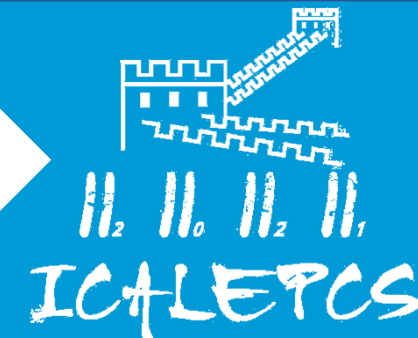


THE CONTROL SYSTEM OF THE FOUR-BOUNCE CRYSTAL MONOCHROMATORS FOR SIRIUS/LNLS BEAMLINES

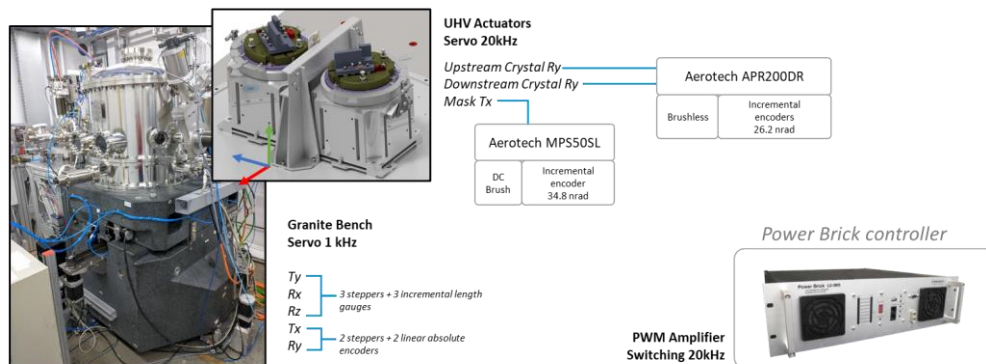
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4CM OVERVIEW



OPTICS

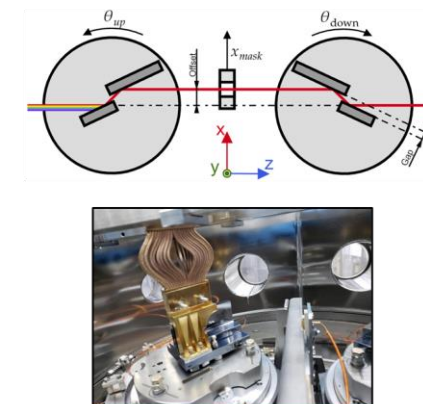
$$\theta_{up} = \arcsin\left(\frac{hc}{2dE}\right) + Offset_{up}$$

$$\theta_{down} = \theta_{up} + Offset_{rel}$$

$$x_{mask} = 2 \cdot Gap \cdot \cos(\theta_{up}) + Offset_{mask}$$

Kinematics

$$E = \frac{hc}{2d \sin(\theta_{up} - Offset_{up})}$$



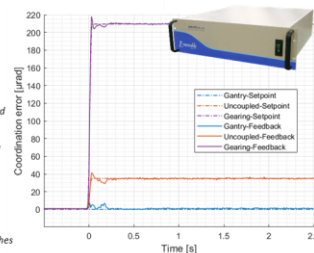
COORDINATION

Constant velocity: 1 %/s
Requirement: < 1 urad

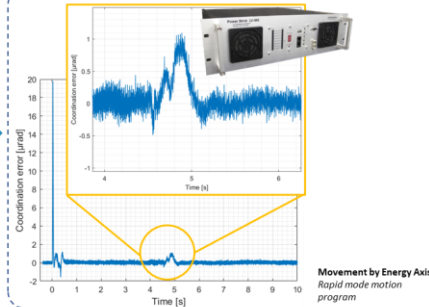
Aerotech Ensemble Epaq MR

Modes:

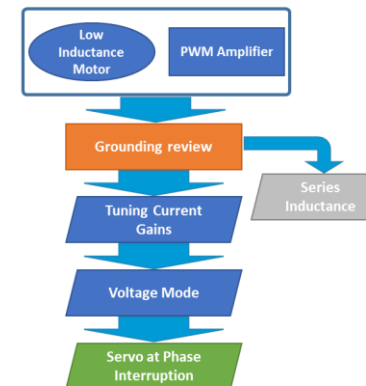
- Gearing
Coordination Error: ~220 urad
 - Uncoupled
Coordination Error: ~36 urad
 - Gantry
Coordination Error: >1 urad
- Issues:
- Unable to independent movement
 - Ignores follower limit switches



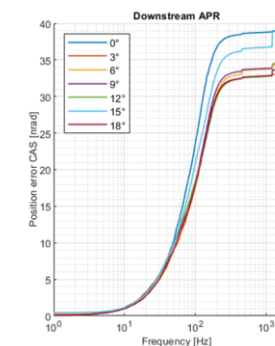
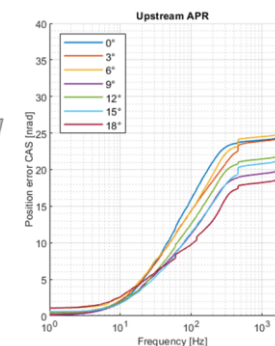
Delta Tau Power Brick LV



STABILITY

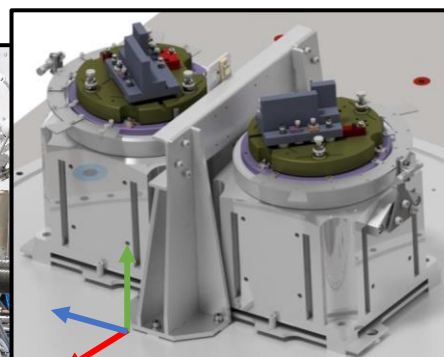
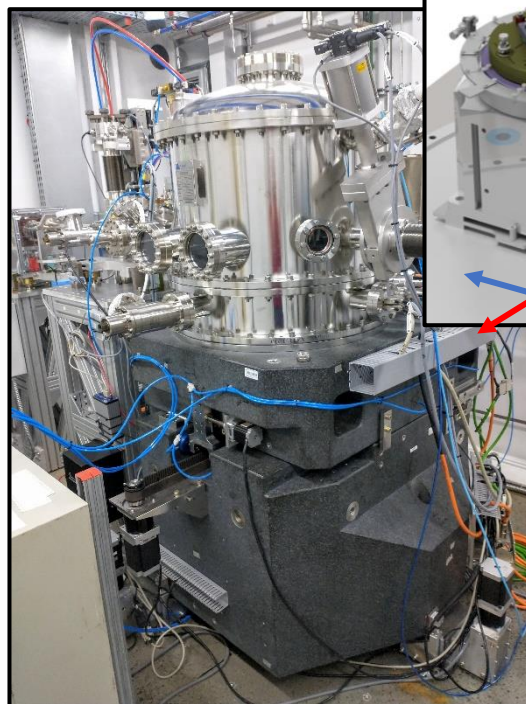


Worst Case RMS Stability (1 – 2500 Hz)
Upstream: 25.1 nrad
Downstream: 39.2 nrad



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4CM OVERVIEW



UHV Actuators Servo 20kHz

Upstream Crystal Ry
Downstream Crystal Ry
Mask Tx

Aerotech APR200DR

Brushless

Incremental
encoders
26.2 nrad

Aerotech MPS50SL

DC
Brush

Incremental
encoder
34.8 nrad

Granite Bench Servo 1 kHz

Ty
Rx
Rz } 3 steppers + 3 incremental length
gauges
Tx
Ry } 2 steppers + 2 linear absolute
encoders

Power Brick controller



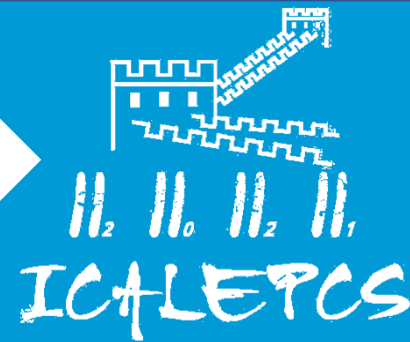
PWM Amplifier
Switching 20kHz

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OPTICS

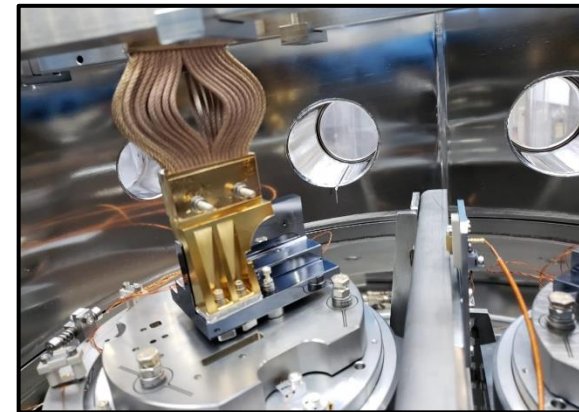
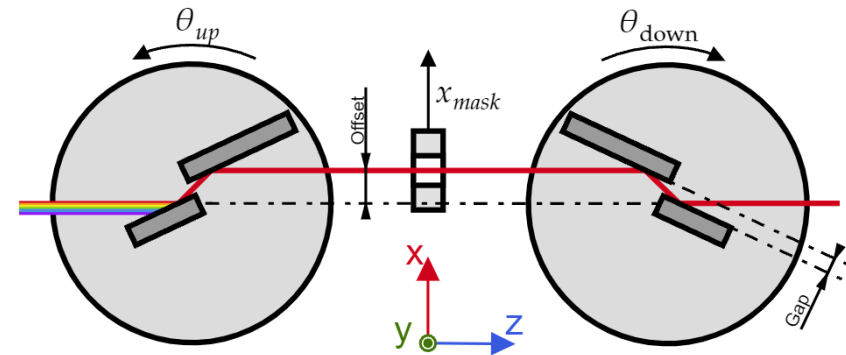
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COORDINATION

Constant velocity: $1^\circ/\text{s}$

Requirement: $< 1\text{urad}$

Aerotech Ensemble Epaq MR

Modes:

- Gearing

Coordination Error: $\sim 220\text{urad}$

- Uncoupled

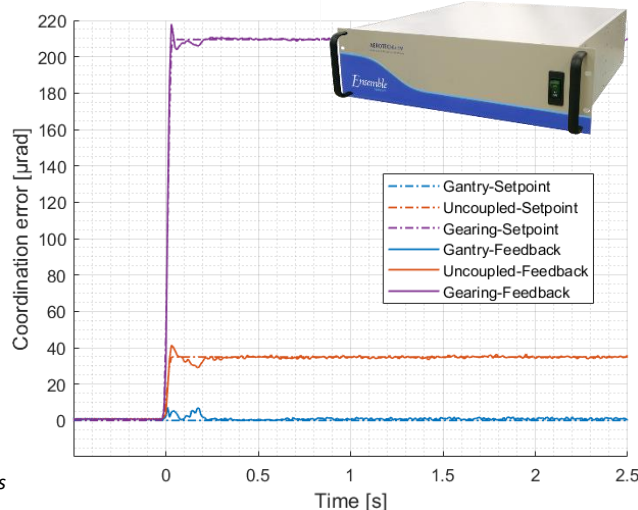
Coordination Error: $\sim 36\text{urad}$

- Gantry

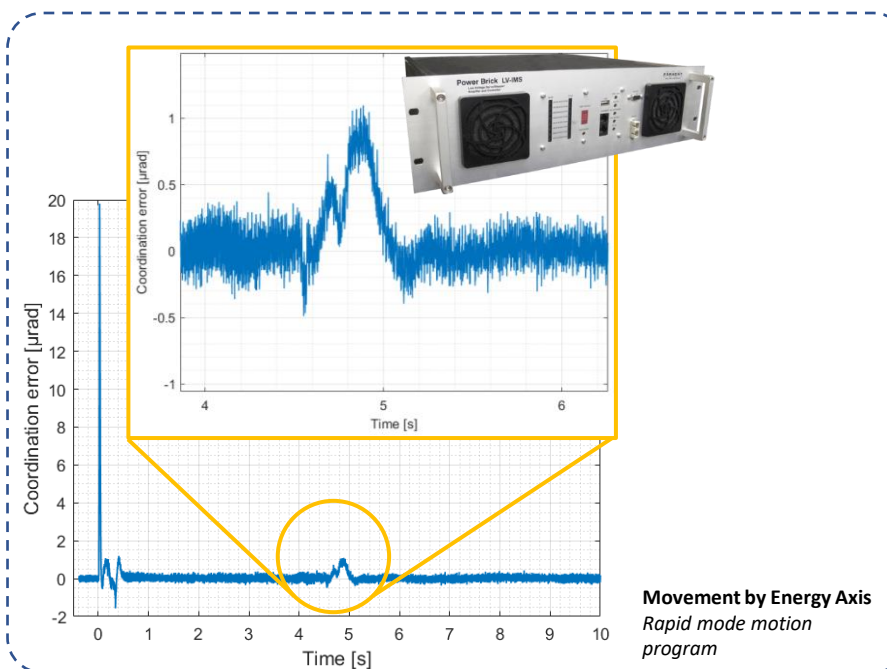
Coordination Error: $> 1\text{urad}$

Issues:

- Unable to independent movement
- Ignores follower limit switches

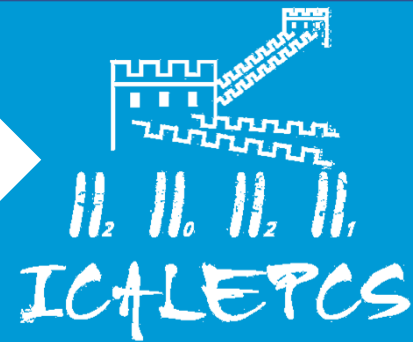


Delta Tau Power Brick LV

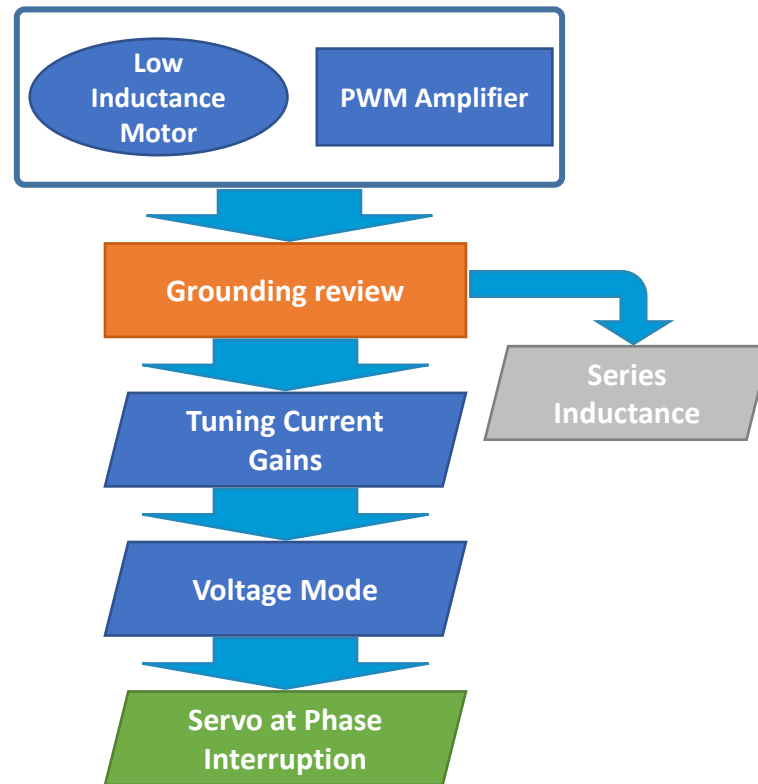


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STABILITY



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Upstream: 25.1 nrad

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