

Past and Current status of DSC algorithm @ ALBA

A. Olmos
ITech Workshop 2013

- 1 - Chronology on DSC reported problems
- 2 - ALBA DSC coeffs analysis
- 3 - Why we did not see that during ITech visit?
- 4 - ESRF DSC coeffs analysis
- 5 - Questions about DSC Algorithm
- 6 - Status on different machines

One of the main topics on this workshop is the **Celebration** of:

- the 15th anniversary of company's foundation and
- the 10th anniversary of launching Libera



But in any birthday celebration there are always the so-called *not-that-welcomed* guests:

- the too much **drunk friend**: politically incorrect, shouting, overwhelming ...
- the **ex girlfriend**: sympathetic, she wants to give a “warm” welcome to your new girlfriend
- the **mother in law**: always complaining “that food is too cold, that drink is too warm ...”



So I'm afraid that today I'll play the role of the **mother in law**

- May 2011 - ESRF

Huge noise on DD-Sum → Coincided with DSC phase coeffs at very erratic values, more frequent at lower Levels

- July 2011 – ESRF

With RF OFF, DSC was learning on noise and so the SUM were noisy after RF ON again. Coeffs did never recover afterwards
Modification of DSCD_MINTBT_LEARN_LIMIT seemed to work at that time

- September 2011 – ALBA

After ESRF case, we asked ITech for ALBA corrected DSCD_MINTBT_LEARN_LIMIT

- October 2011 - ALBA

Proposed value measured by ITech was DSCD_MINTBT_LEARN_LIMIT = 2.4e6

- November 2011 - ALBA

Many phase coeffs out of the range and many at really low level values, below -60dBm
DSCD_MINTBT_LEARN_LIMIT value was still to low and Liberas were learning on noise

- November 2011 - ALBA

ITech measurement ($2.4e6$) and ALBA one ($3.3e6$) did not agree

- November 2011 - DESY

Changed the DSCD_MINTBT value according to the new value received from ITech
The change did unfortunately not work as expected

Detected problem of DSC learn cycle during an inadvertent beam dump
This could shuffle the DSC coefficients of previously DSC-learned input level stages

- November 2011 - ALBA

All machine Liberass changed to DSCD_MINTBT_LEARN_LIMIT = $3.3e6$
When beam was killed, Liberass still calculated phase coeffs at very low Level values (-60dBm)

- February 2012 – ITech visit to ALBA to fix the problem

DSCD_MINTBT tested with values $2.4e6$, $6e6$ and $13e6$
 $6e6$ seemed OK → but it turned out that tests were done with too “gentle” beam killing

COME BACK TO THAT LATER

ALBA DSC coeffs analysis

- 1 - Right after DSC learning (100mA down to 0mA)
- 2 - After some sudden beam drops and reinjections (2 days later)
- 3 - Two months after last calibration from scratch

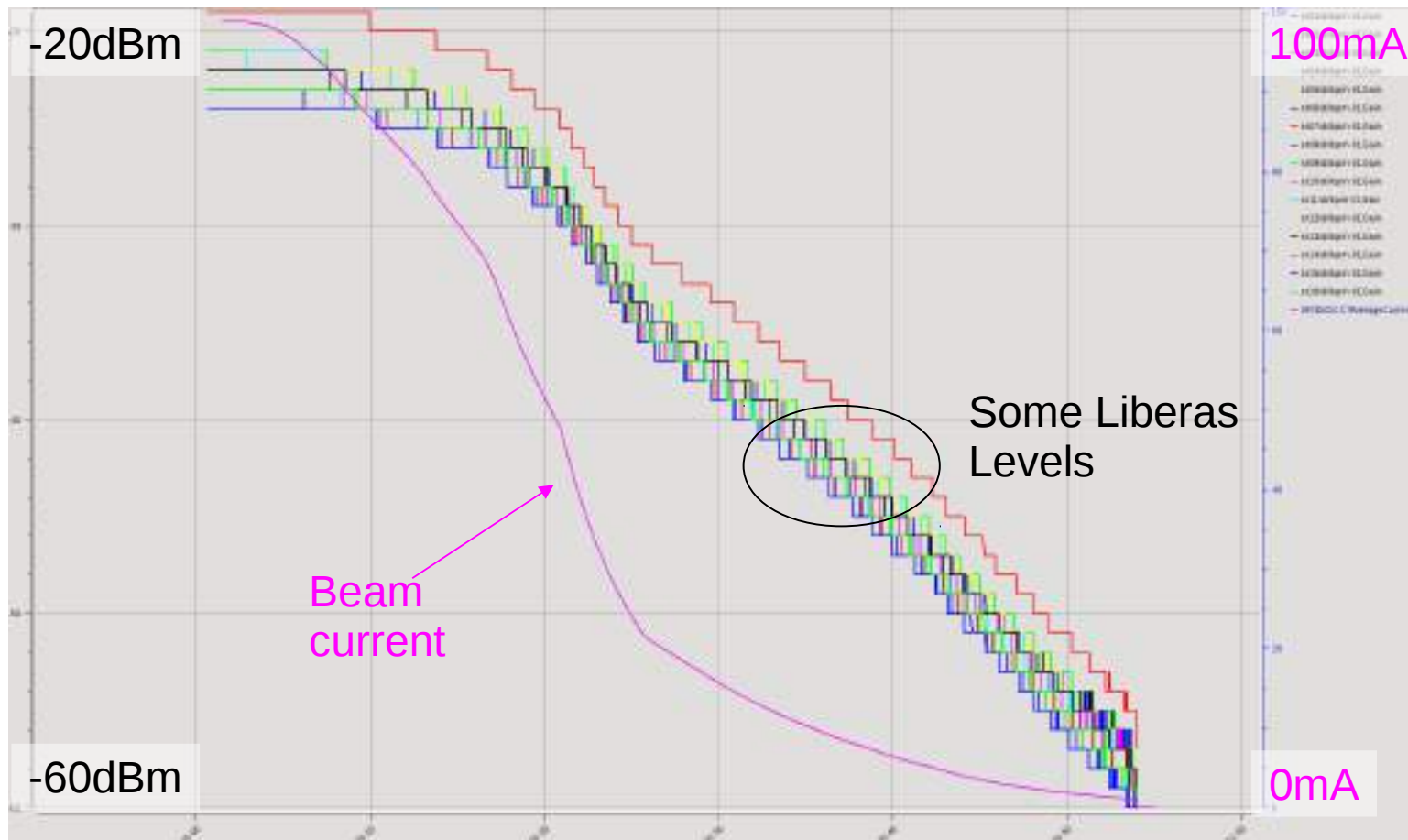
All tests performed with:

DSCD_MINTBT_LEARN_LIMIT = 6e6

DSC mode kept always at '2' (self-learning)

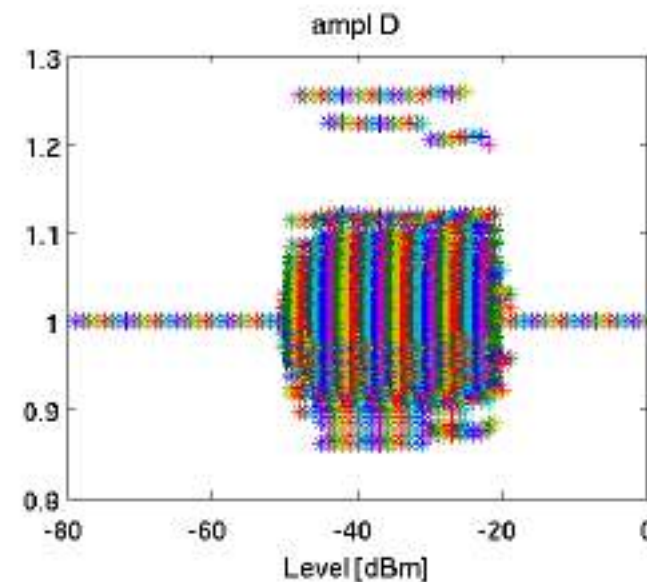
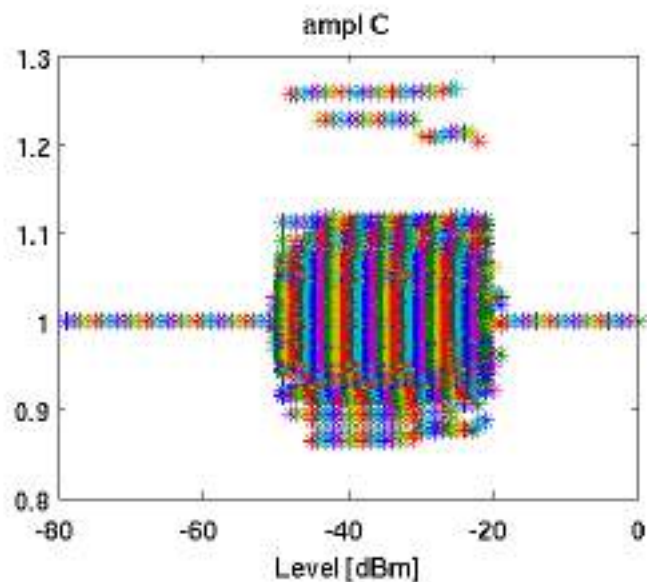
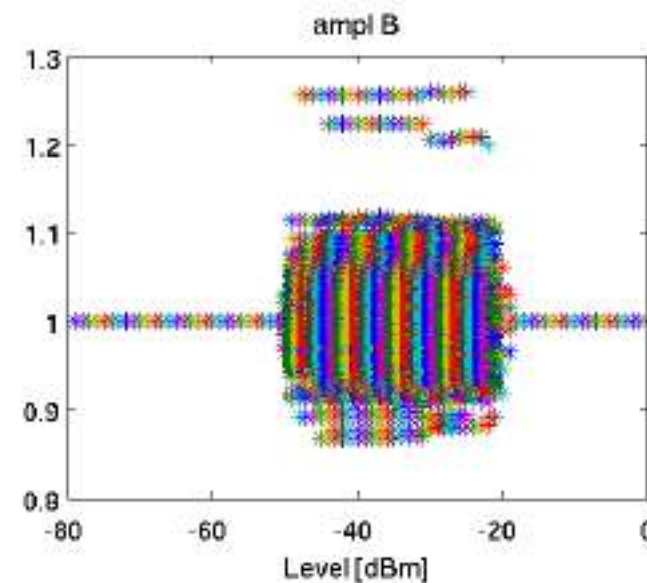
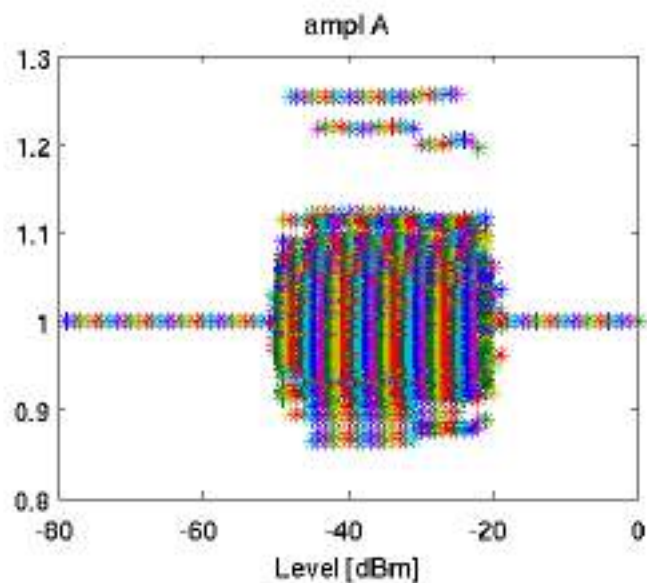
AGC mode kept always ON

What do we do to learn from scratch?



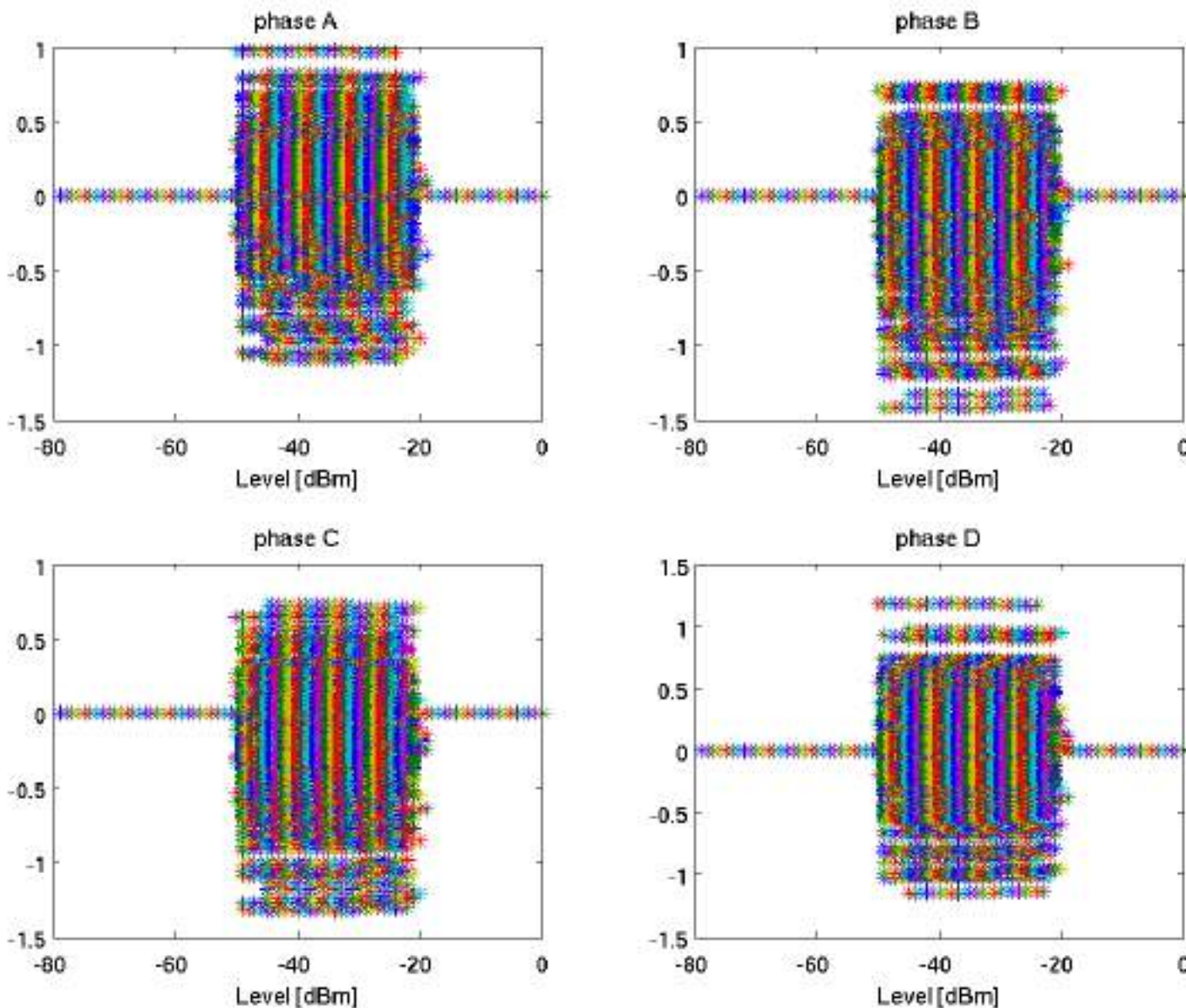
Right after DSC learning (100mA down to 0mA)

How the AMPLITUDE coeffs look on each Libera Channel



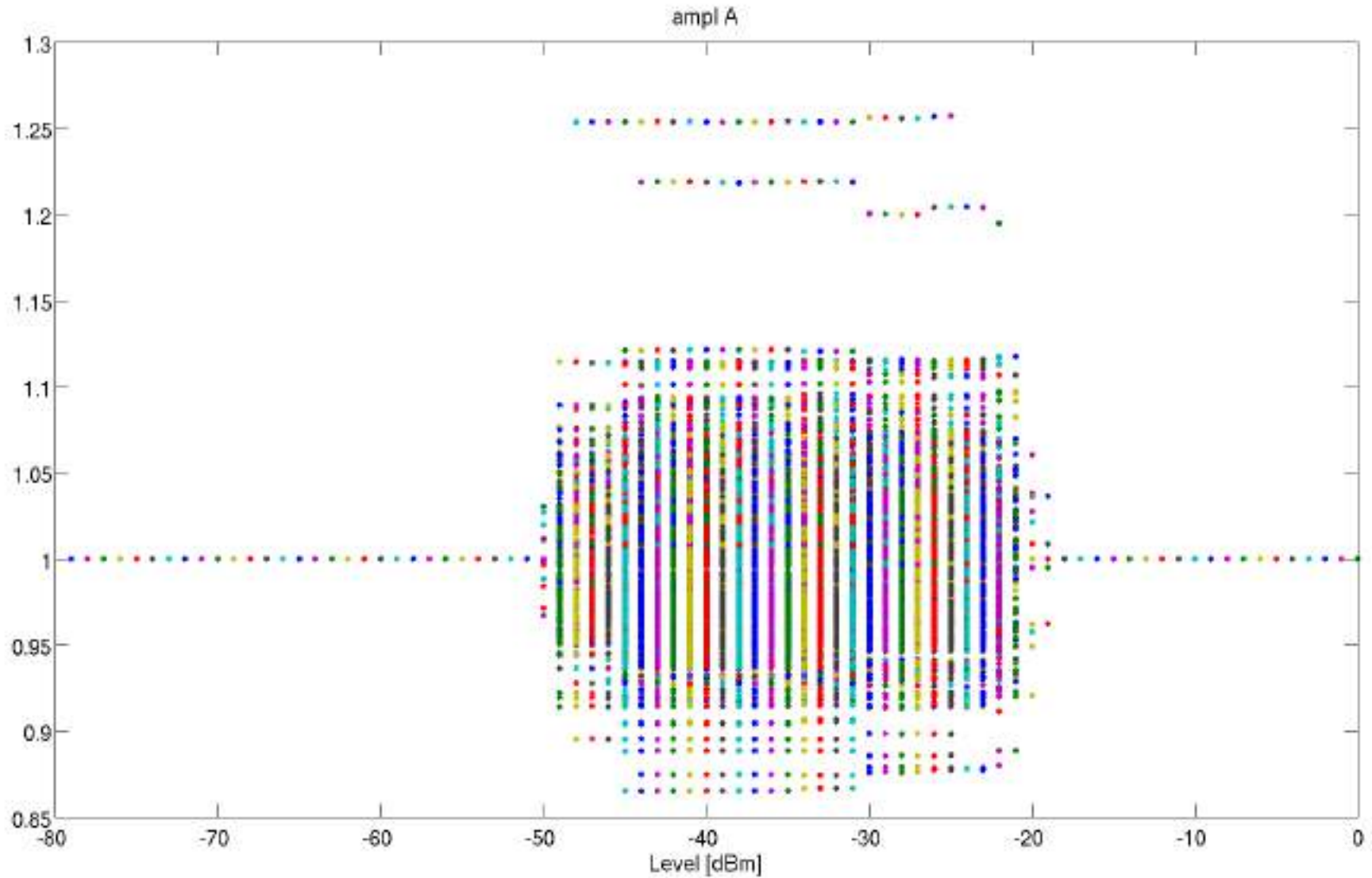
Right after DSC learning (100mA down to 0mA)

How the **PHASE** coeffs look on each Libera Channel

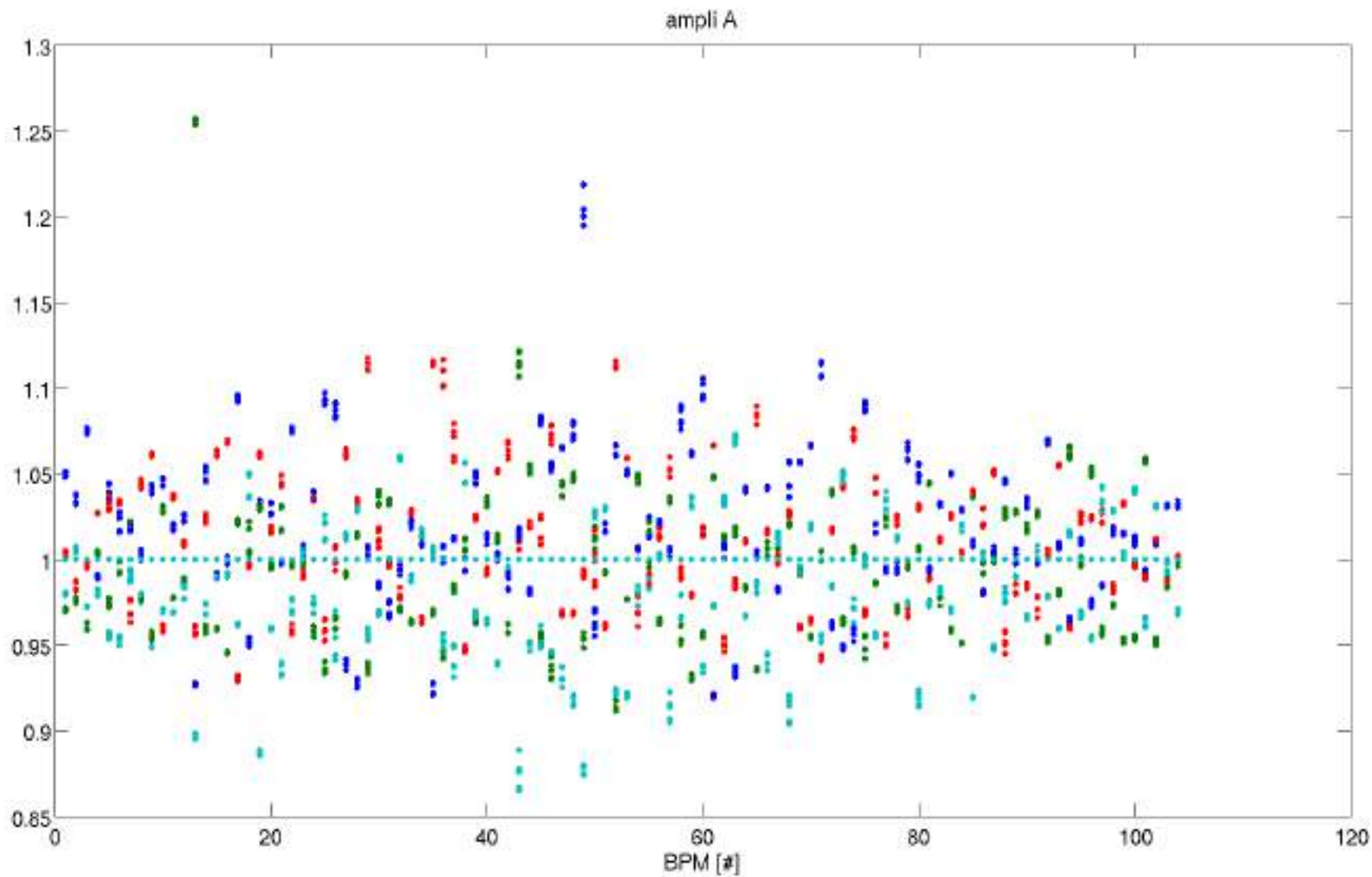


From now on, we focus on Channel A

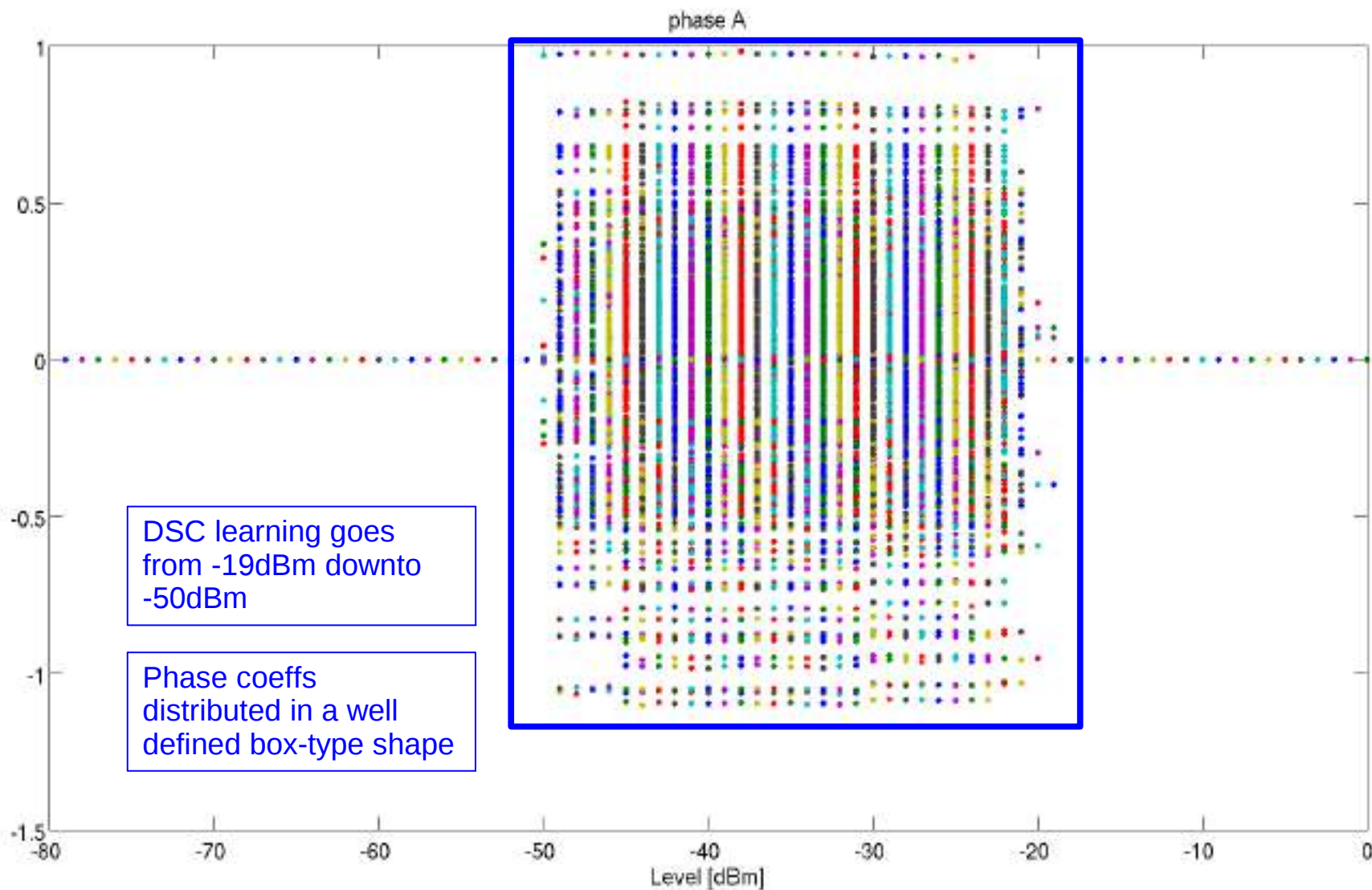
AMPLITUDE coeffs vs. Liberas Level



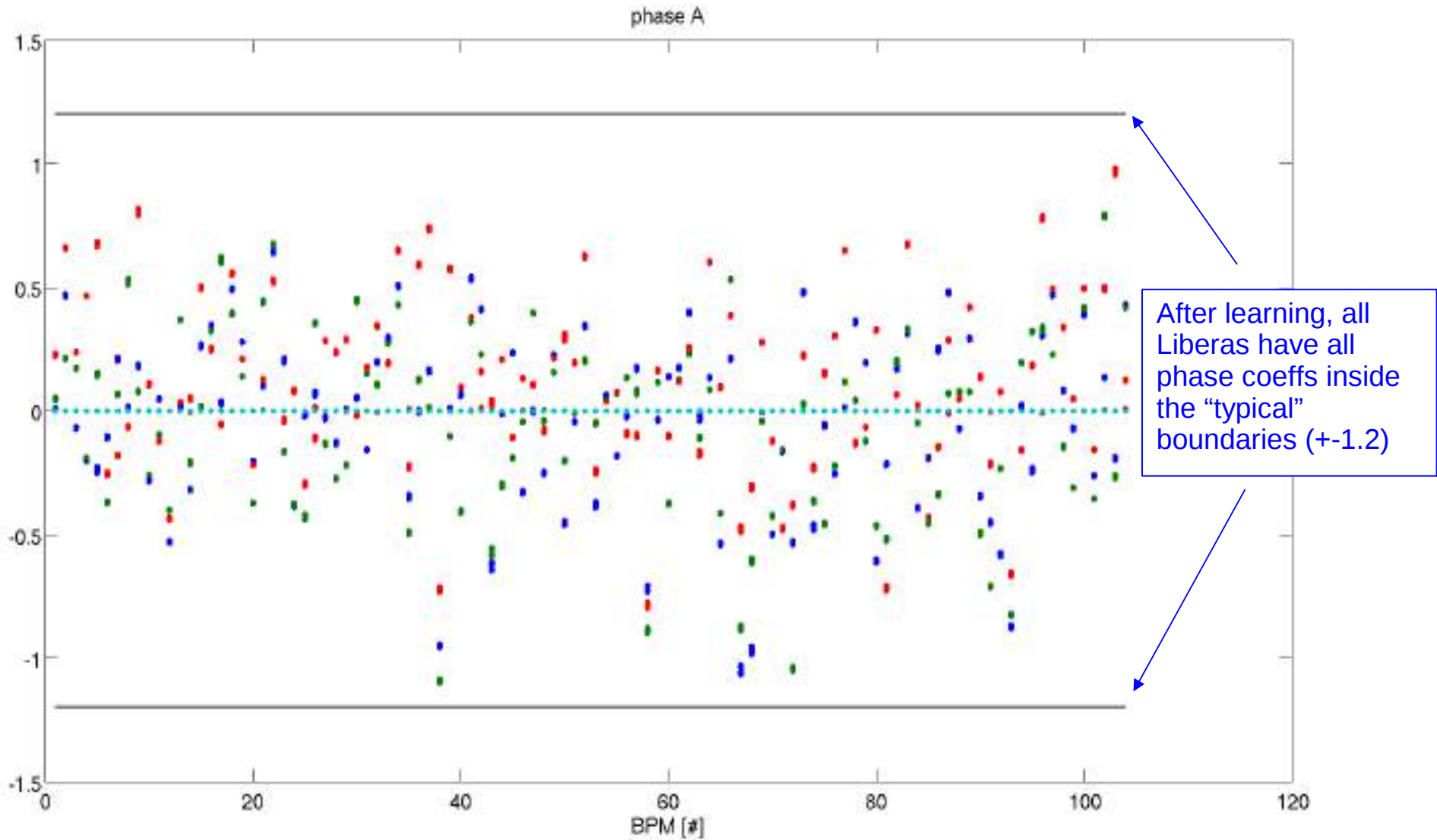
AMPLITUDE coeffs vs. Libera unit



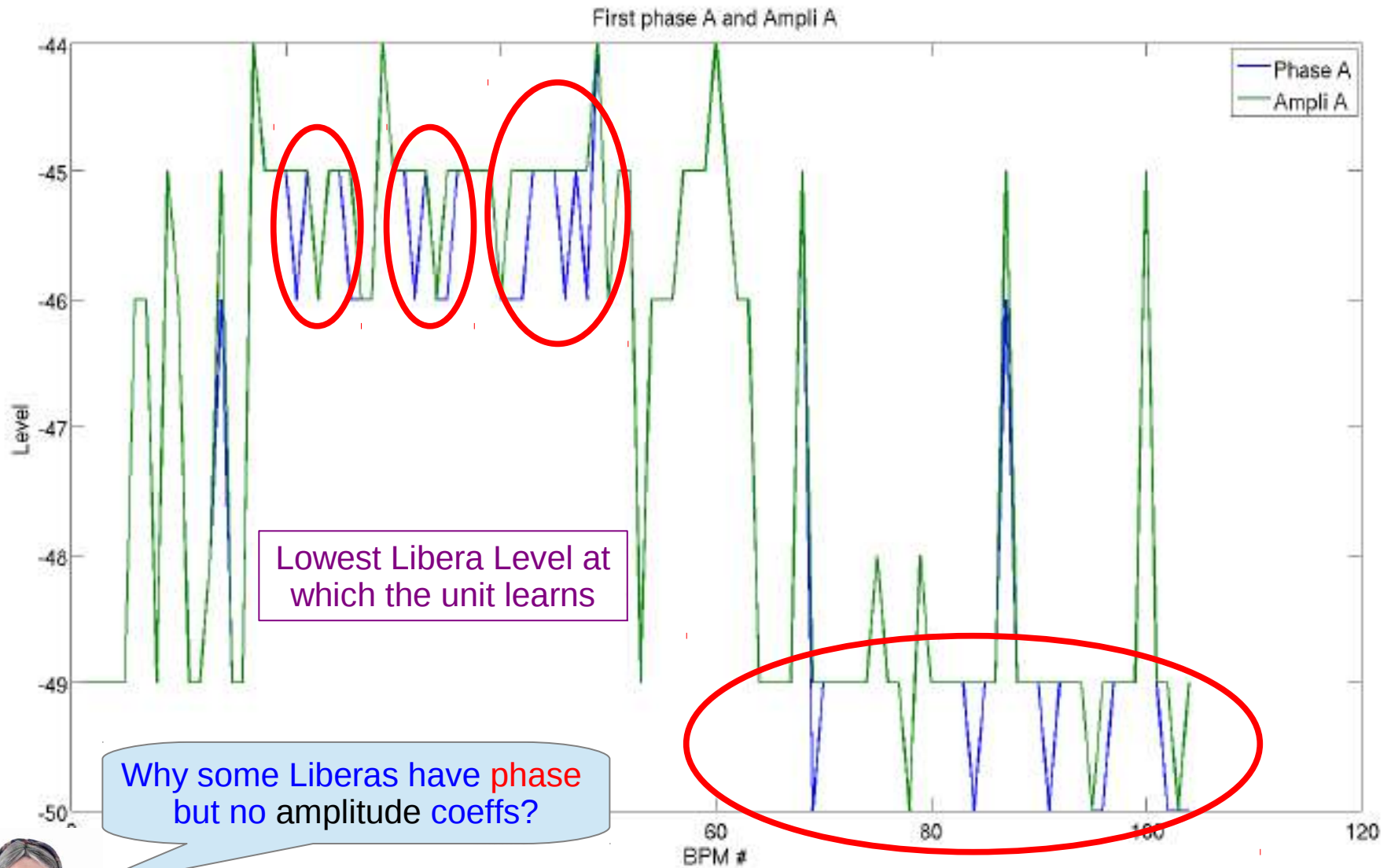
PHASE coeffs vs. Liberas Level

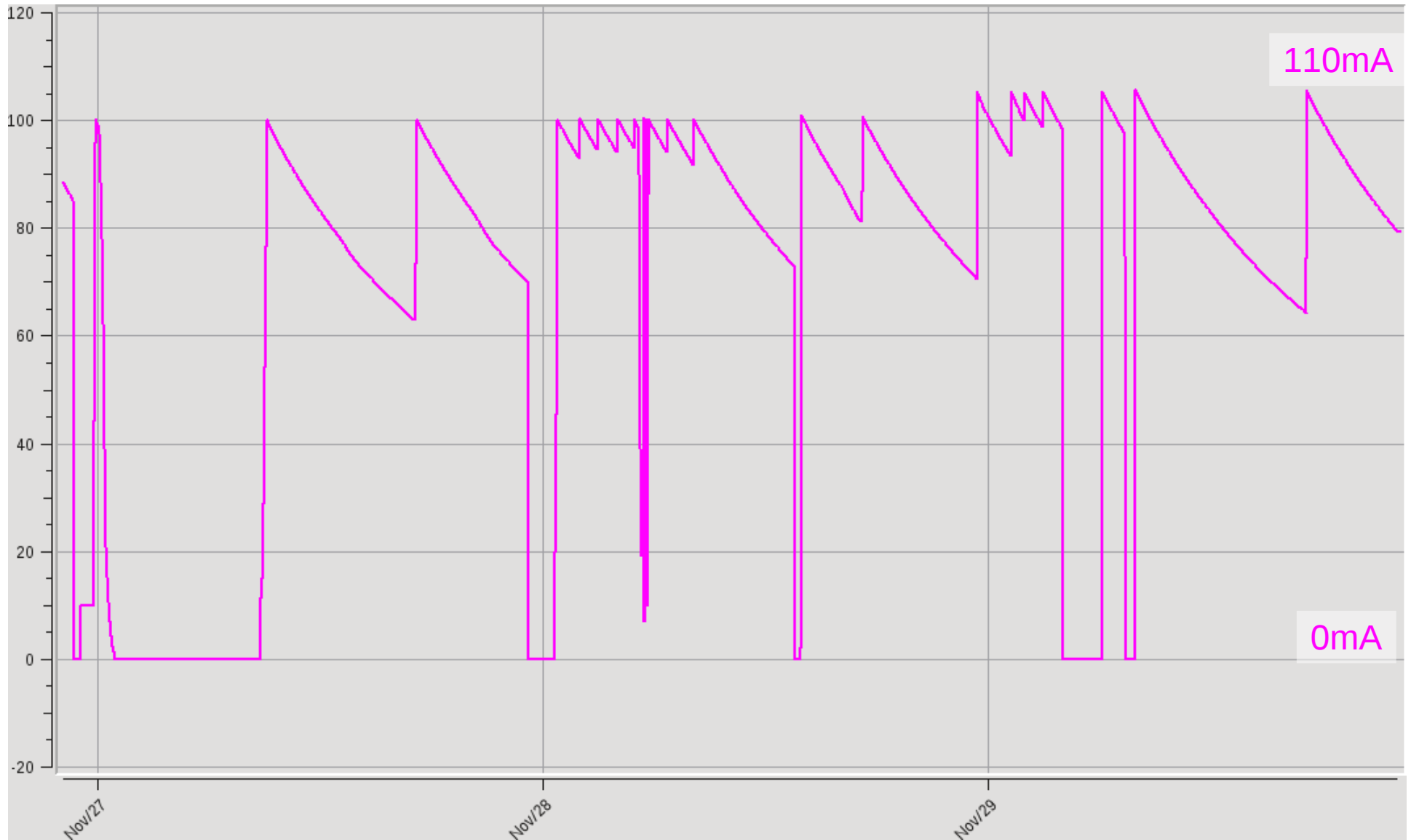


PHASE coeffs vs. Libera unit

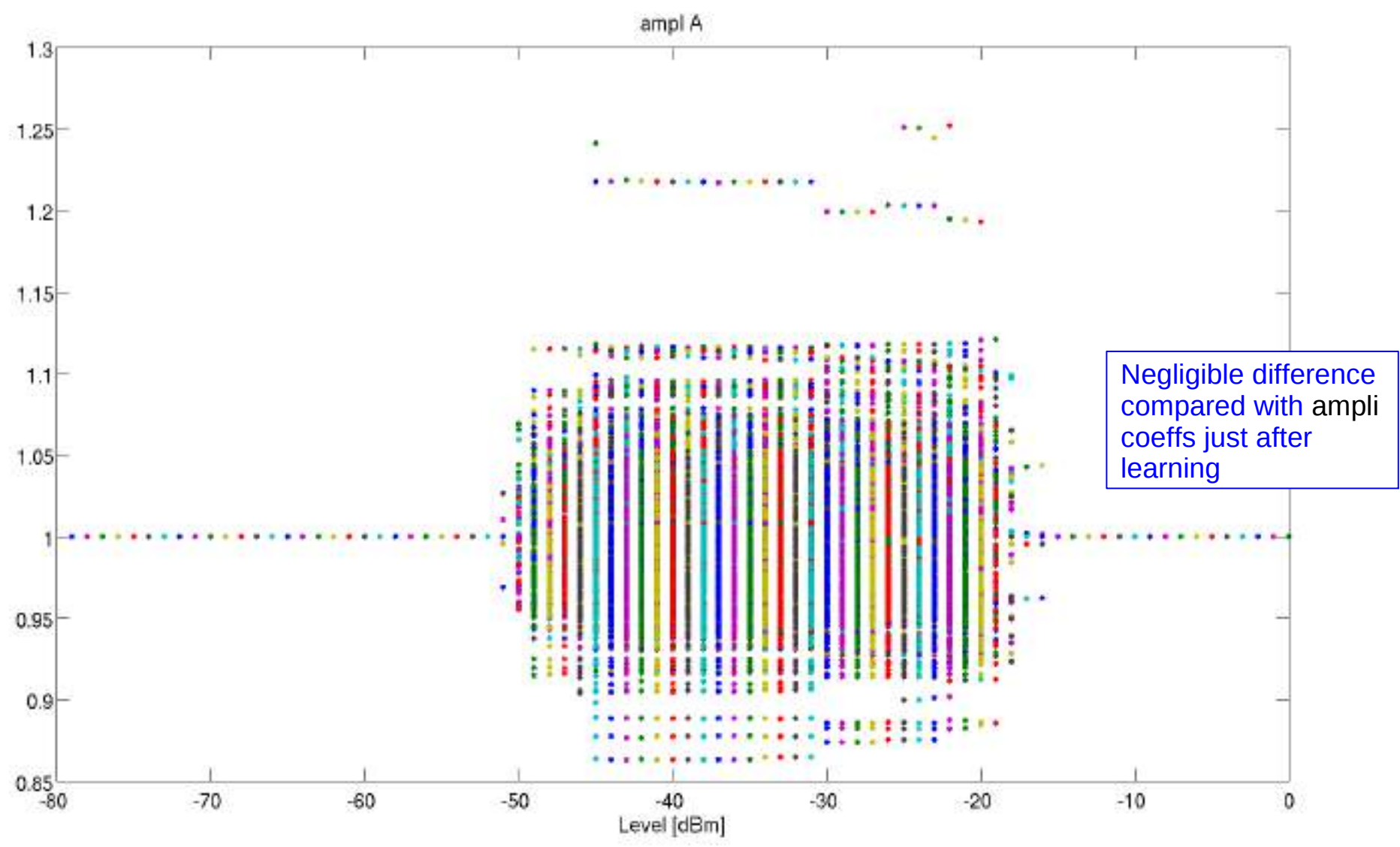


First calculated Amplitude and Phase coeffs

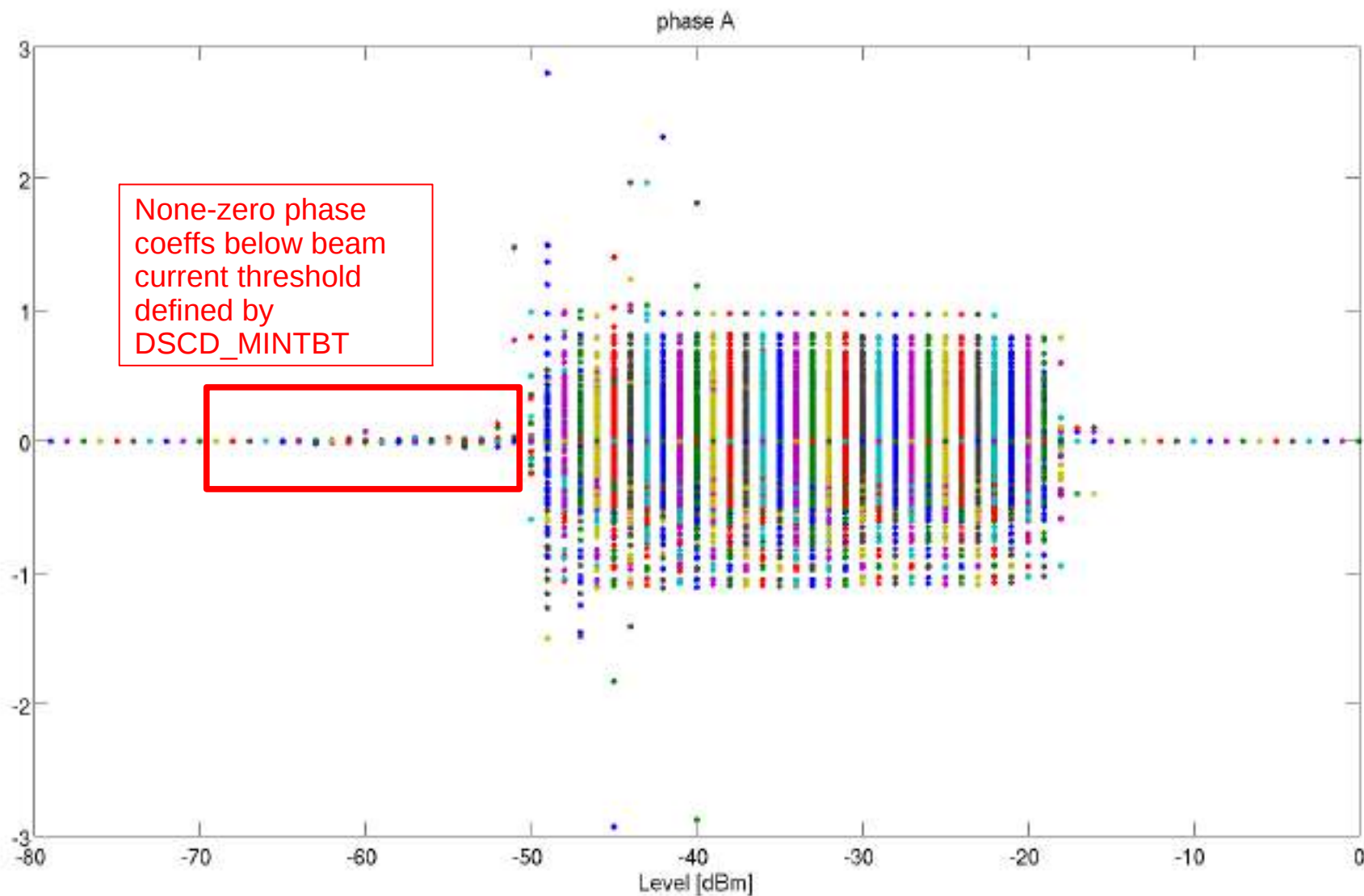




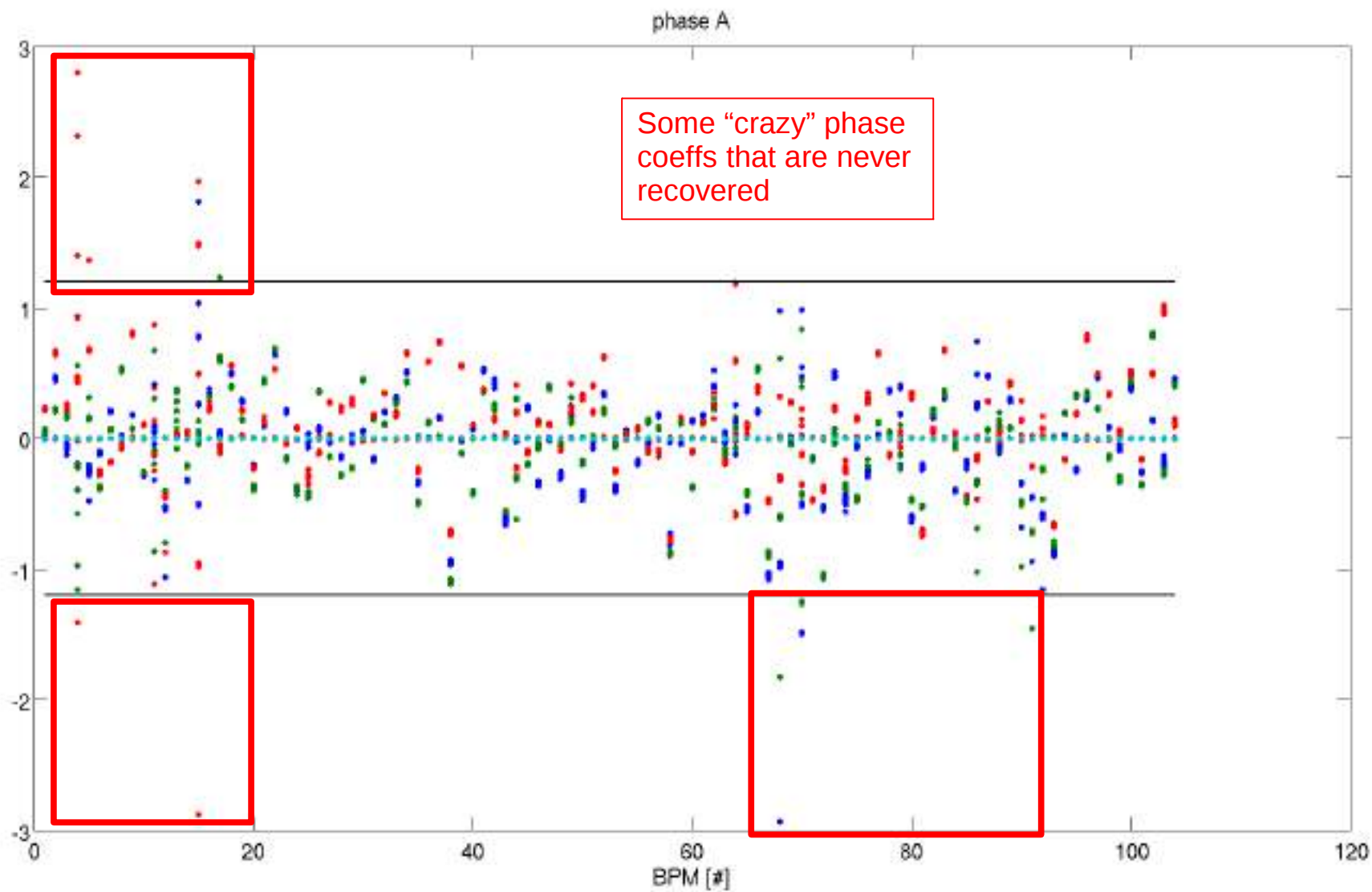
AMPLITUDE coeffs vs. Liberas Level



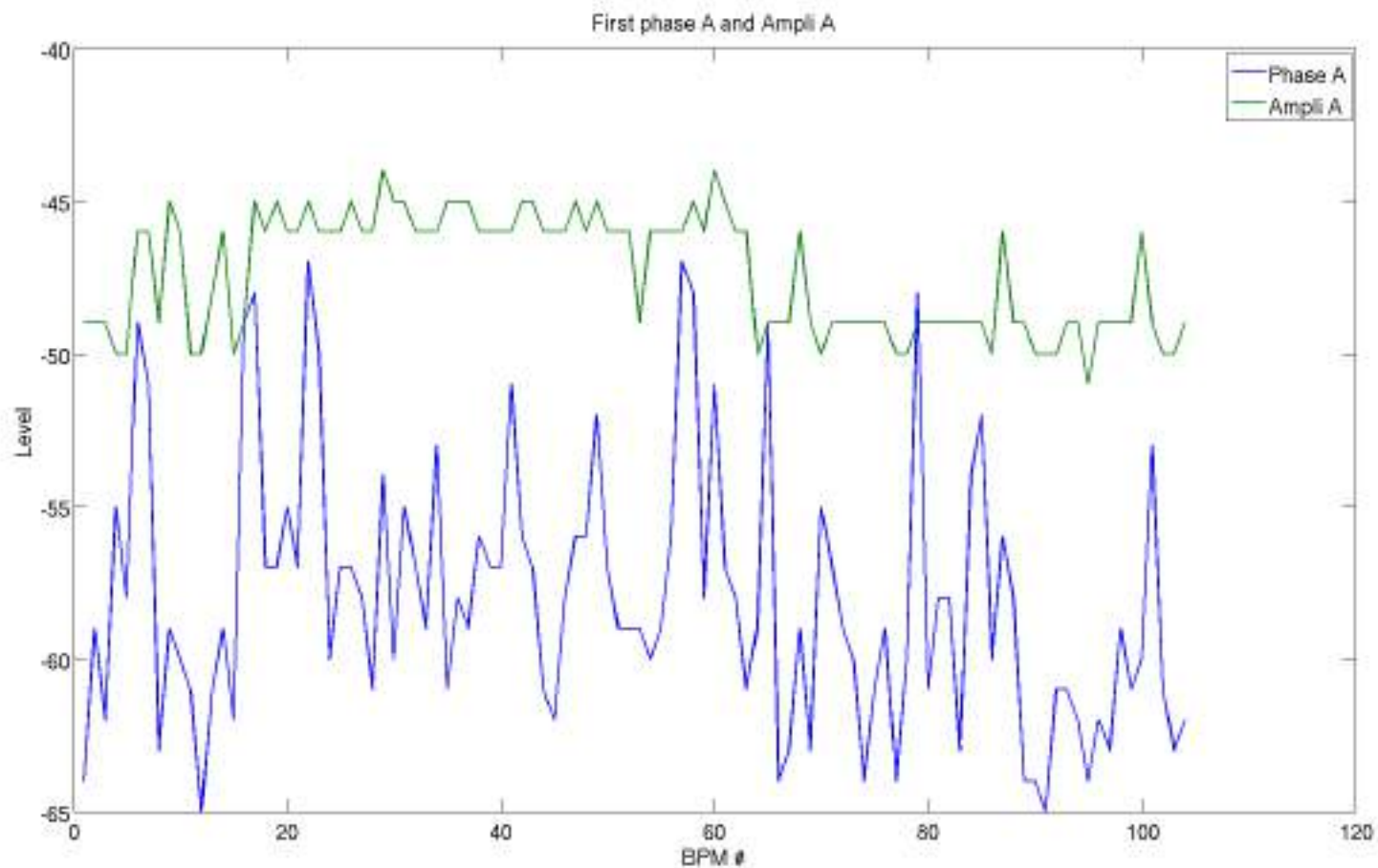
PHASE coeffs vs. Liberas Level



PHASE coeffs vs. Liberas Unit



First calculated Amplitude and Phase coeffs



All Liberas have learned
on noise

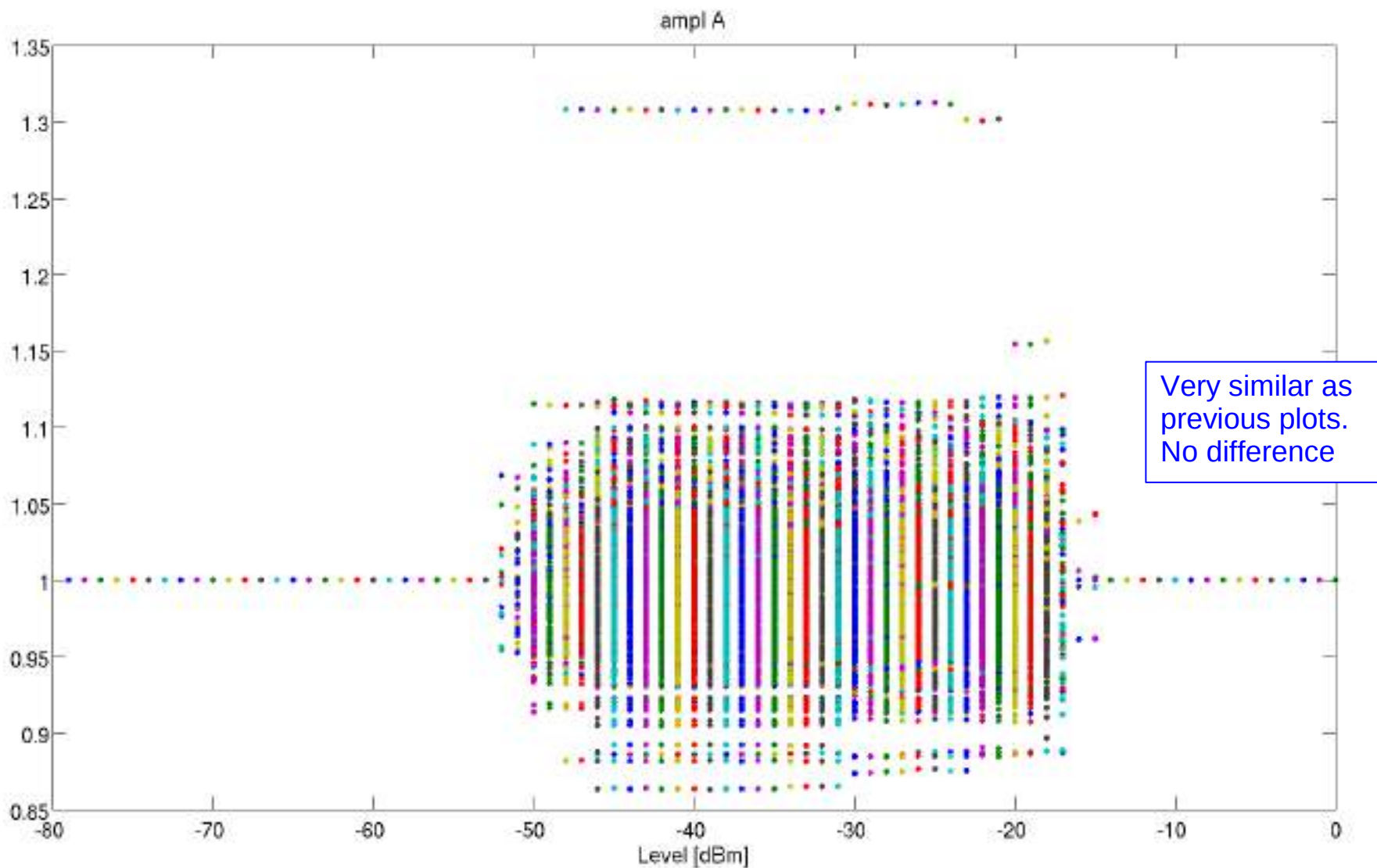


All Liberas have **phase** coeffs at very low beam currents
but no amplitude ones

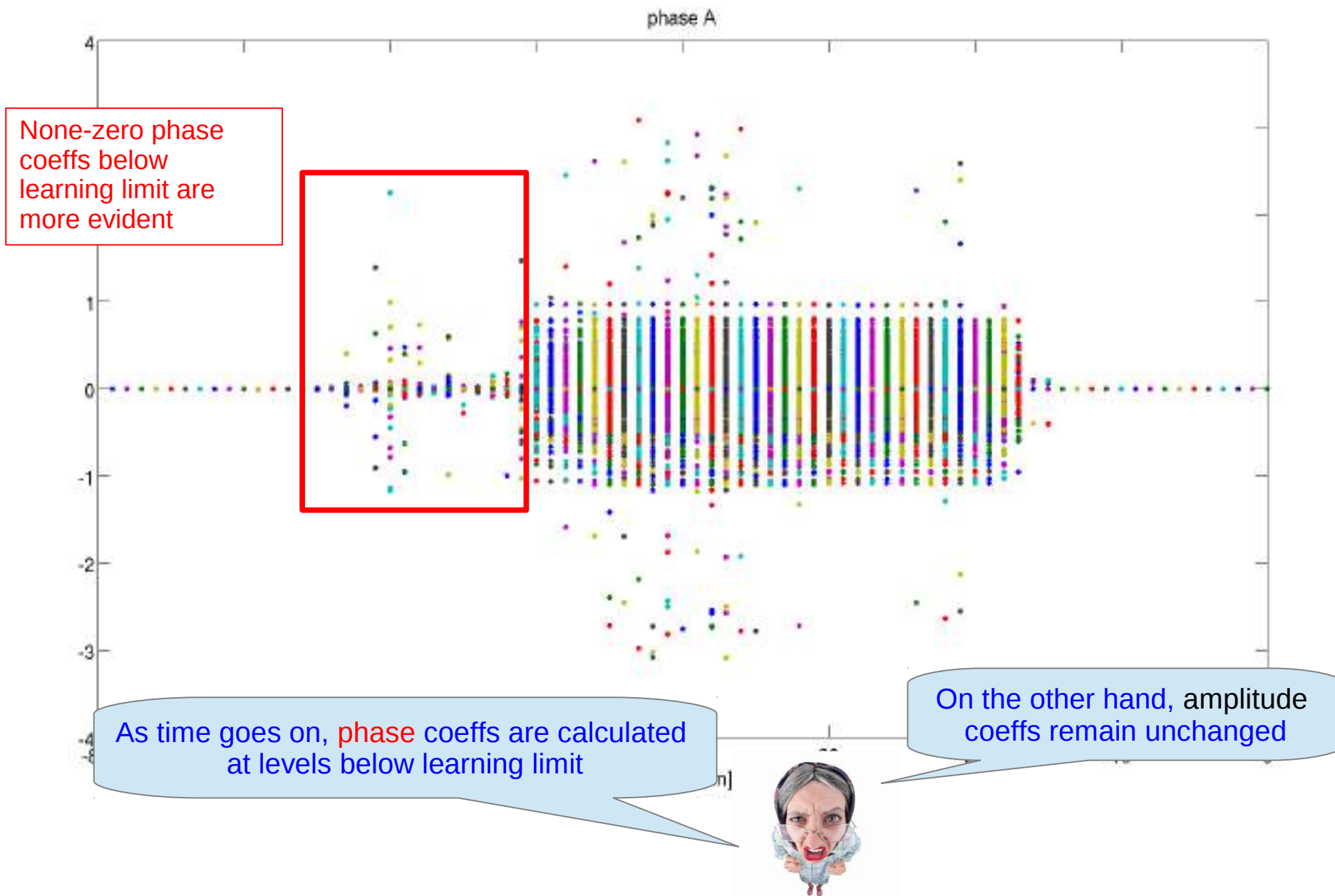
Two months after last calibration from scratch



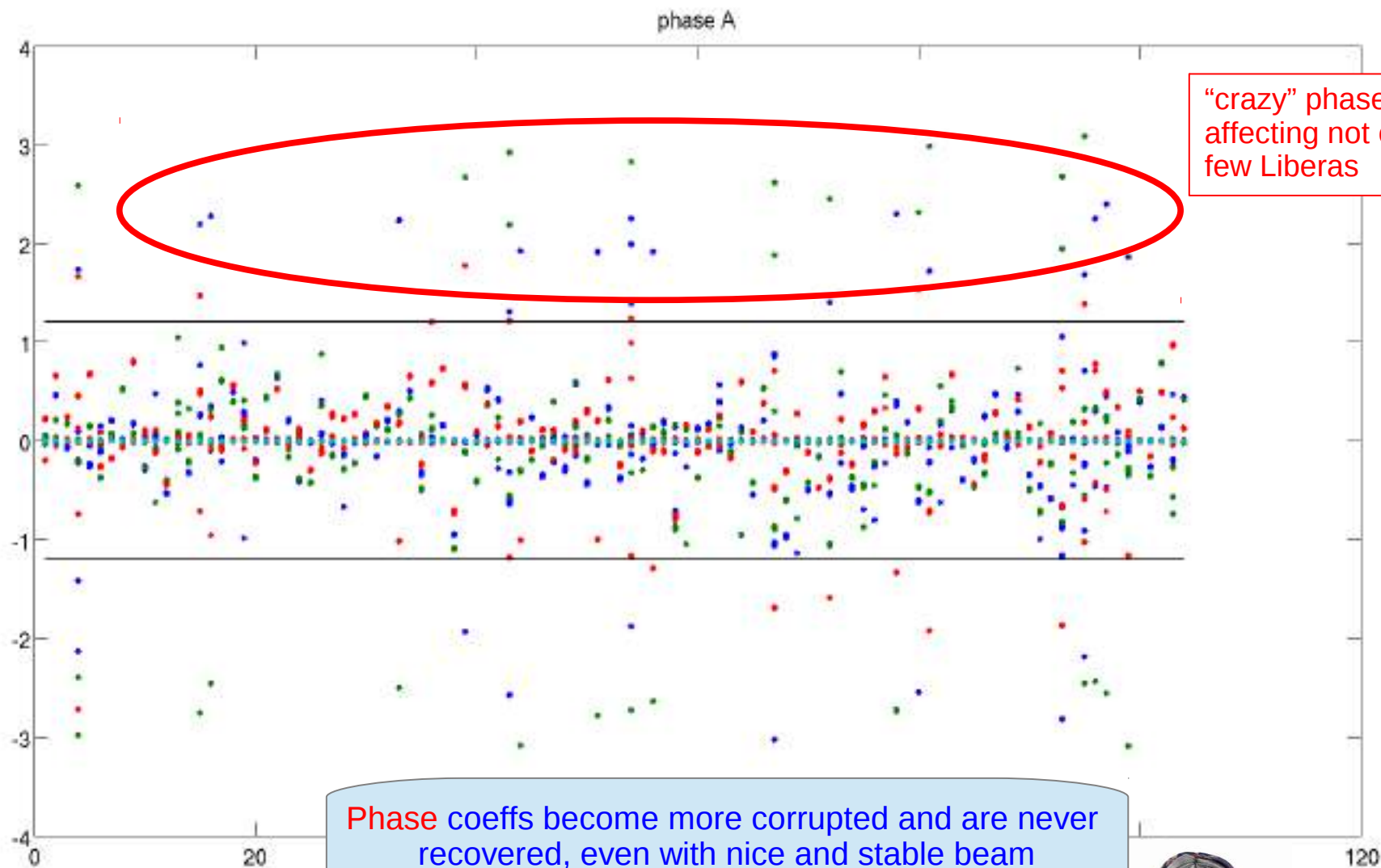
AMPLITUDE coeffs vs. Liberas Level



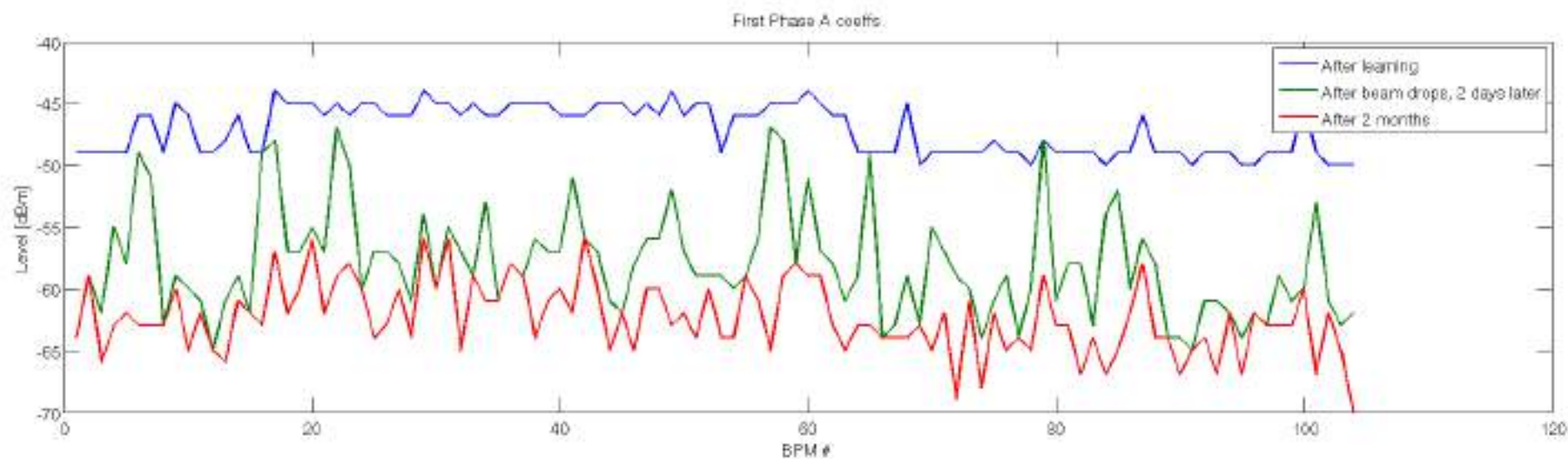
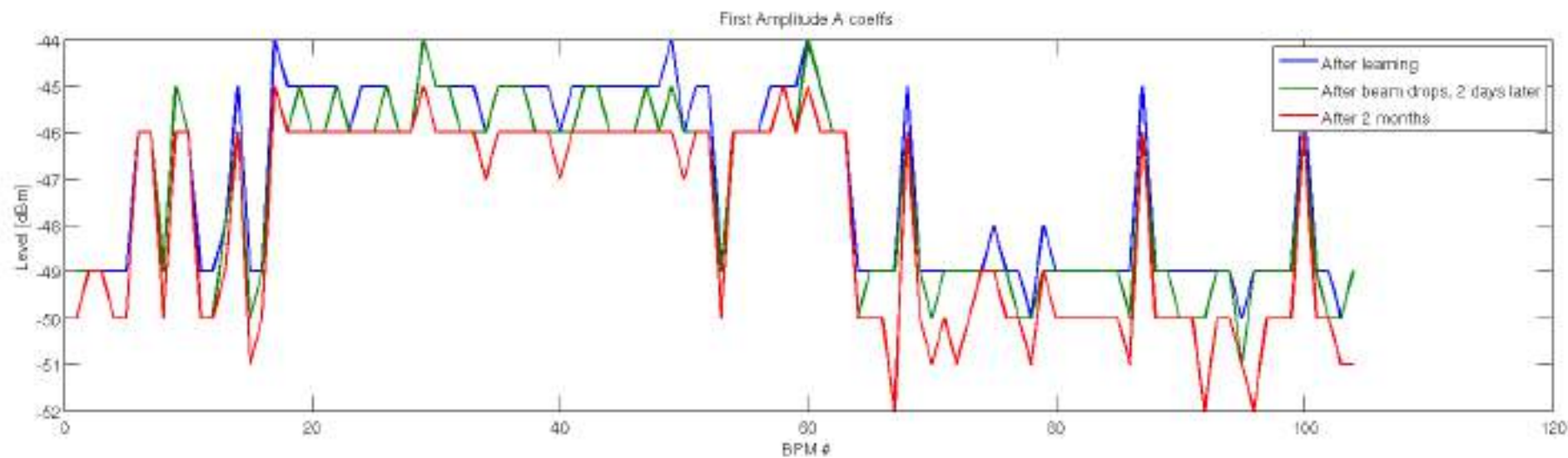
PHASE coeffs vs. Liberas Level



PHASE coeffs vs. Liberas Unit



Evolution of First calculated Ampli (top plot) and Phase coeffs (bottom)

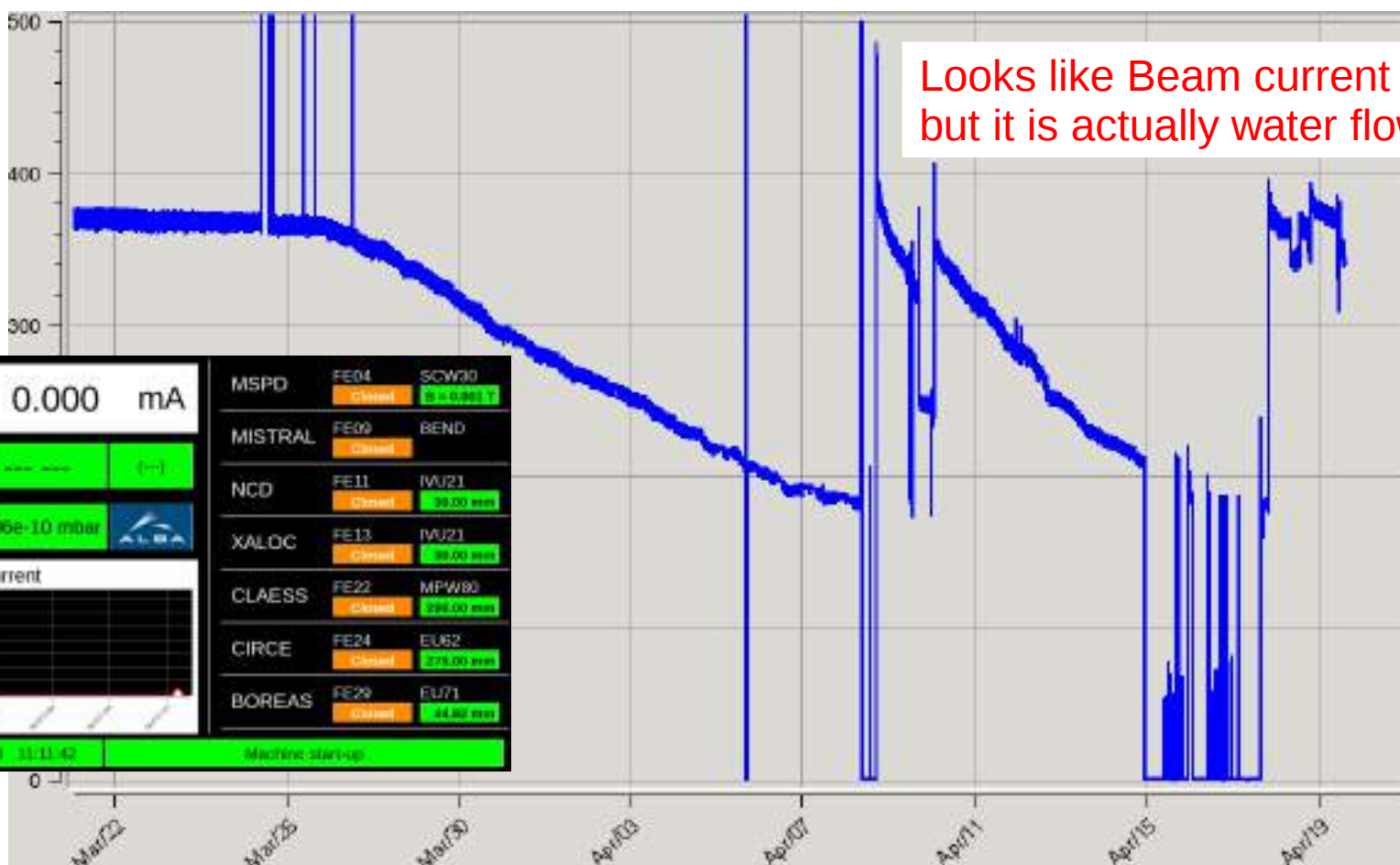


Two months after last calibration from scratch

Still to be crosschecked the effect of wrong phase coeffs on position data, but it's obvious that DSC algorithm is doing some "nasty" things that in principle should not

Planning was to do it after Easter shutdown but ...

Errors already reported by DESY on Libera Workshop 2011



Current	0.000 mA
Life Time	[Progress Bar]
Pressure	2.96e-10 mbar

MSPD	FE04	SCW30	3.0000 mm
MISTRAL	FE09	BEND	
NCD	FE11	IWU21	30.00 mm
XALDC	FE13	IWU21	35.00 mm
CLAESS	FE22	MPW80	295.00 mm
CIRCE	FE24	EU62	275.00 mm
BOREAS	FE29	EU71	44.00 mm

Tuesday 23-Apr-2013 11:11:42 Machine start-up

- November 2011 - ALBA

ITech measurement ($2.4e6$) and ALBA one ($3.3e6$) did not agree

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- February 2012 – ITech visit to ALBA to fix the problem

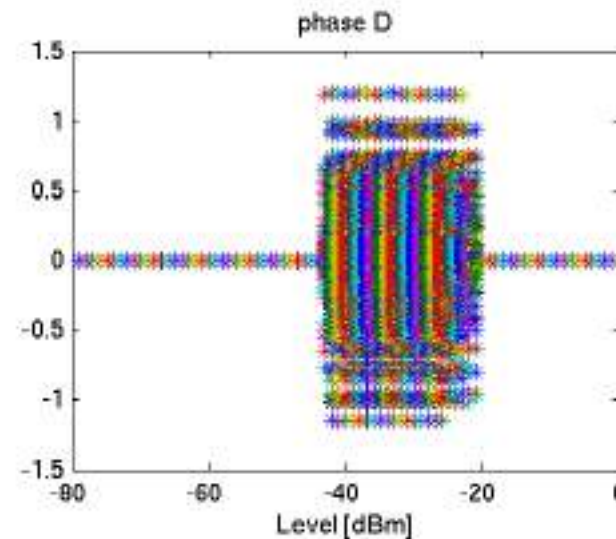
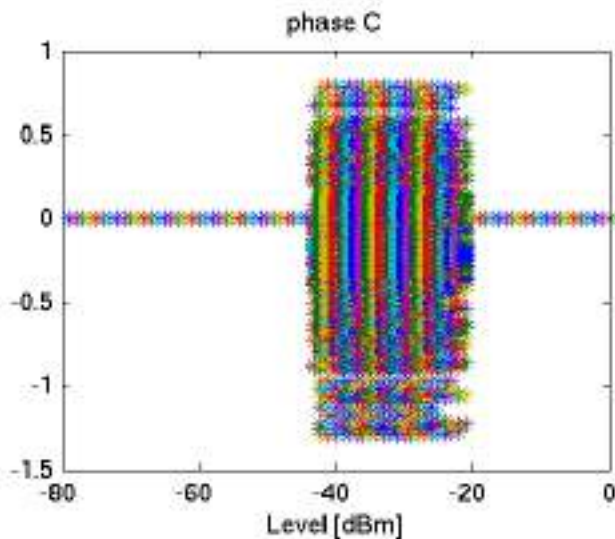
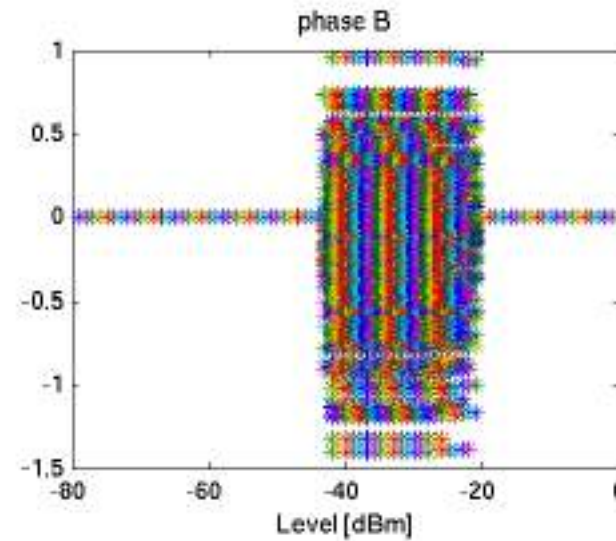
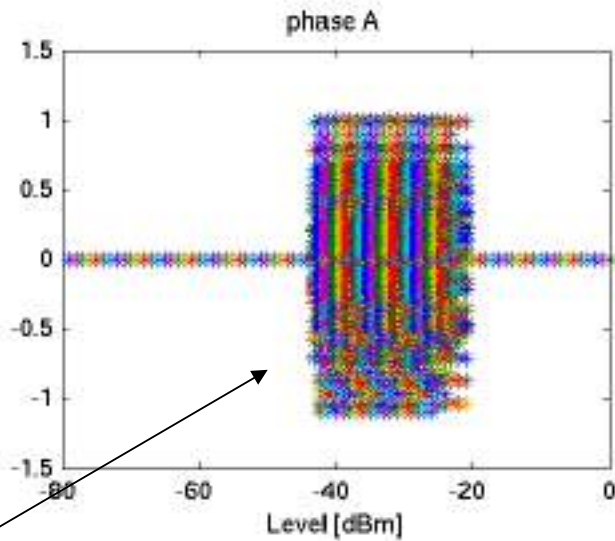
DSCD_MINTBT tested with values $2.4e6$, $6e6$ and $13e6$
 $6e6$ seemed OK → but it turned out that tests were done with too “gentle” beam killing

COME BACK TO THAT LATER

Why we did not see that during ITech visit?

Beam killing from 100mA down to 0mA

DSC_MIN_TbT = 13e6

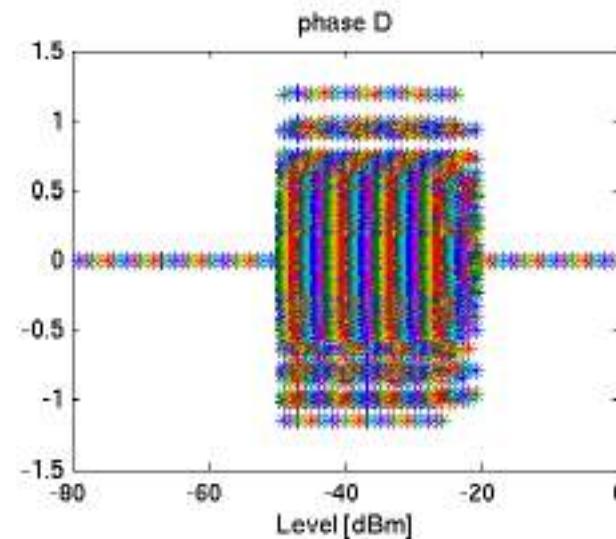
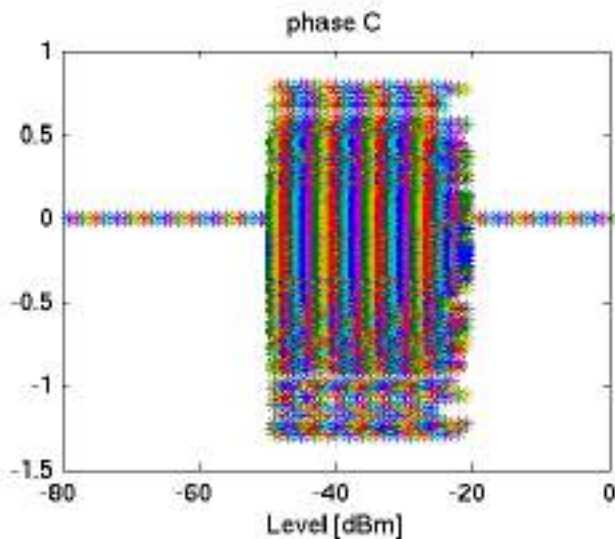
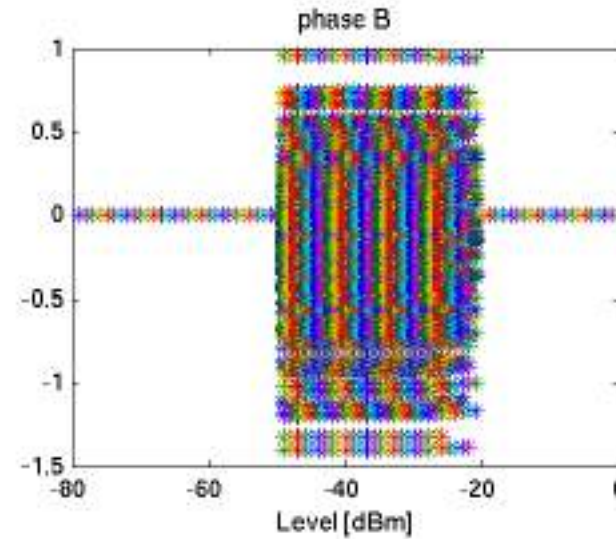
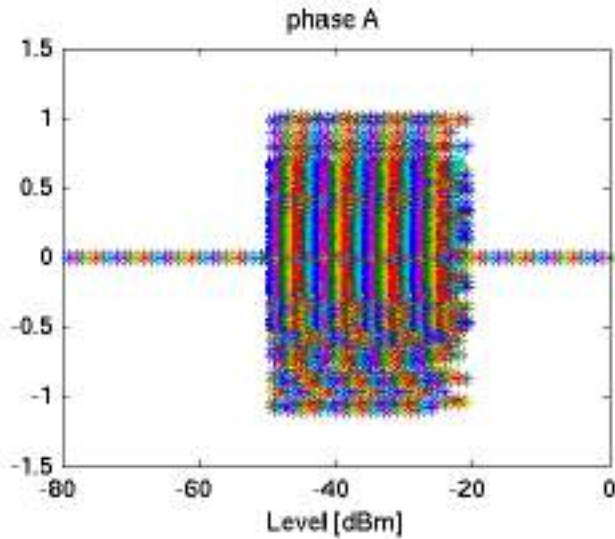


Minimum learning level too high, so we decided to reduce DSC_MIN to 6e6

Why we did not see that during ITech visit?

Beam killing from 100mA down to 0mA

$DSC_MIN_TbT = 6e6$



No phase coeffs at low Levels

No crazy coeffs anywhere

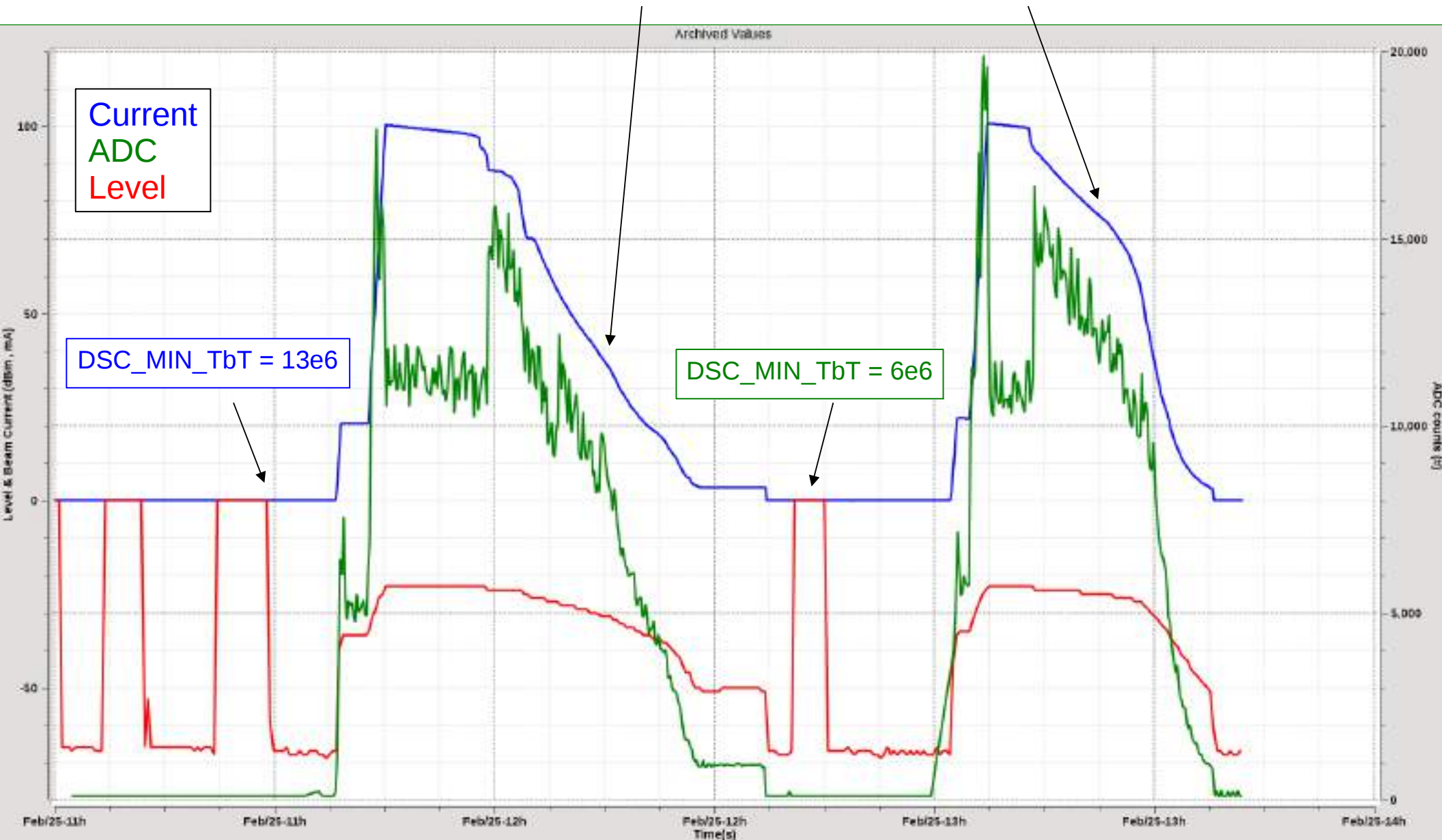
No problems as the ones reported by DESY

At this point we thought problem was fixed



Why we did not see that during ITech visit?

Because we were killing the beam “too gently”
No sudden beam drops as the ones created by RF trips, interlocks ...



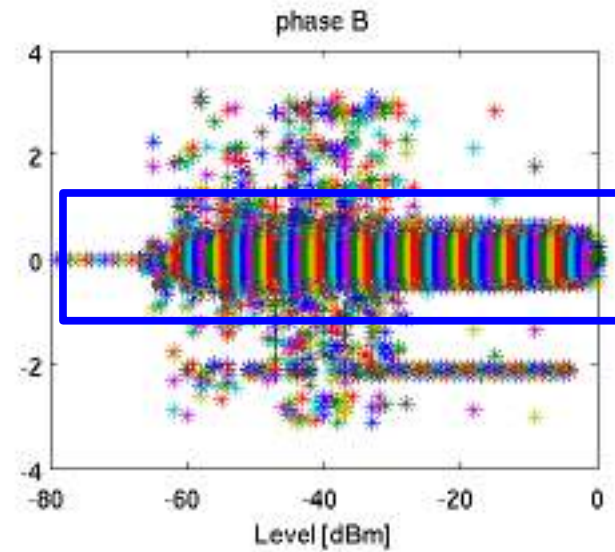
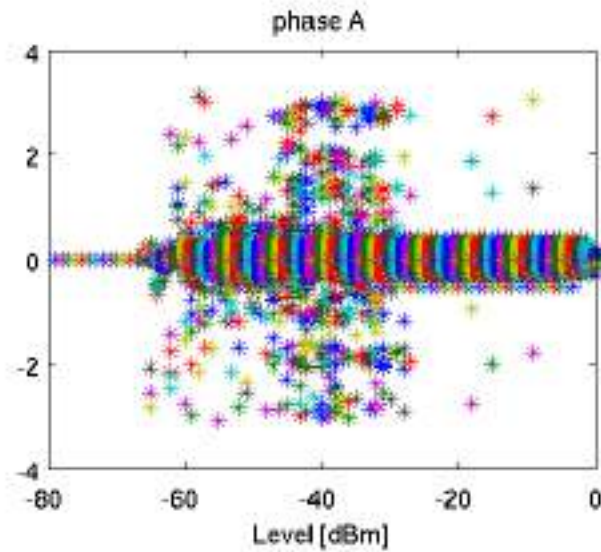
ESRF DSC coeffs analysis

DSCD_MINTBT_LEARN_LIMIT = 8e6 (before it was 0.32e6)

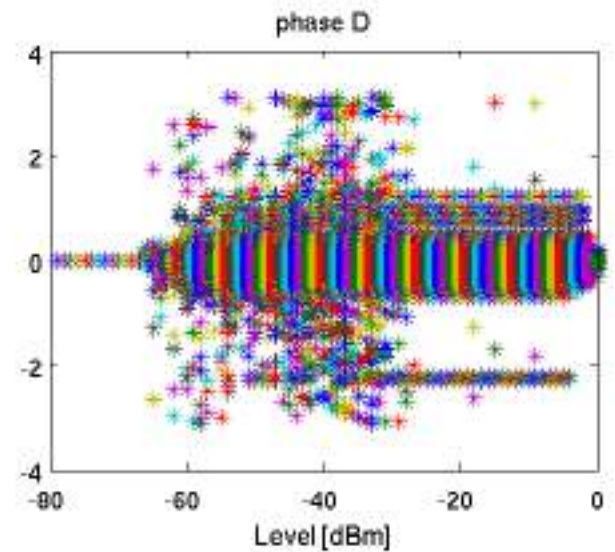
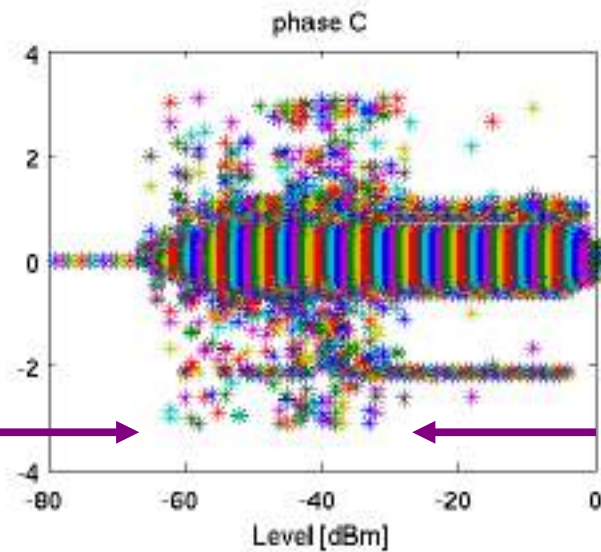
DSC mode kept always at '2' (self-learning)

AGC mode OFF during beamlines time and ON for machine physics studies

PHASE coeffs vs. Liberas Level

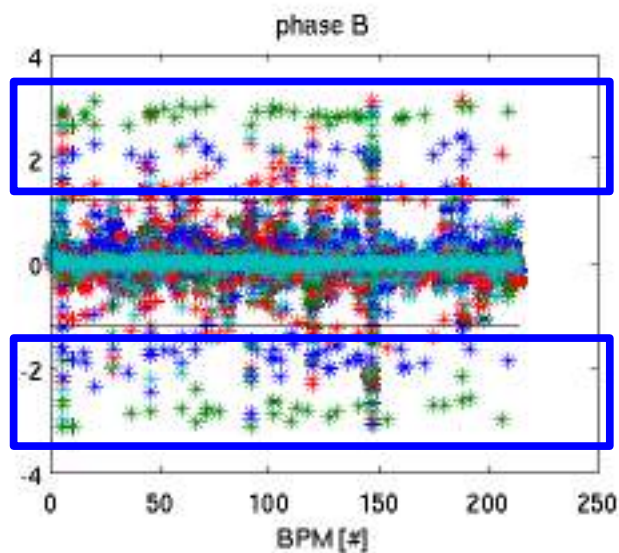
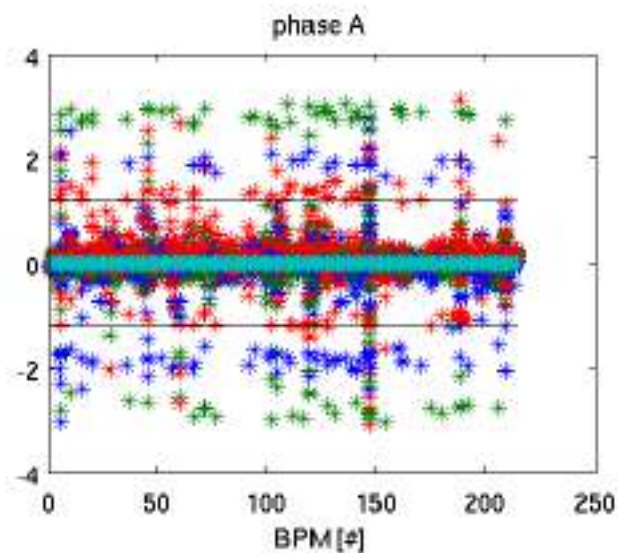


Corrupted phase coeffs outside boundaries

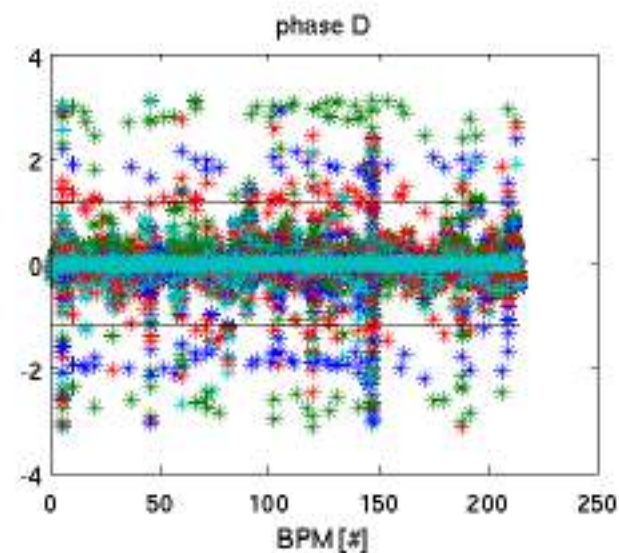
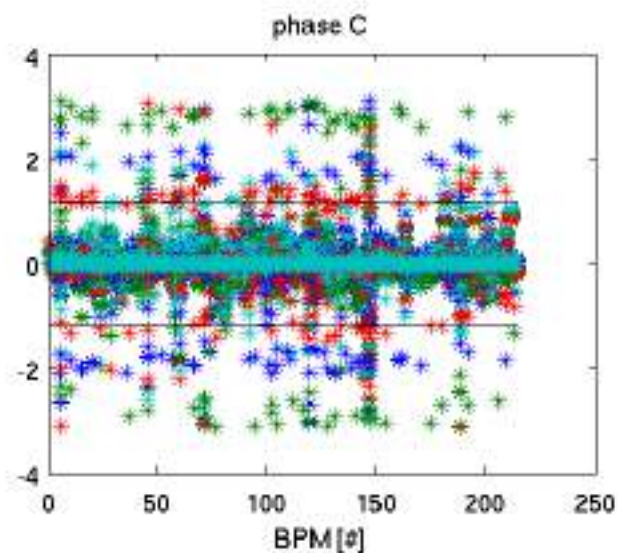


Due to sudden beam drops, phase coeffs become crazy from -27dBm down to -62dBm (mean), while amplitude ones remain OK

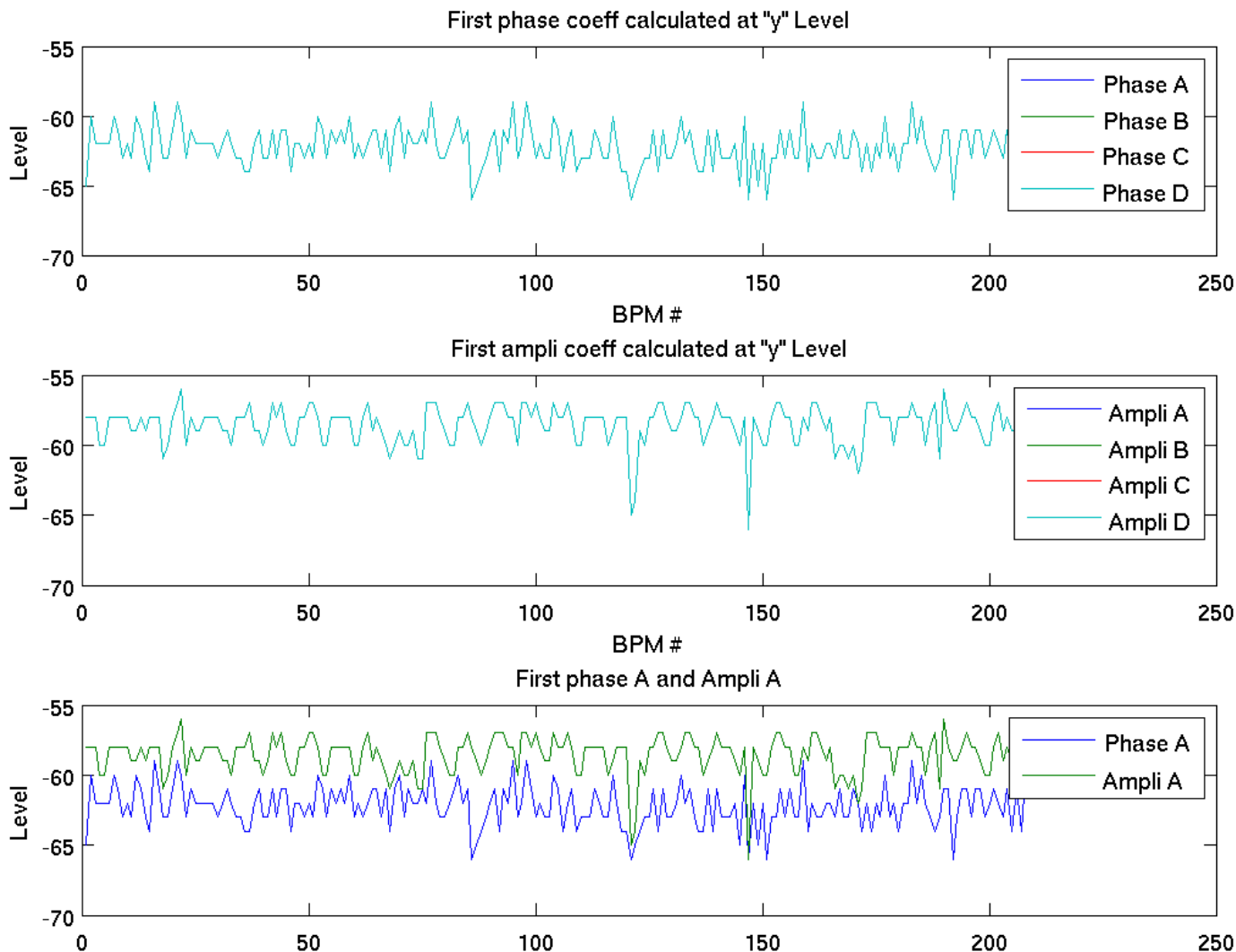
PHASE coeffs vs. Liberas Unit



These crazy phase coeffs happen in all Liberas and are never recovered, even with DSC=2



First calculated Amplitude and Phase coeffs



Looking at First Amplitude coeffs, ideal DSC learning seems to go from 0dBm down to -59dBm (mean)

Due to sudden beam drops, phase coeffs are also calculated at lower Levels (mean -62dBm)

- 1 - Why some Liberass have **phase** but no **amplitude** coeffs calculated? (already right after learning)
- 2 - Why **phase** coeffs are being calculated at Levels below the learning limit and **amplitude** ones are not?
- 3 - Why crazy **phase** coeffs do never recover?
- 4 - Clean-up of coeffs, why does the lastgood file have to be destroyed first?
- 5 - Is there any reason to start learning right after a Level change (as seen in TbT data jumps)? Why not to wait a bit (even seconds) and then start learning? (for us, no need of learning during injection)
- 6 - Why, at fully stable input conditions, does the DSC sometimes change its settings and then, 12 sec later, comes back to the old ones? This is annoying since it disturbs the Sum signal

MOTHER IN LAW
WANNA KNOW



ALBA

- Phase coeffs are corrupted when a sudden beam dump happens. They do not recover

ESRF

- Phase coeffs are corrupted when a sudden beam dump happens. They do not recover
- Lifetime measurement (SUM signal) disturbed because of DSC algorithm changes

DESY


- Phase coeffs are corrupted when a sudden beam dump happens. They do not recover
- Invented a workaround in Petra III top-up mode to reduce the risk of DSC coefficient corruption due to inadvertent beam dumps

DIAMOND

- Have developed their own DSC algorithm
- No problems regarding sudden beam drops

SOLEIL

- Calculation has to be disabled when there is no beam to avoid wrong coefficients
- Beam losses on position interlock when the libera tried to use wrong coeffs



Good job guys
Let's celebrate!!
but...

We've profit of the excellent capabilities of the Liberas for more than 4 years
And no major operation problem due to the Liberas for the time being

... but the **DSC algorithm concept is not fail safe**: there is still a principle risk of applying incorrect or worse DSC coefficients into the DSC correction scheme

THANKS FOR YOUR ATTENTION

Acknowledgments

Fruitful discussions and emails: Kees Scheidt, Guenther Rehm,
Frank Schmidt, Nicolas Hubert

Coeffs data: Kees Scheidt

Support: ITech support people and Peter Paglovec

Personal pictures: My mother in law :-)

The ones I've forgotten ... Sorry