



# Status of design of HOM coupler

(Beam positions from diode-  
downmixed HOM-signals?)

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## Status end of last Nov:

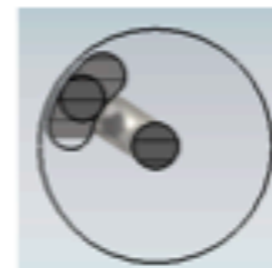
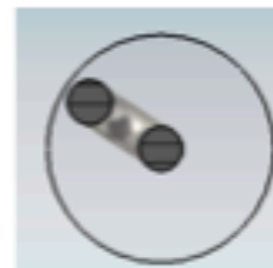
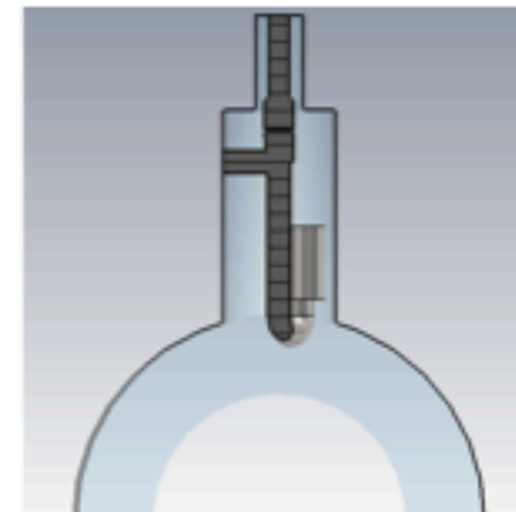
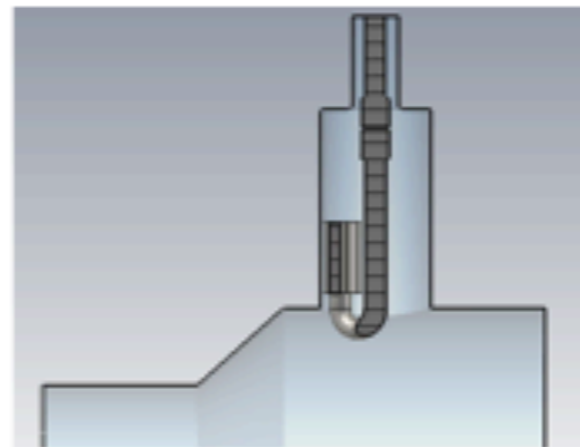
### Some geometrical details

Penetration depth of the antenna/loop in the beam pipe could be increased, but:

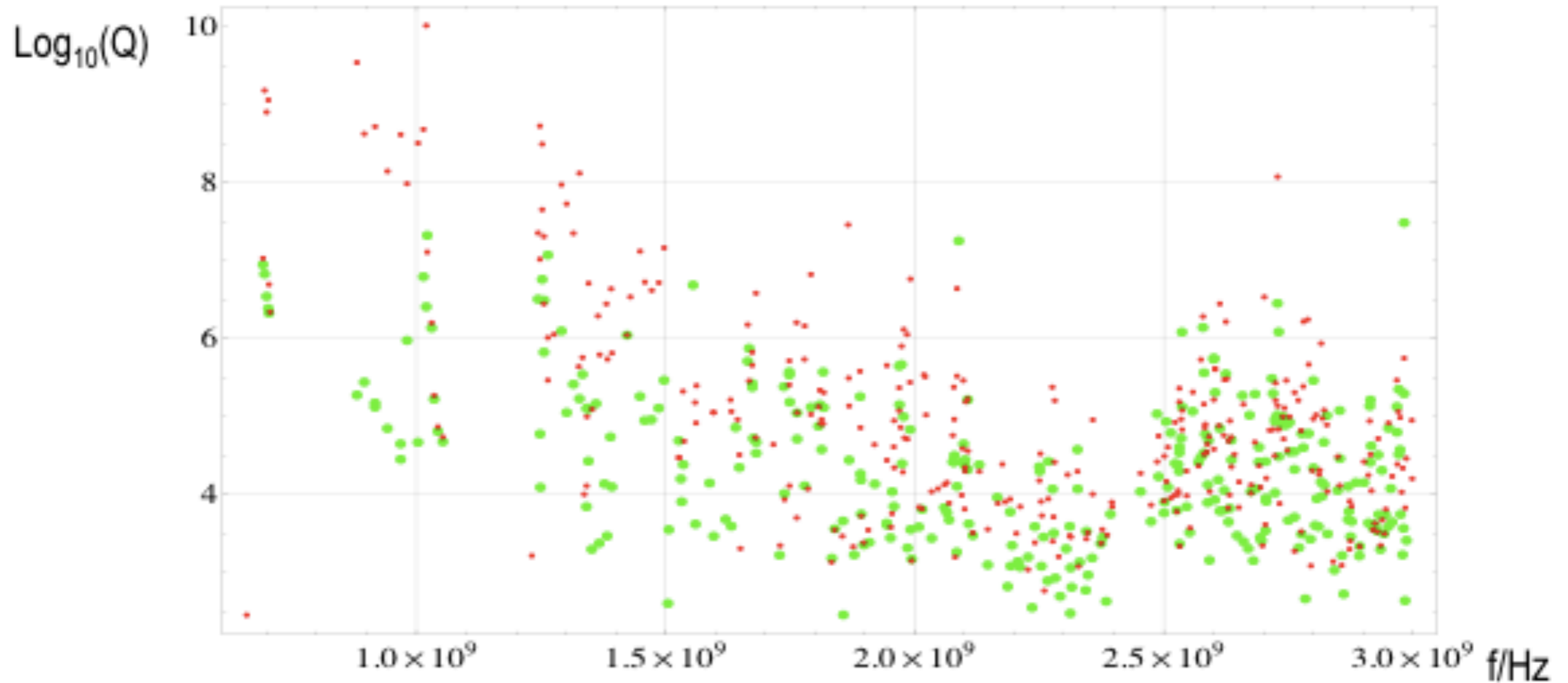
- risc of dark current heating,
- impedance

Mechanical stability, esp. against oscillations, may be an issue.

But: LHC cav. use similar concept (courtesy W.W.)

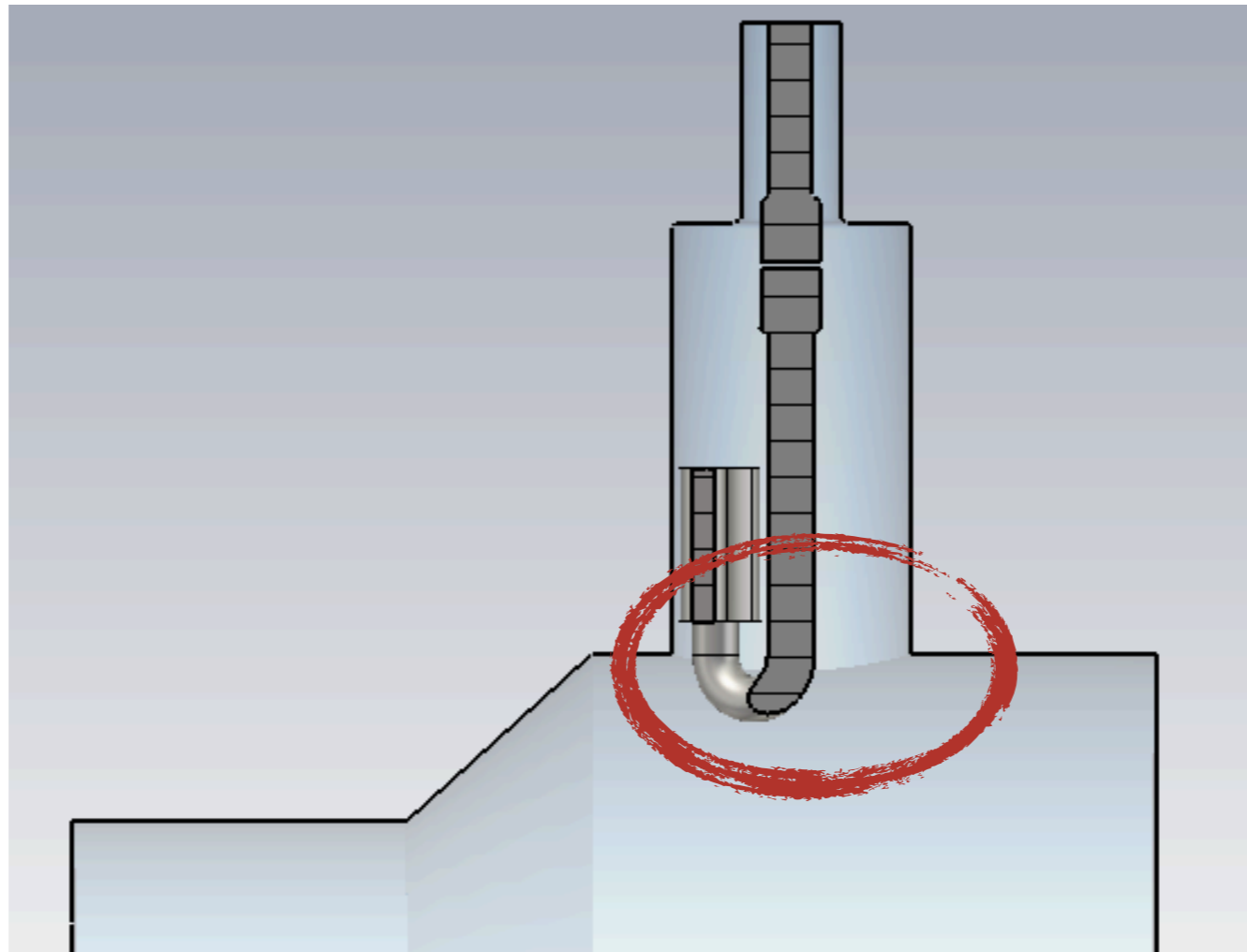


## Status end of last Nov:



- red: HOM coupler only, green with matched power coupler
- main power coupler helps significantly below 2 GHz; still  $Q_s > 10^6$  found

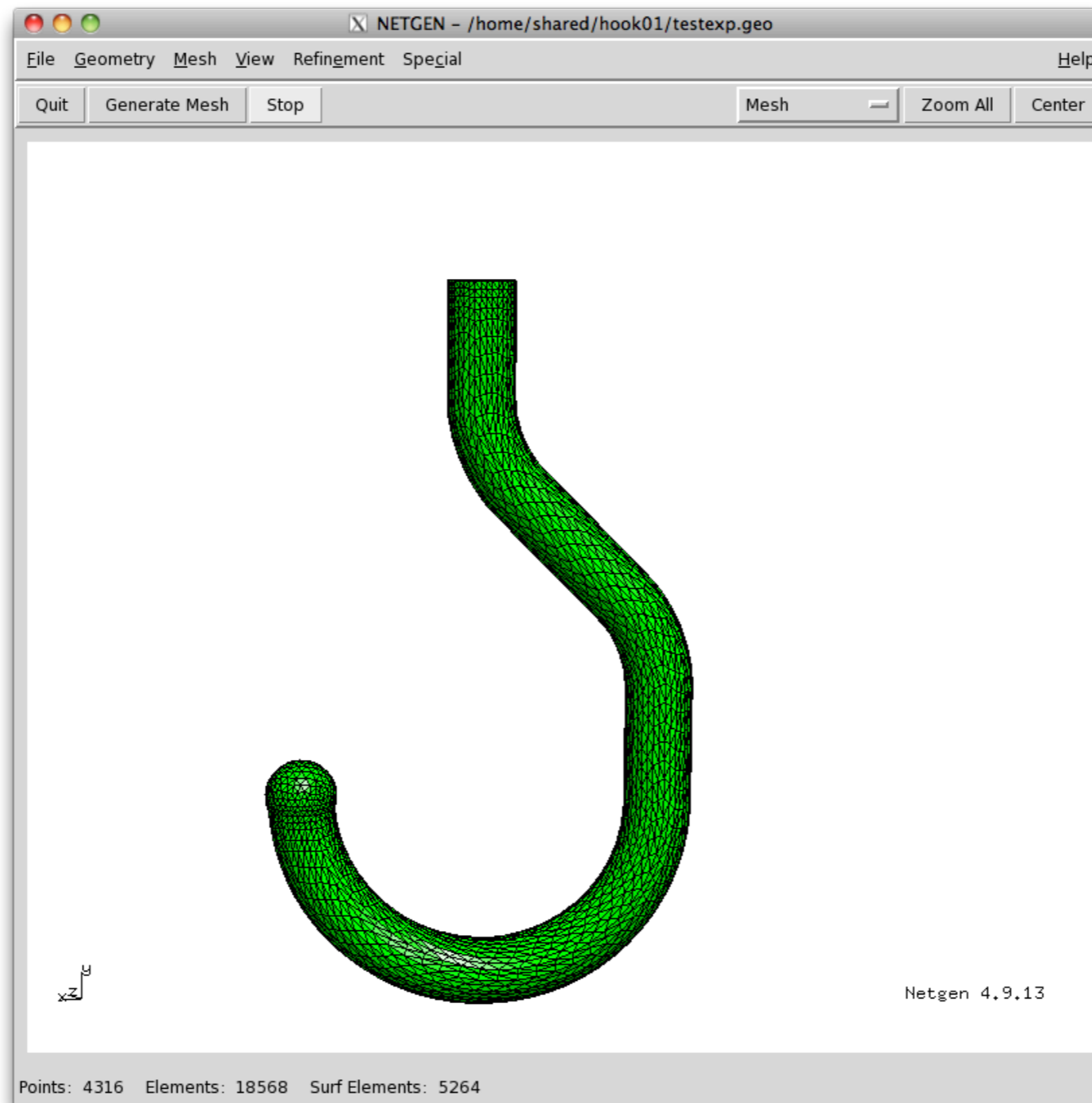
## Conclusion end of last Nov:



increase penetration depth and "coupling area"



So we would like to have something like this



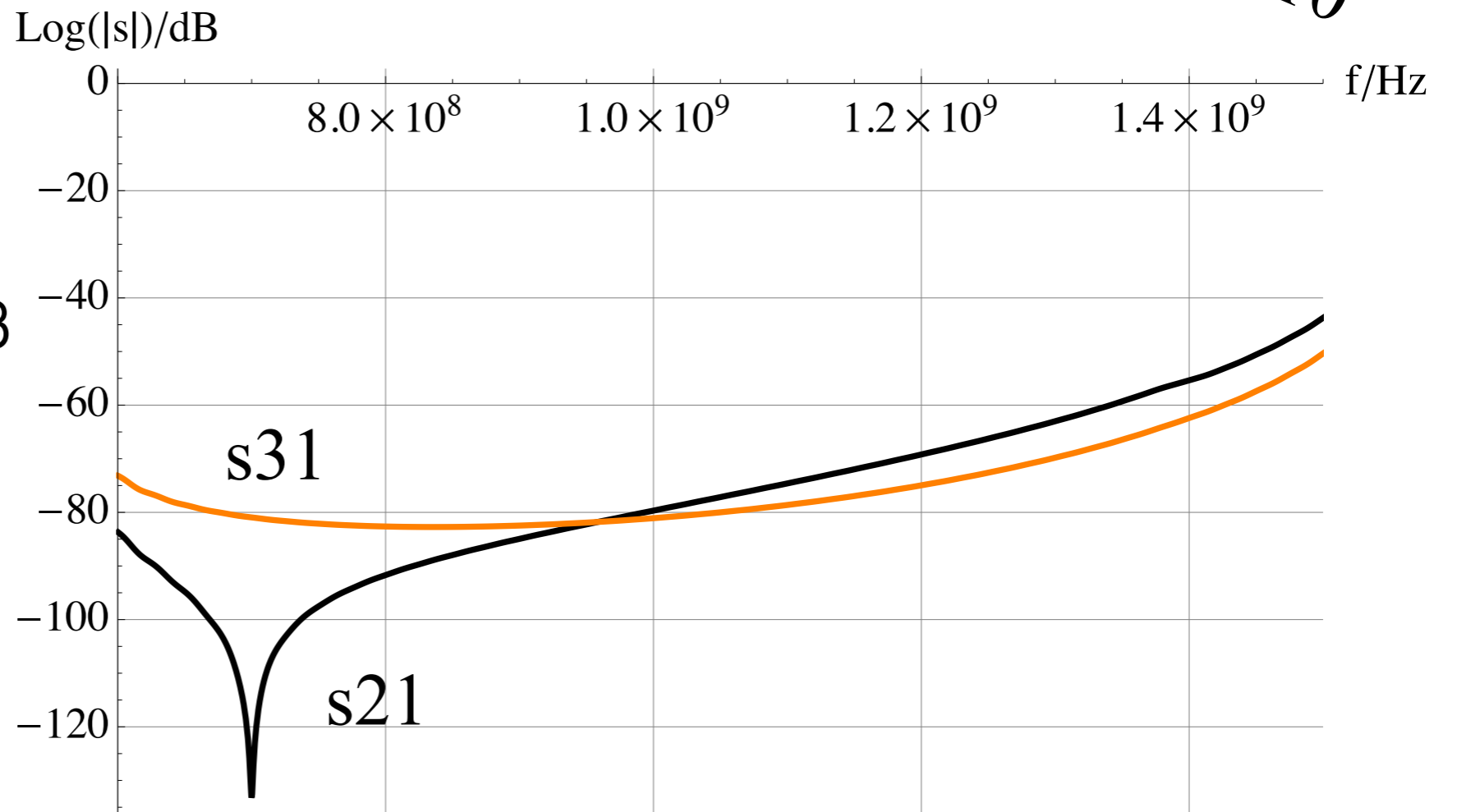
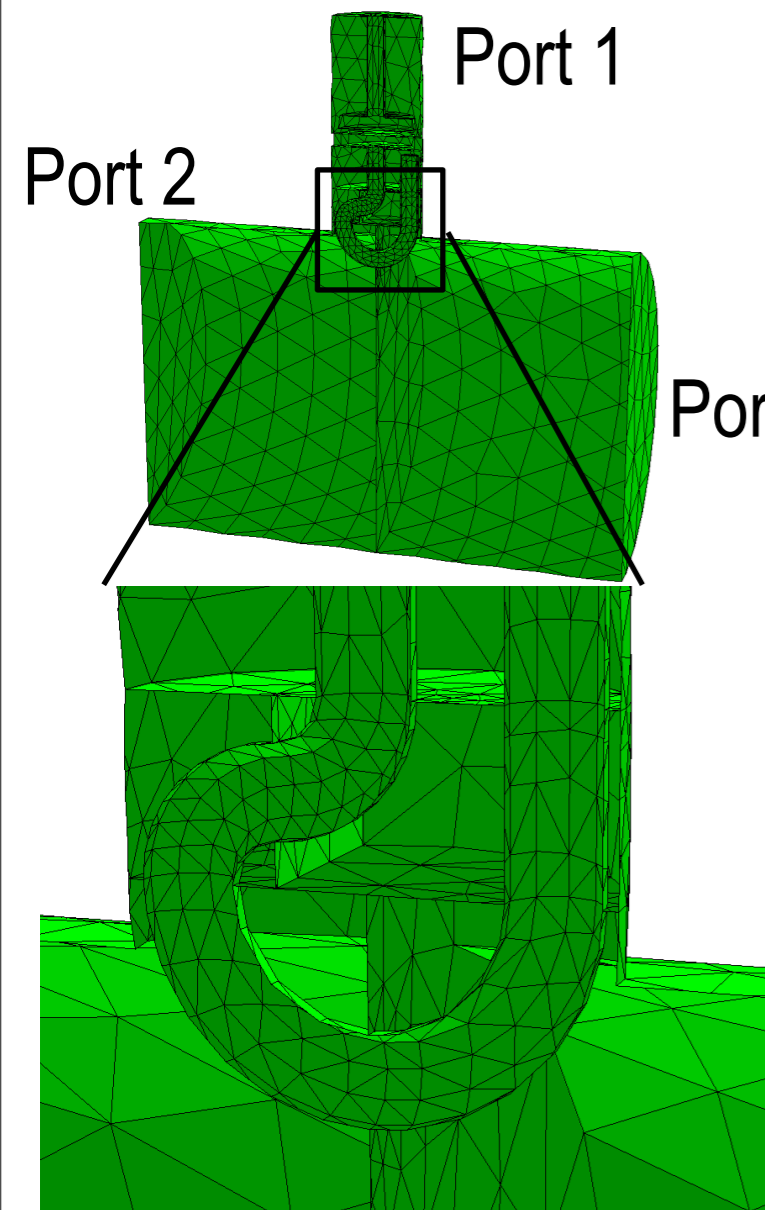


... taking profit from our freshly installed GPU-based ...



shown @ HOM10, Cornell, Oct10

# Then - GPU Accelerated DG-FEM (NUDG\*)

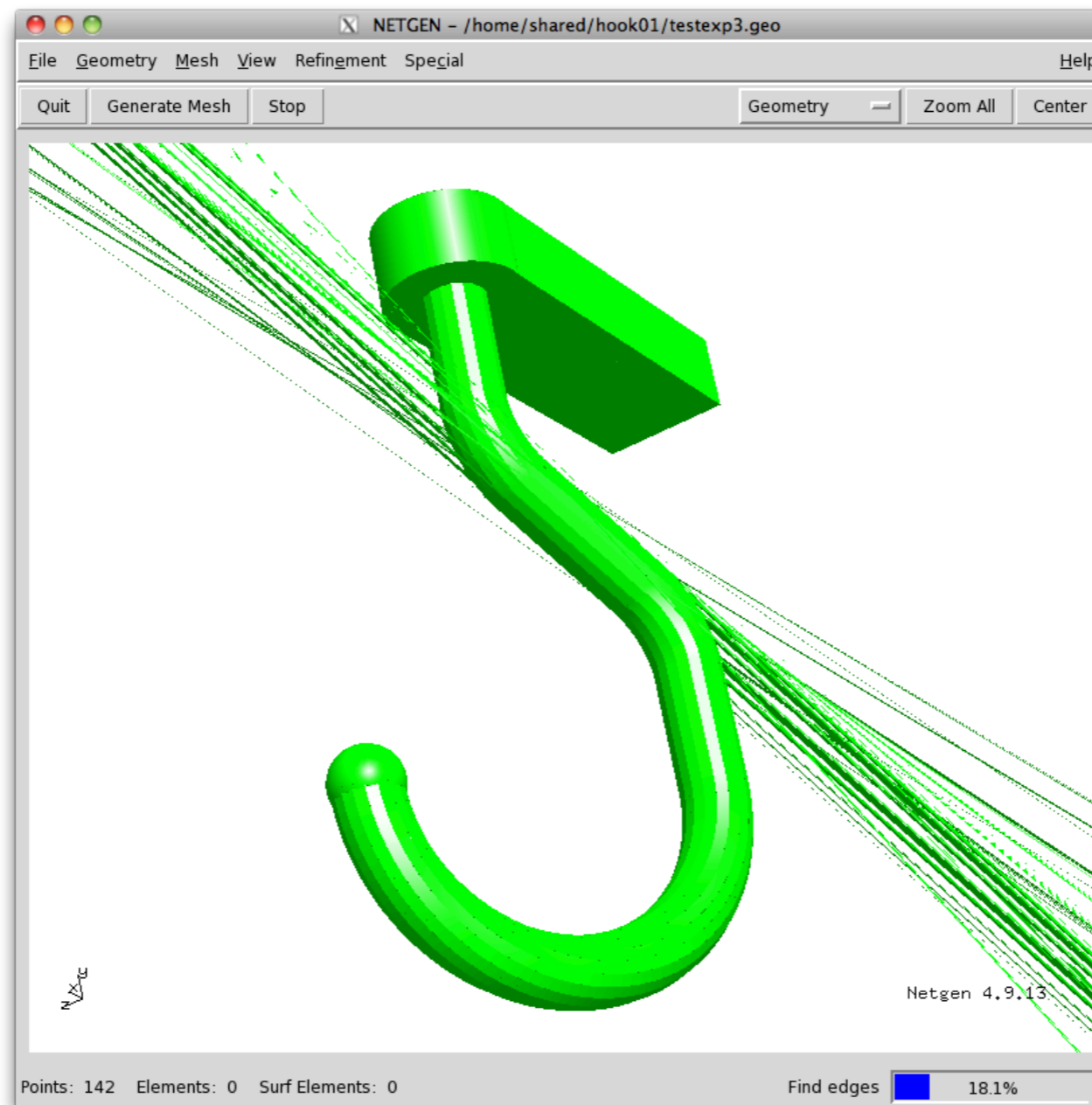


Transmission of TM01 to TEM, Computational Time ~400s on GPU GTX 470

HOM section discretized (12k elements)

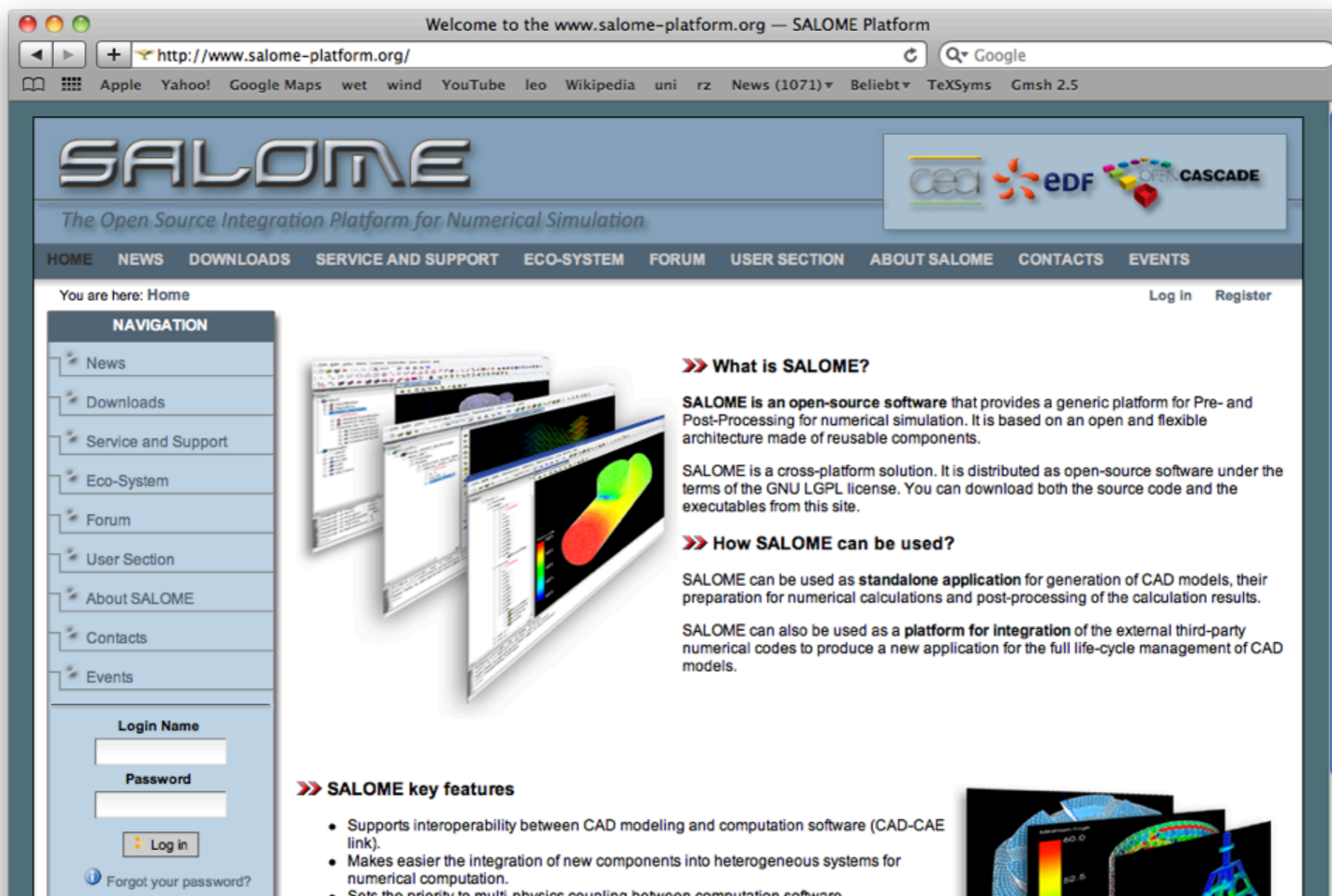
\*[www.nudg.org](http://www.nudg.org)

... well ..., NETGEN introduced some troubles:





## Current decision to delegate geometry and meshing to French product:



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# SALOME

The Open Source Integration Platform for Numerical Simulation

cea EDF OPEN CASCADE

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### >>> What is SALOME?

**SALOME is an open-source software** that provides a generic platform for Pre- and Post-Processing for numerical simulation. It is based on an open and flexible architecture made of reusable components.

SALOME is a cross-platform solution. It is distributed as open-source software under the terms of the GNU LGPL license. You can download both the source code and the executables from this site.

### >>> How SALOME can be used?

SALOME can be used as **standalone application** for generation of CAD models, their preparation for numerical calculations and post-processing of the calculation results.

SALOME can also be used as a **platform for integration** of the external third-party numerical codes to produce a new application for the full life-cycle management of CAD models.

### >>> SALOME key features

- Supports interoperability between CAD modeling and computation software (CAD-CAE link).
- Makes easier the integration of new components into heterogeneous systems for numerical computation.
- Sets the priority to multi-physics coupling between computation software.



Mainly occupied by something, that could be of some interest for SPL:

HOM-based beam position monitoring using diode detectors ...

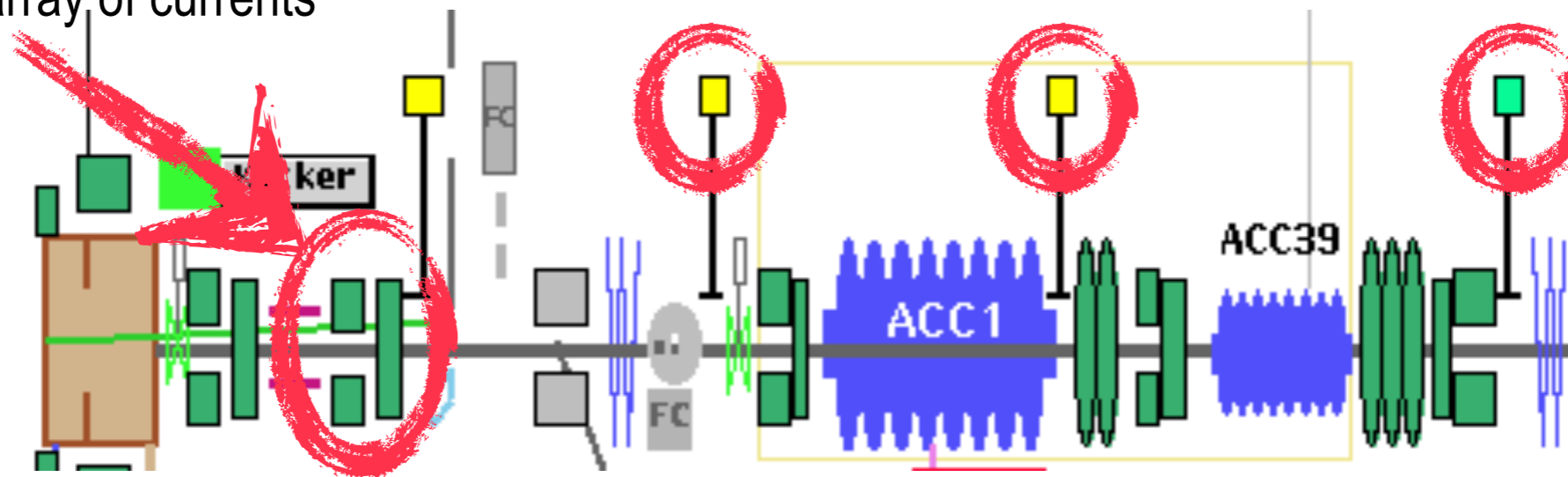


## Taking in parallel signals from ACC1-C8H1 und ACC39-C4H2

manually (Pei :-)) ) steering  
of H2GUN/V2GUN  
using 5x5 array of currents

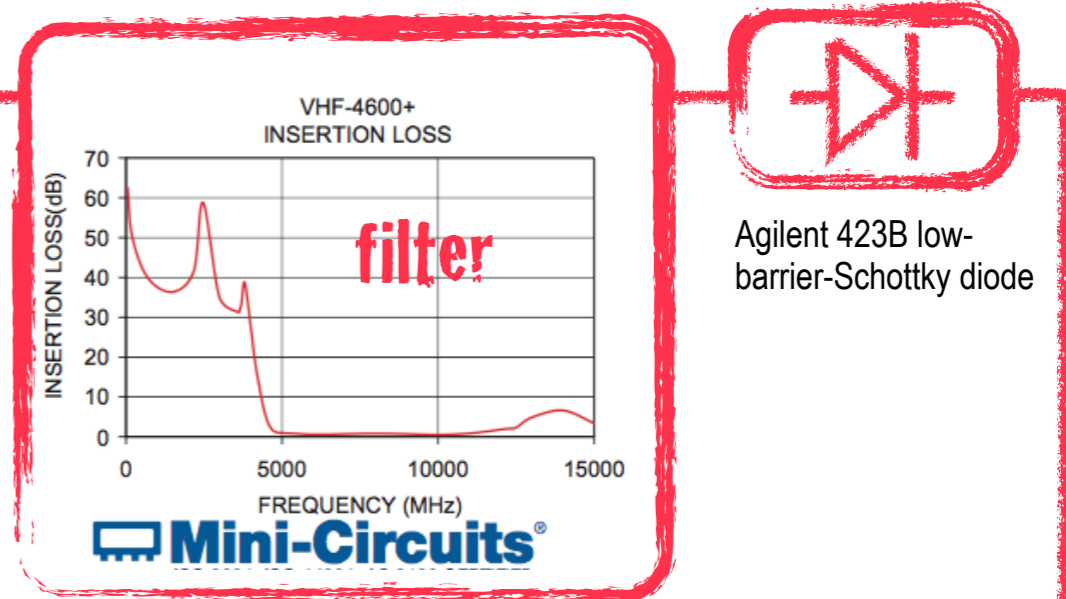
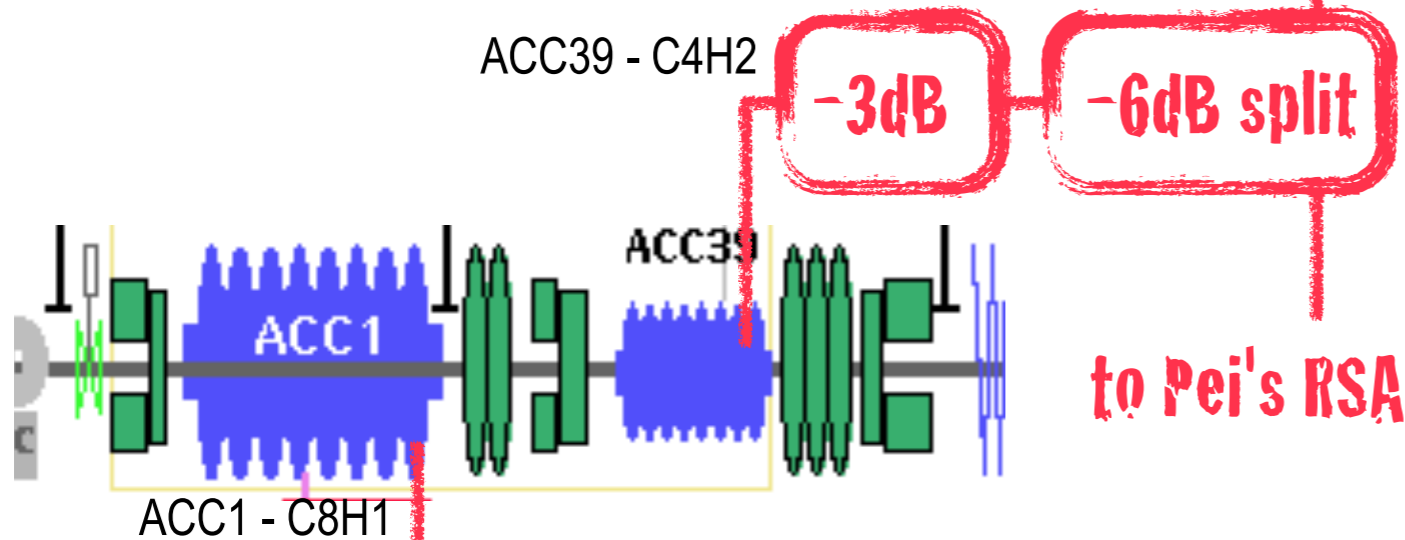
automatic (Pei :-)) ) readout of BPMs  
"3GUN", "9ACC1",

"2UBC2"



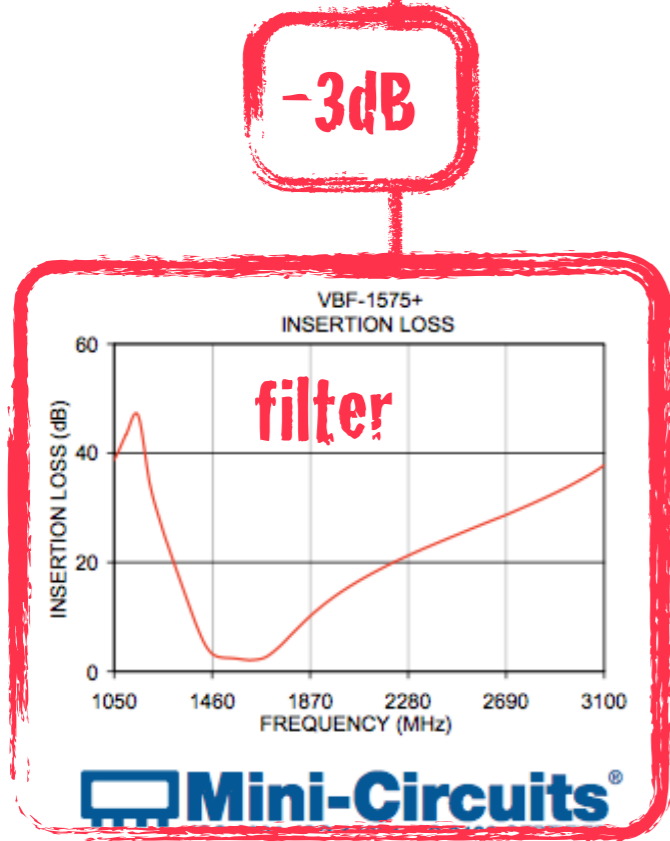
~0.6 nC, single bunch, quads on

# 3 dB, filter, diode, scope



Agilent 423B low-barrier-Schottky diode

to Pei's RSA

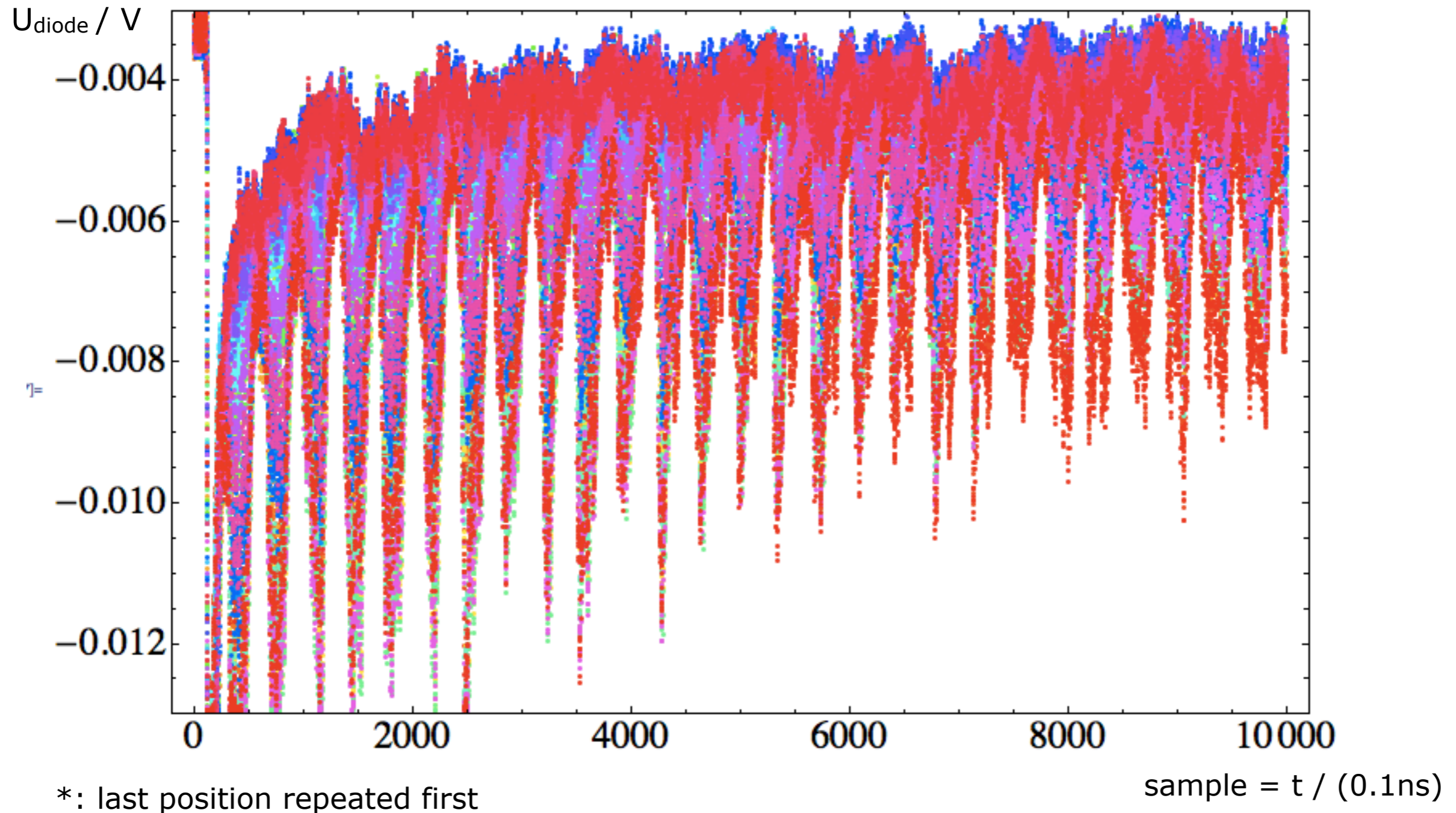


Agilent 423B low-barrier-Schottky diode



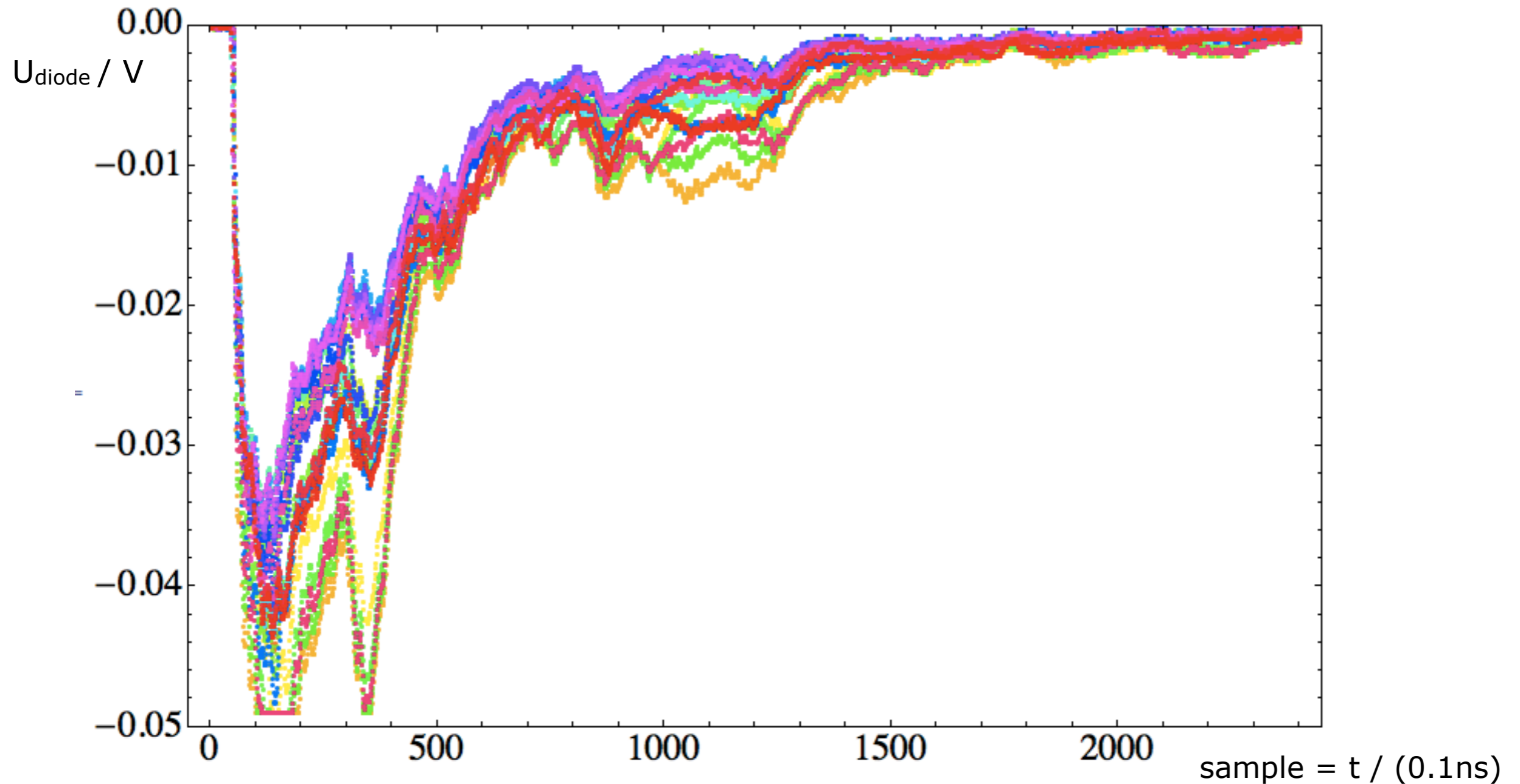
RuS RTO1014, 1 GHz nominal bandwidth, 10 GS/s, 10kS = 1μs (each channel), Ch1: ACC1, 2mV/div, trig, Ch3: ACC39, 5mV/div waveforms manually (Helge :-) ) saved

## ACC1: All 25 (+1)\* raw diode voltage signals vs. time





## ACC39: All 24\* (+1) raw diode voltage signals vs. time\*\*



\*: one position accidentally not stored

\*\* : signal clipped in time covering only "interesting" range = 2400 samples = 0.24  $\mu$ s





## Singular Value Decomposition

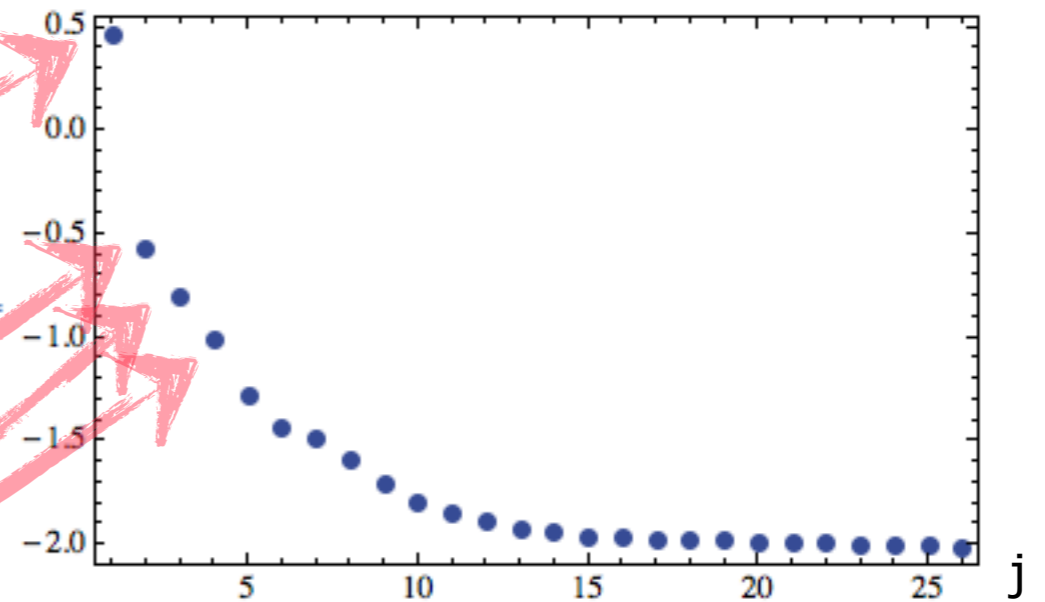
- Analyses set of  $N$  signal curves (of equal length  $n = \text{no. of sample points}$ ), ...
- ... considering each data set as a vector in  $n$ -dimensional space, ...
- ... whether and which dominant directions = svd-basis vectors are apparent in the  $N$  vectors.
- Weight ("prominence") of each svd-basis vector is expressed as it's singular value.
- Large differences of the singular values indicate dependence of the signal curves on few parameters.
- SVD does NOT correlate to any parameter.
- Available as fast ( $<1\text{s}$ ) black-box-algorithm eg. in Mathematica©

## SVD basis vectors and weights for ACC1 signals:

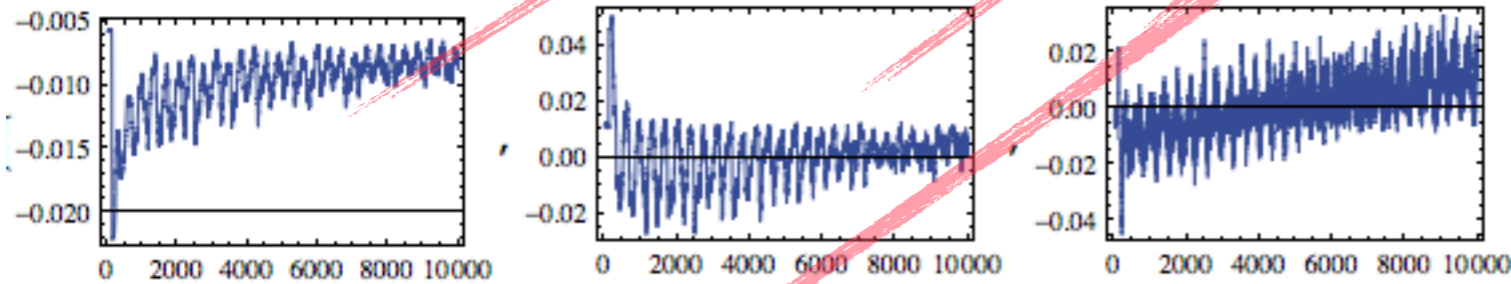
More than one order of magnitude  
between  $sv_1$  and  $sv_2$ .

Approx. 4 dominant vectors.

Log[ $sv_j$ ]



U/V



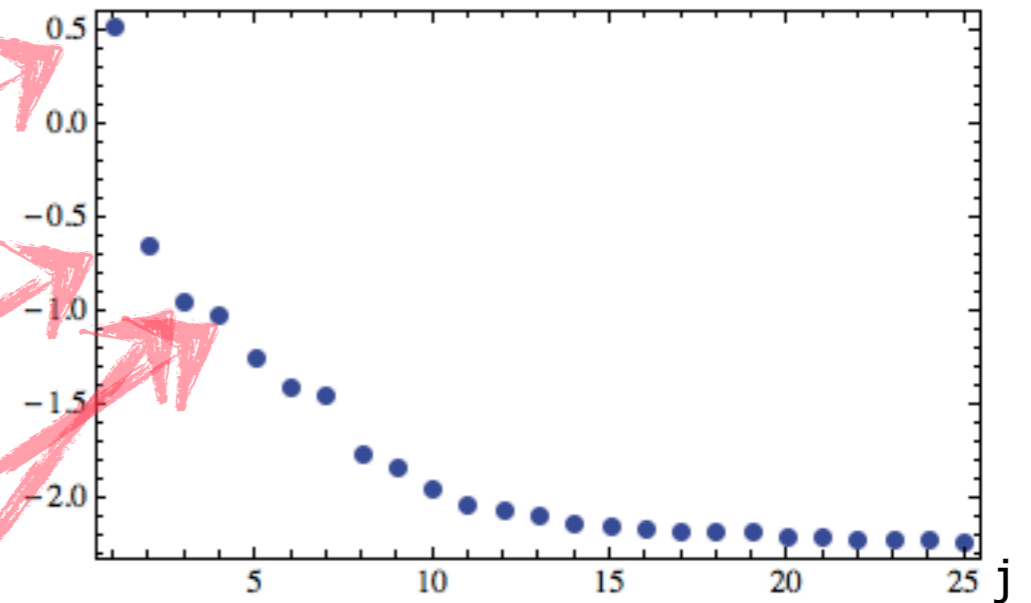
sample

## SVD basis vectors and weights for ACC39 signals:

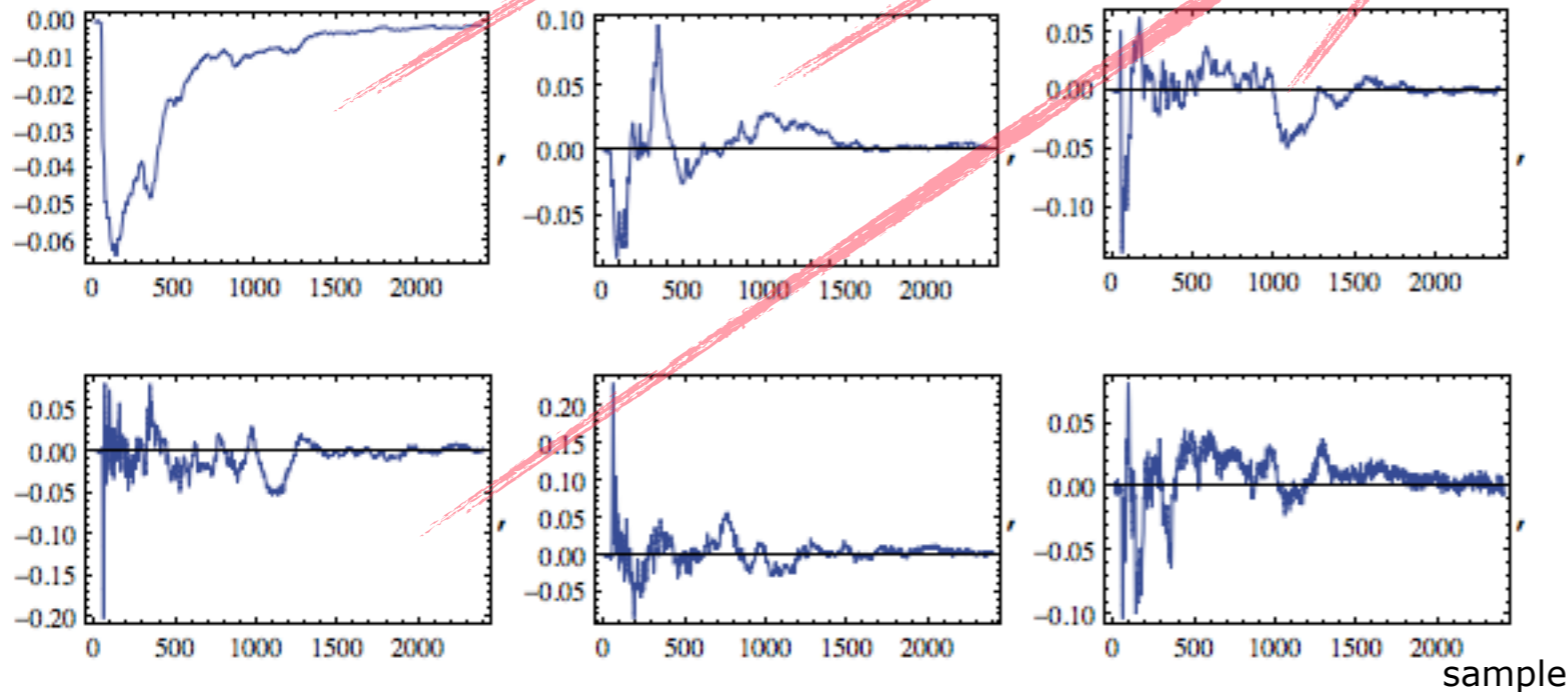
More than one order of magnitude  
between  $sv_1$  and  $sv_2$ .

Approx. 4 dominant vectors.

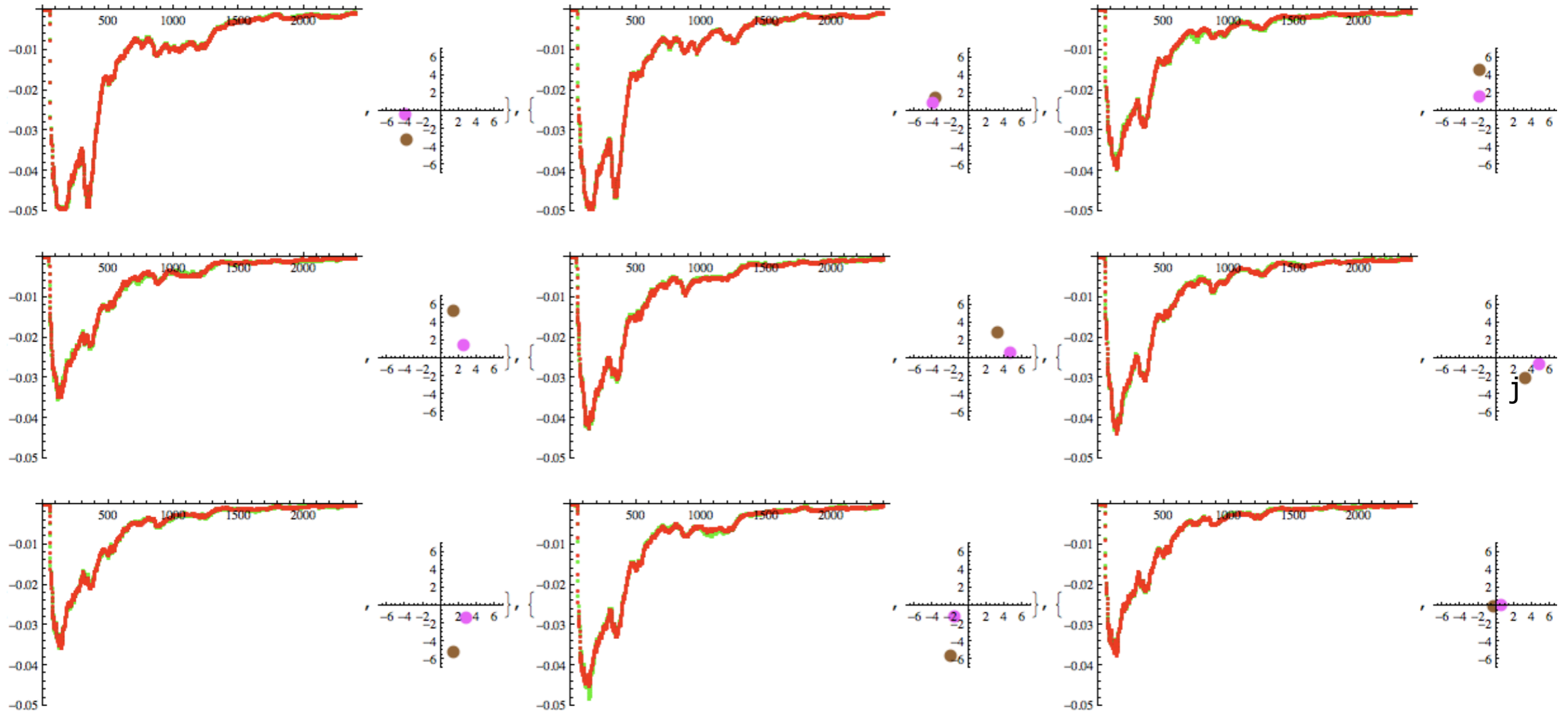
Log[ $sv_j$ ]



U/V



## Check SVD for ACC39 signals (shown 9 of 25) - works very well:



**green:** original - (almost impossible to see)  
**red:** reconstructed out of **4 first svd basis vectors**

**magenta:** BPM 2UBC2/mm  
**brown:** BPM 9ACC1/mm

all graphs U/V vs. sample



Use amplitudes  $a$  of prominent svd vectors instead of entire signals

$$\underline{a} := \begin{pmatrix} a_{v1, meas 1} & \dots & a_{v4, meas 1} \\ \vdots & & \vdots \\ a_{v1, meas 25} & \dots & a_{v4, meas 25} \end{pmatrix}$$

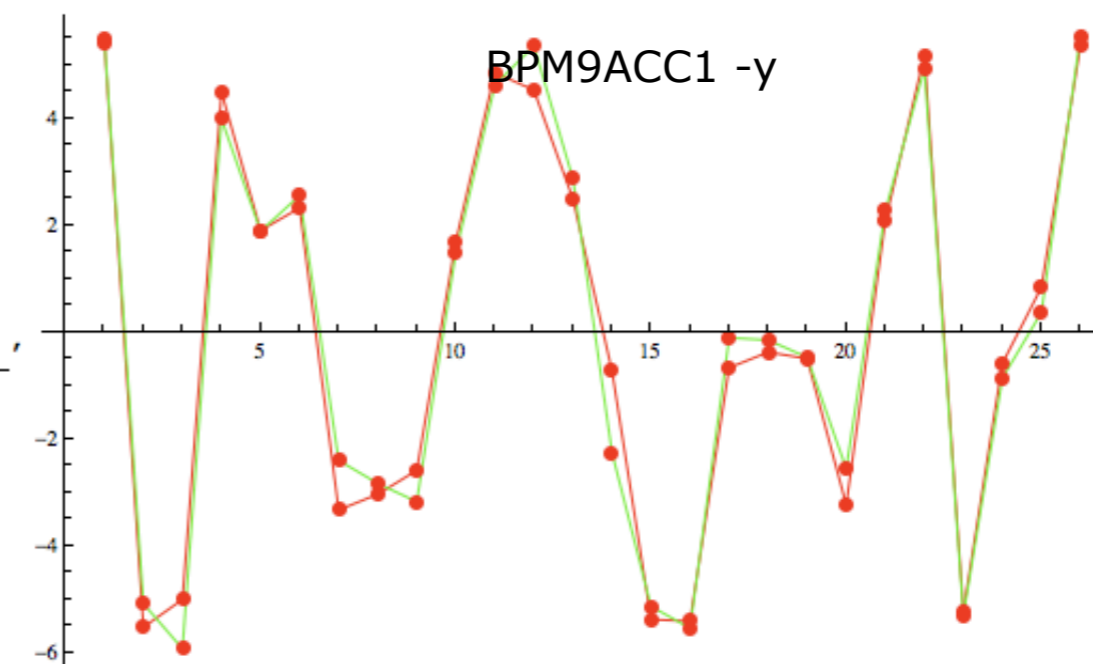
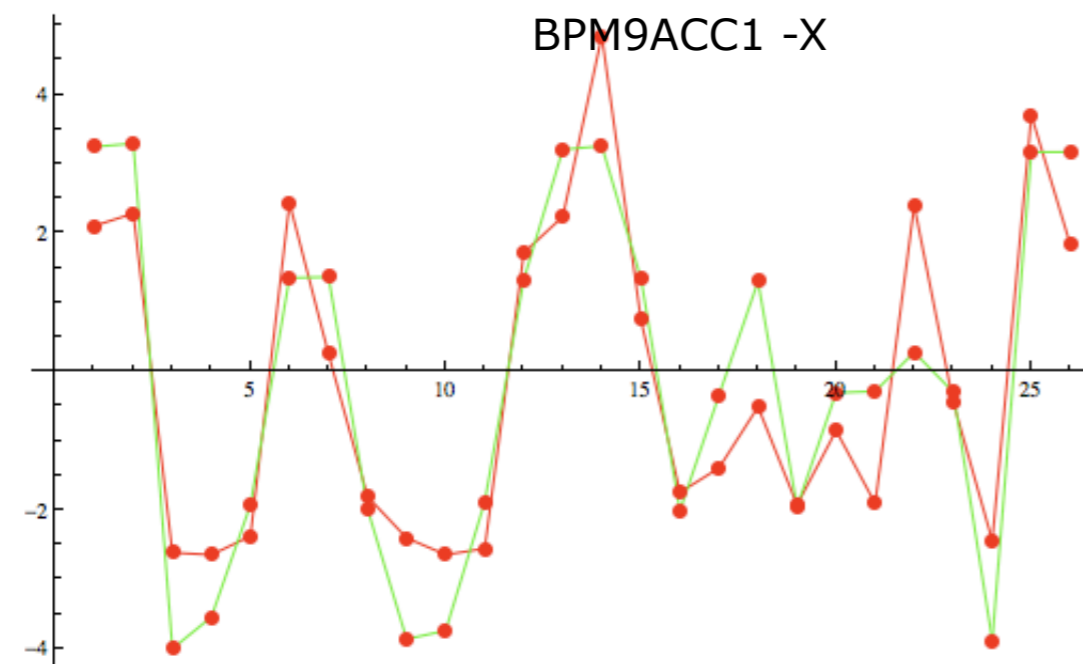
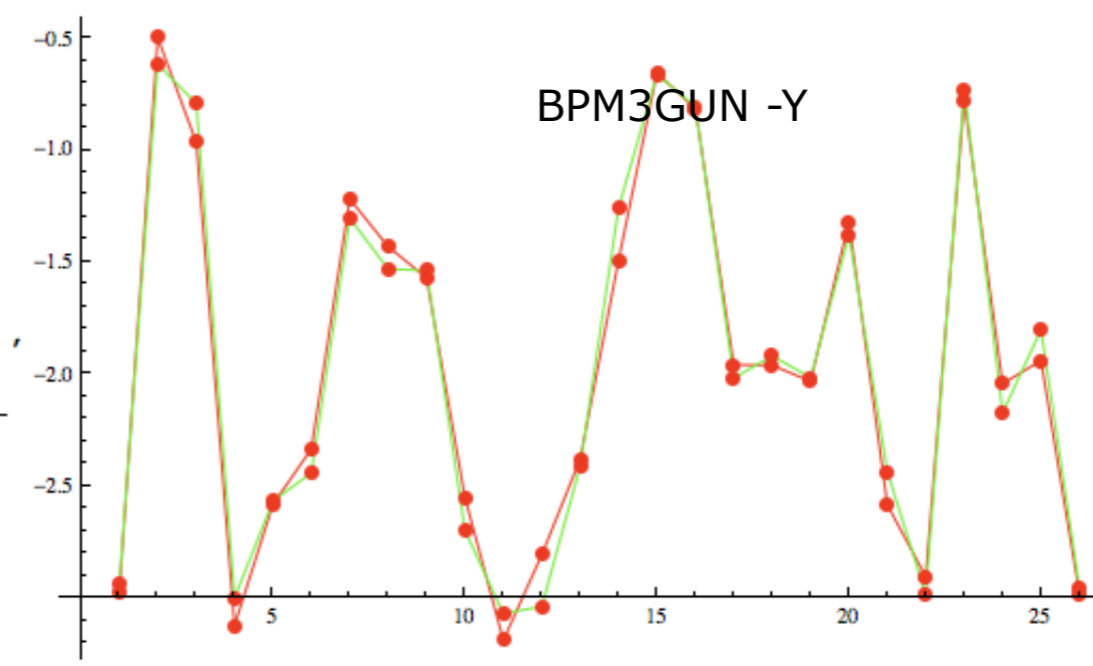
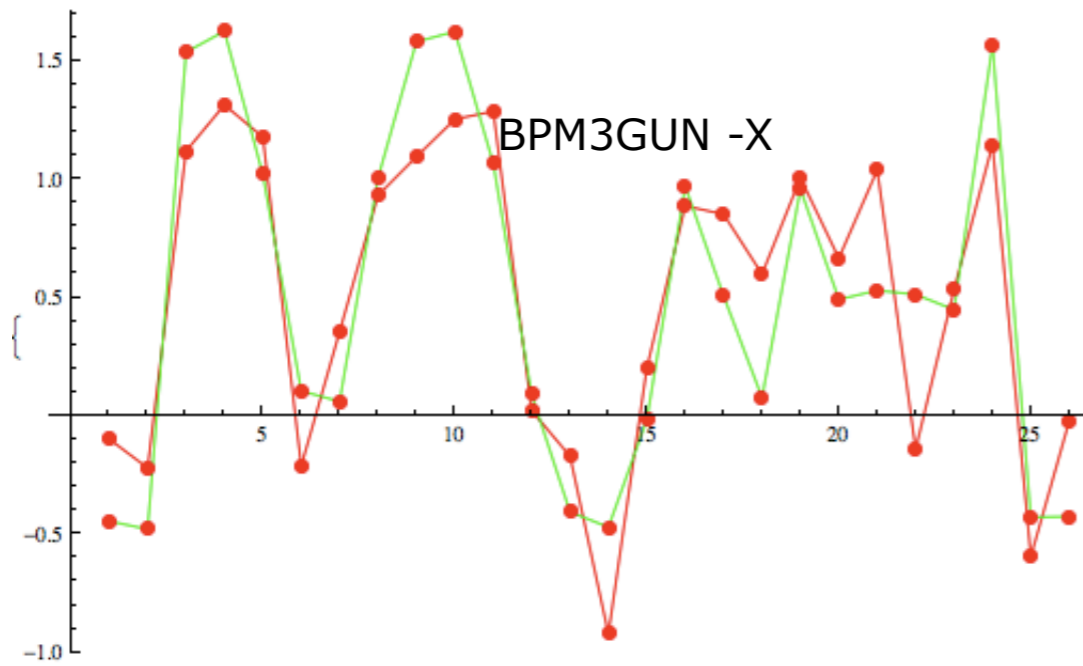
$$\underline{k} := \begin{pmatrix} x_{bpm1, meas 1} & \dots & x_{bpm2, meas 1} \\ \vdots & & \vdots \\ x_{bpm1, meas 25} & \dots & x_{bpm2, meas 25} \end{pmatrix}$$

$$\text{exist } \underline{D}_{4 \times 4} \cdot \underline{a} \stackrel{??}{=} \underline{k}$$

with good coincidence

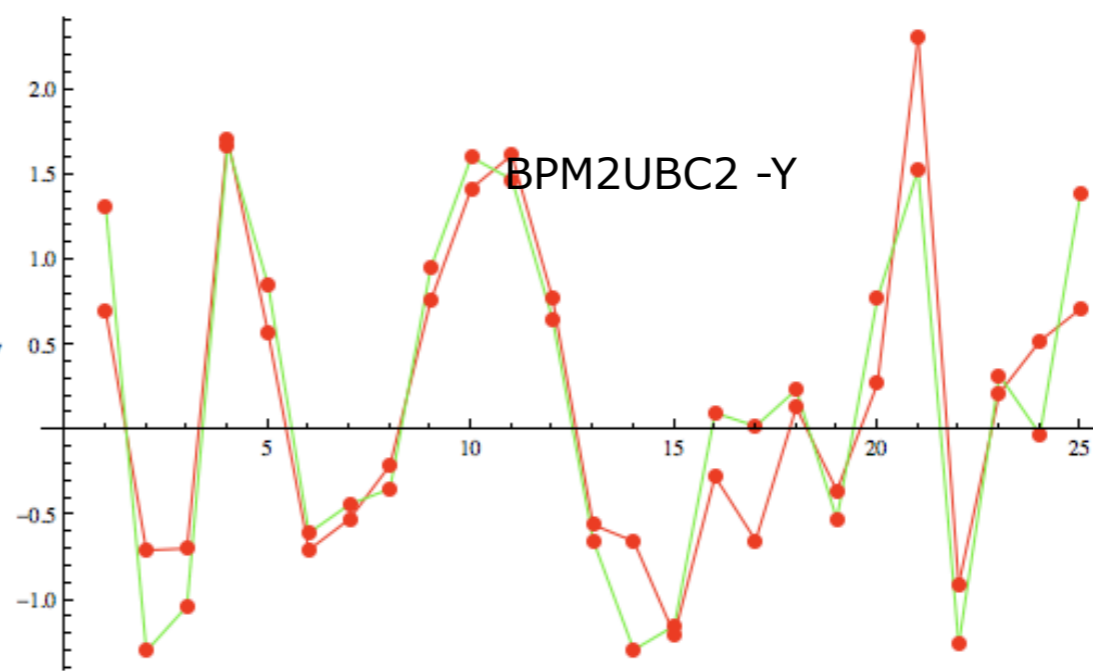
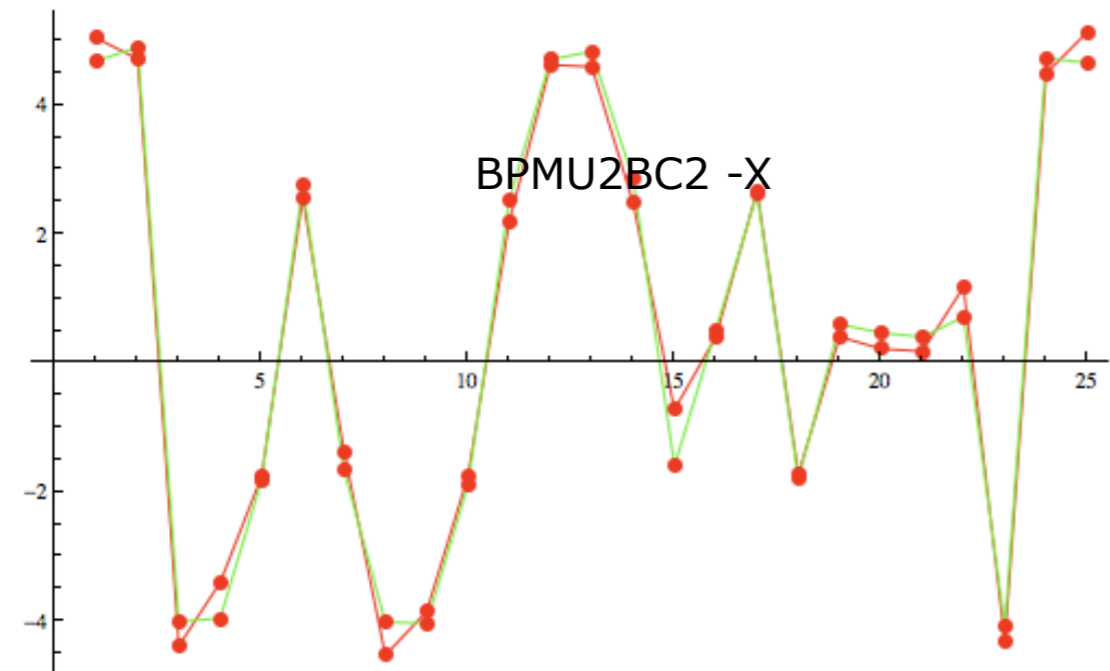
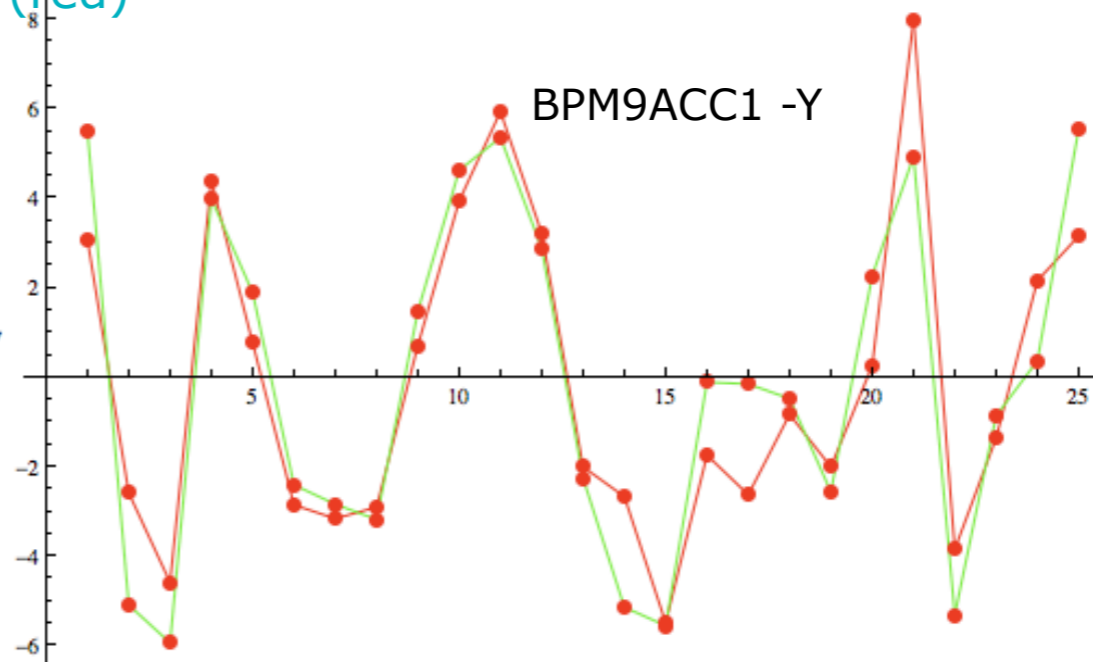
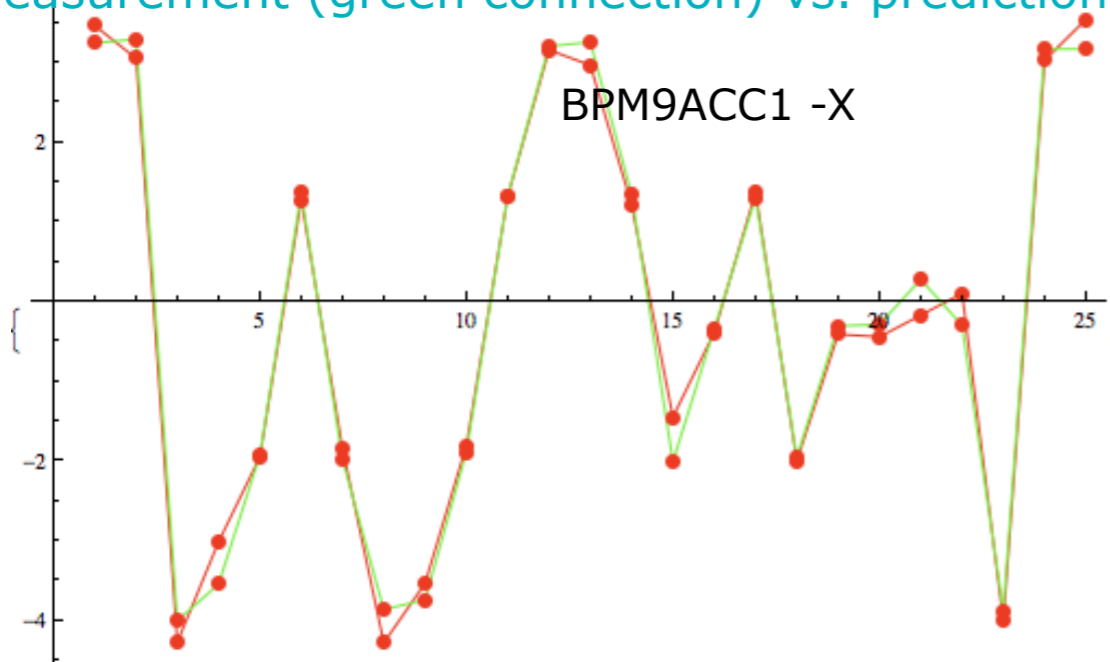
# ACC1: take SVD-vecs 2-5 and introduce bpm/signal offset\* ☺

Measurement (green connection) vs. prediction (red); \* courtesy to Rob/Steve for suggestion



# ACC39: svd-vecs 2-5 and using an bpm/signal offset ☺☺

Measurement (green connection) vs. prediction (red)



## Conclusions

- try to release hold of HOM coupler design a.s.a.p
- switch back to CST one possibility; preference for own solution (but geometry input some issue)
- spent almost all available manpower to beam measurement @ FLASH Jan/Feb
- achieved promising results for HOM-based beam position monitoring using SIMPLE and UNSPECIFIC components