

Investigating Beamformer Feedback

Divya Oberoi

Haystack Observatory

Shane Rightly

University of Arizona, REU Haystack

- Objective
 - Quantify the BF feedback ripple in interferometric data
- Plan (Suggested by Colin, executed by the night shift – Chris/Ed/Mitch)
 - Take data cycling through a large number of adjacent 1.28 MHz channels while looking towards a strong source
 - Typically 3-5 min on source
 - To track or not to track (did both)
 - Tracking changes the beamformer ‘state’
 - Not tracking causes the tile gain towards the dominant (~point) source to change (predictably) as a function of time, as the source drifts in the beam
- Analysis
 - Only gross flagging done - bad antenna/pols
 - No attempt to identify and flag bad spectral or time slices
 - Computed and examined average bandpasses for some selected baselines (both the ACFs + the CCF for both the pols)

Data Used

- X6, 24 and 25 April 09
- Identified useful data using Chris's M&C log

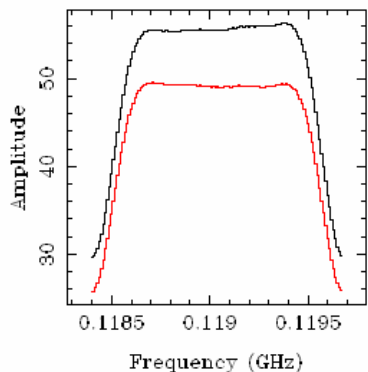
	Start Ch/v	Stop Ch/v	Start T (UT)	Stop T (UT)	Tracking
CenA	089/113.92	123/157.44	0424;13:51	0424;16:37	Yes
HydA	089/113.92	100/128.00	0424;12:43	0424;13:34	Yes
HerA	080/102.4	104/133.12	0424;20:52	0424;21:50	No
HerA	080/102.4	104/133.12	0425;16:04	0425;19:26	No

MIRIAD-Tile-BF mapping

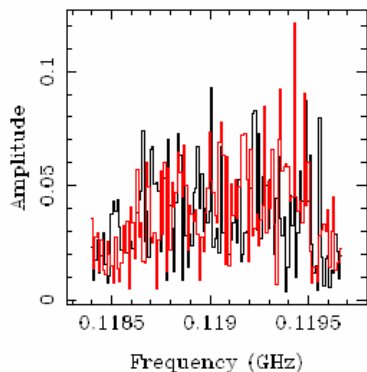
					X6 Miriad->Tile/BF mapping				
					Haystack	X delay	Y delay		Interface
Miriad index	Tile No	BmFormer No.	BF Coms	BF S/N	ship date	brd S/N	brd S/N	CPLD S/N	rev (S/N)
1	1	20	96.00%	0708-20	22 oct 08	0070	0051	KGM038	2 (12)
2	6	28	74.00%	0708-28	11 sep 08	0080	0062	KGM026	2 (02)
3	9	25	77.00%	0708-25	11 sep 08	0076	0059	KGM017	2 (01)
4	13	22	96.00%	0708-22	22 oct 08	0072	0050	KGM034	2 (17)
5	17	27	88.00%	0708-27	11 sep 08	0078	0061	KGM018	2 (03)
6	21	19	92.00%	0708-27	11 sep 08	0078	0061	KGM018	2 (03)
7	25	17	96.00%	0708-17	12 sep 08	0047	0042	KGM024	2 (11)
8	29	32	46.00%	0708-32	29 oct 08	0034	0067	KGM020	2 (19)

CenA, 0424, tracking, 5min average bandshapes for 1 scan (118.5-119.5 MHz)

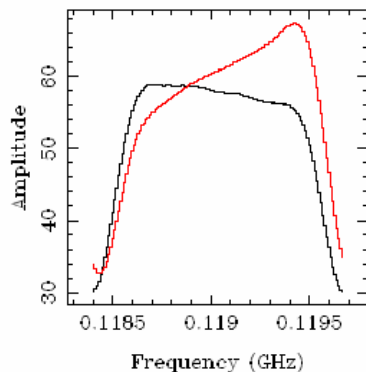
XX.YY, $\tau=15.0$ min, BI=1-1, T=14:17:31



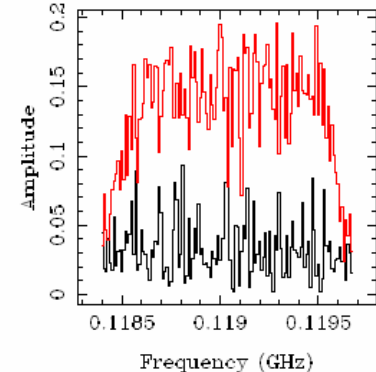
XX.YY, $\tau=15.0$ min, BI=1-2, T=14:17:31



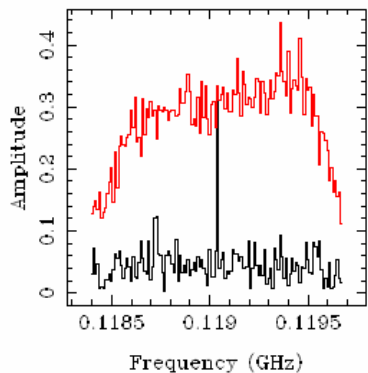
XX.YY, $\tau=15.0$ min, BI=3-3, T=14:17:31



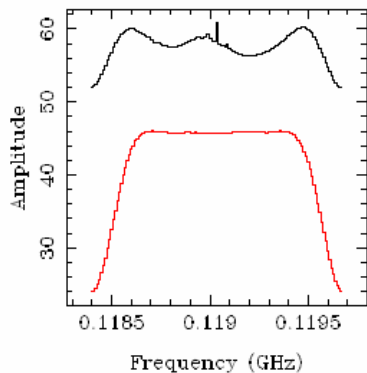
XX.YY, $\tau=15.0$ min, BI=1-3, T=14:17:31



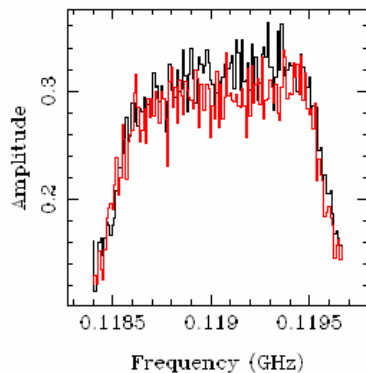
XX.YY, $\tau=15.0$ min, BI=2-3, T=14:17:21



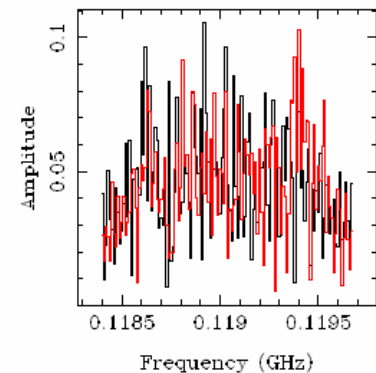
XX.YY, $\tau=15.0$ min, BI=3-3, T=14:17:21



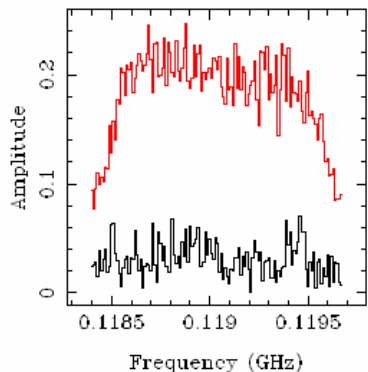
XX.YY, $\tau=15.0$ min, BI=1-4, T=14:17:21



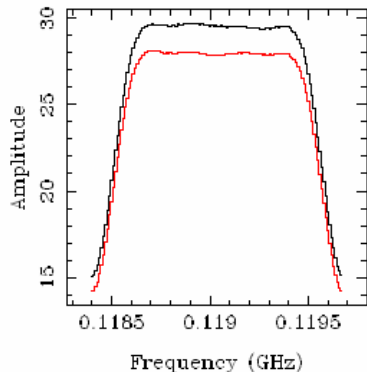
XX.YY, $\tau=15.0$ min, BI=2-4, T=14:17:21



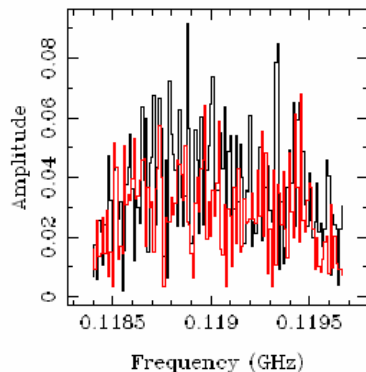
XX.YY, $\tau=15.0$ min, BI=3-4, T=14:17:21



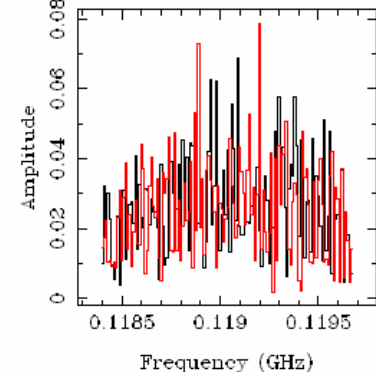
XX.YY, $\tau=15.0$ min, BI=4-4, T=14:17:21



XX.YY, $\tau=15.0$ min, BI=1-5, T=14:17:21

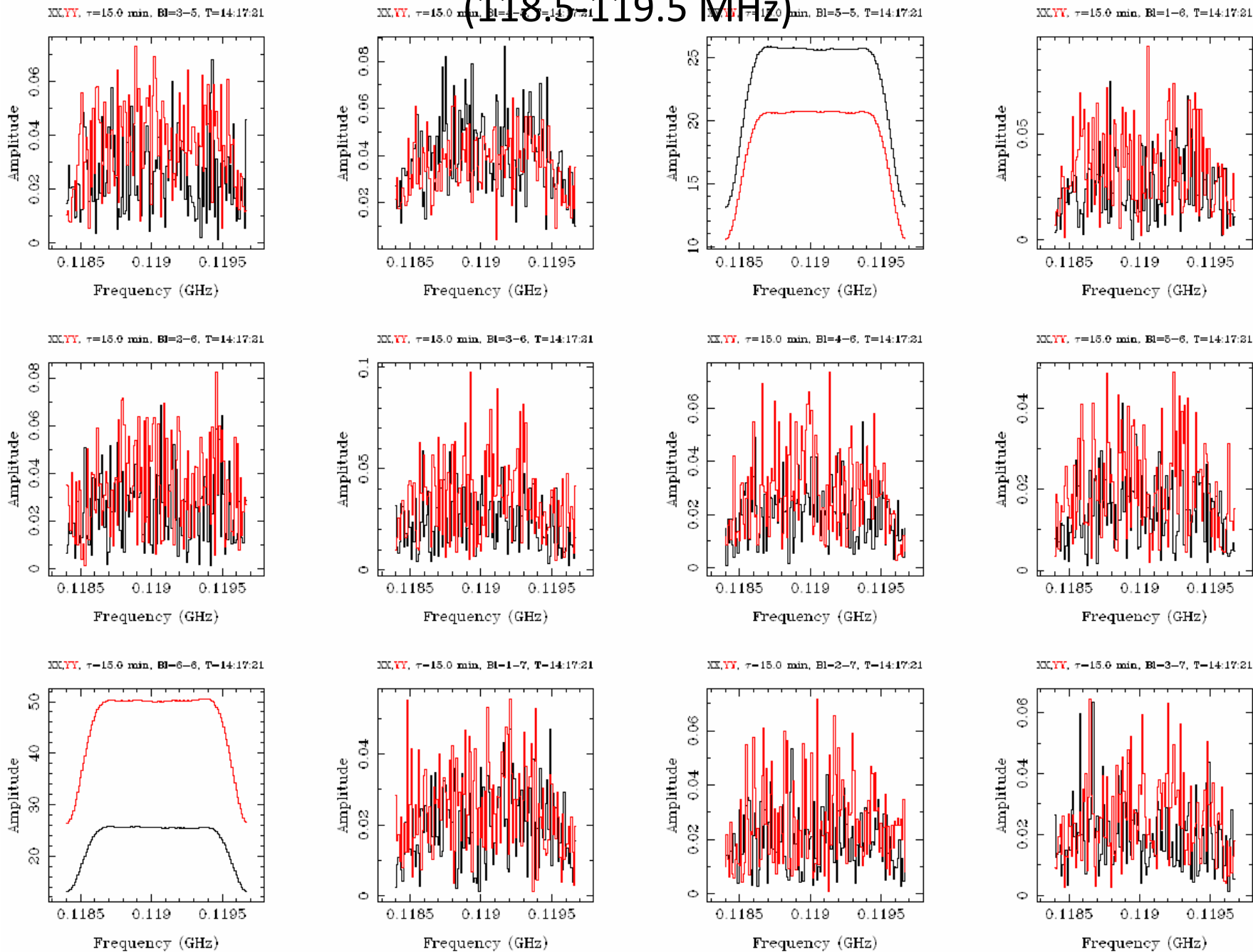


XX.YY, $\tau=15.0$ min, BI=2-5, T=14:17:21

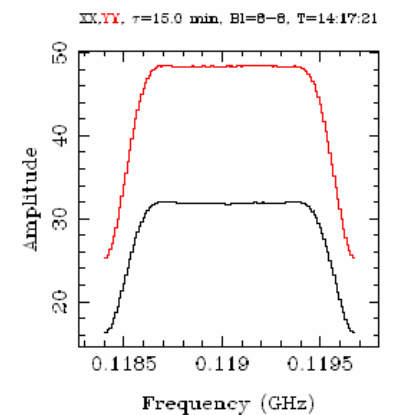
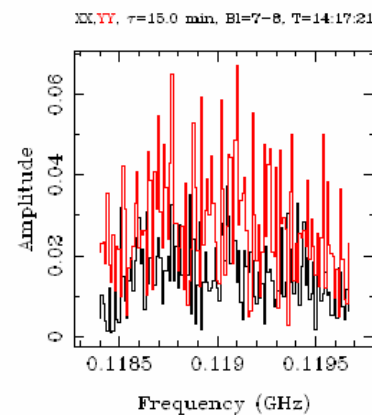
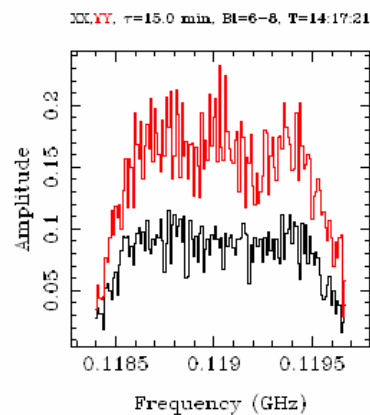
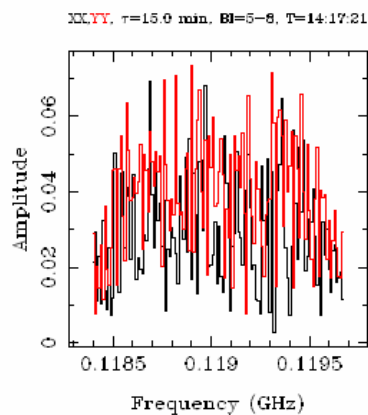
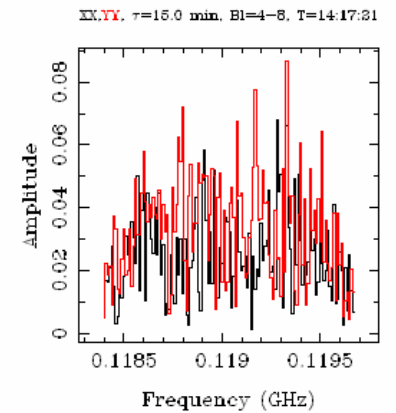
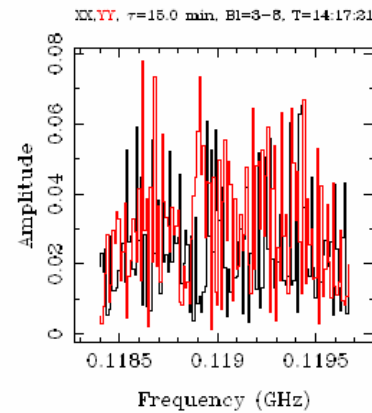
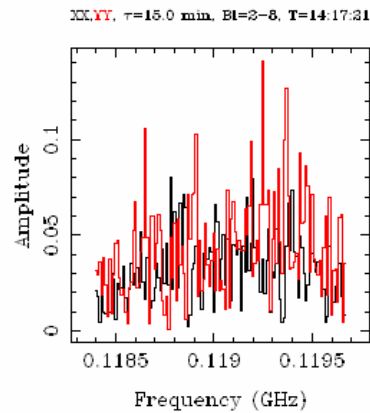
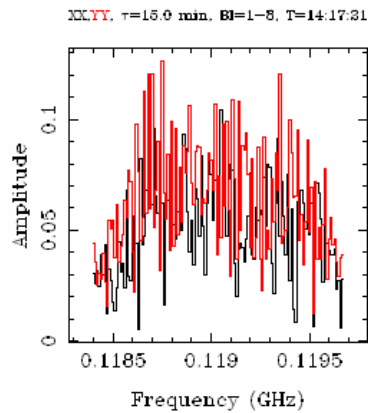
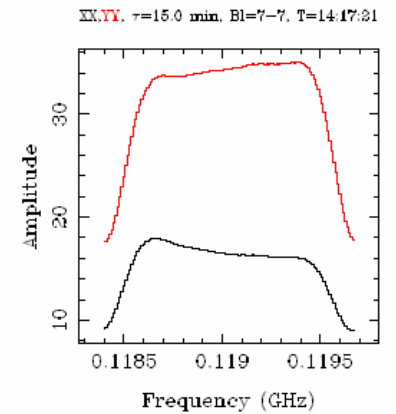
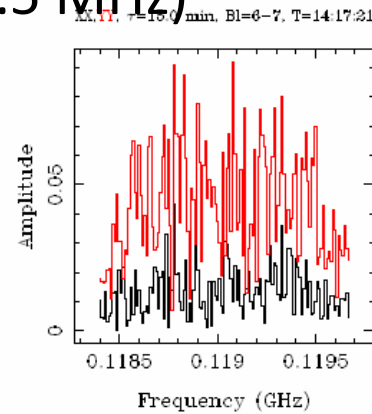
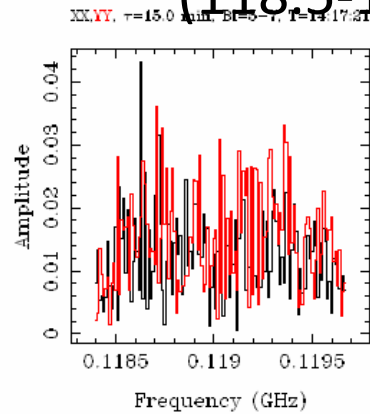
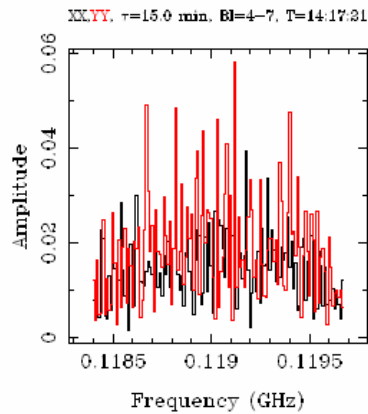


CenA, 0424, tracking, 5min average bandshapes for 1 scan

(118.5-119.5 MHz)

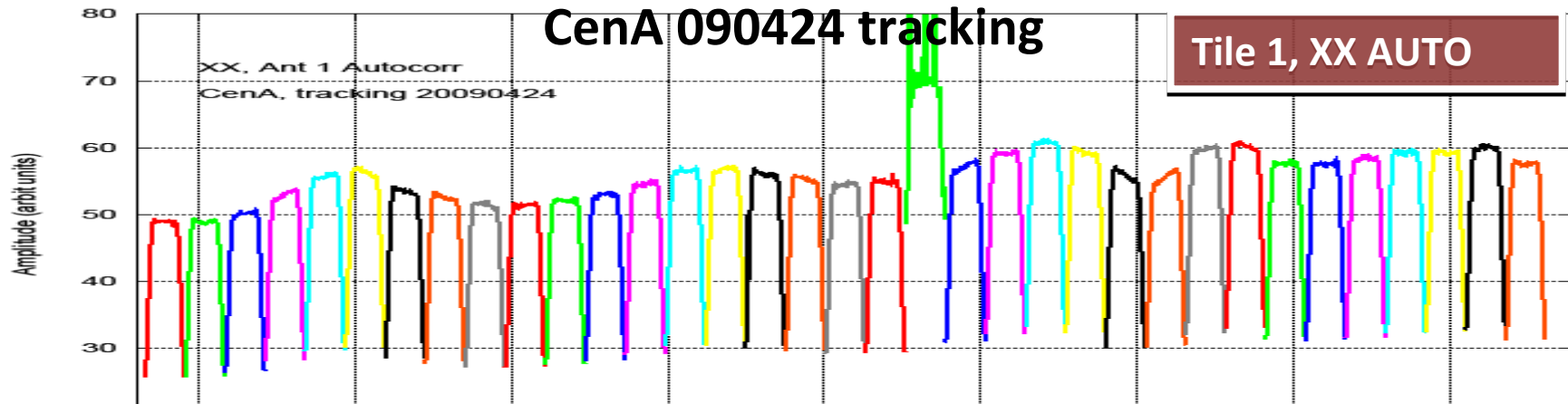


CenA, 0424, tracking, 5min average bandshapes for 1 scan (118.5-119.5 MHz)

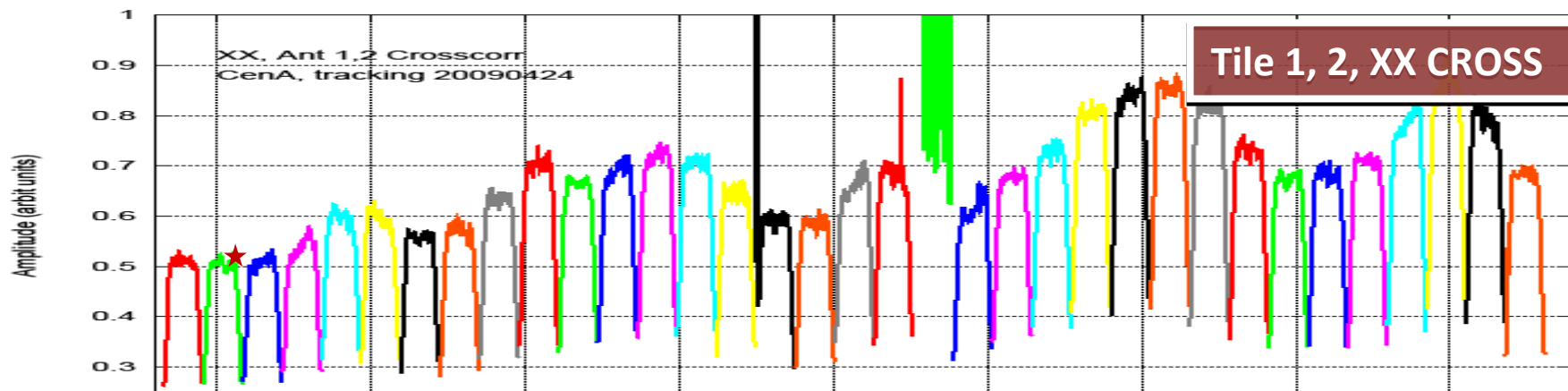


CenA 090424 tracking

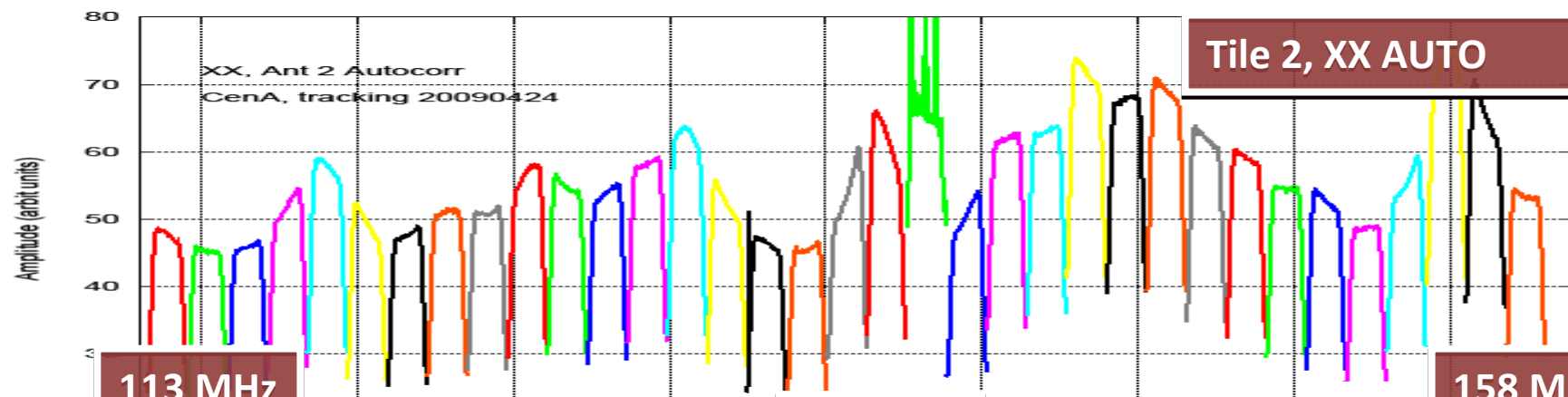
Tile 1, XX AUTO



Tile 1, 2, XX CROSS



Tile 2, XX AUTO



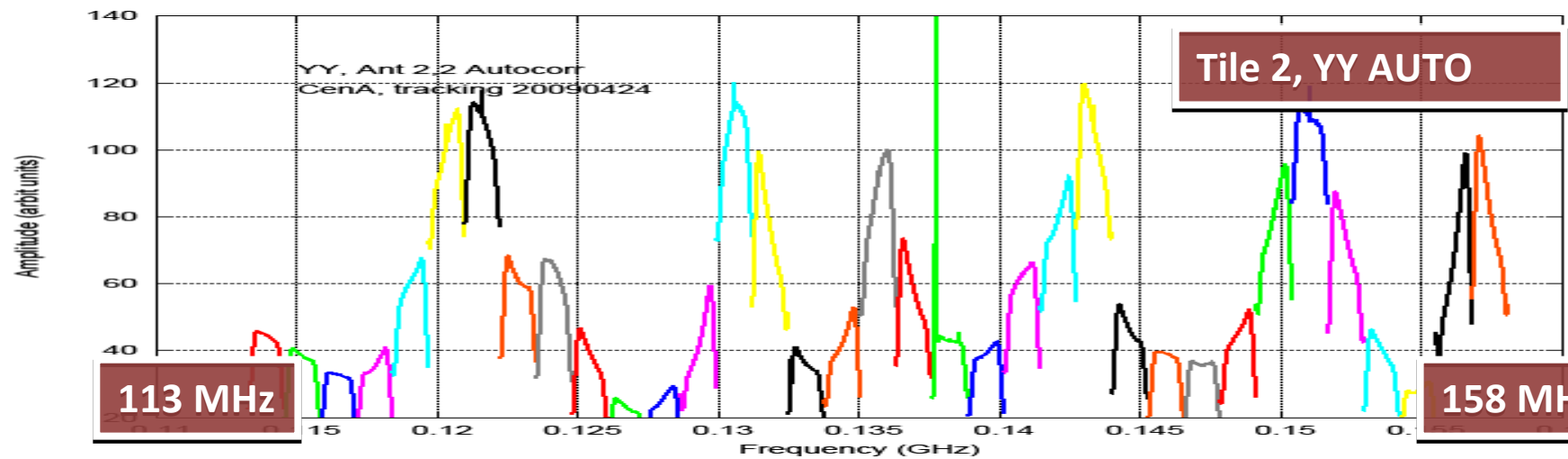
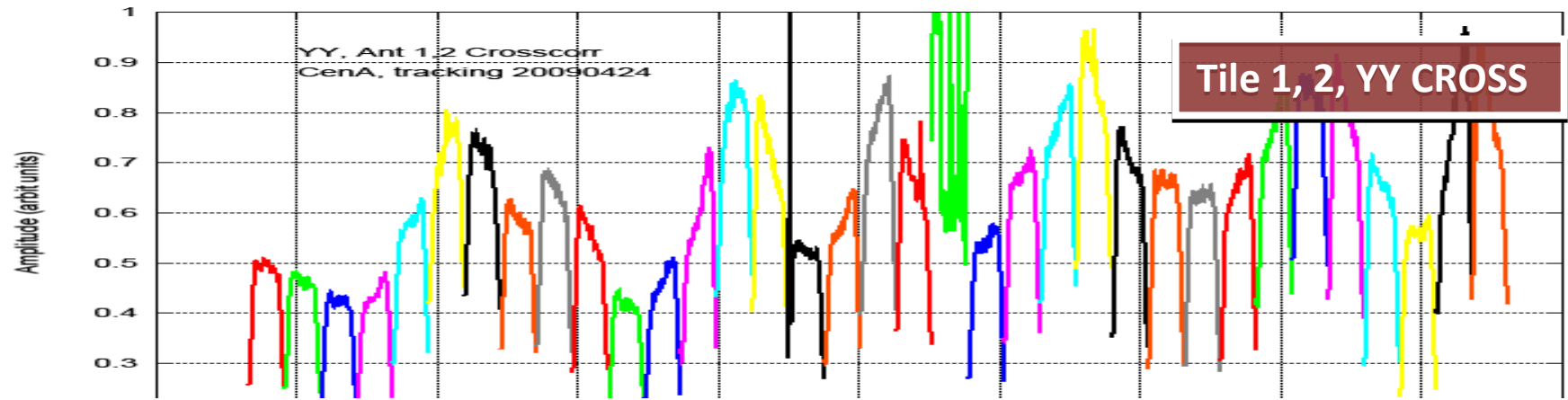
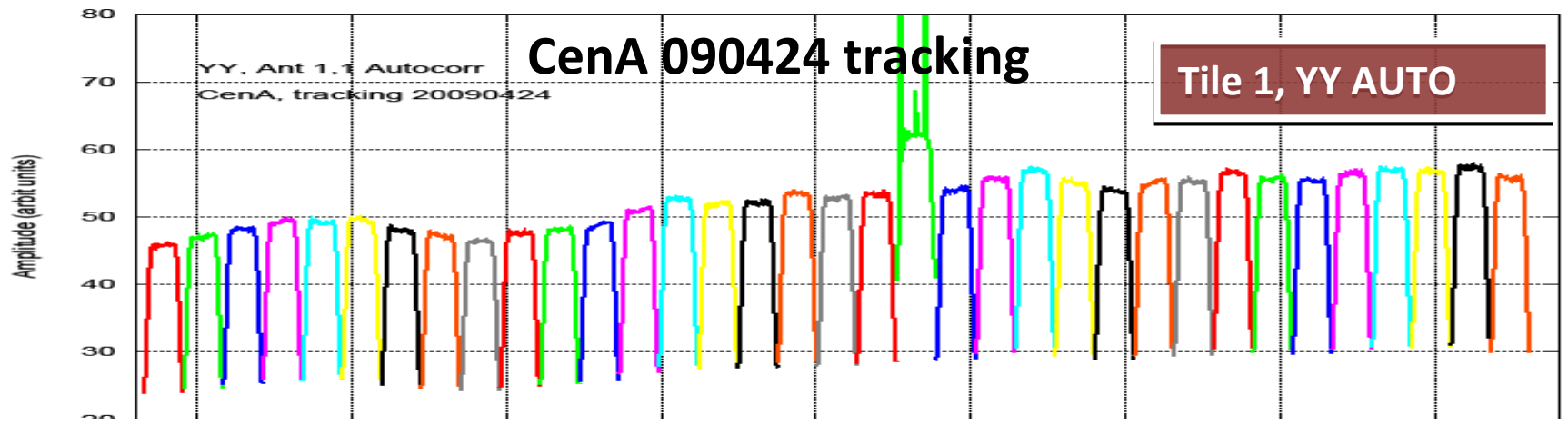
113 MHz

45 MHz

158 MHz



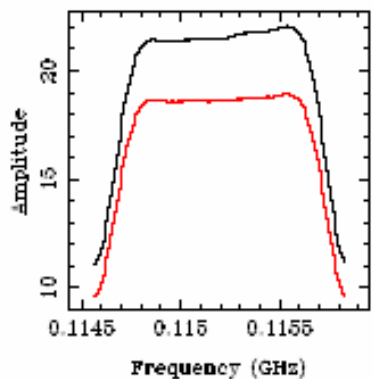
CenA 090424 tracking



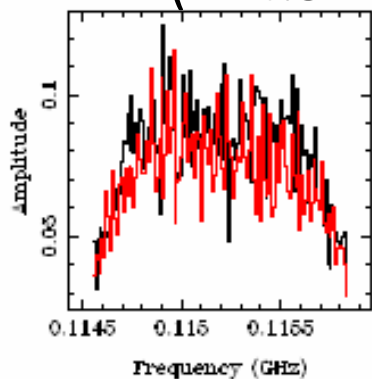
HerA, 0425, not tracking, 5min average bandshapes for 1 scan

(114.5-116.75 MHz)

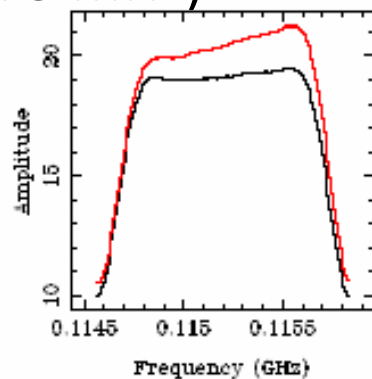
II.VV, $\tau=2.0$ min, BI=1-1, T=18:39:15



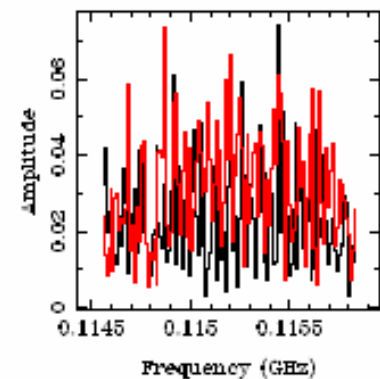
II.VV, $\tau=2.0$ min, BI=1-2, T=18:39:15



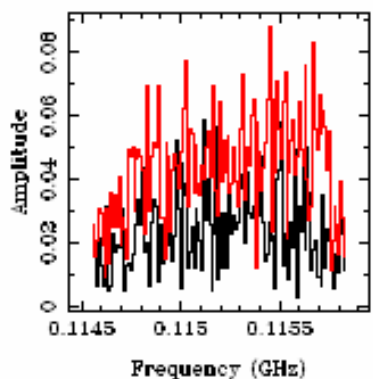
II.VV, $\tau=2.0$ min, BI=2-3, T=18:39:15



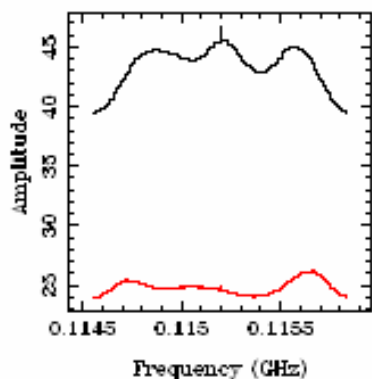
II.VV, $\tau=2.0$ min, BI=1-3, T=18:39:15



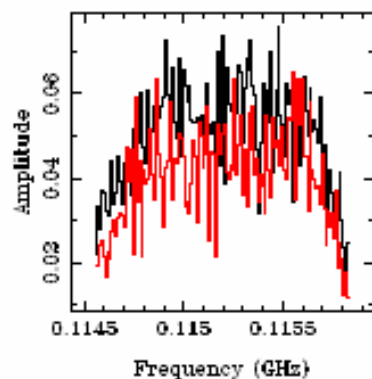
II.VV, $\tau=2.0$ min, BI=2-3, T=18:39:15



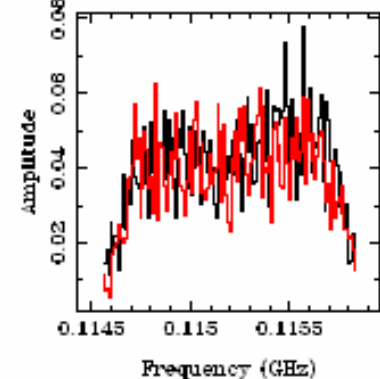
II.VV, $\tau=2.0$ min, BI=3-3, T=18:39:15



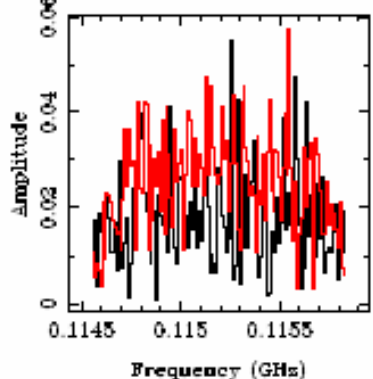
XXXV, $\tau=2.0$ min, BI=1-4, T=18:39:15



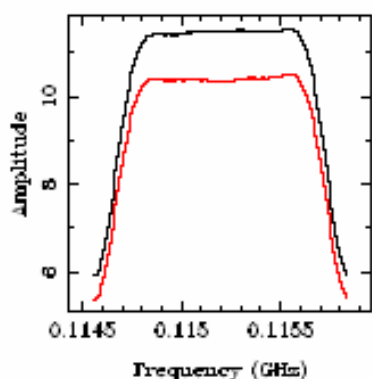
II.VV, $\tau=2.0$ min, BI=2-4, T=18:39:15



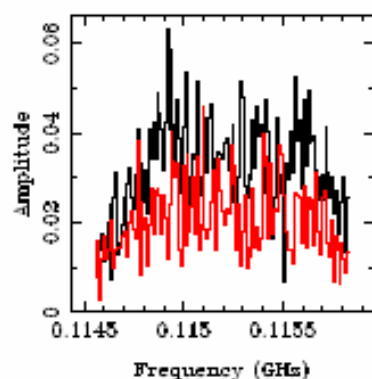
II.VV, $\tau=2.0$ min, BI=3-4, T=18:39:15



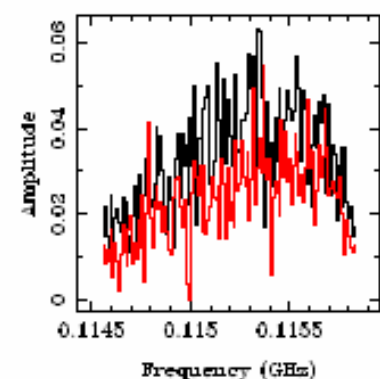
II.VV, $\tau=2.0$ min, BI=4-4, T=18:39:15



XXXV, $\tau=2.0$ min, BI=1-5, T=18:39:15

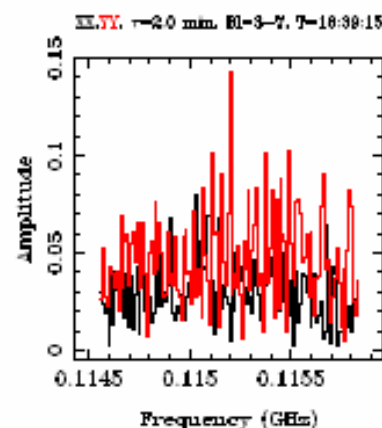
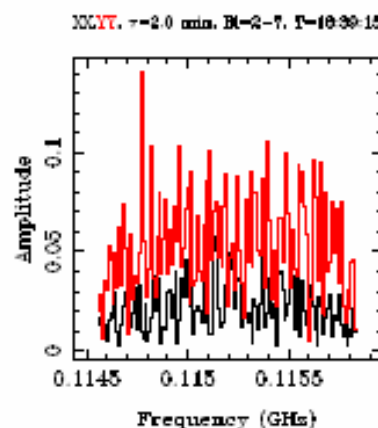
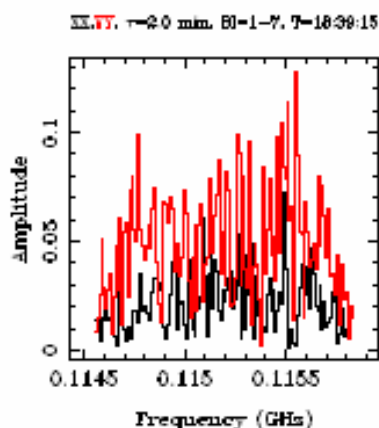
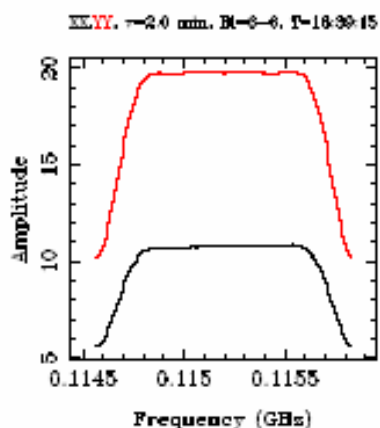
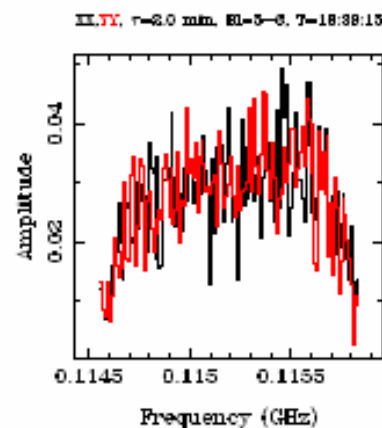
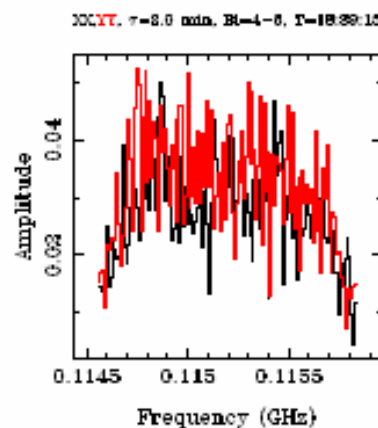
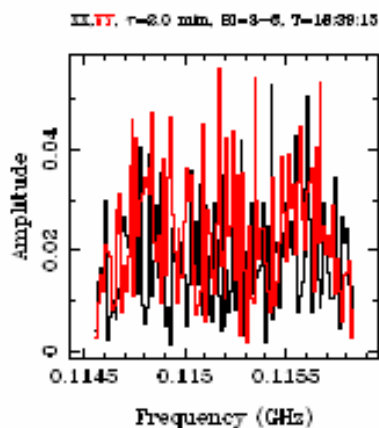
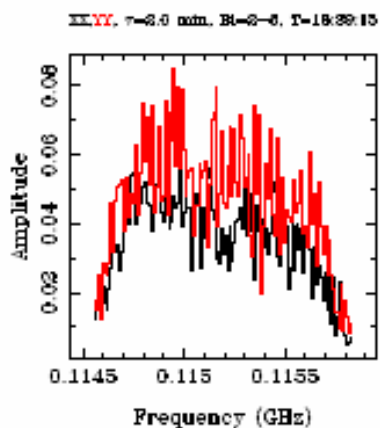
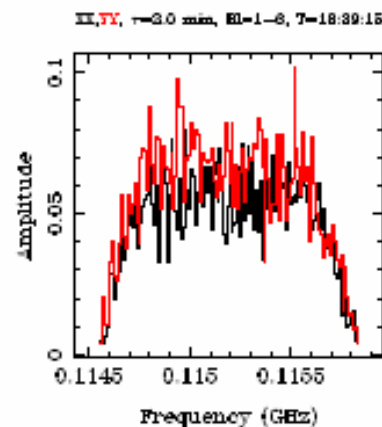
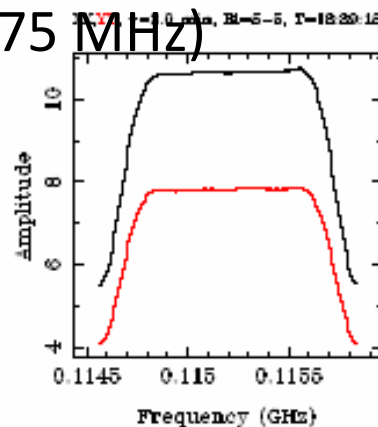
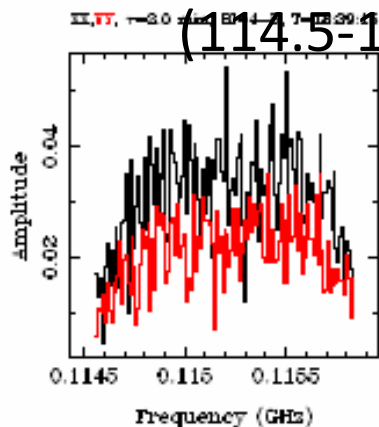
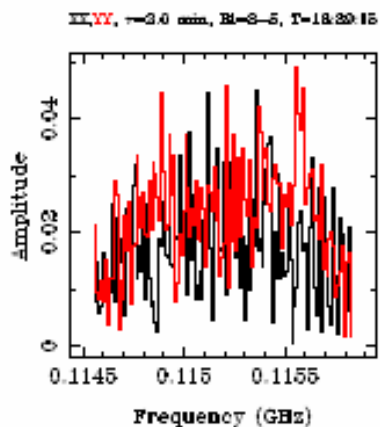


II.VV, $\tau=2.0$ min, BI=2-5, T=18:39:15



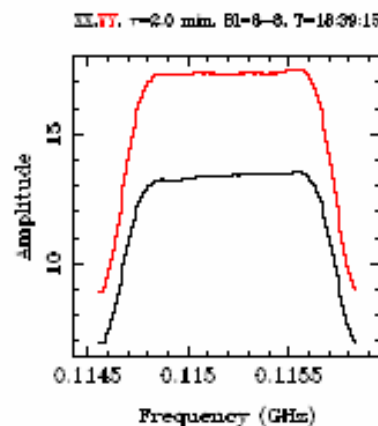
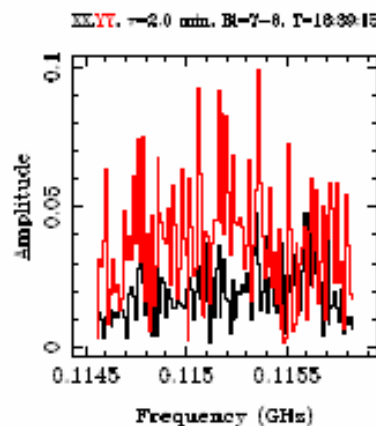
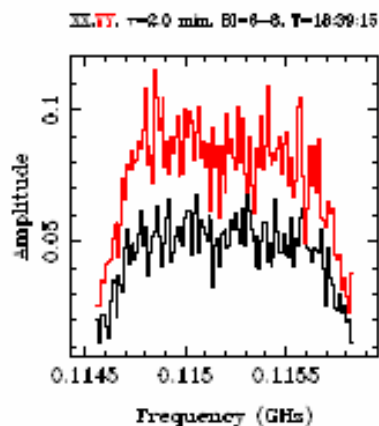
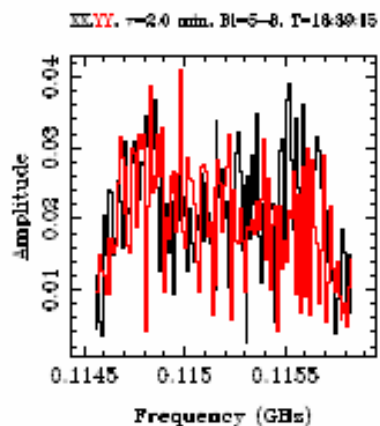
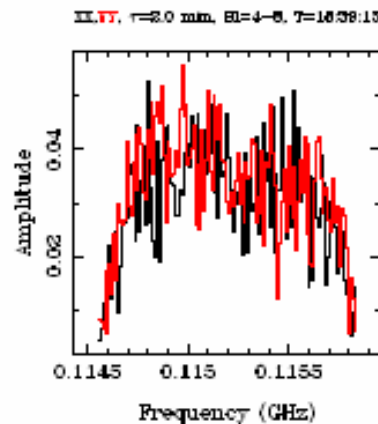
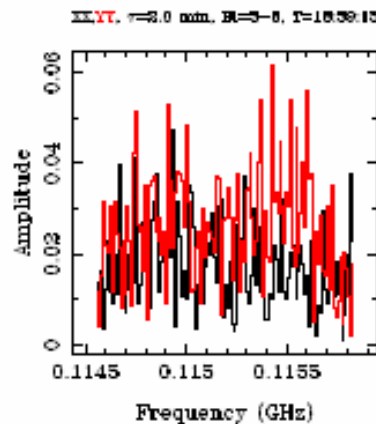
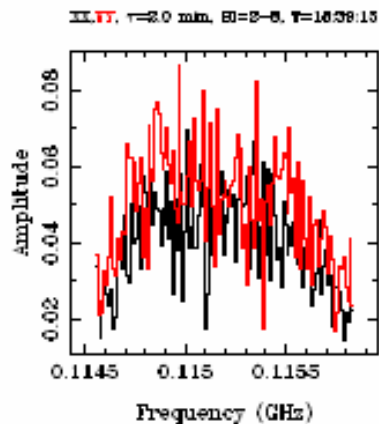
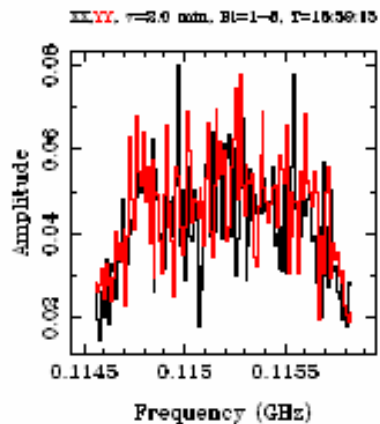
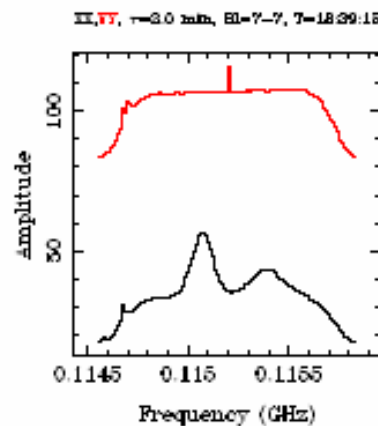
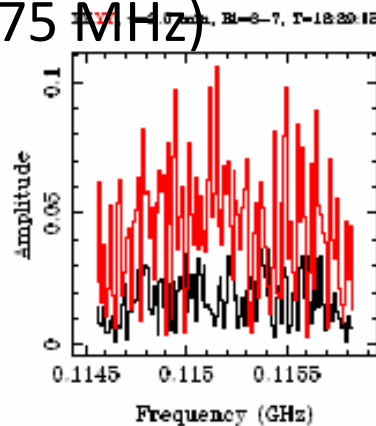
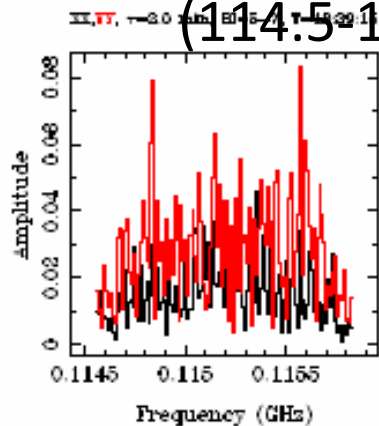
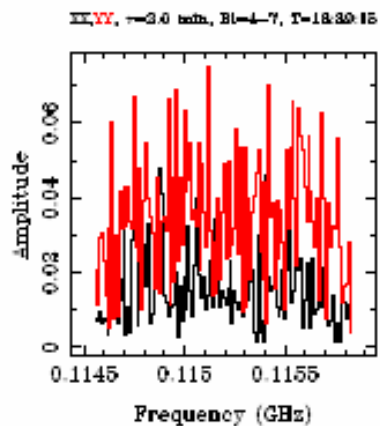
HerA, 0425, not tracking, 5min average bandshapes for 1 scan

(114.5-116.75 MHz)

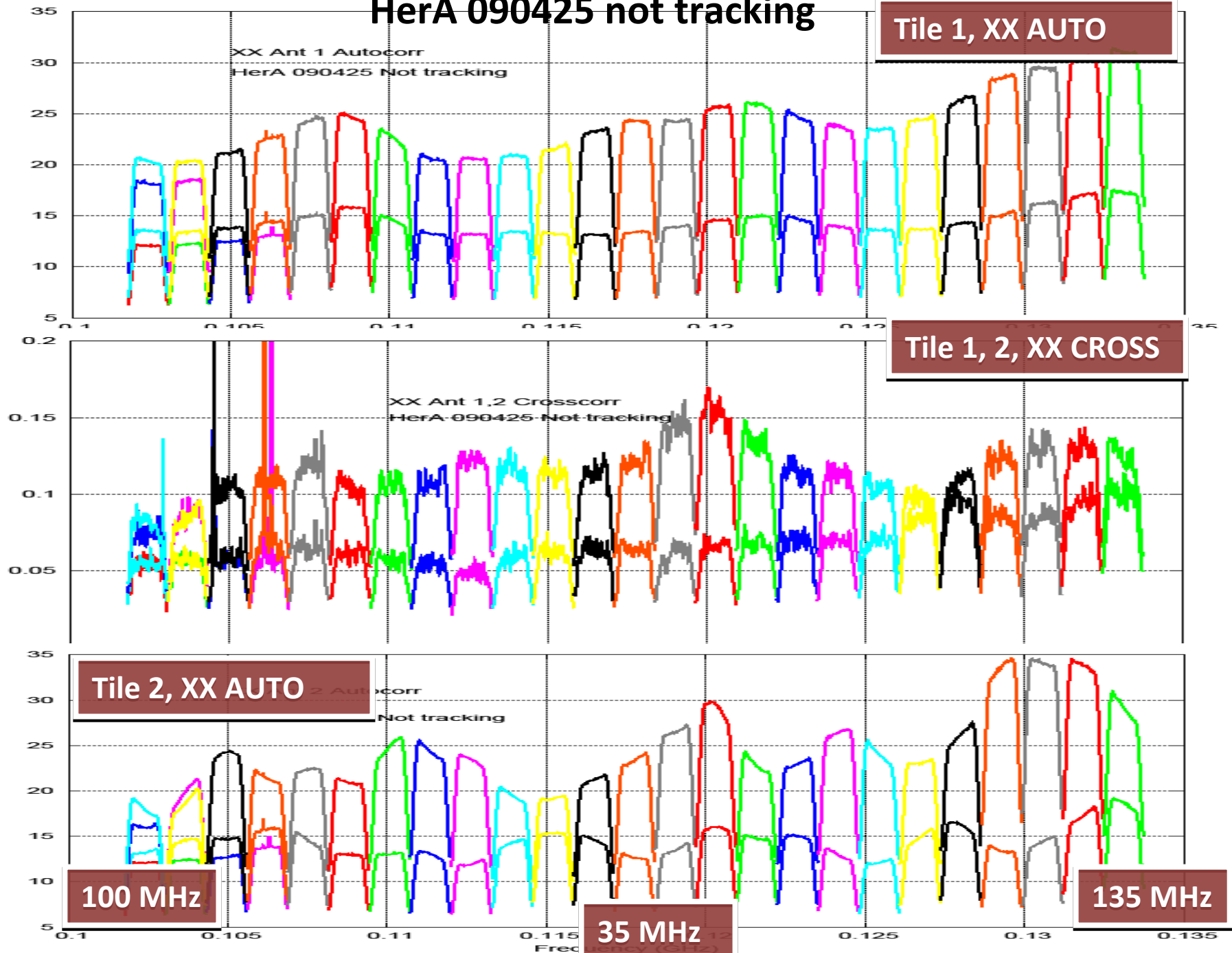


HerA, 0425, not tracking, 5min average bandshapes for 1 scan

(114.5-116.75 MHz)

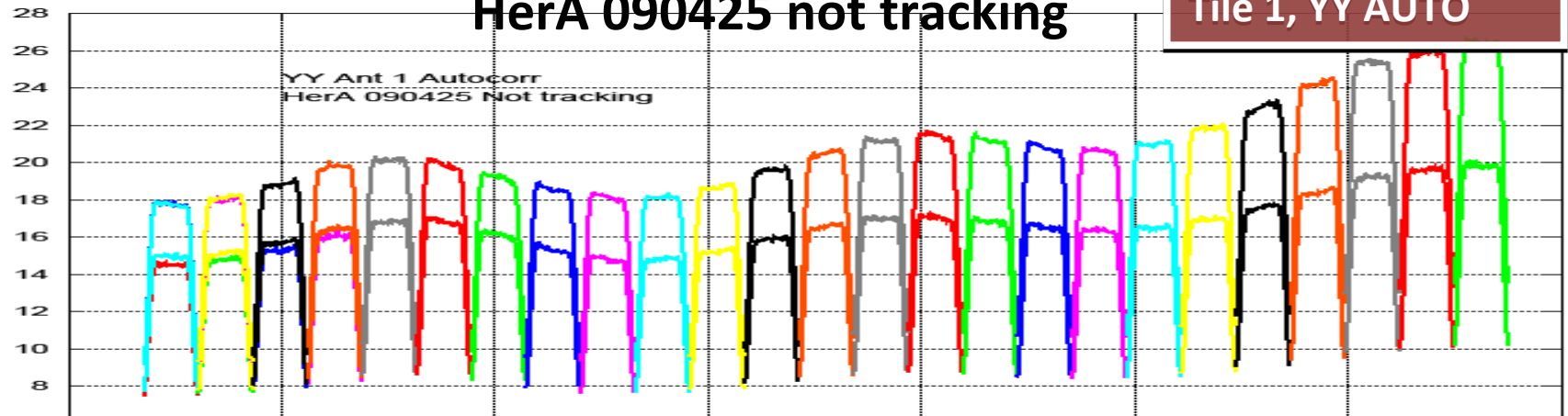


HerA 090425 not tracking

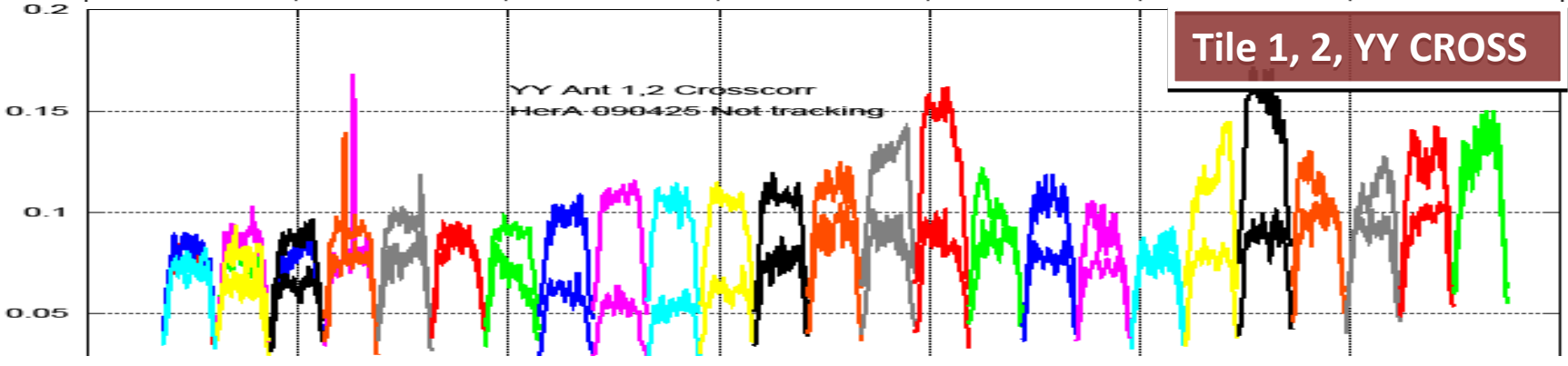


HerA 090425 not tracking

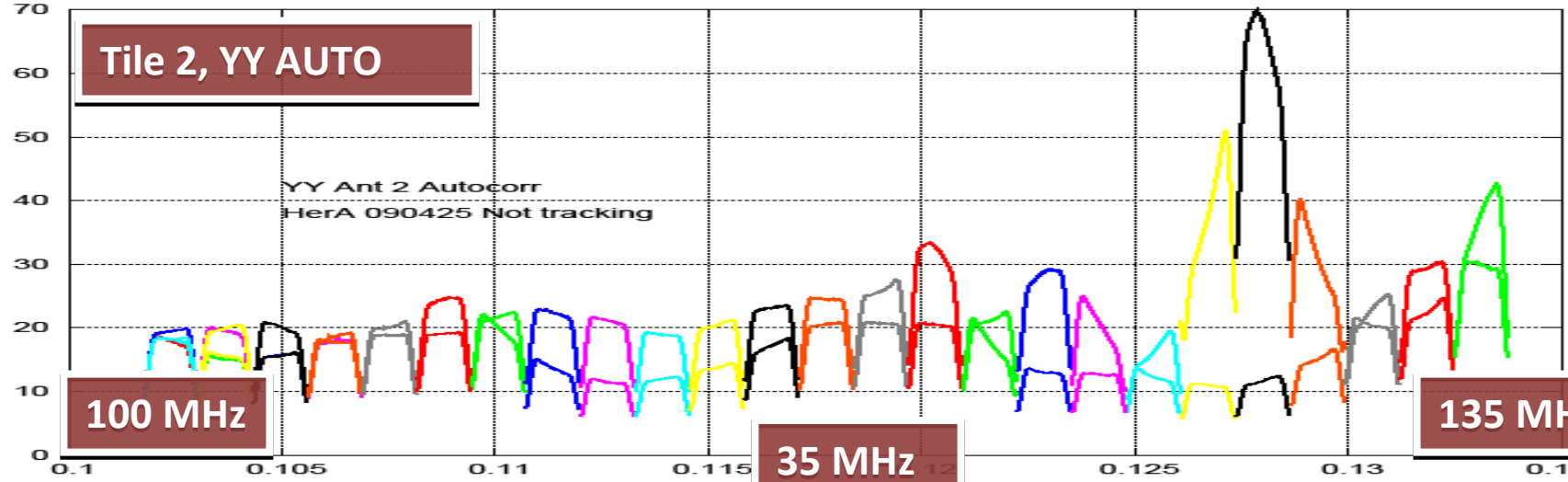
Tile 1, YY AUTO



Tile 1, 2, YY CROSS



Tile 2, YY AUTO



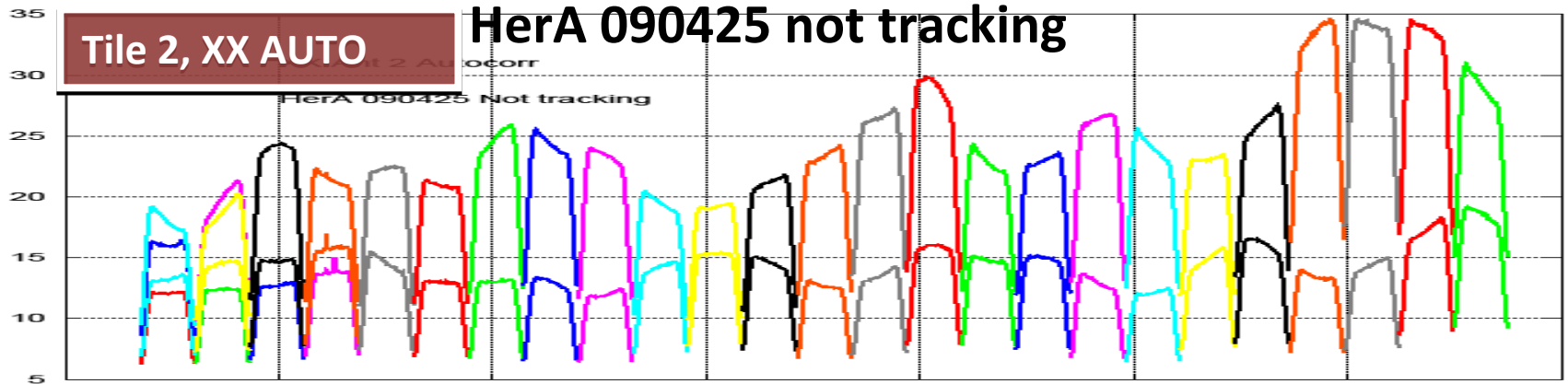
100 MHz

35 MHz

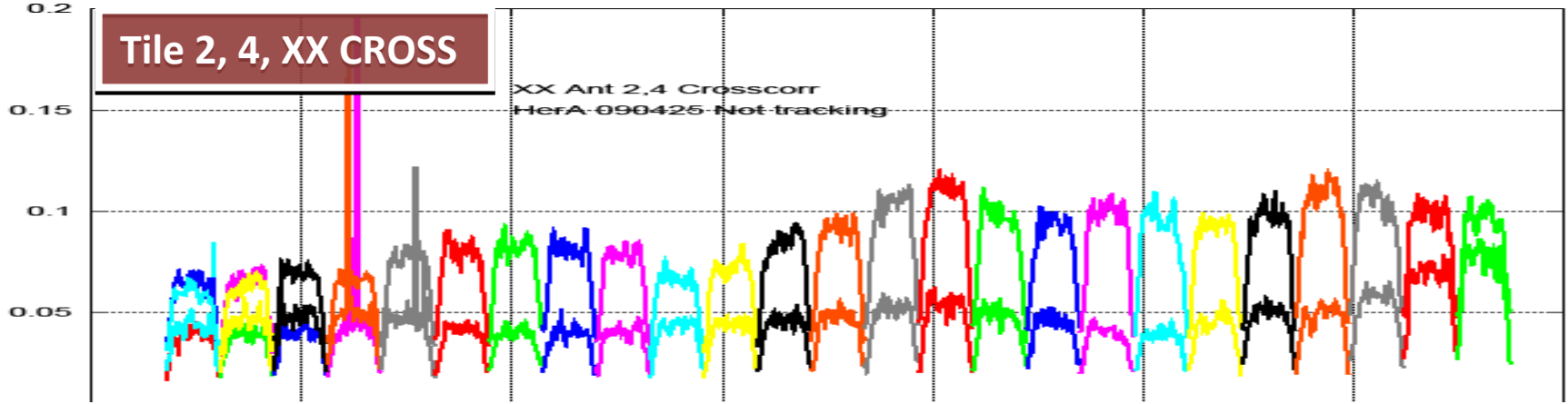
135 MHz

HerA 090425 not tracking

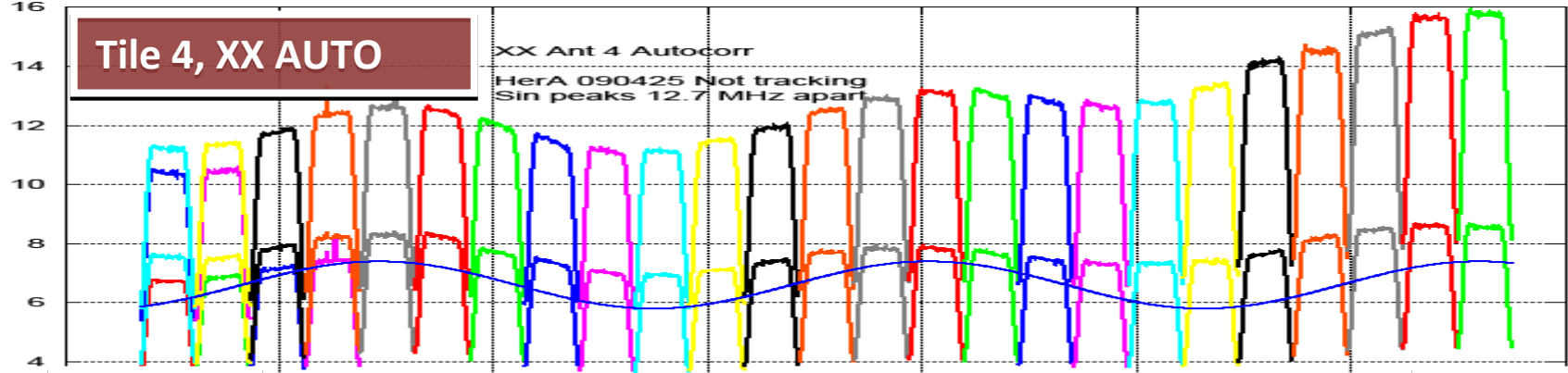
Tile 2, XX AUTO



Tile 2, 4, XX CROSS



Tile 4, XX AUTO

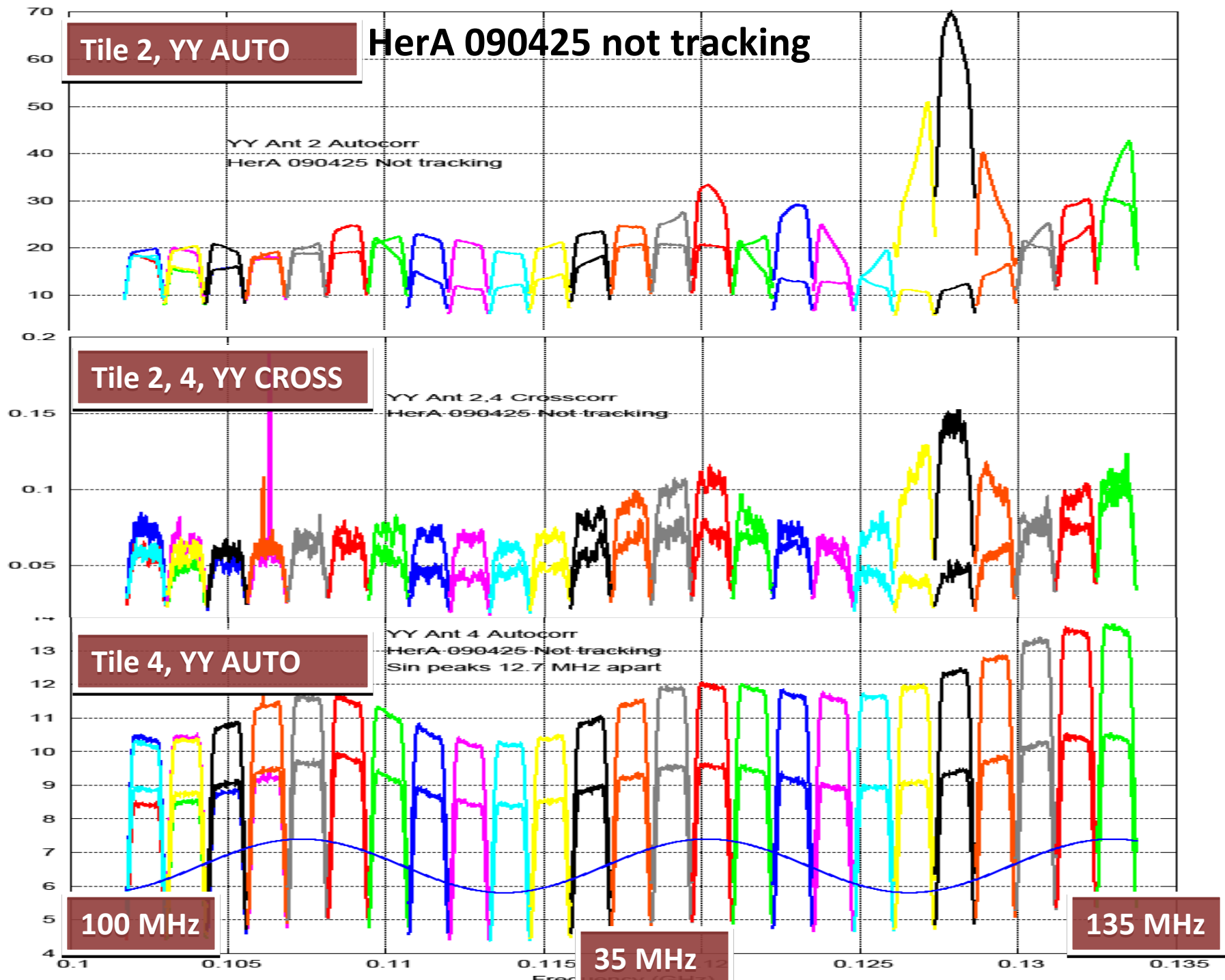


100 MHz

35 MHz

135 MHz

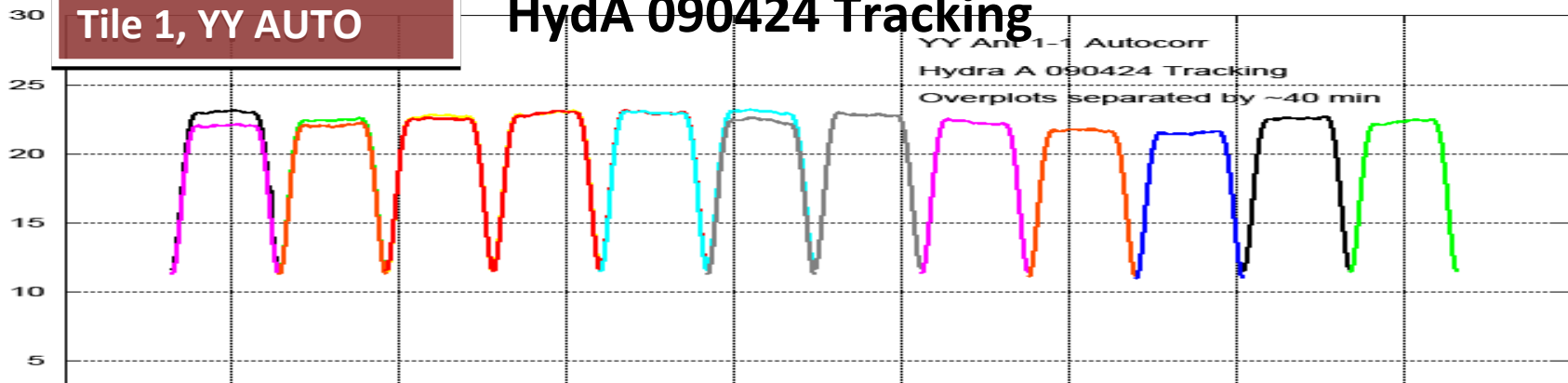
105 0.11 0.115 0.12 0.125 0.13 0.135



HydA 090424 Tracking

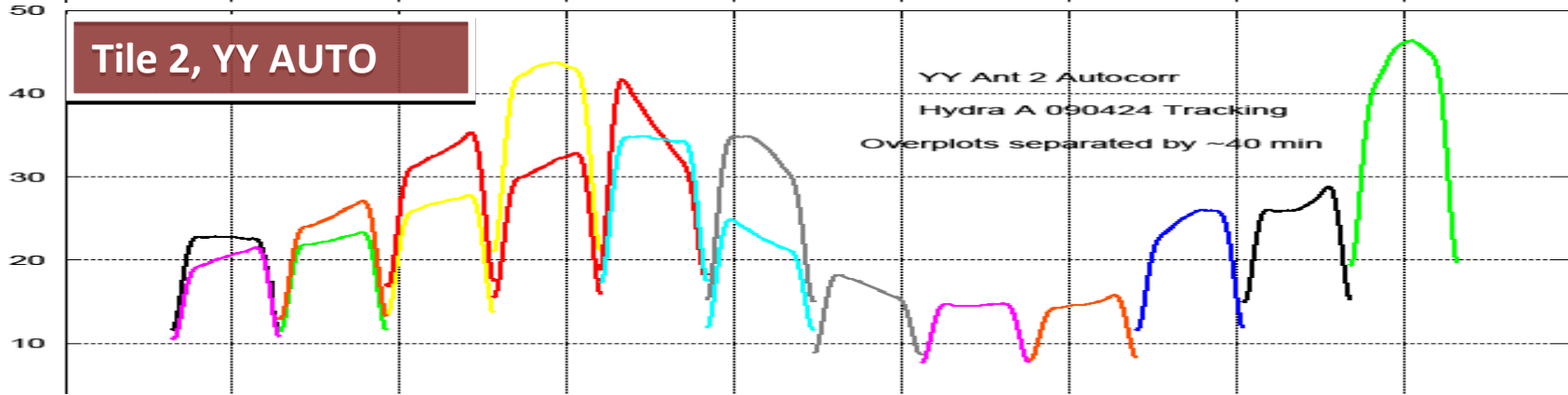
Tile 1, YY AUTO

YY Ant 1-1 Autocorr
Hydra A 090424 Tracking
Overplots separated by ~40 min



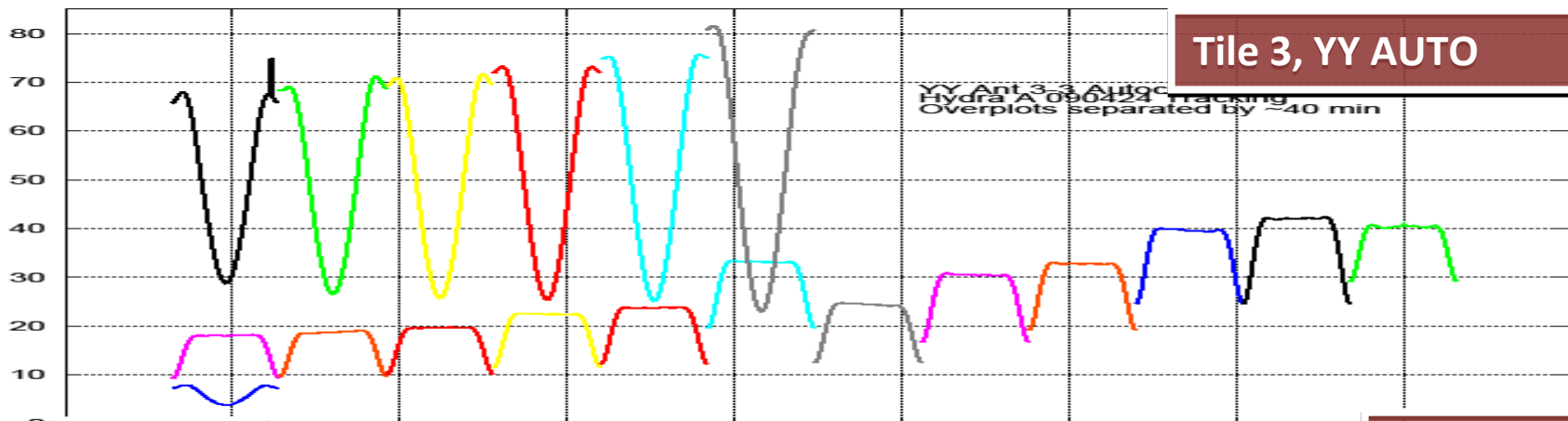
Tile 2, YY AUTO

YY Ant 2 Autocorr
Hydra A 090424 Tracking
Overplots separated by ~40 min



Tile 3, YY AUTO

YY Ant 3 Autocorr
Hydra A 090424 Tracking
Overplots separated by ~40 min

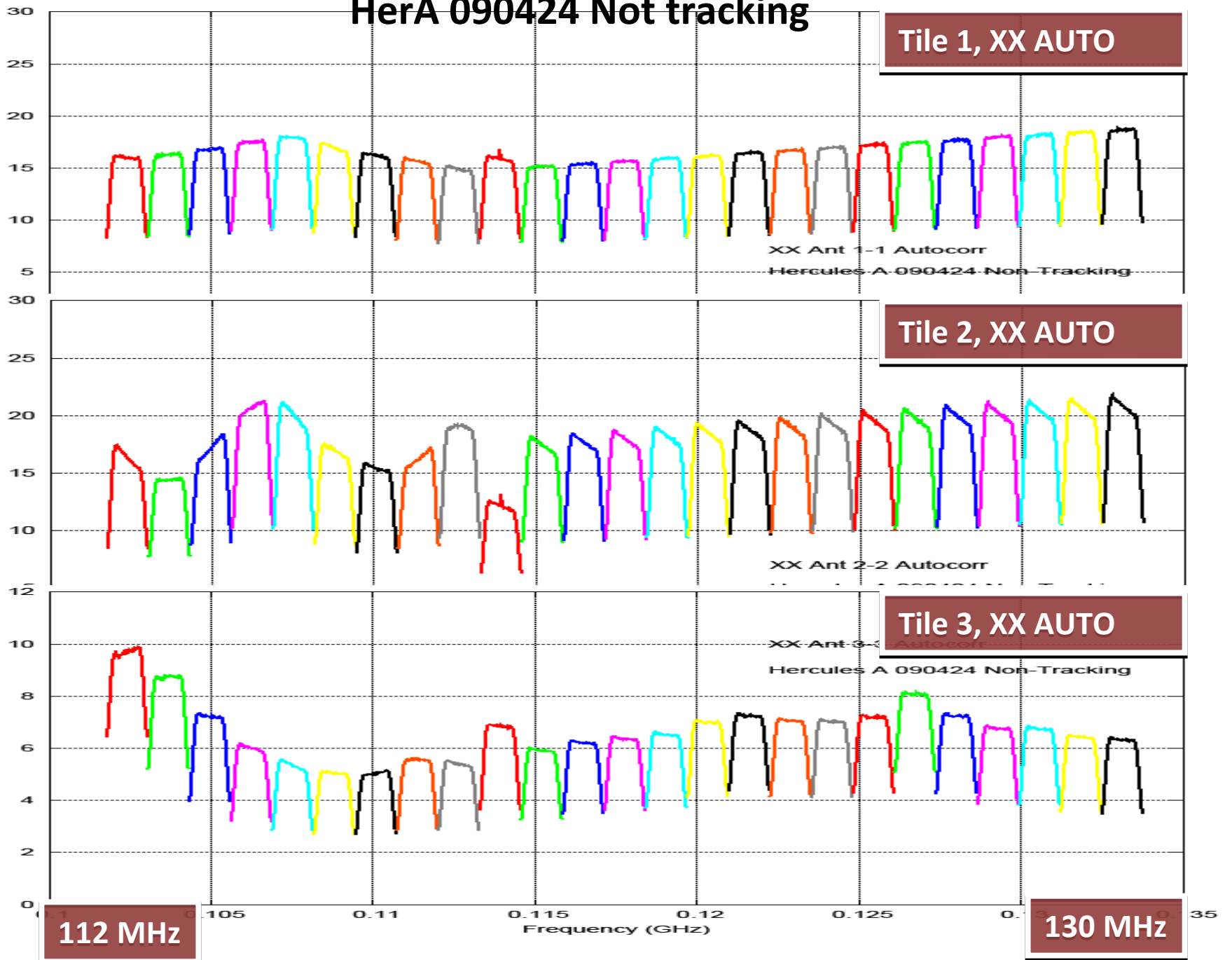


112 MHz

Frequency (GHz)

130 MHz

HerA 090424 Not tracking

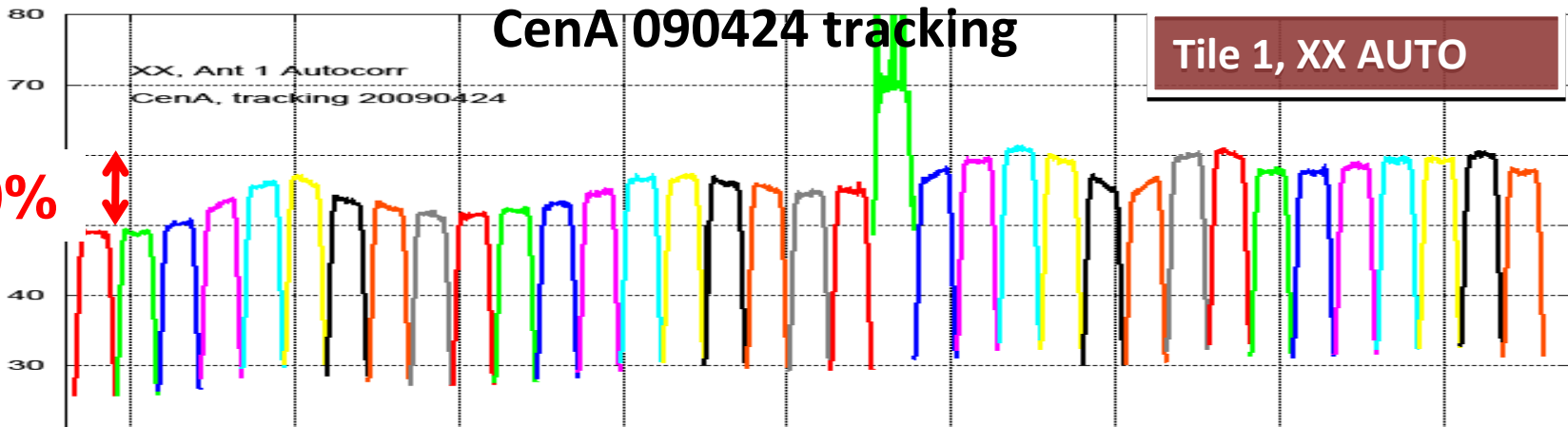


CenA 090424 tracking

Tile 1, XX AUTO

20%

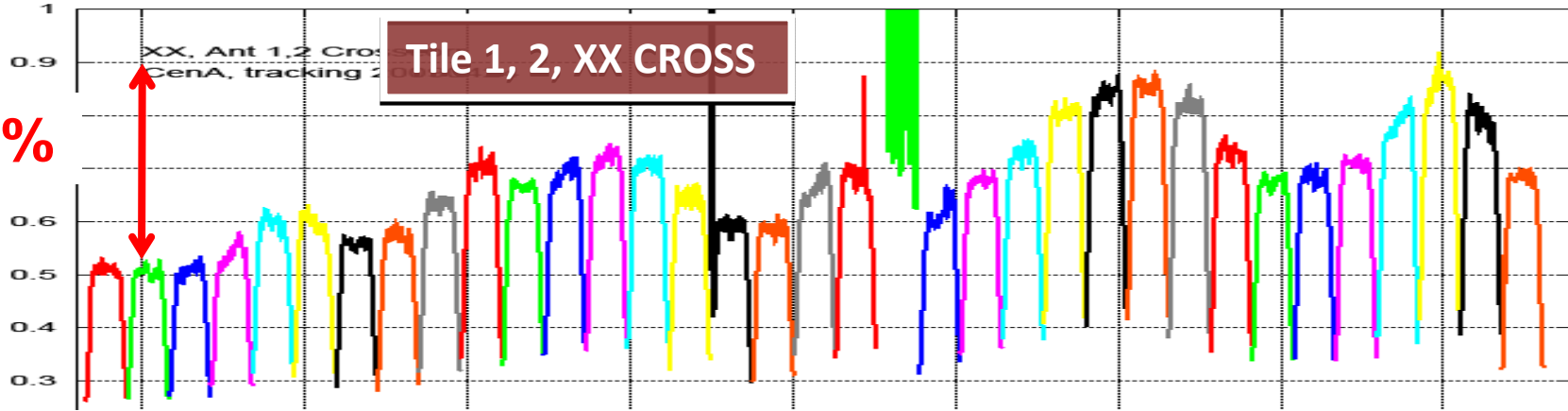
Amplitud



Tile 1, 2, XX CROSS

80%

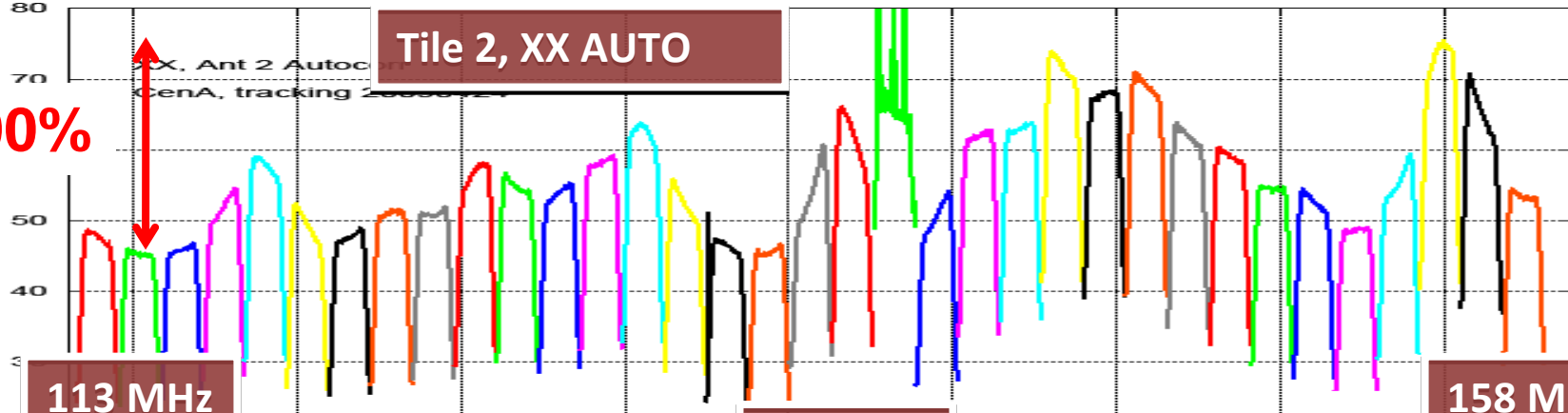
Amplitud (arbitu



Tile 2, XX AUTO

100%

Amplitud (arbitu



113 MHz

45 MHz

158 MHz

- $T_{\text{Sys}} \sim T_{\text{Sky}} + T_{\text{Rec}}$
- $C \sim T_{\text{Ant}}$ – fraction of T_{Sky} which correlated across a baseline
 - $C_{\text{Norm}} = T_{\text{Ant}} / (T_{\text{Sky}} + T_{\text{Rec}})$
 - $T_{\text{Ant}(12)} / \sqrt{T_{\text{Sys1}} * T_{\text{Sys2}}}$
- $T_{\text{ObsSys}} = T_{\text{TrueSys}} + T_{\text{Feedback}}$
 - $T_{\text{Feedback}} = \alpha T_{\text{true}}$
 - $T_{\text{ObsSys}} = (1+\alpha) * (T_{\text{Sky}} + T_{\text{Rec}})$
 - $C_{\text{Norm}} = (1+\alpha) * T_{\text{Ant}} / \sqrt{((1+\alpha) * T_{\text{TrueSys1}} * (1+\alpha) * T_{\text{TrueSys2}})}$
 - Independent of α

