

Subject: [Fwd: Band 7 beam pattern [2nd attempt]]
From: Antonio Perfetto <aperfett@nrao.edu>
Date: Wed, 09 Jul 2008 13:14:52 -0400
To: Darrel Emerson <demerson@nrao.edu>

Bernard's email of 2008-Feb-12

Subject: Band 7 beam pattern [2nd attempt]
From: Bernard Lazareff <lazareff@iram.fr>
Date: Tue, 12 Feb 2008 12:34:02 +0100
To: Antonio Perfetto <aperfett@nrao.edu>
CC: Sylvain Mahieu <mahieu@iram.fr>, Geoff Ediss <gediss@nrao.edu>, Gie Han Tan <ghtan@eso.org>

[This is the second attempt after my email client sent my message in text-only mode]

Dear Antonio,

I'm not quite sure what you mean by "narrow phase response". And I assume that the issue is with cartridge #1. You do not give much information about the issue that you seem to have.

Regards,
Bernard

Anyway, we looked at the Cart#1 measurements on file here. The spillover efficiency was given in the PAI report as follows:

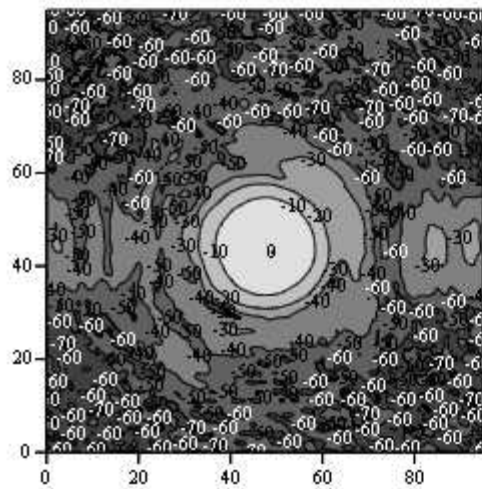
Table 9: table showing the beam efficiency test results.

Freq (LO)	At Cryostat Window		At 900 mm (f/8) from window		Efficiency	Polarisation
	Phot (uW)	Pcold	Phot	Cold		
283	2,62	1,14	2,72	1,3	0,96	Pol0 (LSB)
320	1,9	0,784	2	0,92	0,97	Pol0 (LSB)
361	1,44	0,789	1,5	0,88	0,95	Pol0(LSB)
361	1,4	0,77	1,44	0,85	0,94	Pol0 (USB)
283	1,88	0,7	1,97	0,819	0,98	Pol1 (LSB)
320	1,16	0,525	1,21	0,6	0,96	Pol1 (LSB)
361	0,875	0,429	0,898	0,483	0,93	Pol1 (USB)

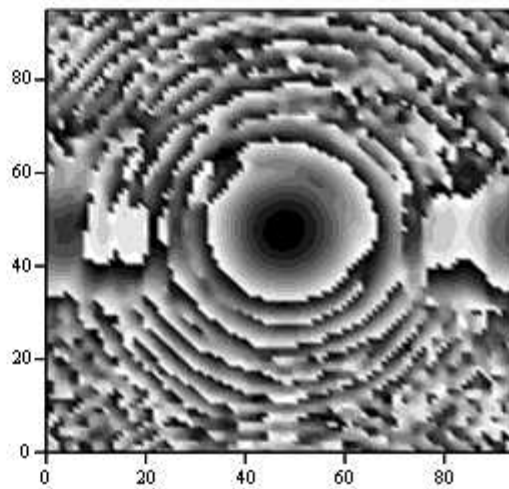
That was derived from a cold load subtending the angle of the subref. We re-analyzed coherent antenna range measurements, with the following results (excerpts from a MathCad worksheet, modified ad hoc to try to answer your question)

Pol 0, 279GHz RF (283LO, LSB)

Far-field (computer-generated) 2D map



$\xrightarrow{\hspace{1.5cm}}$
 $20 \log(|\text{FarE}| + 0.0001)$



$\xrightarrow{\hspace{1.5cm}}$
 $\arg(\text{FarE})$

Derivation of spillover efficiency

$$P_{\text{tot}} := \sum_{iE} \sum_{jE} (|\text{FarE}_{iE, jE}|)^2 \quad \text{Integrate power over whole pattern}$$

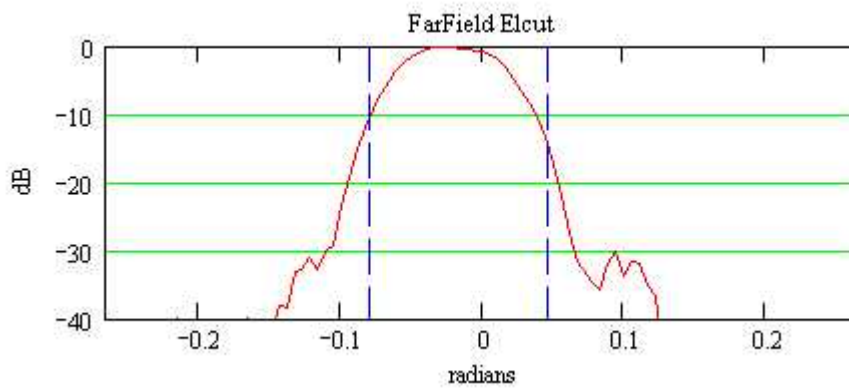
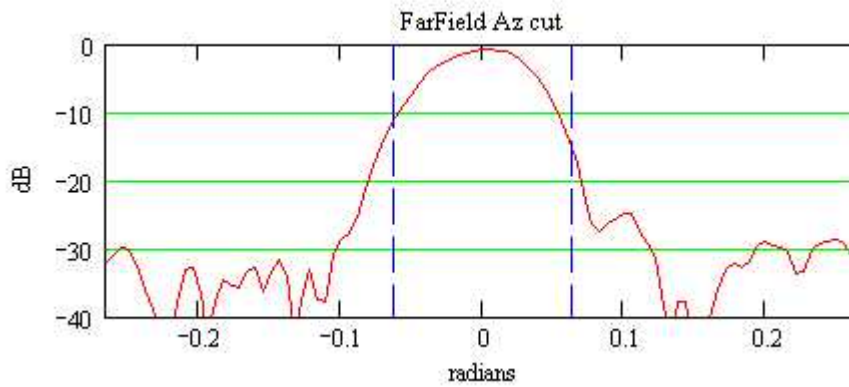
$$\text{FarSub}_{iE, jE} := \text{FarE}_{iE, jE} \cdot \text{if} \left[\left[(iE - ibore)^2 + (jE - jbore)^2 < ksub^2 \right], 1.0, 0.0 \right]$$

$$P_{\text{sub}} := \sum_{iE} \sum_{jE} (|\text{FarSub}_{iE, jE}|)^2 \quad \text{SubEff} := \frac{P_{\text{sub}}}{P_{\text{tot}}} \quad \text{SubEff} = 0.949$$

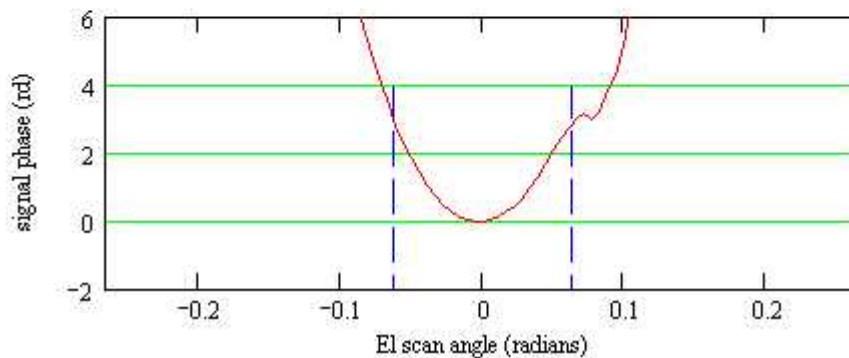
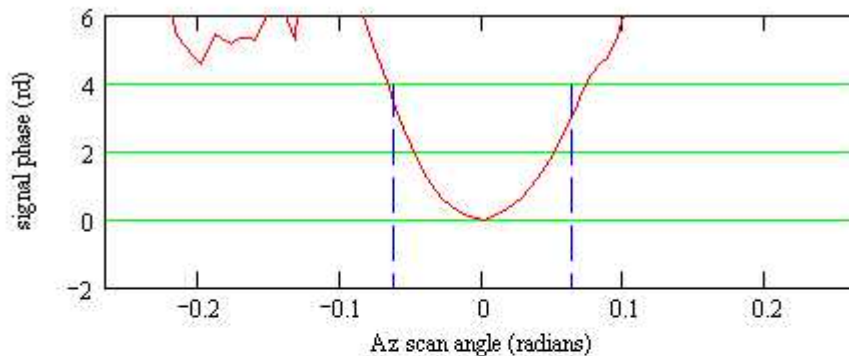
(in fairly good agreement with the value in the PAI test report)

Far Field amplitude cross-cuts

Vertical bars mark the edges of the subref.



Far field phase (uncorrected) cross cuts

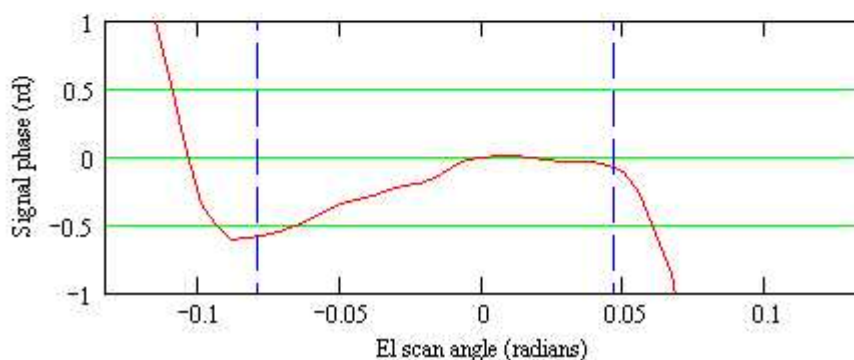
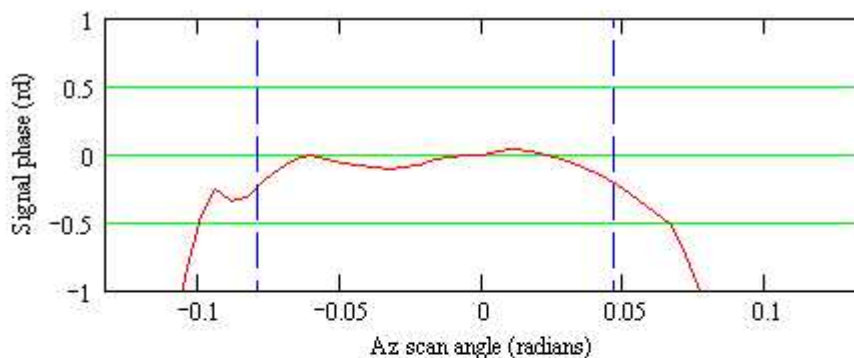


Notice the significant wavefront curvature. That is due to the phase origin being at the origin of the scanning plane, while the phase center of the beam pattern is at the beam.waist

Far field phase (corrected) cross cuts

Move (in the computer) the phase origin by -300mm, bringing it at the top plate of the cartridge cold optics (approximate position of the beamwaist). In this and the previous graph, the phase has been un-folded and

reset to zero at the origin; these changes are purely cosmetic and intended to facilitate the presentation of the graphs. The Elevation cut shows a residual slope, which is just an error in the assumed "Y" position of the beamwaist (not to worry about), and some residual curvature, same sign as for the Az cut. Any astigmatism must be small.



Antonio Perfetto wrote:

Dear Bernard,

We want to compare the beam measurements made at SRON and FEIC. Our beam efficiency calculations using the measured data is worse than predicted and we are trying to sort it out. It would be very helpful to have two orthogonal cuts of the far field pattern plots showing the amplitude and phase response across the main beam.

The measurements at the integration center show a narrow phase response and it could explain the low efficiency numbers. Thanks in advance.

Regards,

Antonio

Sorry, I meant IRAM and FEIC... However this is the case for the band 9 as well.

Bernard Lazareff <lazareff@iram.fr>

Head

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