DN) Gain = 16
Detector (column)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0
50
100
150
200
250
300
350

Figure 7-19c

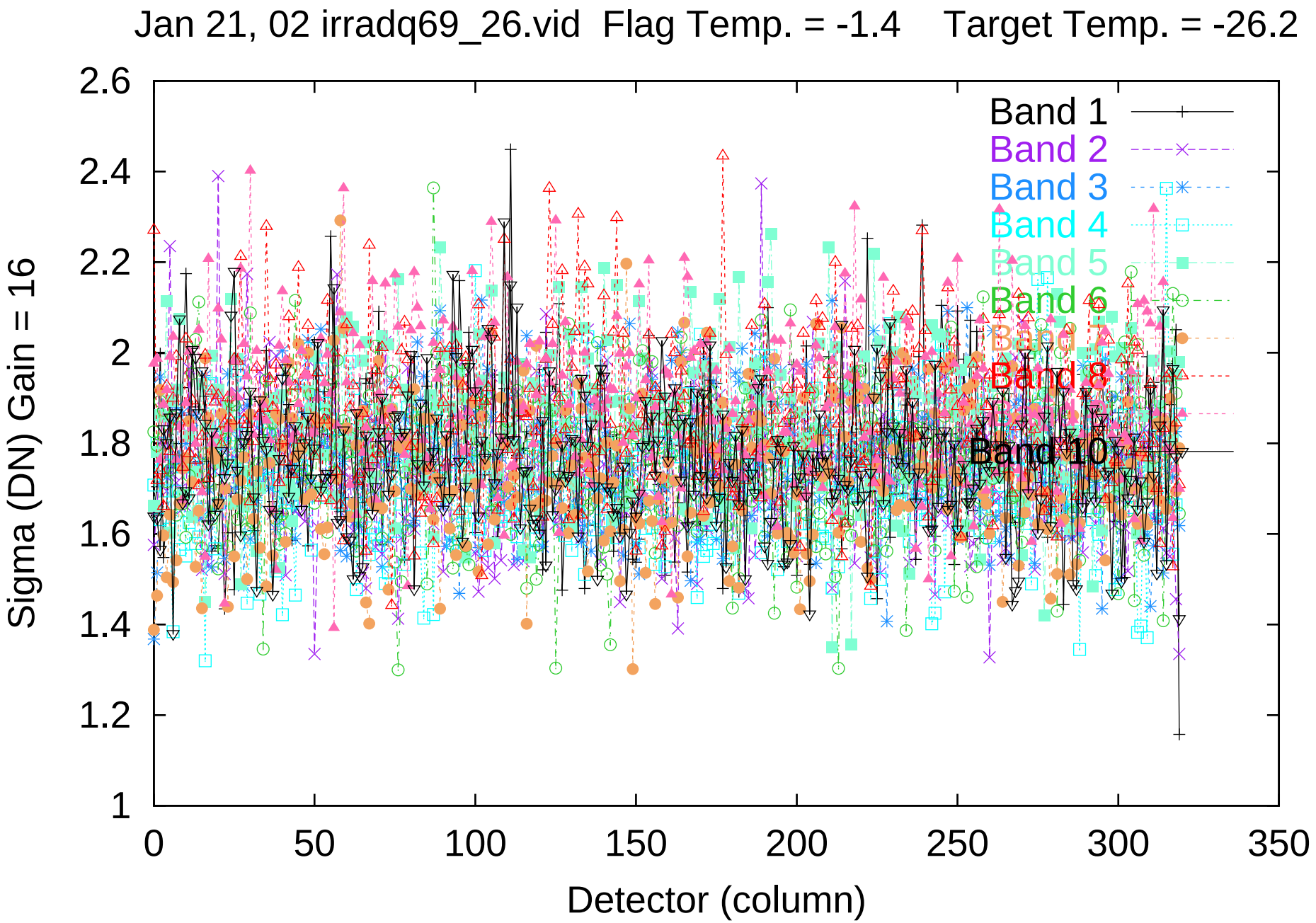

Jan 21, 02 irradq69_26.vid Flag Temp. = -1.4 Target Temp. = -26.2
Sigma (DN) Gain = 16
Detector (column)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 8
Band 10
2.6
2.4
2.2
2
1.8
1.6
1.4
1.2
1
0
50
100
150
200
250
300
350

Figure 7-20

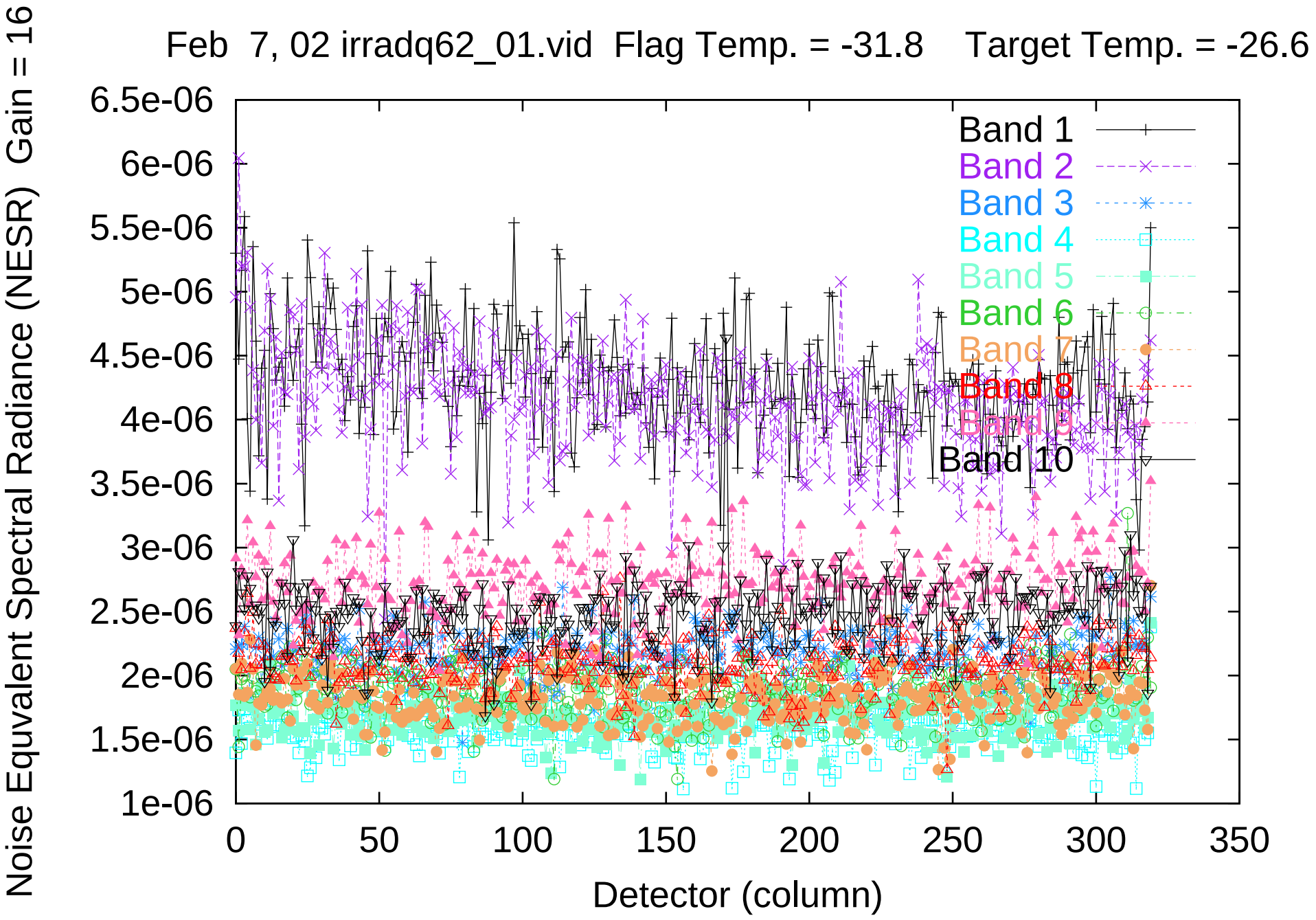

Feb 7, 02 irradq62_01.vid Flag Temp. = -31.8 Target Temp. = -26.6
Noise Equivalent Spectral Radiance (NESR) Gain = 16
6.5e-06
6e-06
5.5e-06
5e-06
4.5e-06
4e-06
3.5e-06
3e-06
2.5e-06
2e-06
1.5e-06
1e-06
0
50
100
150
200
250
300
350
Detector (column)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10

Figure 7-23a

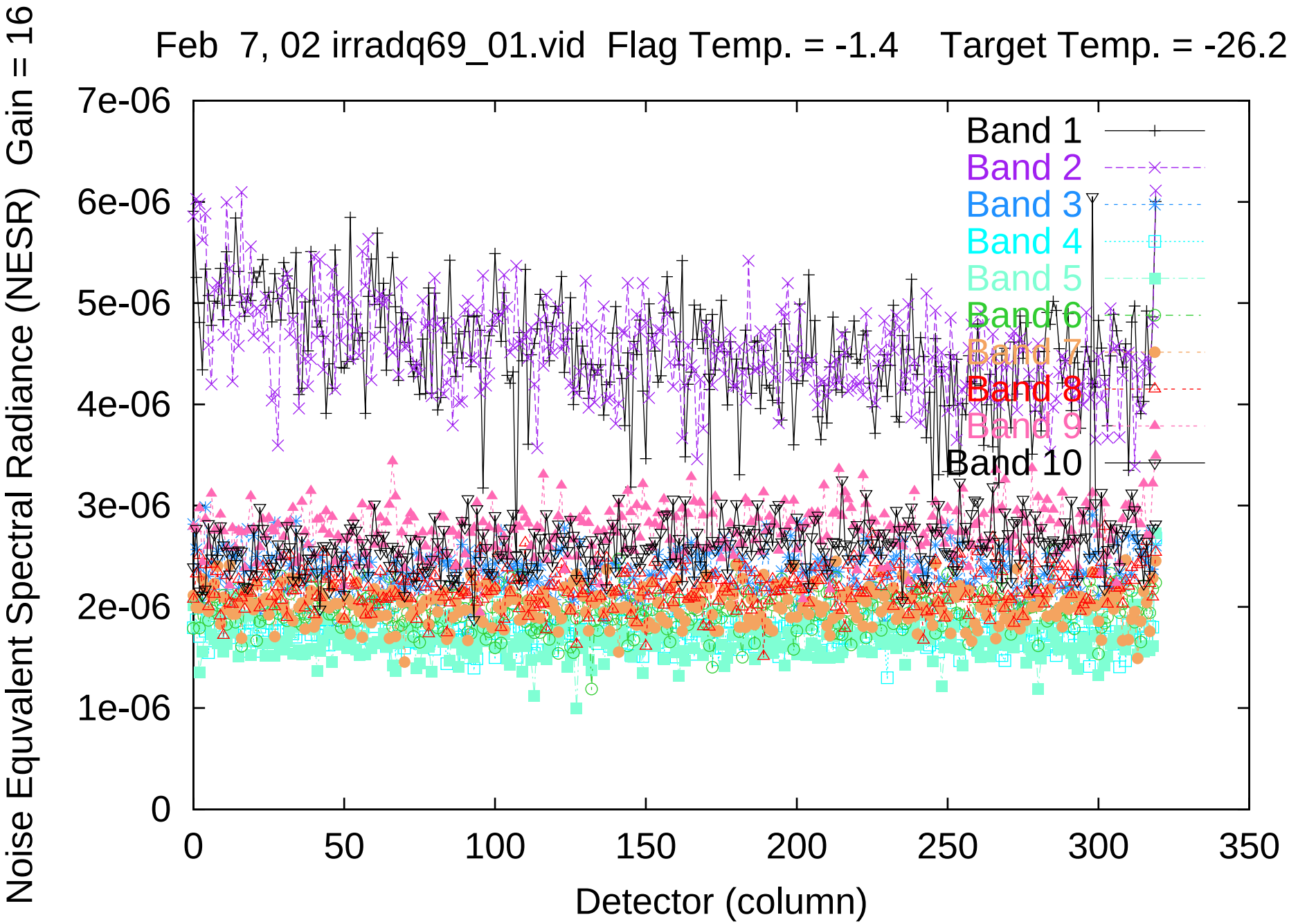

Feb 7, 02 irradq69_01.vid Flag Temp. = -1.4 Target Temp. = -26.2
Noise Equivalent Spectral Radiance (NESR) Gain = 16
Detector (column)
0
1e-06
2e-06
3e-06
4e-06
5e-06
6e-06
7e-06
0
50
100
150
200
250
300
350
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10

Figure 7-23b

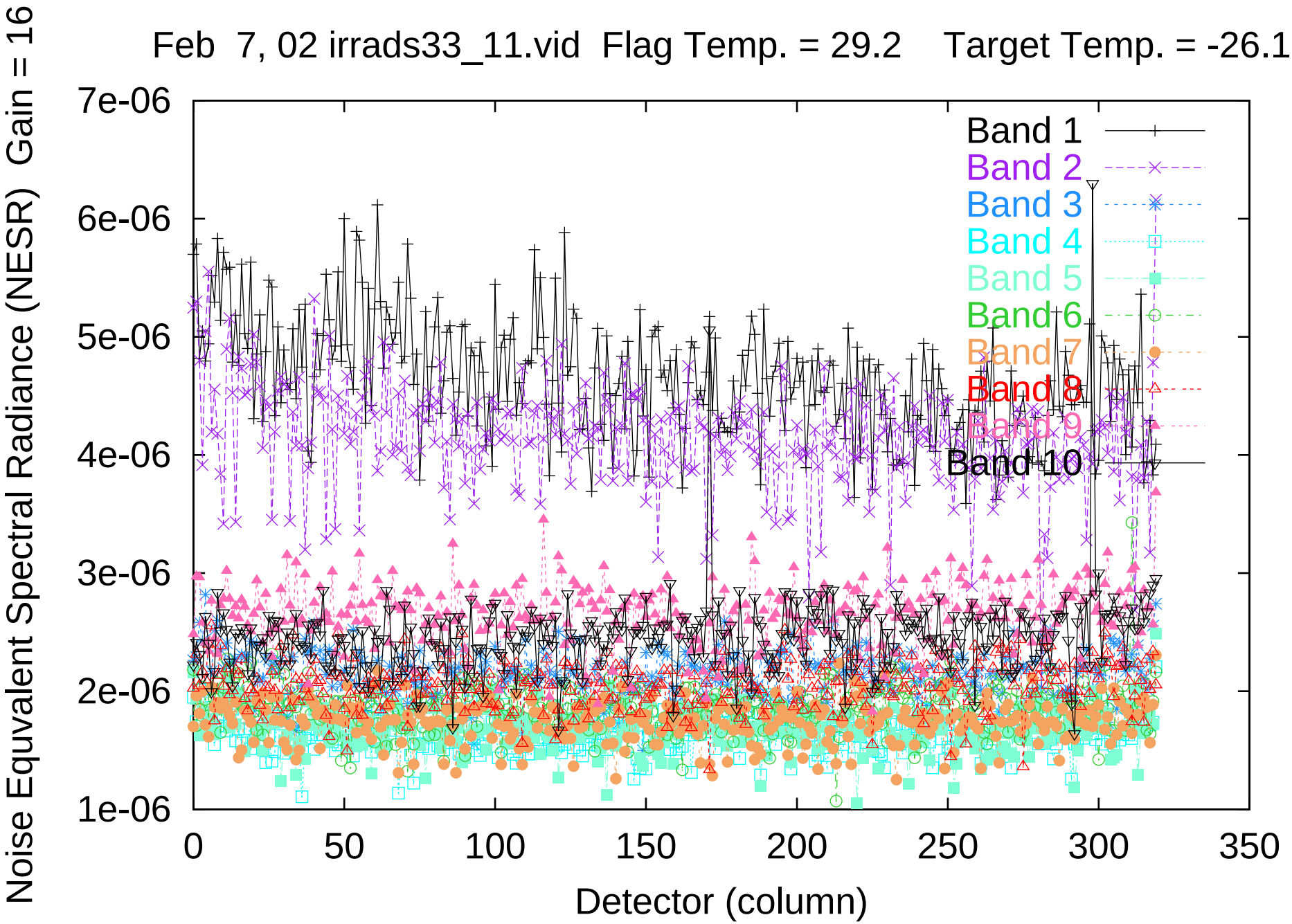

Feb 7, 02 irrads33_11.vid Flag Temp. = 29.2 Target Temp. = -26.1
Noise Equivalent Spectral Radiance (NESR) Gain = 16
7e-06
6e-06
5e-06
4e-06
3e-06
2e-06
1e-06
0
50
100
150
200
250
300
350
Detector (column)
Band 1
Band 2
Band 3
Band 4
Band 5
Band 6
Band 7
Band 8
Band 9
Band 10

Figure 7-23c

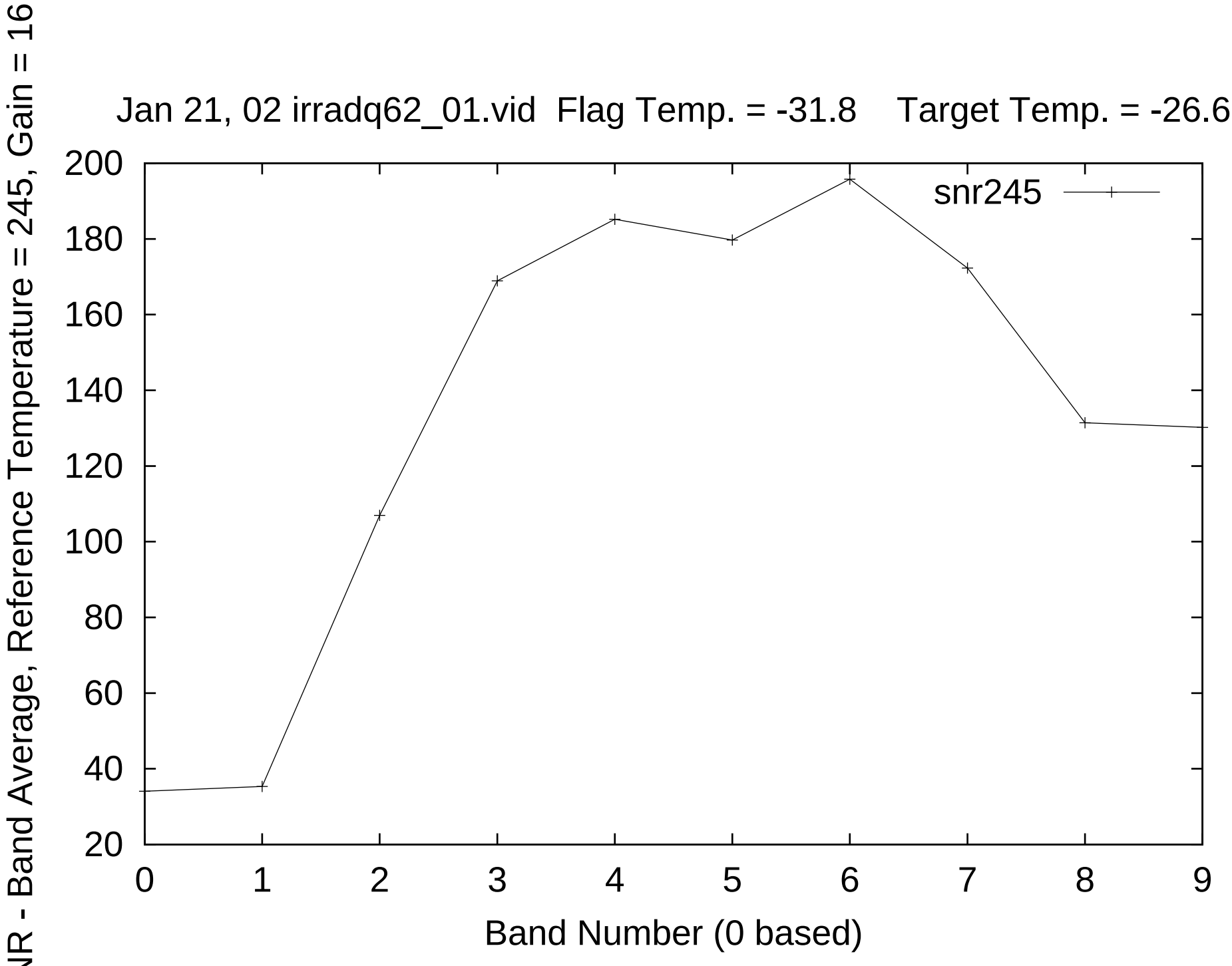

Jan 21, 02 irradq62_01.vid Flag Temp. = -31.8 Target Temp. = -26.6
SNR - Band Average, Reference Temperature = 245, Gain = 16
Band Number (0 based)
snr245
200
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9

Figure 7-24a

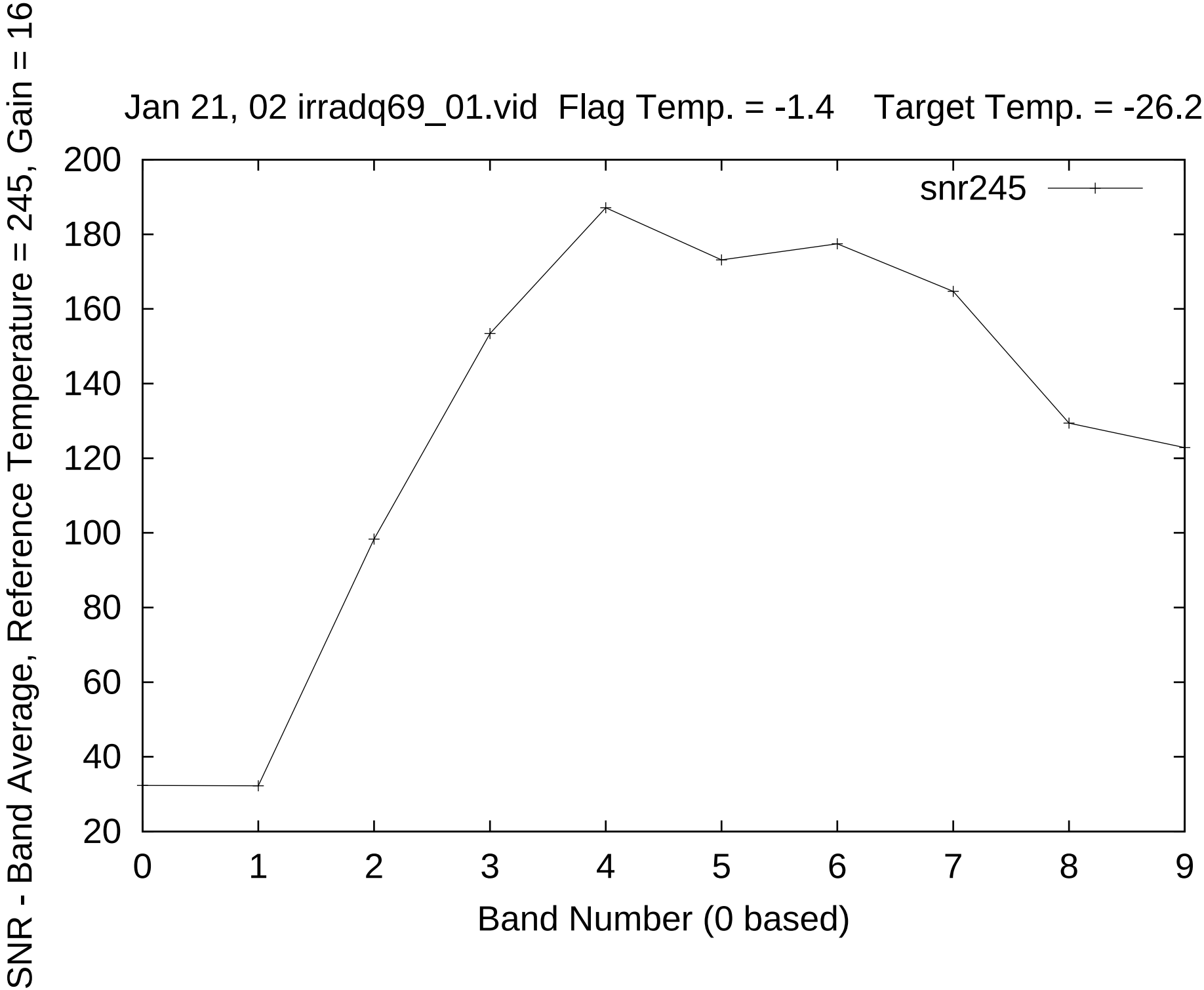

Jan 21, 02 irradq69_01.vid Flag Temp. = -1.4 Target Temp. = -26.2
SNR - Band Average, Reference Temperature = 245, Gain = 16
Band Number (0 based)
snr245
200
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9

Figure 7-24b

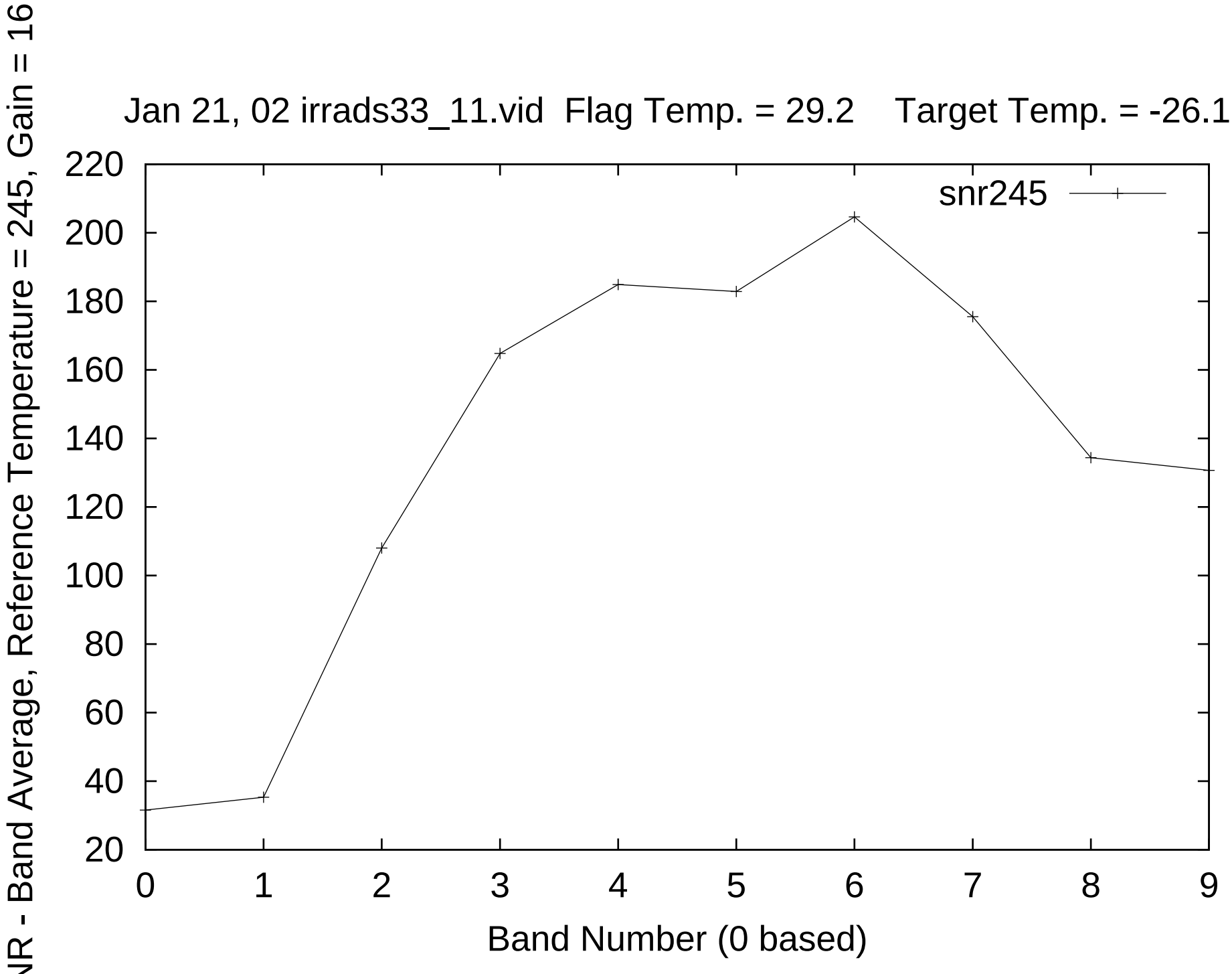

Jan 21, 02 irrads33_11.vid Flag Temp. = 29.2 Target Temp. = -26.1
SNR - Band Average, Reference Temperature = 245, Gain = 16
Band Number (0 based)
snr245
220
200
180
160
140
120
100
80
60
40
20
0
1
2
3
4
5
6
7
8
9

Figure 7-24c