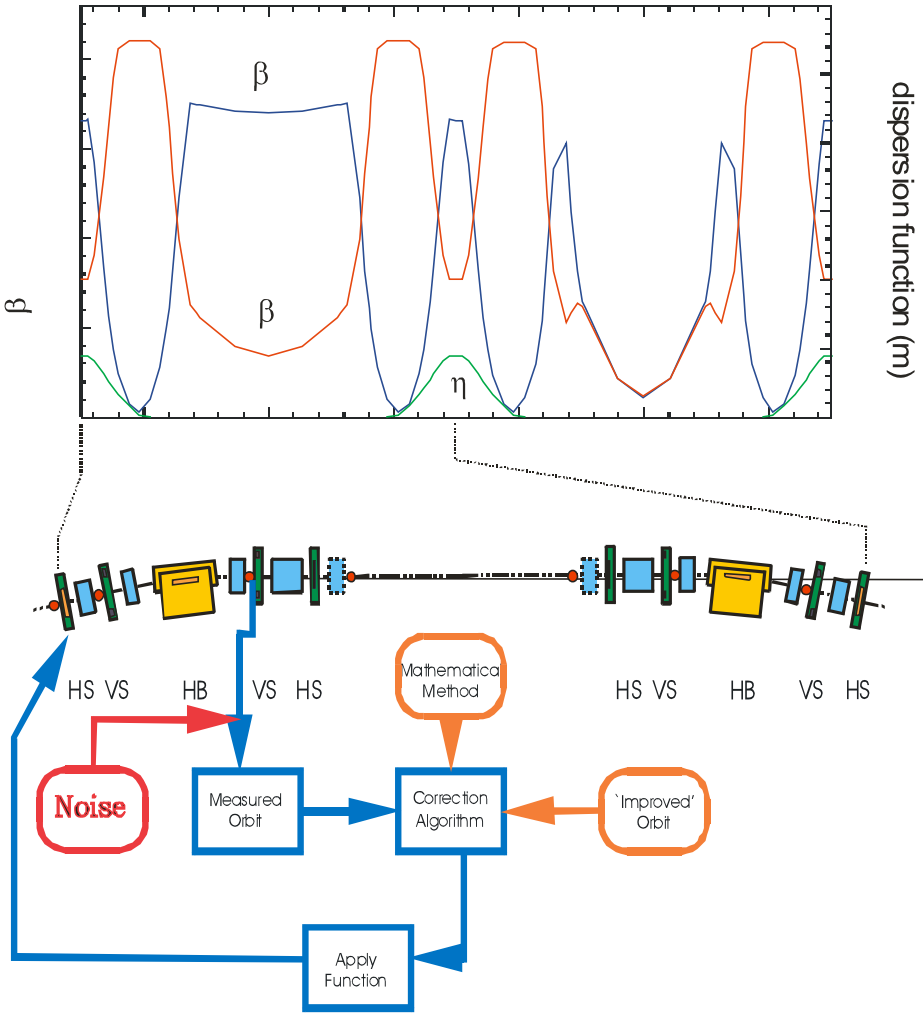
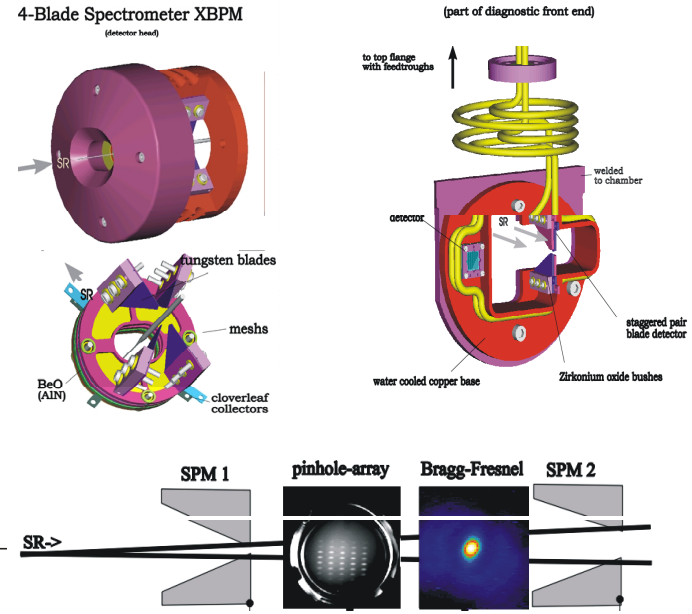
Orbit Correction with 2x16 Bit: Effects on Modelling

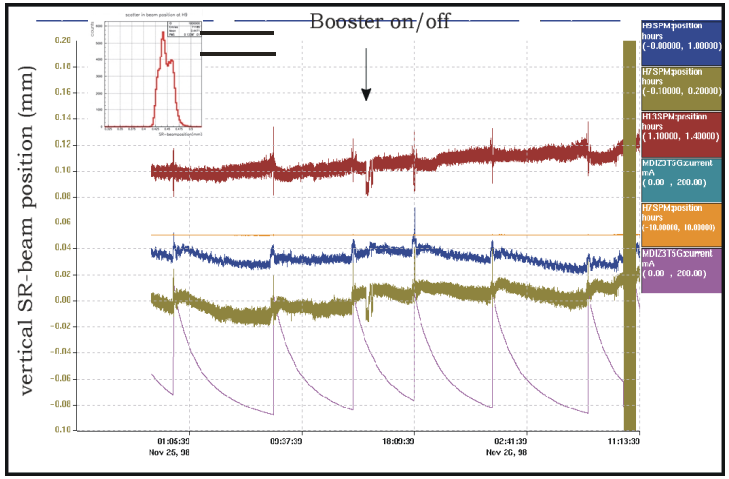
- Initial design: 3mrad correctors, 16 bit DAC
- First experiences with continous correction: High resolution experiments unacceptably perturbed by correction activity
- Full dynamic range of correctors required by MD studies (large bump scans)
- Solution: 2x16 bit coarse/fine DAC with range overlap provide 24 bit resolution

Corrector Pattern



Diagnostic Means:Electronic + Photon BPM
Precise, Reliable, Fast, Complementary





Orbit Correction Set-Up

`Intrinsic' Stability of SR: High

Orbit Correction Software:

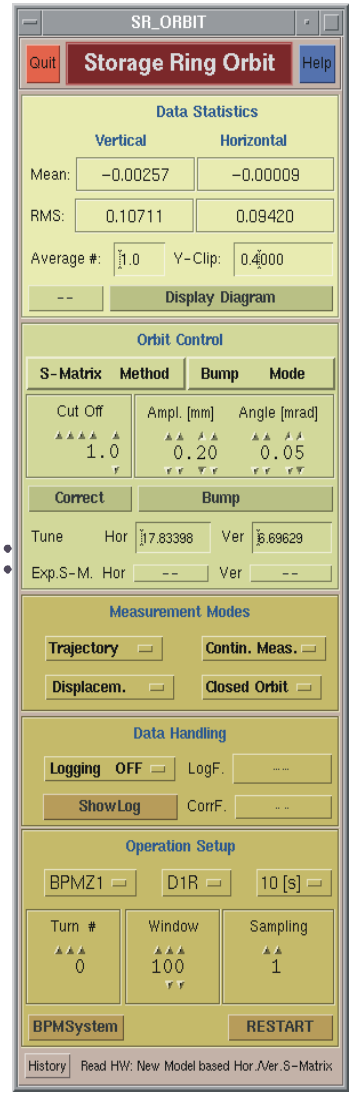
Versatile,
Accurate,
All-In-One
Working Horse

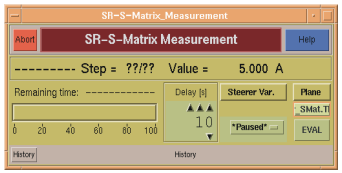
`Continous Mode':

1 Orbit / 2 sec

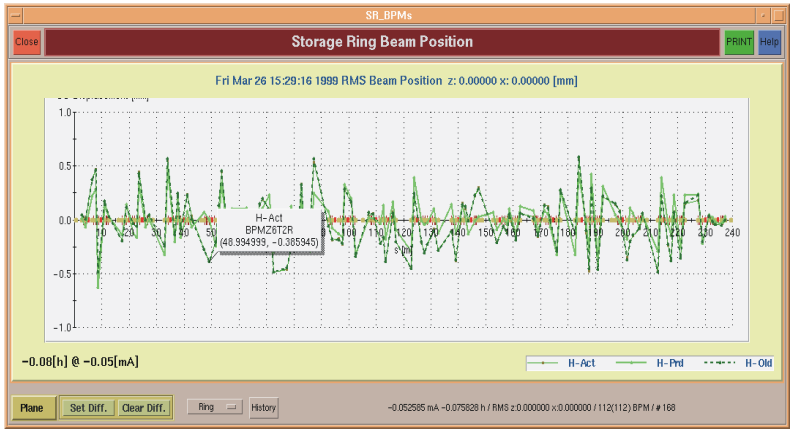
Read Orbit
Calculate/Set
Settle/Discard
Read Orbit
…

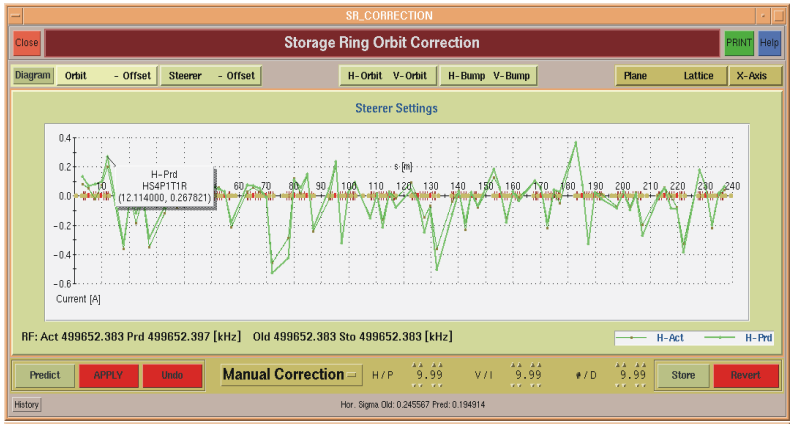
1 Corr. / 6 sec

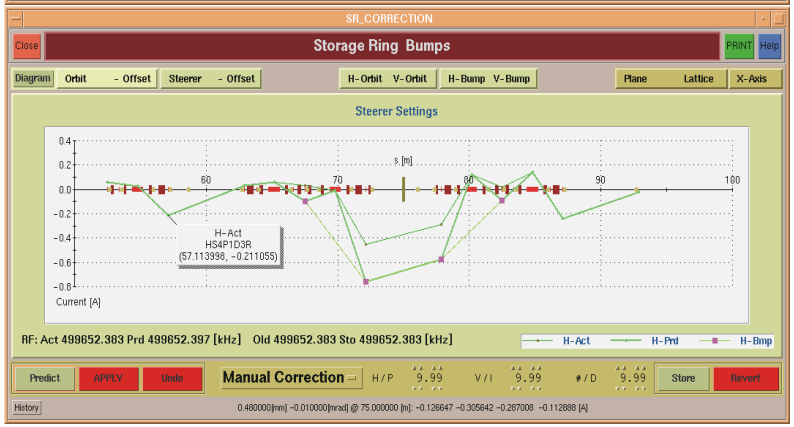


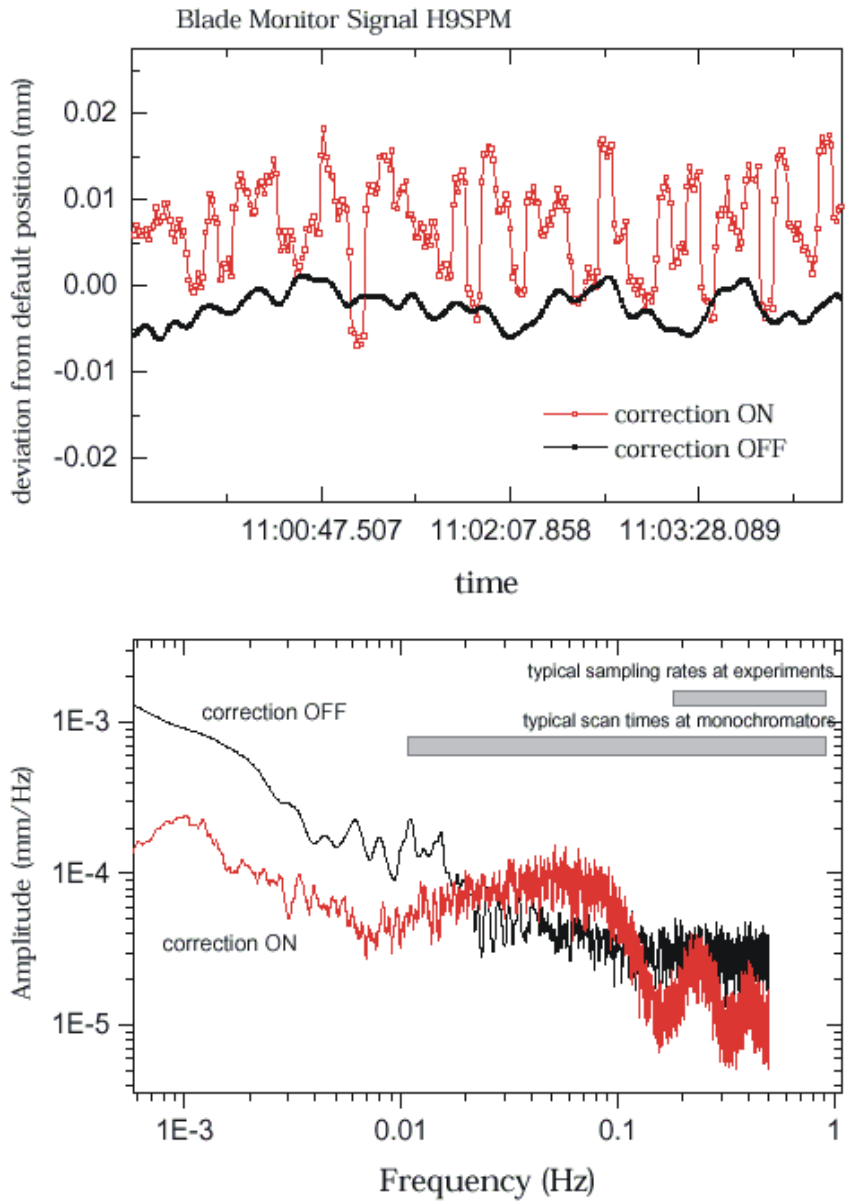


Orbit Display and Control Interface

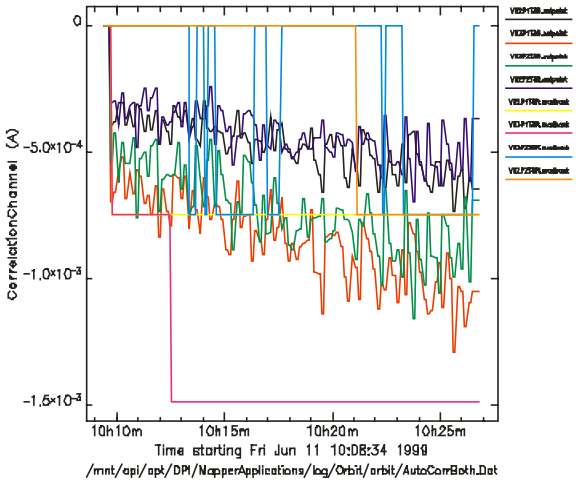






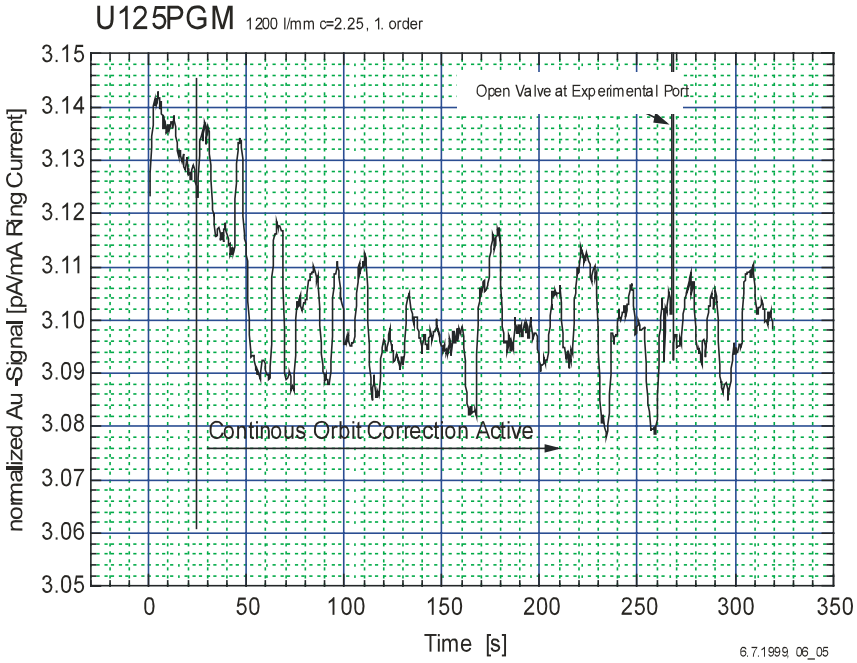


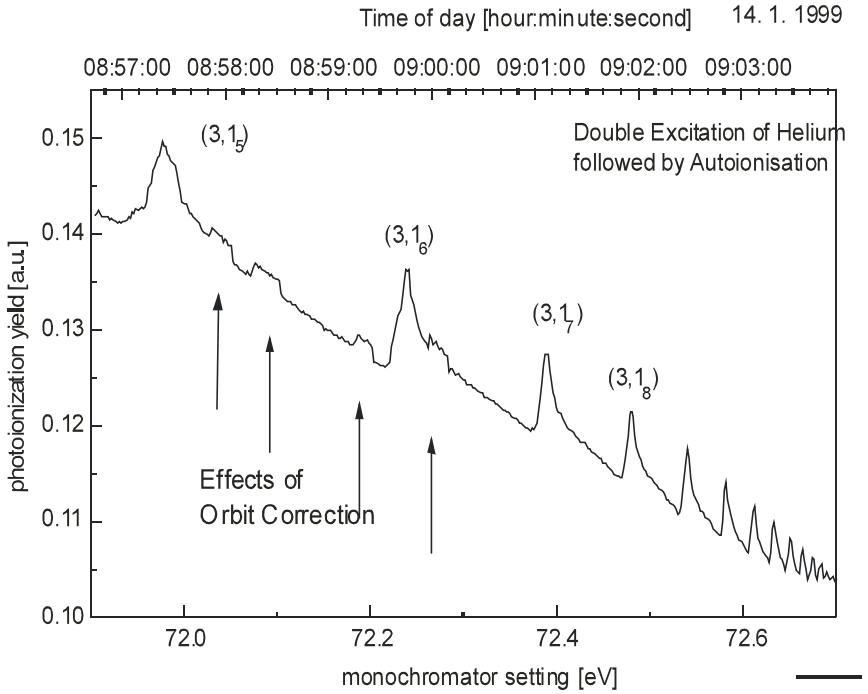
Typical noise induced by continous 16 bit orbit



Powersupplies do not provide the currents (see readback values) required for the correction (see set points).

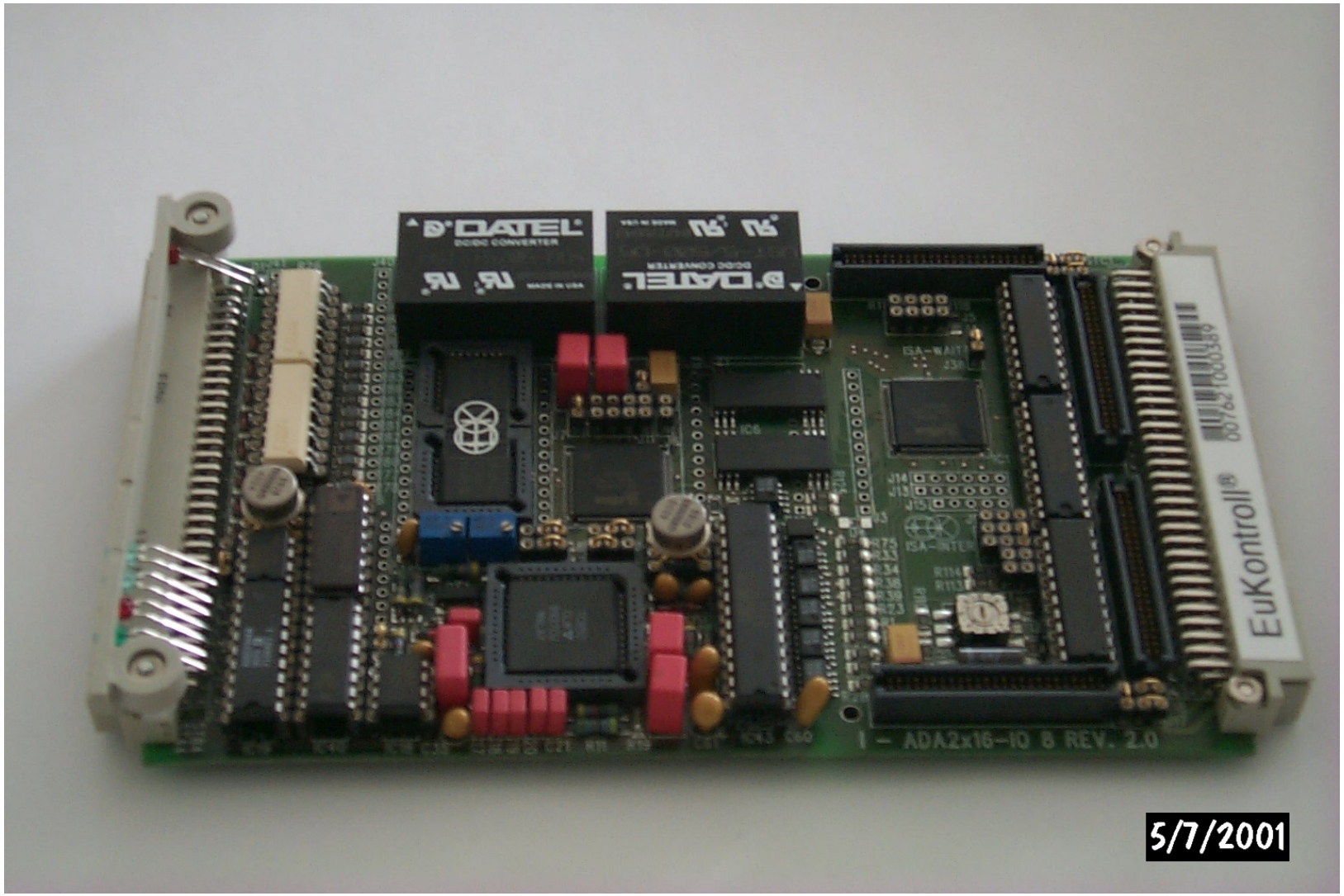
At threshold noise produces bit flips seen by the experiments.





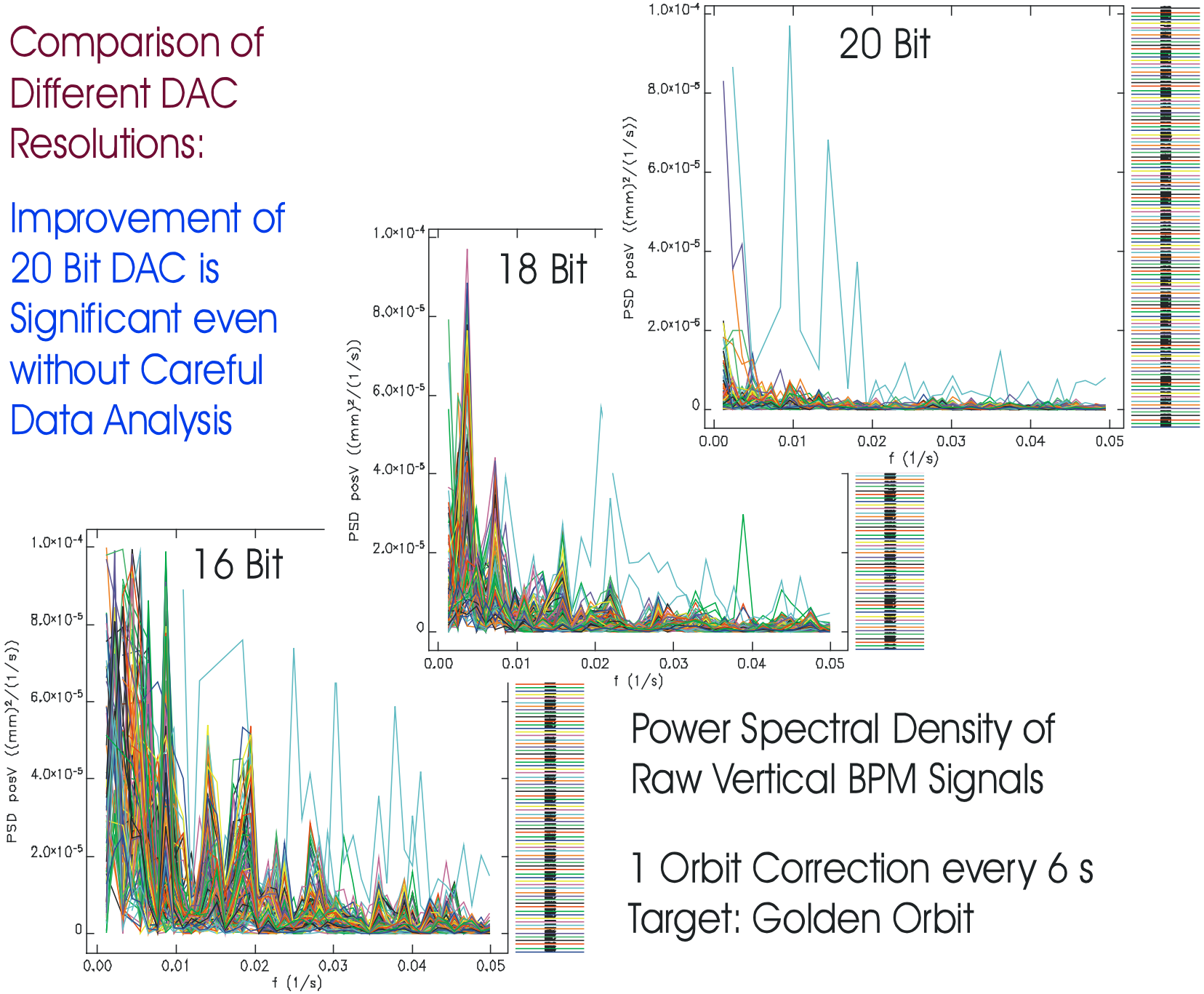
High resolution experiments perturbed by minimal orbit corrective action

New I/O Board: 2x16 Bit DAC



Comparison of Different DAC Resolutions:

Improvement of 20 Bit DAC is Significant even without Careful Data Analysis



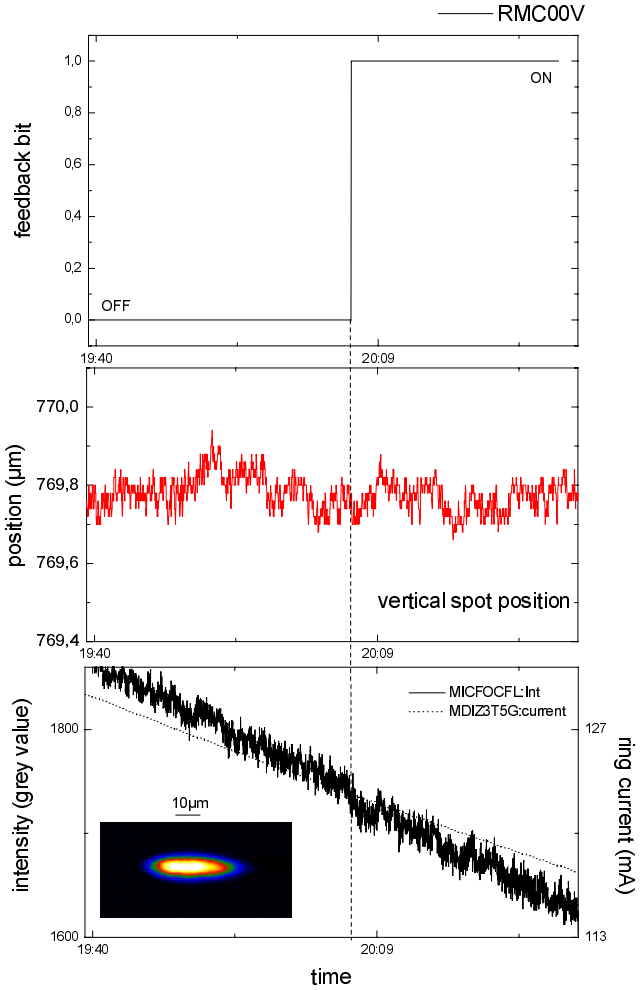
Power Spectral Density of Raw Vertical BPM Signals

1 Orbit Correction every 6 s
Target: Golden Orbit

Stabiltät des Microfocus am U41 bei Einschalten der Orbitkorrektur

15.11.00 Holldack, Jung Müller

-vertikale Spot-Größe 7µm sigma (!)
-Photonenenrgie 400 eV auf blauer Flanke der 1. Harmonischen bei gap 24.641 mm
-kein Unterschied in der spot-stabiltät (100 nm peak to peak !) durch feedback
-Intensität macht bei Anschlten des feedbacks Sprung von der Größenordnung 1%
-Die Stabiltät der integralen Intensität im Focus ist +-0.5% peak to peak

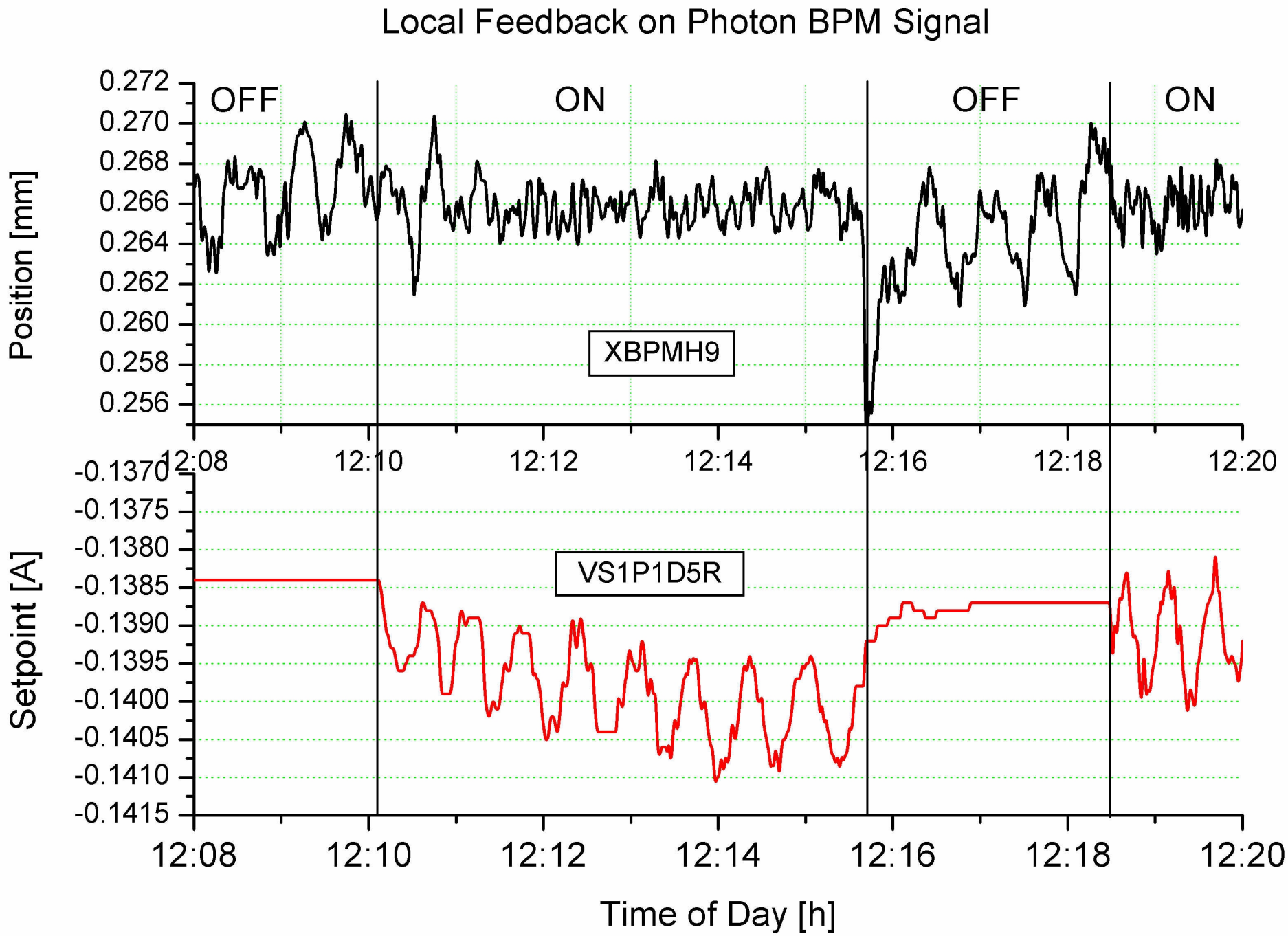


Continous drift correction: Present Status

- Result: Orbit stabilized to ±3μm/day
- `All' residual insertion device perturbations compensated below users sensitivity
- Routine operation during user runs.
- Mandatory for:
  - decaying superconducting magnet currents
  - field changes of electromagnetic undulator

Continous drift correction: Present Status (cont'd)

- Very reliable and precise
- Faster BPM data acquisition with same precision under development : 10 orbits/s
- New limit: electronic pick up BPM resolution


Local Feedback on Photon BPM Signal
OFF
ON
OFF
ON
XBPMH9
VS1P1D5R
Position [mm]
Setpoint [A]
Time of Day [h]
0.272
0.270
0.268
0.266
0.264
0.262
0.260
0.258
0.256
-0.1370
-0.1375
-0.1380
-0.1385
-0.1390
-0.1395
-0.1400
-0.1405
-0.1410
-0.1415
12:08
12:10
12:12
12:14
12:16
12:18
12:20

Conclusions from Pilot Experiments

- Perturbations beyond resolution of electronic pick-up BPMs correctable using photon BPMs
- Idea: Staged correction scheme:
  - →At larger deviations: Absolute to electronic pick-up BPM signals (center of Quads)
  - → At resolution limit: Relative to photon BPM signals
  - → `Passive' complementary system data: used for consistency/HW sanity check

Consequences for Modelling

- Difficult photon BPM source point calibration: Measured sensitivity matrix
- Adaptive figure of merit
- Fitting procedures to estimate data quality
  - Current dependencies/Failures
  - Unforeseen anomalities