# Status and new Developements in Motion Control at BESSY II

Overview

Beam Positionion Control

Heydemann Correction

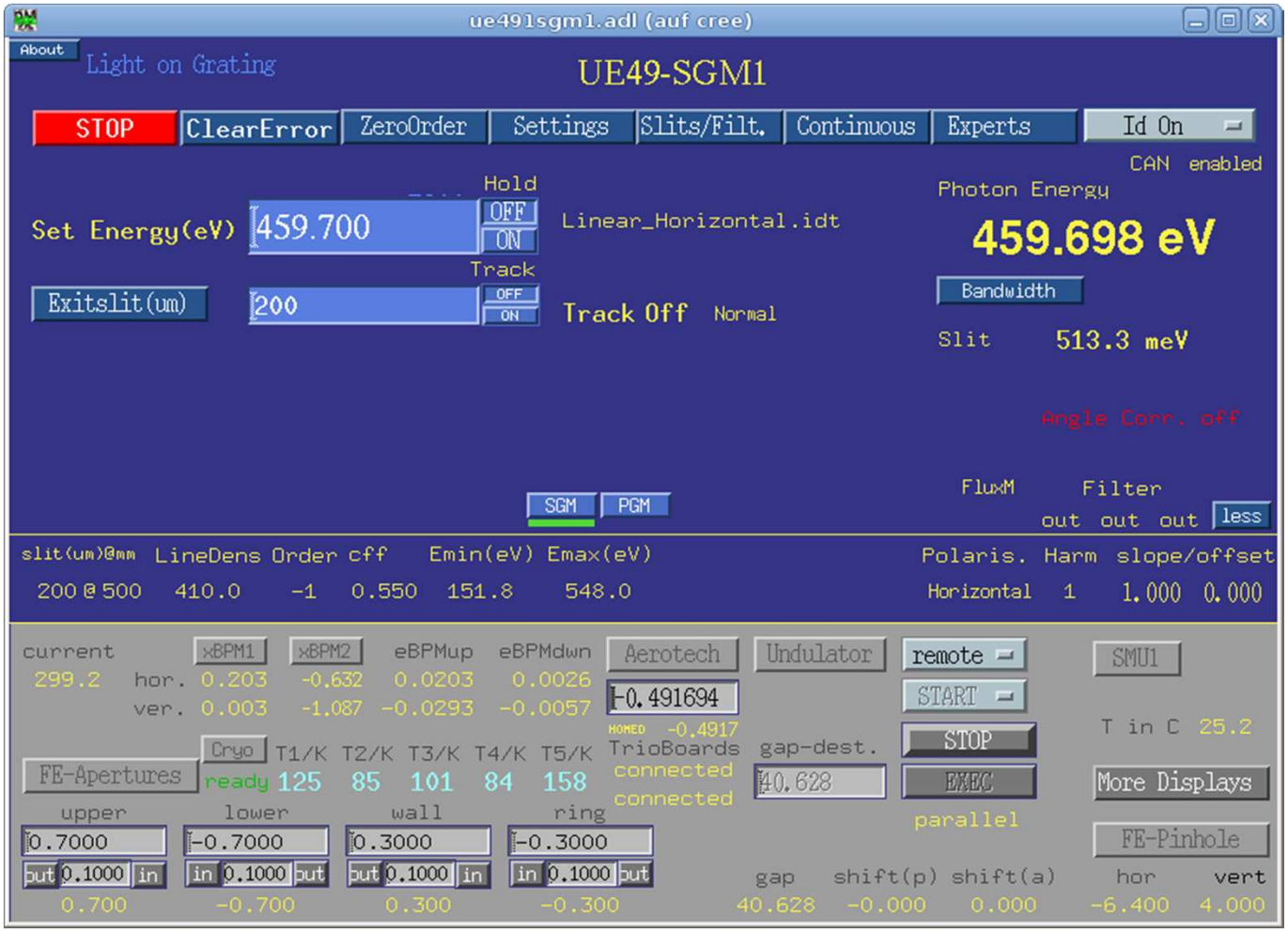
Energy Materials In-Situ Laboratory (EMIL)

New Control Scheme for Continuous Mode

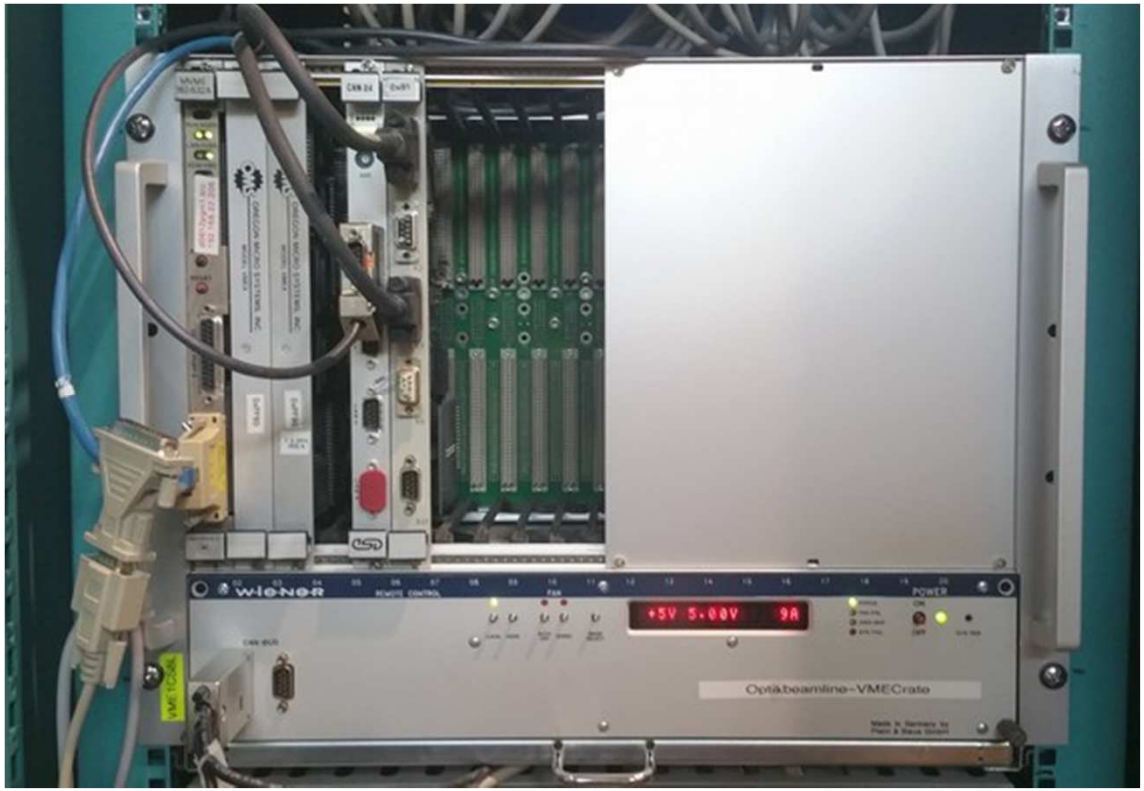
Issues with Absolute Encoders

# Monochromator Control Program (MCCP) Overview

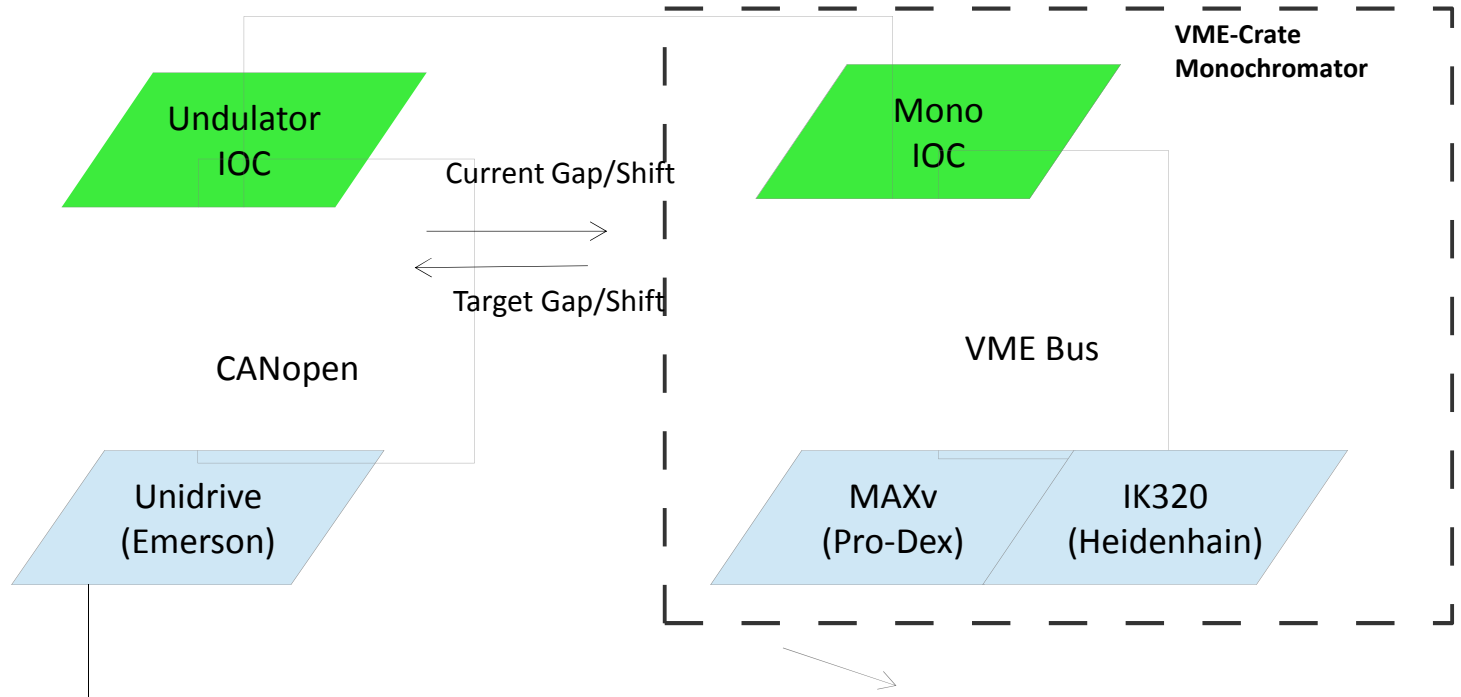
- Undulator
- Switching Mirror
- Grating Chamber
- High Order Suppressor
- Filter
- Apertures
- PSD
- Exit Slit



# Monochromator Control Program (MCCP) Overview

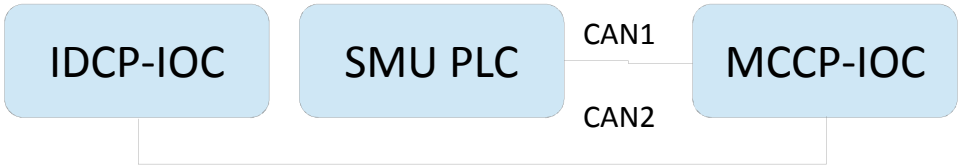



# Beamline Control Scheme

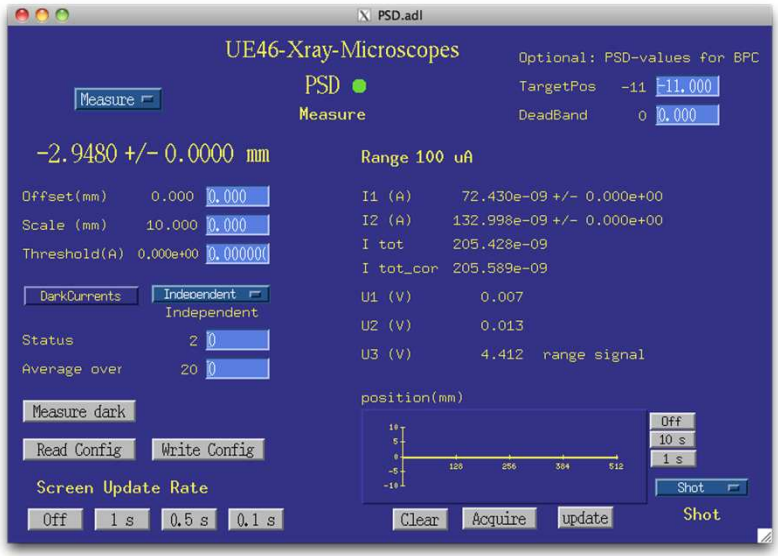


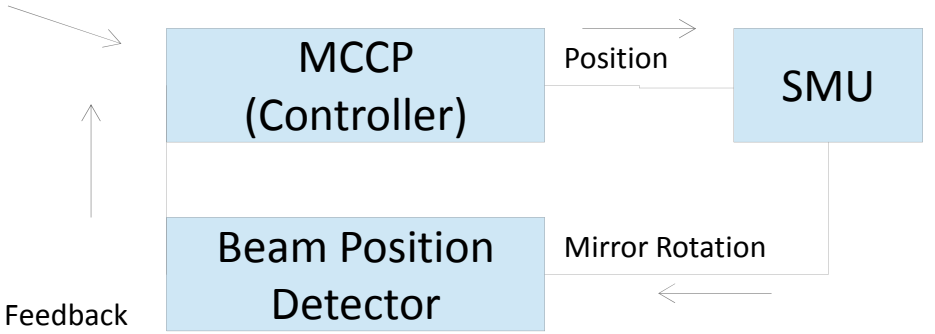

- Position Feedback via CANopen
- Monochromator IOC: MVME162 (Motorola)
  VME6/OMS58/MAXv (Pro-Dex)
  IK320 (Heidenhain)
- Undulator IOC: MVME 2100 (Motorola)
  Unidrive SP (Emerson)

# Beam Position Control




- Full LoCuM Support:
- Configuration via RS232 Interface
- DAQ of 4 Channels up to 4kHz
- Drift of beam position
- due to temperature changes.
- Compensation by moving M1



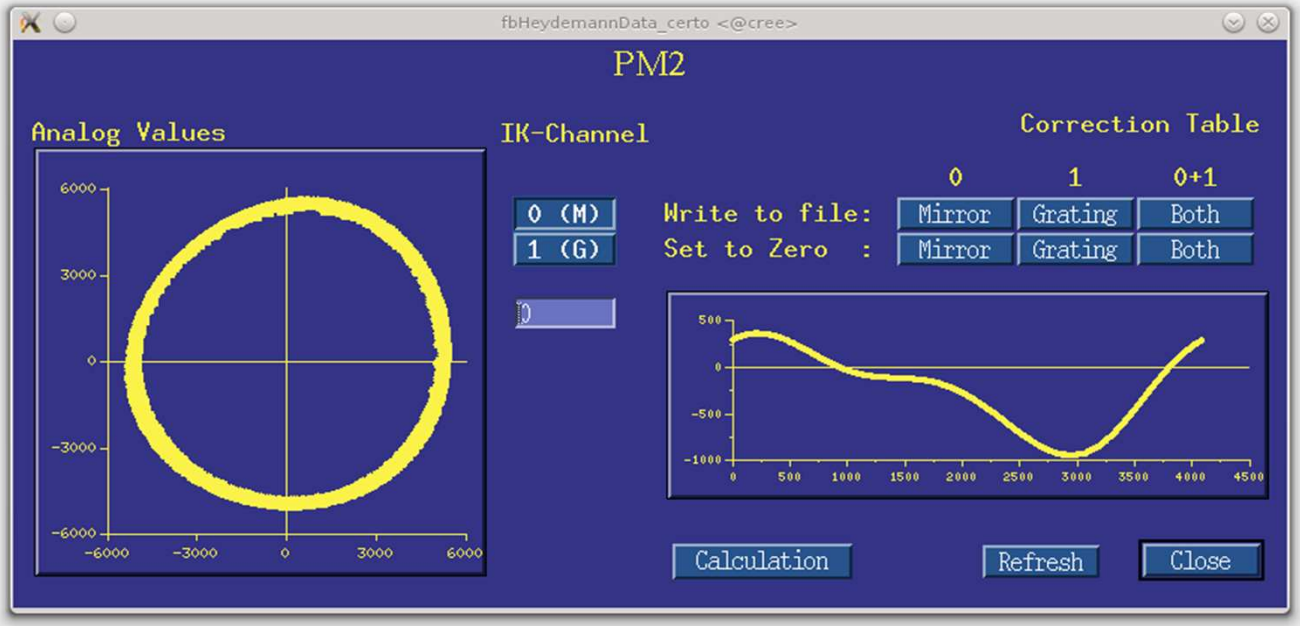
# Feedback Support Modules

Feeback Support Modules  are being created for specific hardware (Encoder Cards, Laser Inter

Used for beamline diagnostic, closed loop systems (feedback), optimisation (e.g. Heydamann (

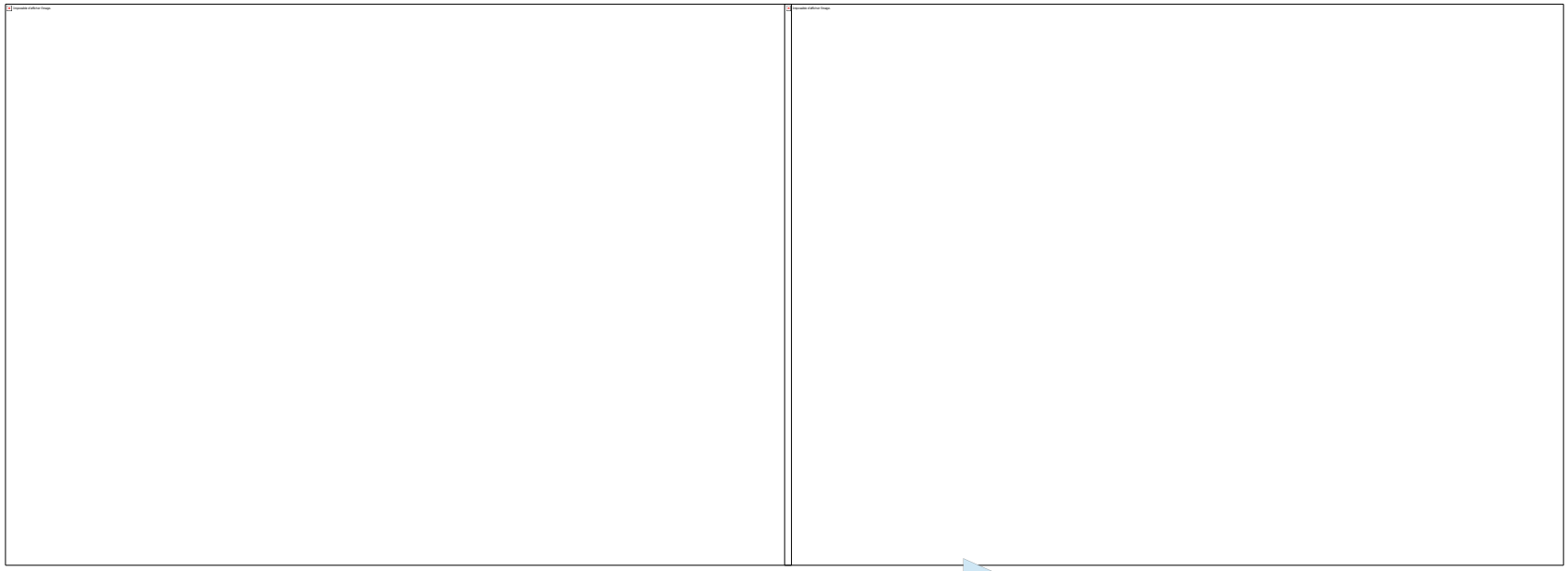
DAQ up to 4kHz

Can be triggerd on special events or continuous.



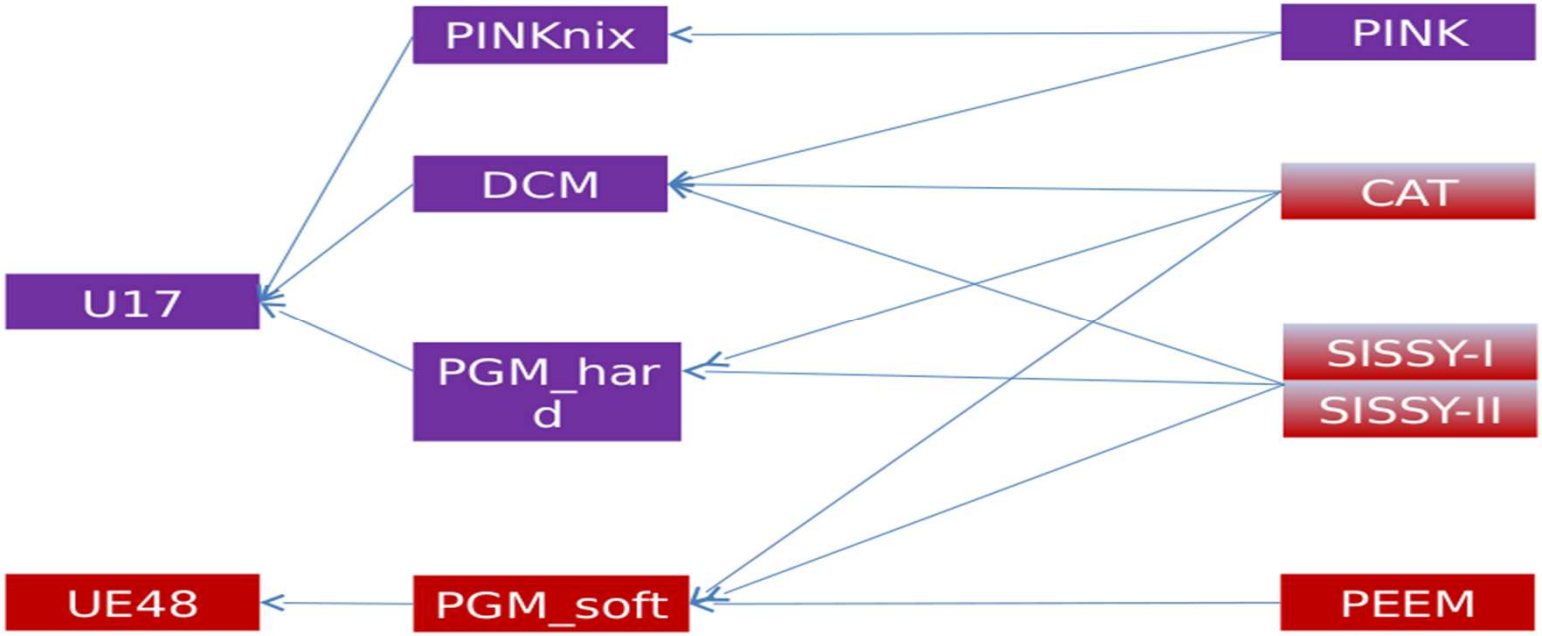
# Heydemann Correction

The Heydemann Correction is the determination and correction of quadrature errors of th
This has to be done if anything is changed on the encoder system (cable, interpolator card



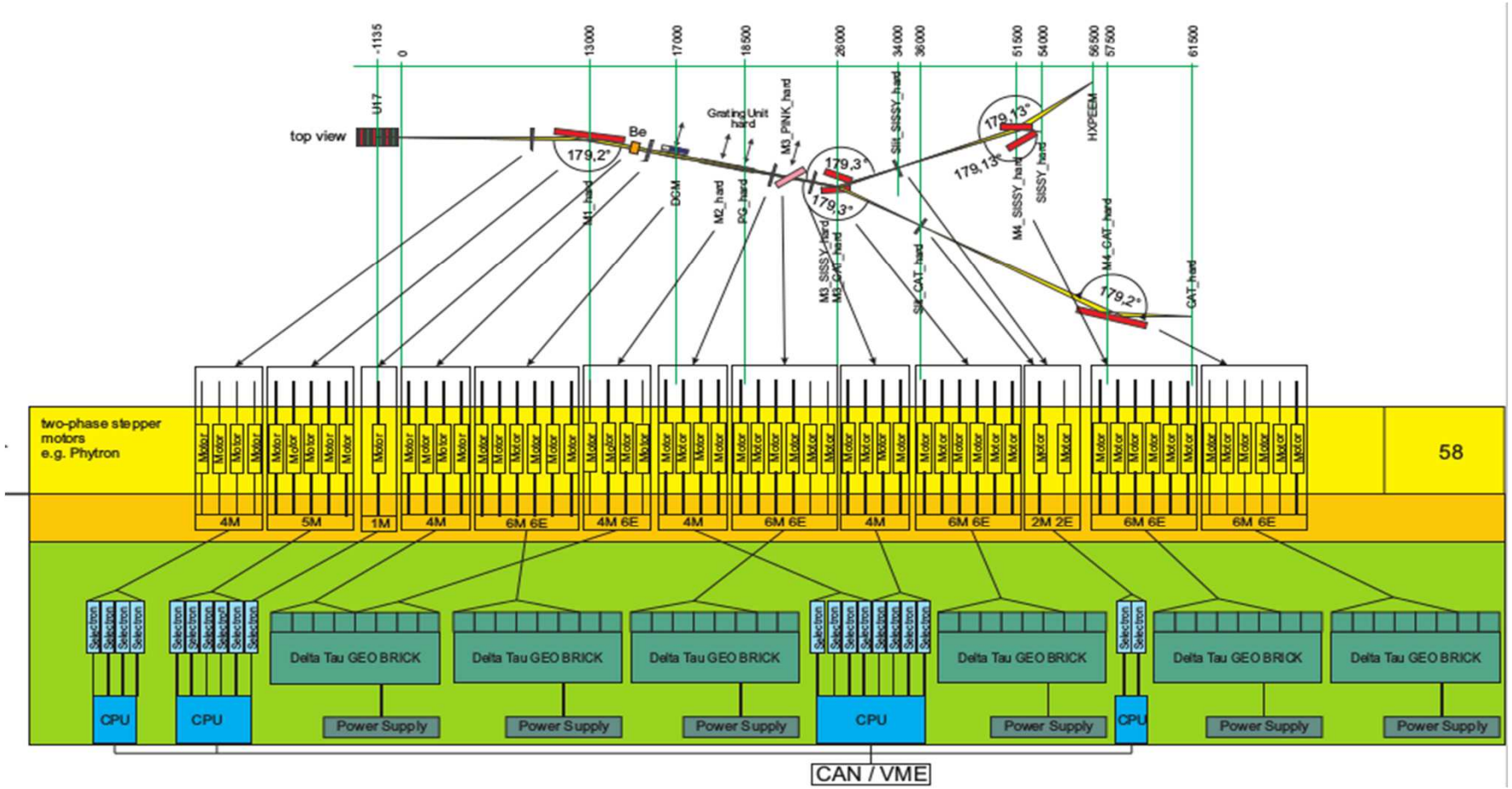
Correction of all 4 RON905 signals.

# EMIL Beamline Layout




- ~ 150 Axes
- PGM, Hexapods and DCM with absolute
- encoder Renishaw Resolute REXA
- ES with incremental encoder Renishaw Tonic
- Aperture without encoder

# EMIL Hardware Overview



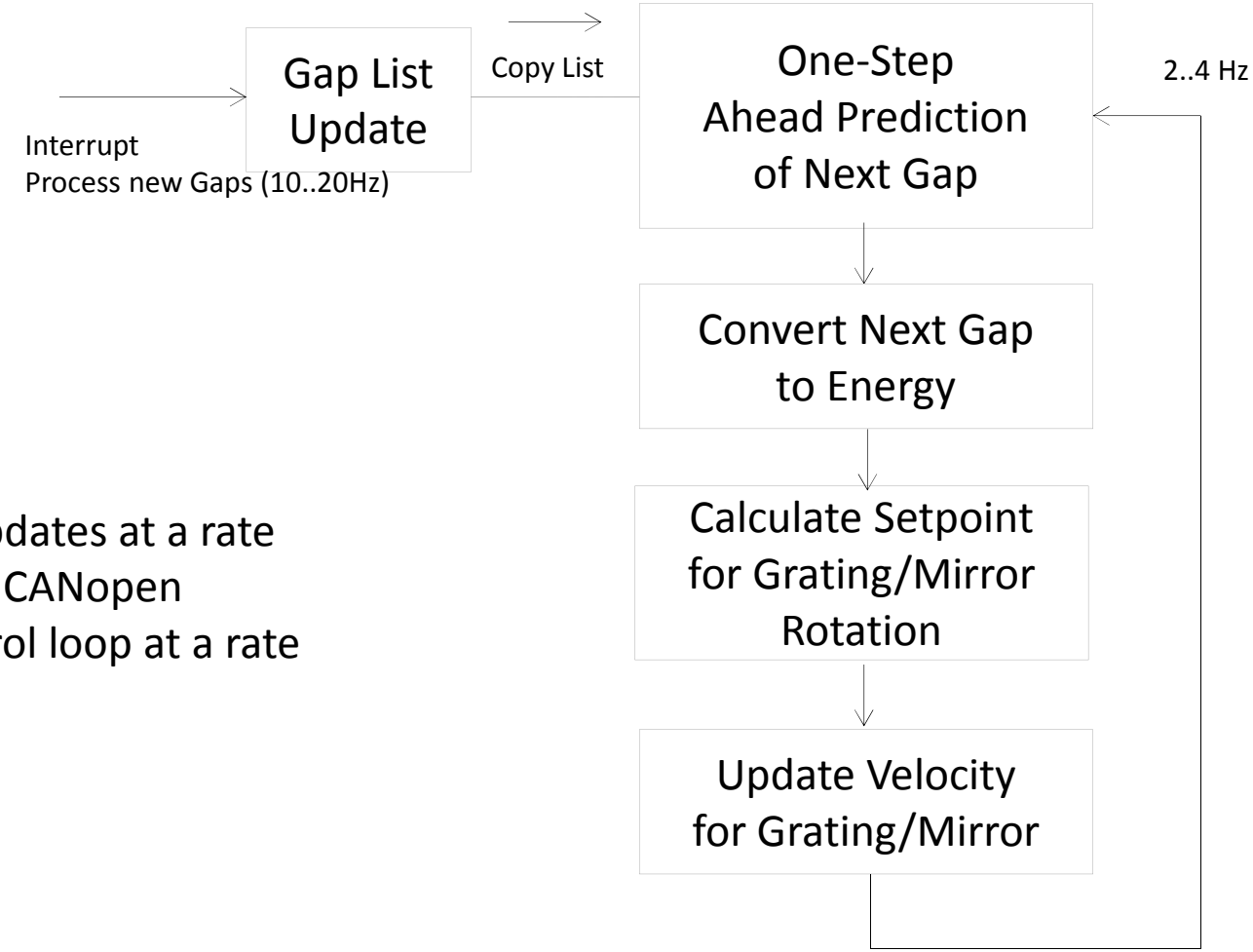

- Geobrick LV IMS II
- Selectron PLC with Motion Module
- VME Crate as slow control IOC
- Unidrive SP Emerson

# EMIL: New Motion Controller

## Geobrick LV IMS II

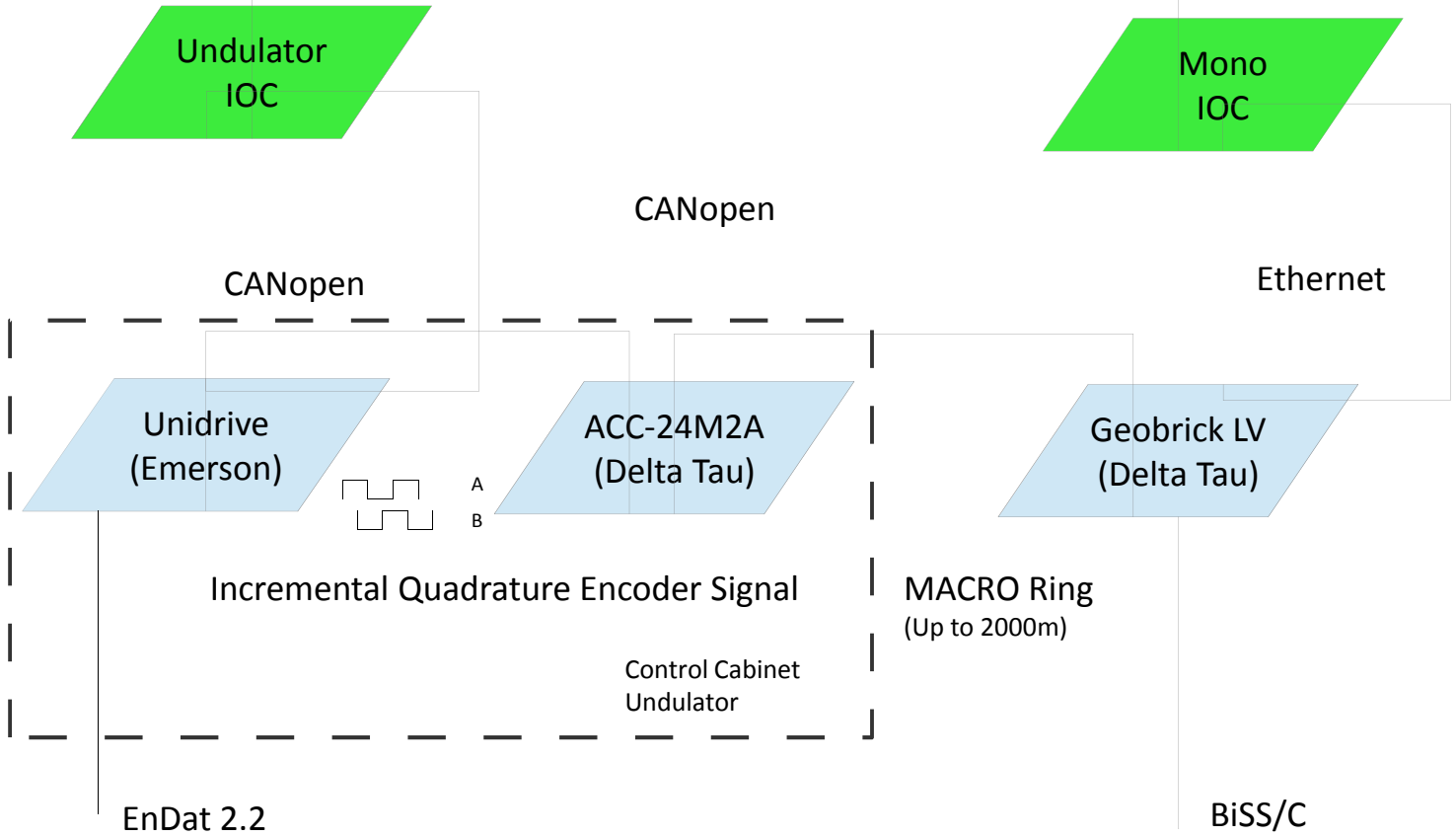
- 240 Mhz DSP
- * Stepper in Open-loop
- * Non-Linear Control Scheme
- * Complex Fwd/Inverse Kinematics
- * Encoder Filtering, Collision Check, Watch Dog
- * Following Error, Motor Current
- * Undulator Look-up Tables
- BiSS/C Absolute Encoder
- * No Reference Procedure
- * No Signal Correction
- * Delay Compesation (up to 80m@4MHz)
- MACRO Bus
- * Undulator Gap/Position ACC-24M
- * DAQ for PSD and Bl Diagnostics ACC-52M

# Continuous Mode – Data Flow and Processing




- Gap position updates at a rate of 10..20 Hz via CANopen
- Predictive control loop at a rate of 2..4 Hz

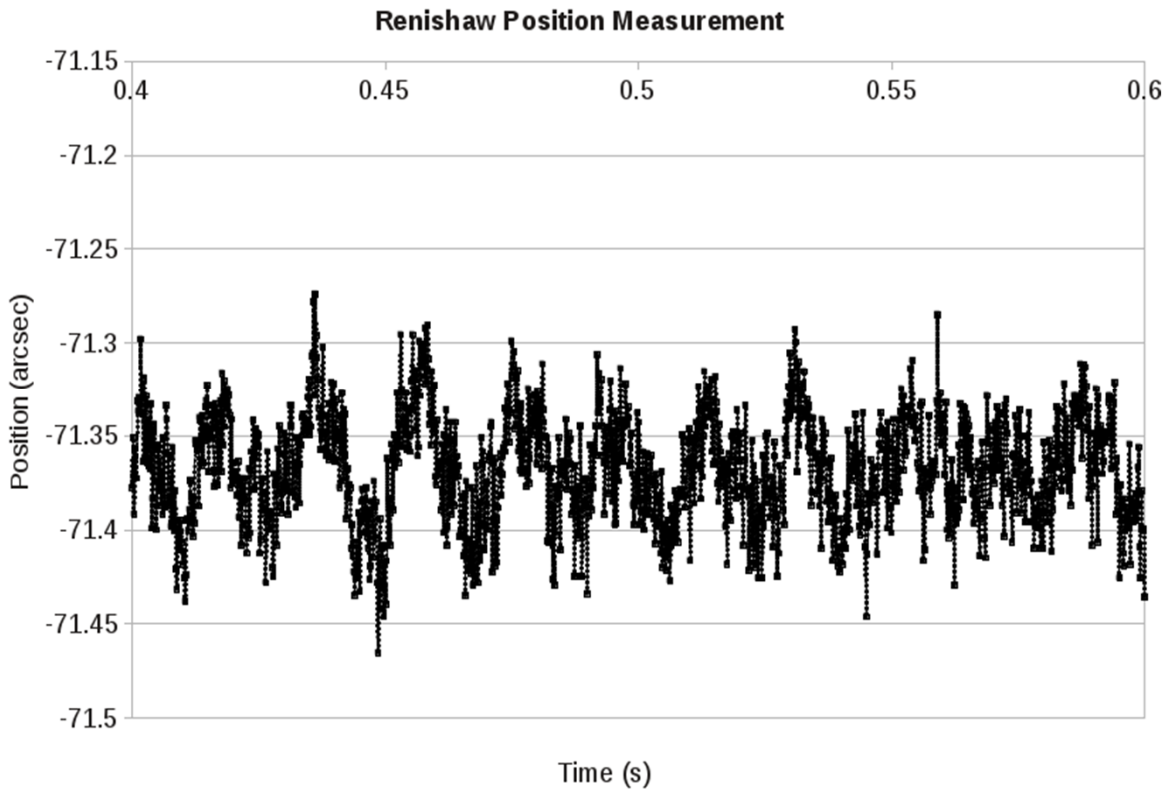
# Continuous Mode – New Implementation for EMIL



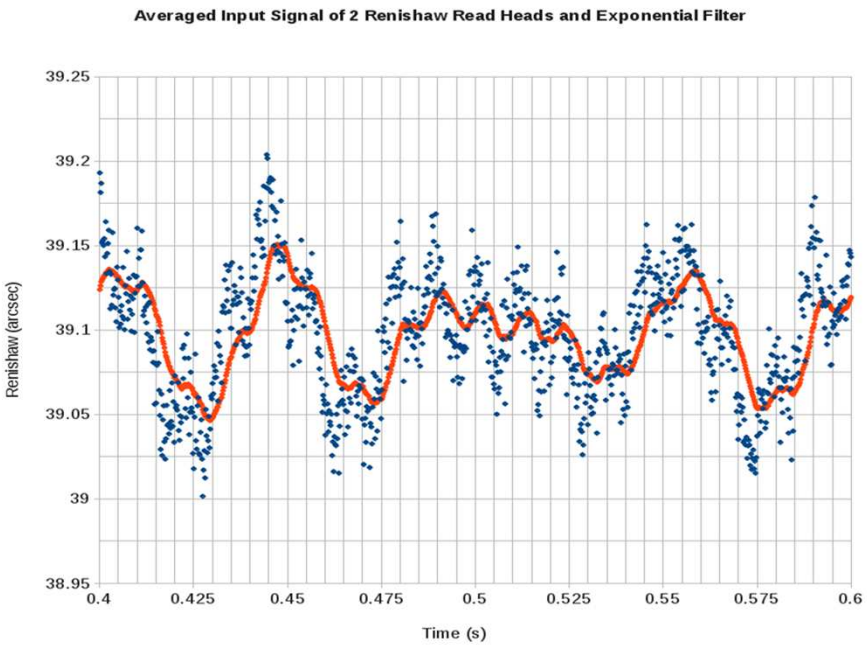

- Motion controller connected via non deterministic Ethernet to IOC.
- Hard real time position feedback via encoder signal from undulator to the motion controller of monochromator.
- Slow control providing lookup tables from monochromator IOC.
- Generated smooth output to monochromtor stepper drives using splined moves on motion controller.

# Renishaw Resolute 32Bit BiSS/C

- Cable Length 20m
- Digital Resolution: 360° / 2^32 = 0.301748514 marcsec
- Tested Sample Rate 4..10 kHz at 1MHz Serial Clock
- Disturbance: standard deviation σ=0.028 arcsec
- Voltage drop on long cable length

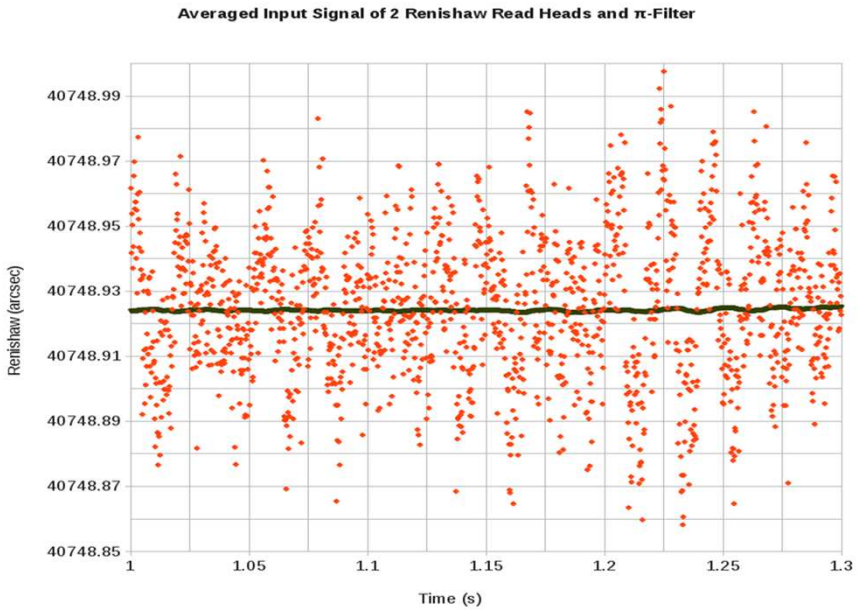


# Position Measurement (BiSS/C) and Position Filtering

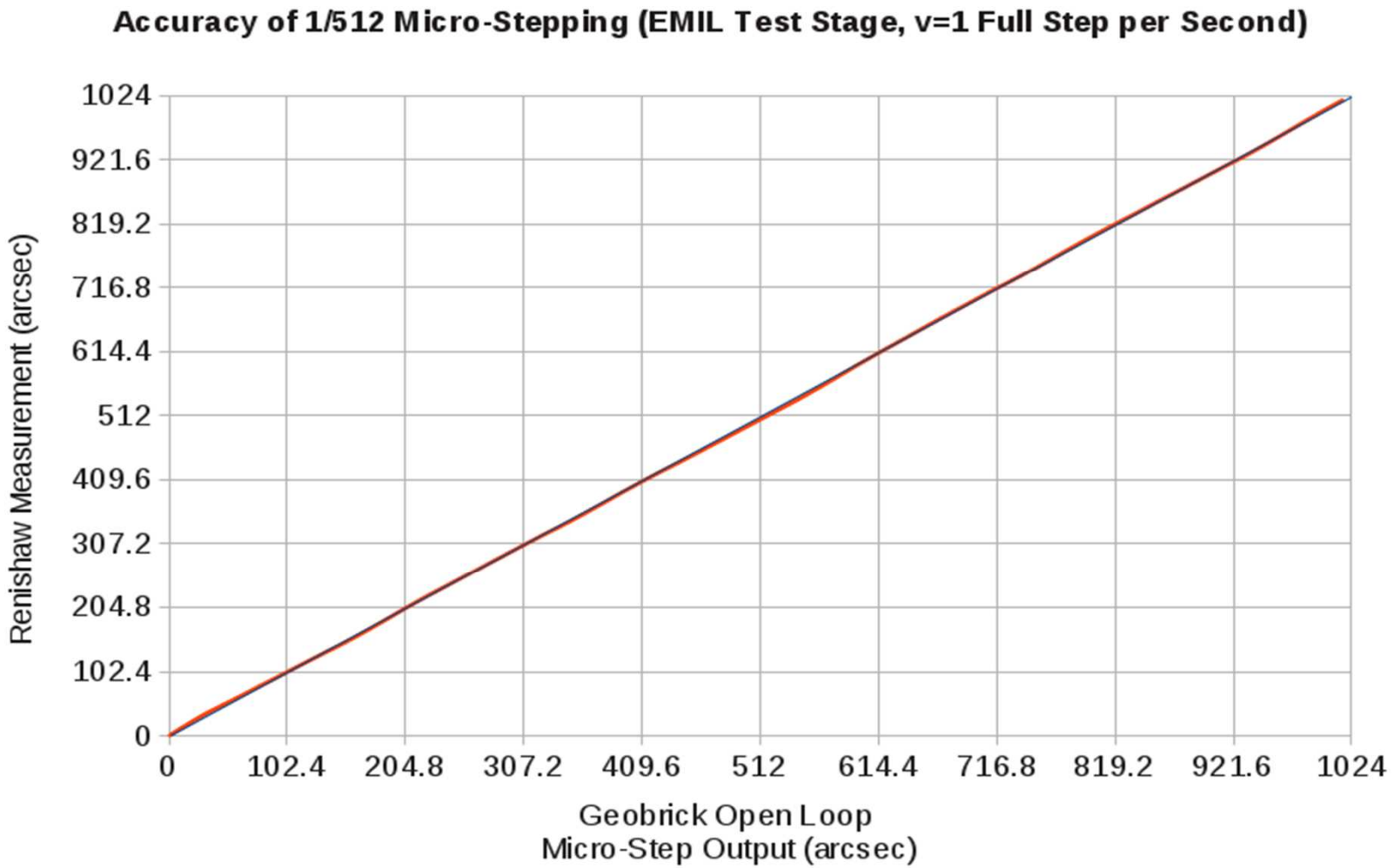



Exponential Filter used for
Closed Loop Positioning

Moving Average Filter for
Monochromator Position



# Accuracy of Micro-Stepping on Test Sage

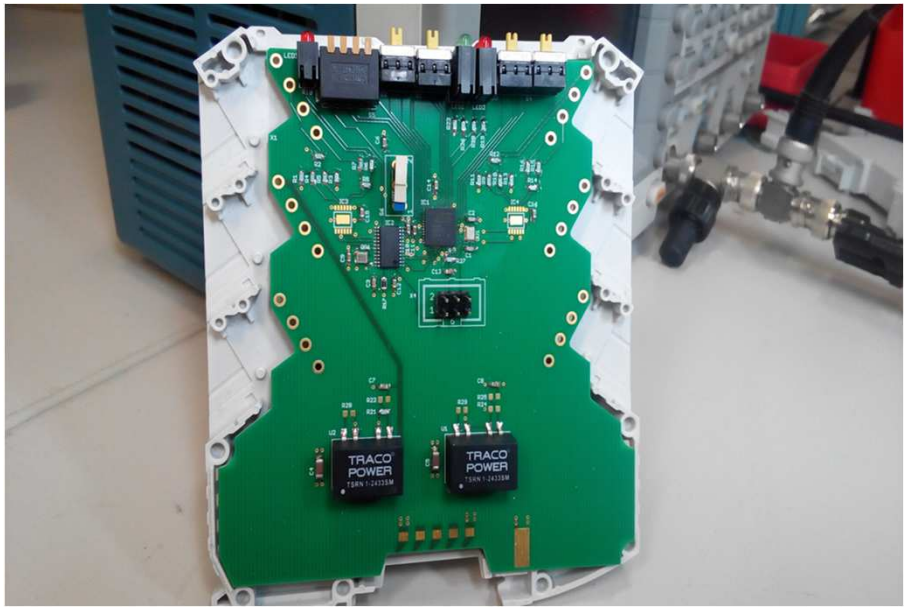


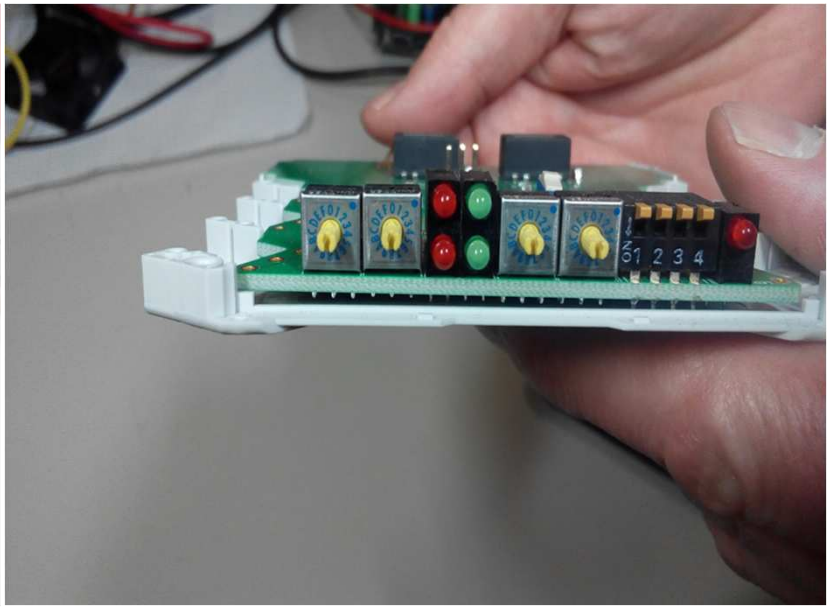

Accuracy of open loop micro-stepping better than 1/10 full step.

1 Micro Step ≈ 0.19 arcsec

1 Step ≈ 0.19 * 512 arcsec ≈ 100 arcsec

# BiSS/C to SSI Converter




- SSI as Industrial Protocol for Absolute Encoder
- Different Clock Speed
- BiSS/C 32 Bit ↔ SSI 27 Bit
- Delay Compensation
- Up to 2.5 kHz sample Rate on SSI side
- Further questions to roland.fleschhauer@helmholtz-berlin.de