



Memorandum

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From: John Effland
Dave Schmitt

Date: 2007-02-14

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Subject: Comparison of Sidelobes in Band 6 Cartridges SN 001, 002, and 004

1. Conclusions

Sidelobe levels in Band 6 cartridges 004, 001, and 002 are generally similar, as summarized in Table 1, although the most recent cartridge measured, SN 004, shows lower levels. An interesting pattern was found for SN 002 at 261 GHz where the sidelobe decreased to near 30 dB, as shown in Figure 1.

For completeness, sidelobes measurements of SN 004 are repeated here from our previous memo¹ where IRAM's IR filters are replaced by Gore-Tex and the vacuum window is tilted. That data, summarized for three frequencies in Table 6, Table 7, and Table 8, shows sidelobe levels change but an overall reduction is only significant at 229 GHz.

| Table 1: Sidelobe Summary (Level Below Beam Peak) | | | | | | |
|--|----------------|--------------|--------------------|--------------|--------------------|--------------|
| RF: | 211 GHz | | ~229 GHz | | ~265 GHz | |
| Patterns: | Table 3 | | Table 4 | | Table 5 | |
| Cart S/N | Pol 0 | Pol 1 | Pol 0 | Pol 1 | Pol 0 | Pol 1 |
| 004 | 22 dB | Shoulder | 21 dB | 25 dB | 21 dB | 25 dB |
| 001 | 15 dB | 19 dB | 18 dB | Shoulder | 16 dB | 15 dB |
| 002 | 16 dB | N/A | 23 dB ² | N/A | 17 dB ³ | N/A |
| | | | | | | |

A summary of the filter replacement and window changes is tabulated in Table 2 and details are provided in the results document¹.

¹ "Comparison of Band 6 Sidelobes with IRAM and Gore-Tex IR Filters and with a Tilted and Un-tilted Vacuum Window," Effland and Schmitt, ALMA Memo FEND-40.02.06.01-032-A-REP, 2007-01-31.

² Pattern measured at @ 231 GHz.

³ Pattern measured at @ 261 GHz

Table 2: Summary of Cryostat Changes for Cartridge B6-004

| Stage | Initial State: IRAM Filters and Windows | IR Filters Replaced | Window Tilted |
|----------------------|--|--|--|
| 15 K Stage | Single layer of 0.5 mm Mupor mounted flat with a 65 mm clear aperture. | Two layers of 0.5mm Gore-Tex sandwiched together with 65 mm clear aperture. | |
| 110 K Stage | Molded PFA filter, mounted at an angle of 2.4° to the beam. | Single layer of 0.5 mm Gore-Tex mounted flat to the 110K plate with a 1.58 mm (1/16") G-10 filter ring and a 61 mm clear aperture, | |
| Vacuum Window | Quartz vacuum window with 50 mm clear aperture | Quartz vacuum window with 50 mm clear aperture | Tilted 5° perpendicular to the major axis of the beam. Tilt was in the +Y direction as referenced to beam scanner axis |

Table 3: Beam Patterns, SN's 004, 001, and 002 at 211 GHz

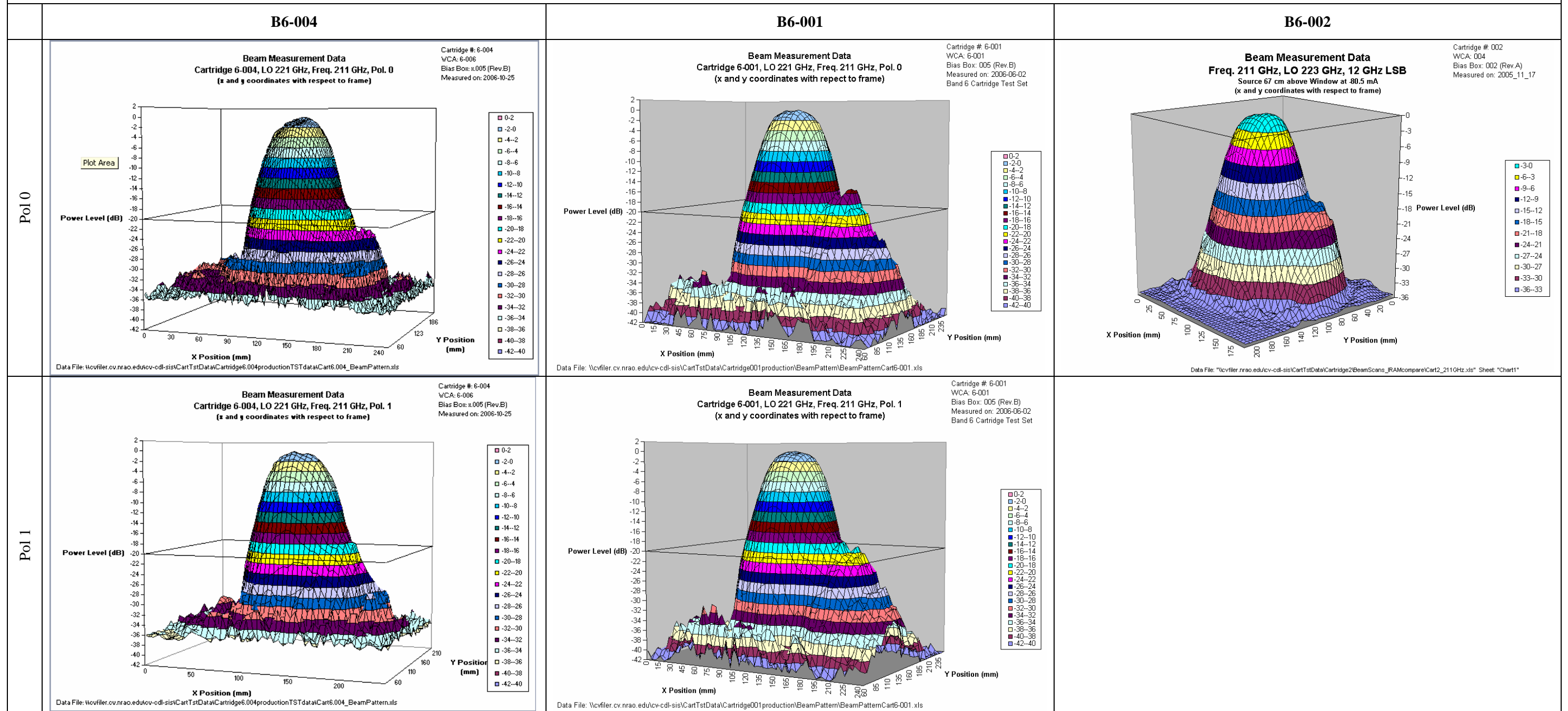


Table 4: Beam Patterns, SN's 004, 001, and 002 at ~229 GHz

| | B6-004 | B6-001 | B6-002 (231 GHz) |
|-------|--|---|--|
| Pol 0 | <p>Beam Measurement Data Cartridge 6-004, LO 237 GHz, Freq. 229 GHz, Pol. 0 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: s.005 (Rev.B) Measured on: 2006-10-27</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdi-sis\CartTstData\Cartridge6.004\production\TSTdata\Cart6.004_BeamPattern.xls</p> | <p>Beam Measurement Data Cartridge 6-001, LO 237 GHz, Freq. 229 GHz, Pol. 0 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-001 WCA: 6-001 Bias Box: 005 (Rev.B) Measured on: 2006-06-05 Band 6 Cartridge Test Set</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdi-sis\CartTstData\Cartridge001\production\BeamPattern\BeamPatternCart6-001.xls</p> | <p>Beam Measurement Data Cartridge 2 Freq. 231 GHz LO 223 GHz_8 GHz USB Measured in ALMA Receiver_Source 67 cm above window (x and y coordinates with respect to frame)</p> <p>Data File: \\cvfiler.nrao.edu\cv-cdi-sis\CartTstData\Cartridge2\BeamScans\BeamScanCart2_231GHz@67cm\GRAPH.xls" Sheet: "Chart1"</p> |
| Pol 1 | <p>Beam Measurement Data Cartridge 6-004, LO 237 GHz, Freq. 229 GHz, Pol. 1 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: s.005 (Rev.B) Measured on: 2006-10-27</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdi-sis\CartTstData\Cartridge6.004\production\TSTdata\Cart6.004_BeamPattern.xls</p> | <p>Beam Measurement Data Cartridge 6-001, LO 237 GHz, Freq. 229 GHz, Pol. 1 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-001 WCA: 6-001 Bias Box: 005 (Rev.B) Measured on: 2006-06-05 Band 6 Cartridge Test Set</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdi-sis\CartTstData\Cartridge001\production\BeamPattern\BeamPatternCart6-001.xls</p> | |

Table 5: Beam Patterns, SN's 004, 001, and 002 at ~265 GHz

| | B6-004 | B6-001 | B6-002 (261 GHz) |
|-------|---|---|--|
| Pol 0 | <p>Beam Measurement Data Cartridge 6-004, LO 253 GHz, Freq. 265 GHz, Pol. 0 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: s.005 (Rev.B) Measured on: 2006-10-27</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge6.004\productionTSTdata\Cart6.004_BeamPattern.xls</p> | <p>Beam Measurement Data Cartridge 6-001, LO 253 GHz, Freq. 265 GHz, Pol. 0 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-001 WCA: 6-001 Bias Box: 005 (Rev.B) Measured on: 2006-06-08 Band 6 Cartridge Test Set</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge001\production\BeamPattern\BeamPatternCart6-001.xls</p> | <p>Beam Measurement Data Frequency 261 GHz LO 253 GHz, 8 GHz USB, Source 67 cm above window Source current -102.75 mA, 24 dB Pad in Line from Cartridge, Var. Attenuator 22 dB. Cartridge 002, WCA 004, Bias Box 002 (Rev.A)</p> <p>Cartridge #: 6-002 WCA: 6-004 Bias Box: 002 (Rev.A)</p> <p>Data File: \\cvfiler.nrao.edu\cv-cdl-sis\CartTstData\Cartridge2\Test09_23_05\BeamScan\Cart2_261GHz.xls Sheet: "Chart1"</p> |
| Pol 1 | <p>Beam Measurement Data Cartridge 6-004, LO 253 GHz, Freq. 265 GHz, Pol. 1 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: s.005 (Rev.B) Measured on: 2006-10-27</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge6.004\productionTSTdata\Cart6.004_BeamPattern.xls</p> | <p>Beam Measurement Data Cartridge 6-001, LO 253 GHz, Freq. 265 GHz, Pol. 1 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-001 WCA: 6-001 Bias Box: 005 (Rev.B) Measured on: 2006-06-08 Band 6 Cartridge Test Set</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge001\production\BeamPattern\BeamPatternCart6-001.xls</p> | |

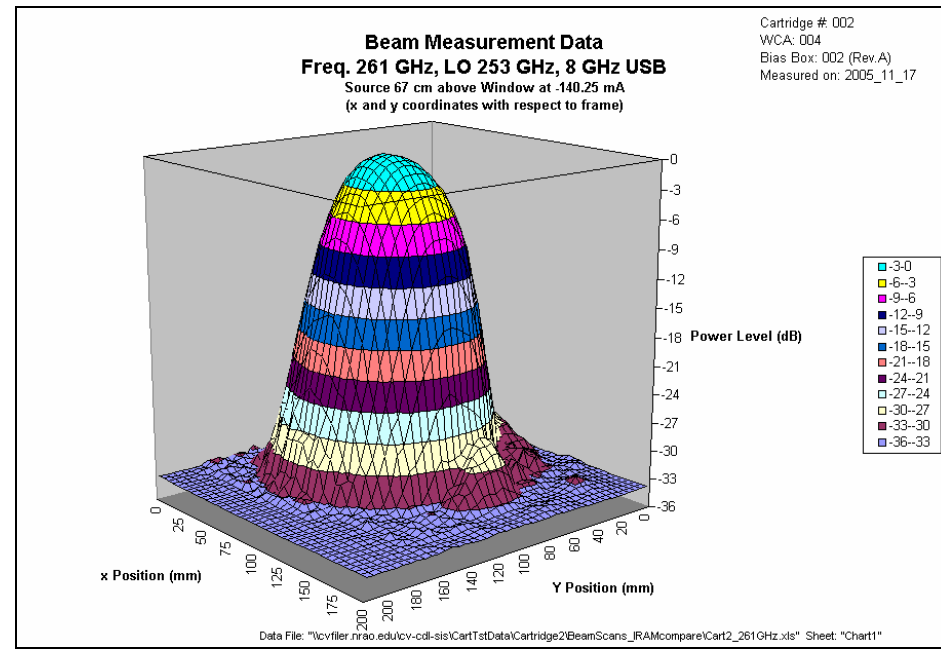


Figure 1: Essentially no sidelobe present for SN 002. Compare to pattern in right column on Table 5

Table 6: Beam Patterns, IR Filters changed and Windows tilted, B6-004, 211 GHz

| | RAL IR Filters | Gore-Tex IR filters | Gore-Tex IR filters / Vacuum Window 5 deg. Tilt |
|-------|--|---|---|
| Pol 0 | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 211 GHz, Pol. 0 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: x.005 (Rev.B) Measured on: 2006-10-25</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\Cart6.004_BeamPatterns.xls</p> | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 211 GHz, Pol. 0, GoreTex Filters (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-22</p> <p>Chart Area</p> | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 211 GHz, Pol. 0, GoreTex Filters / 5 Deg. Window Tilt (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-22</p> <p>Data File: \\cvfiler.cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\BeamPatternGoreTexFilters\WindowTiltGoreTex_Tilt_Summary.xls</p> |
| Pol 1 | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 211 GHz, Pol. 1 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: x.005 (Rev.B) Measured on: 2006-10-25</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\Cart6.004_BeamPatterns.xls</p> | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 211 GHz, Pol. 1, GoreTex Filters (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-22</p> | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 211 GHz, Pol. 1, GoreTex Filters / 5 Deg. Window Tilt (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-22</p> <p>Data File: \\cvfiler.cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\BeamPatternGoreTexFilters\WindowTiltGoreTex_Tilt_Summary.xls</p> |

Table 7: Beam Patterns, IR Filters changed and Windows tilted, B6-004, 229 GHz

| | RAL IR Filters | Gore-Tex IR filters | Gore-Tex IR filters / Vacuum Window 5 deg. Tilt |
|-------|---|---|--|
| Pol 0 | <p>Beam Measurement Data Cartridge 6-004, LO 237 GHz, Freq. 229 GHz, Pol. 0 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: s.005 (Rev.B) Measured on: 2006-10-27</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge6.004\productionTSTdata\Cart6.004_BeamPattern.xls</p> | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 229 GHz, Pol. 0, GoreTex Filters (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-23</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge6.004\productionTSTdata\BeamPatternGoreTexFilters\WindowTilt\GoreTex_Tilt</p> | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 229 GHz, Pol. 0, GoreTex Filters / 5 Deg. Window Tilt (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-26</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge6.004\productionTSTdata\BeamPatternGoreTexFilters\WindowTilt\GoreTex_Tilt</p> |
| Pol 1 | <p>Beam Measurement Data Cartridge 6-004, LO 237 GHz, Freq. 229 GHz, Pol. 1 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: s.005 (Rev.B) Measured on: 2006-10-27</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge6.004\productionTSTdata\Cart6.004_BeamPattern.xls</p> | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 229 GHz, Pol. 1, GoreTex Filters (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-23</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge6.004\productionTSTdata\BeamPatternGoreTexFilters\WindowTilt\GoreTex_Tilt</p> | <p>Beam Measurement Data Cartridge 6-004, LO 221 GHz, Freq. 229 GHz, Pol. 1, GoreTex Filters / 5 Deg. Window Tilt (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-26</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-cdl-sis\CartTstData\Cartridge6.004\productionTSTdata\BeamPatternGoreTexFilters\WindowTilt\GoreTex_Tilt</p> |

Table 8: Beam Patterns, IR Filters changed and Windows tilted, B6-004, 265 GHz

| | RAL IR Filters | Gore-Tex IR filters | Gore-Tex IR filters / Vacuum Window 5 deg. Tilt |
|-------|---|---|---|
| Pol 0 | <p>Beam Measurement Data Cartridge 6-004, LO 253 GHz, Freq. 265 GHz, Pol. 0 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: s.005 (Rev.B) Measured on: 2006-10-27</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\Cart6.004_BeamPattern.xls</p> | <p>Beam Measurement Data Cartridge 6-004, LO 253 GHz, Freq. 265 GHz, Pol. 0, GoreTex Filters (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-23</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\BeamPattern\GoreTexFilters\Window_Tilt\GoreTex_Tilt_Summary.xls</p> | <p>Beam Measurement Data Cartridge 6-004, LO 253 GHz, Freq. 265 GHz, Pol. 0, GoreTex Filters / Window Tilt (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-23</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\BeamPattern\GoreTexFilters\Window_Tilt\GoreTex_Tilt_Summary.xls</p> |
| Pol 1 | <p>Beam Measurement Data Cartridge 6-004, LO 253 GHz, Freq. 265 GHz, Pol. 1 (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: s.005 (Rev.B) Measured on: 2006-10-27</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\Cart6.004_BeamPattern.xls</p> | <p>Beam Measurement Data Cartridge 6-004, LO 253 GHz, Freq. 265 GHz, Pol. 1, GoreTex Filters (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-23</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\BeamPattern\GoreTexFilters\Window_Tilt\GoreTex_Tilt_Summary.xls</p> | <p>Beam Measurement Data Cartridge 6-004, LO 253 GHz, Freq. 265 GHz, Pol. 1 USB, GoreTex Filters / Window Tilt (x and y coordinates with respect to frame)</p> <p>Cartridge #: 6-004 WCA: 6-006 Bias Box: C2.005 Measured on: 2007-01-23</p> <p>Data File: \\cvfiler.cv.nrao.edu\cv-odl-sist\CartTestData\Cartridge6.004\productionTSTdata\BeamPattern\GoreTexFilters\Window_Tilt\GoreTex_Tilt_Summary.xls</p> |

