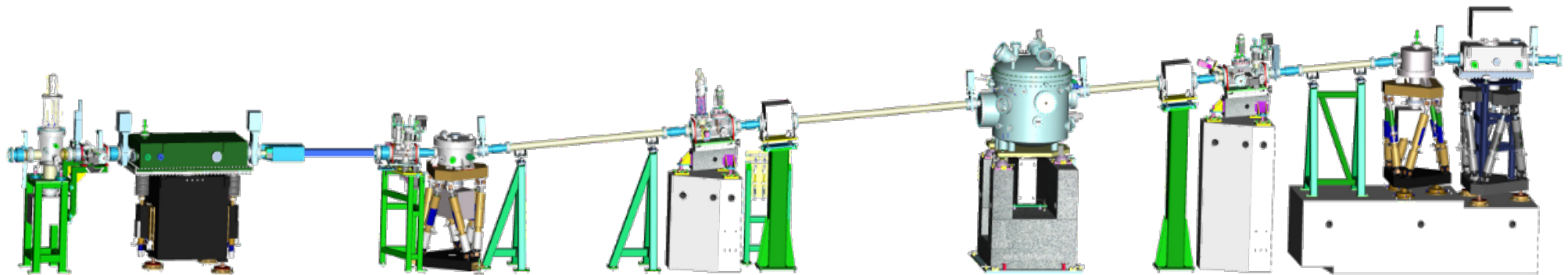


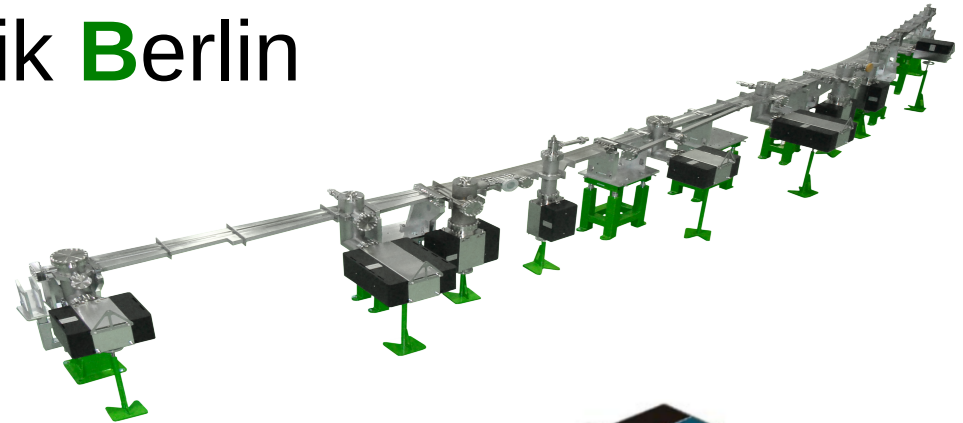
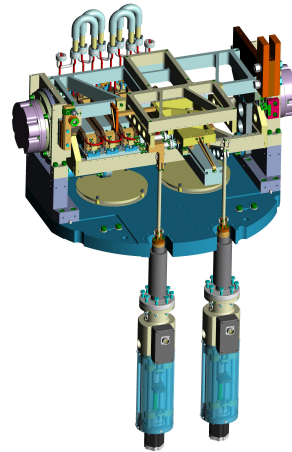
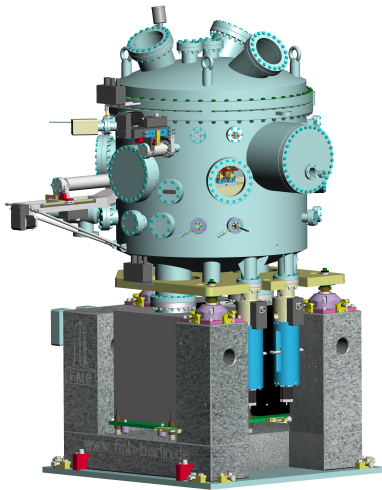
EPICS for Beamline Applications



- Introducing FMB
- Collaboration
- Systems Architecture
- Motion Control
- PLC Integration
- Operator Interface
- Conclusions

Introducing ...

Feinwerk und Messtechnik Berlin



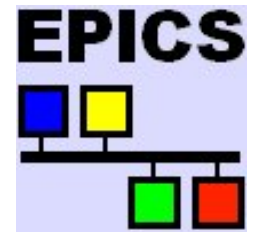
Soft X-Ray Applications
Beamlines & Components
Storage Ring Vessels
Controls Software



Hard X-Ray Applications
Beamlines & Components
Detectors and Electronics
Controls Hardware

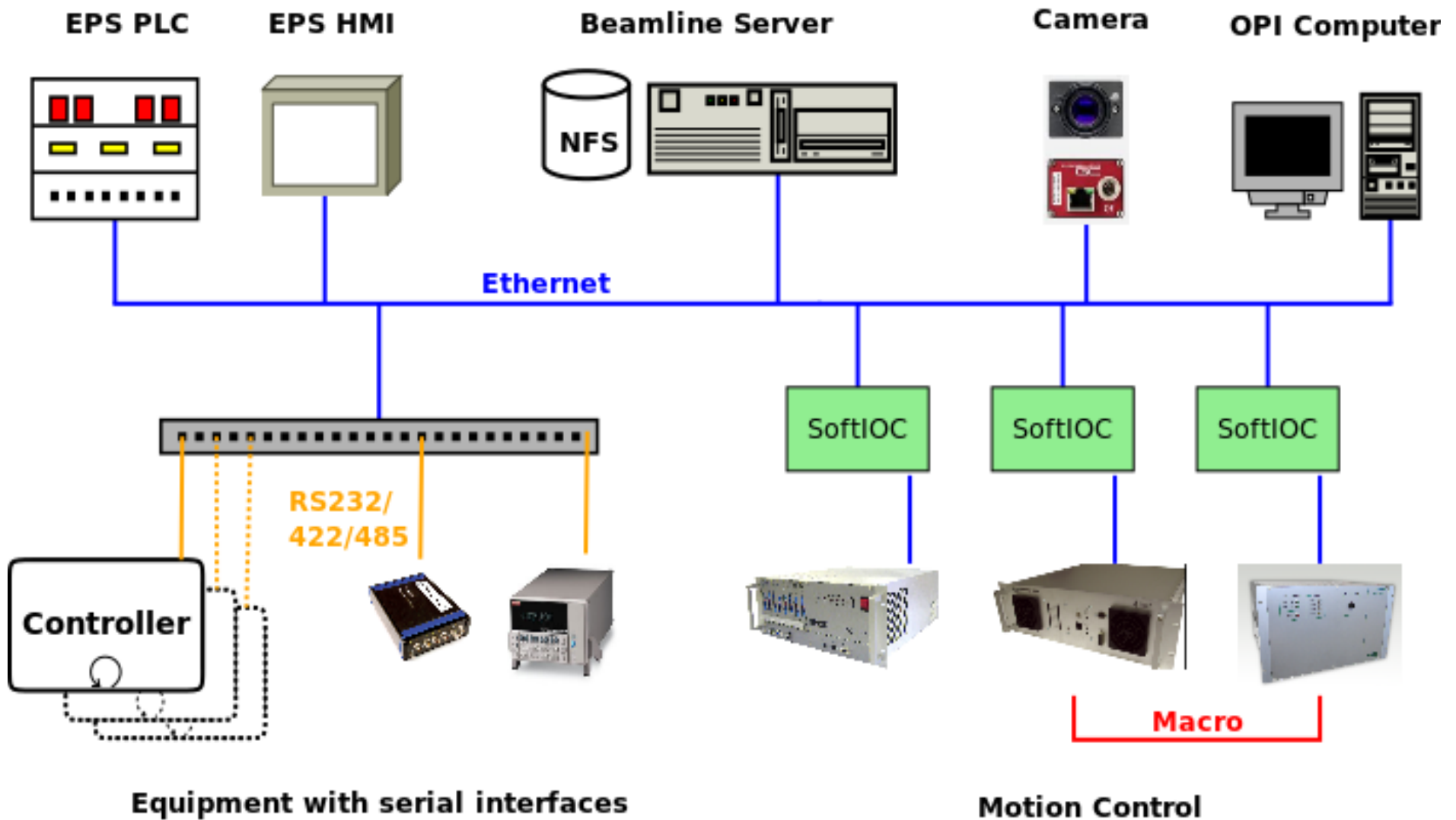
Why EPICS?

- What we use it for...
 - Implementing functionality & features of our products for easy on-site integration
 - For in-house applications
- How we collaborate...
 - Adopting standards
 - Developing drivers
 - Help spreading EPICS



- EPICS on Linux
- Standard x86 hardware running softIOCs
 - fanless embedded systems or virtual machines
- Highly based on Ethernet communication
 - distributed, modular, scalable, cheap, POE
- Move realtime tasks to embedded hardware
 - fast/failsafe protection logic
 - complex trajectories
 - Fast and/or synchronised data capturing

Network Diagram



Control Hardware: DeltaTau PMAC

- programmable motion controller
- Ethernet interface



- MCS-8 Plus

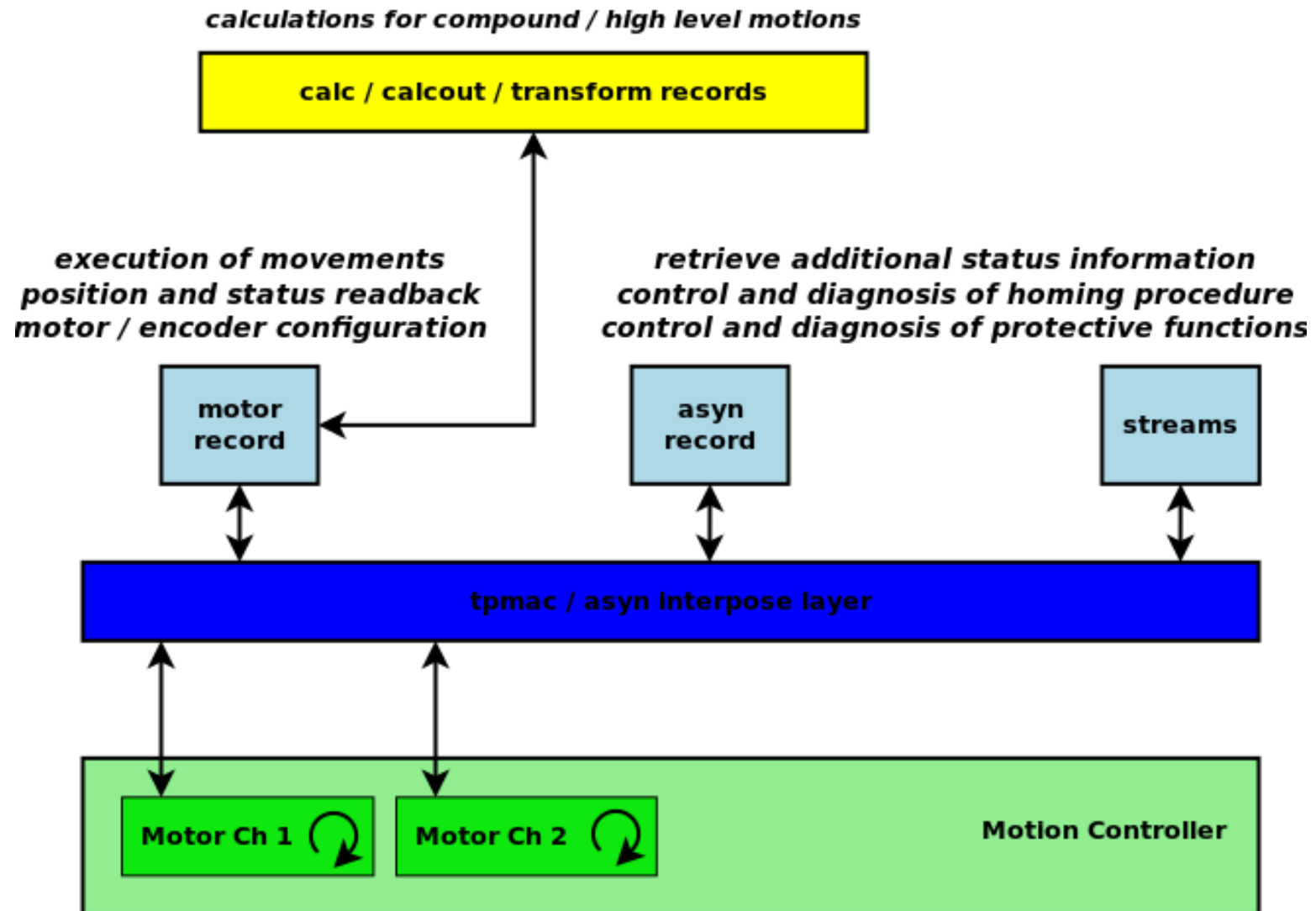


- Brick Controller



- GeoBrickLV IMS







Standard Motion Control


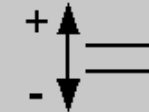
SLH01 / SLV01 - 4-Blade Beam Defining Aperture

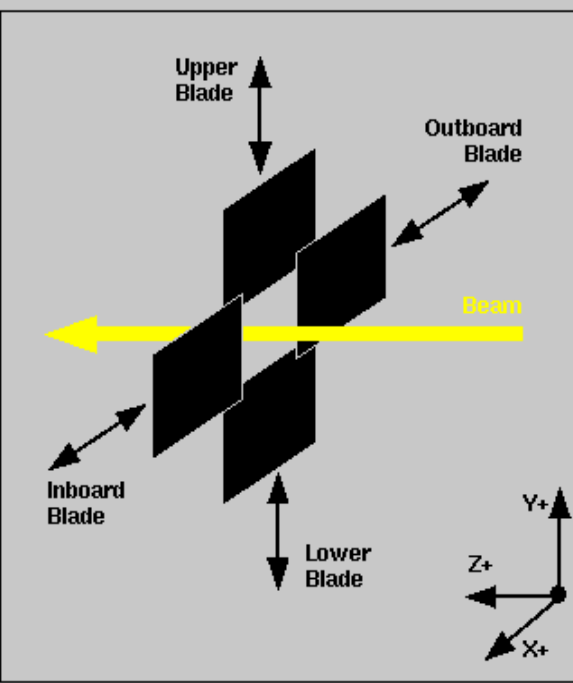
Scan H Size
Scan H Offset
Scan V Size
Scan V Offset
Stop All Motors
Kill All Motors
Close This Panel

Horizontal Aperture

Size 	Readback 4.000 mm	Setpoint 4.000	Tweak Value 1.000
Offset 	Readback 0.000 mm	Setpoint 0.000	Tweak Value 1.000
		Move	Stop

Vertical Aperture

Size 	Readback 161.002 mm	Setpoint 5.000	Tweak Value 1.000
Offset 	Readback 24.829 mm	Setpoint 5.000	Tweak Value 1.000
		Move	Stop

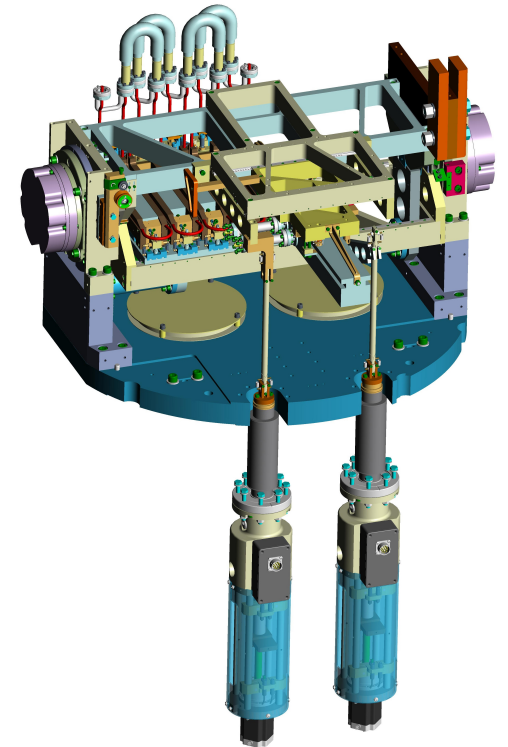
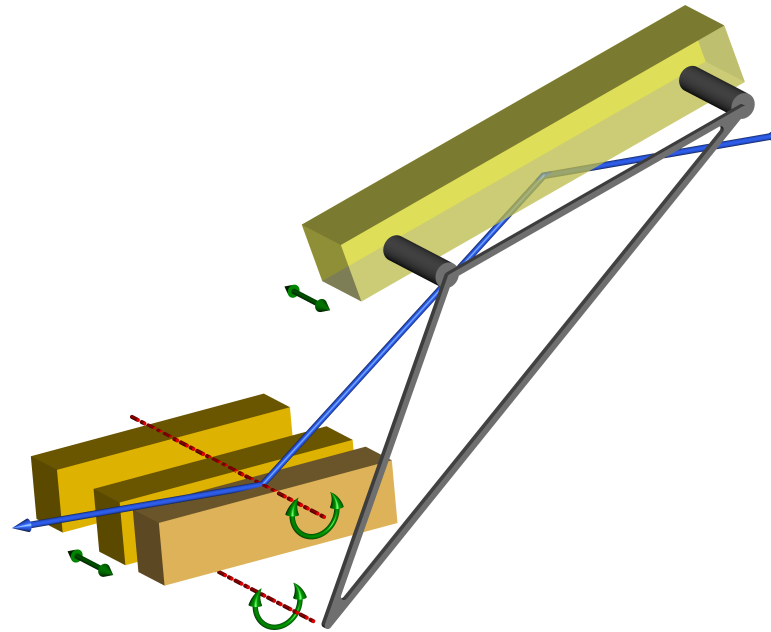


Individual Drives

Drive	Position	Motion Status	Homing Status					
Inner/Left Blade	2.0003 mm	Positioned	Homed	Home	Enable	Stop	Kill	Single Axis Panel
Outer/Right Blade	-1.9996 mm	Positioned	Homed	Home	Enable	Stop	Kill	Single Axis Panel
Upper/Top Blade	165.3298 mm	Moving	Homed	Home	Enable	Stop	Kill	Single Axis Panel
Lower/Bottom Blade	-55.6703 mm	Moving	Homed	Home	Enable	Stop	Kill	Single Axis Panel

If interpolation and synchronisation is required ...

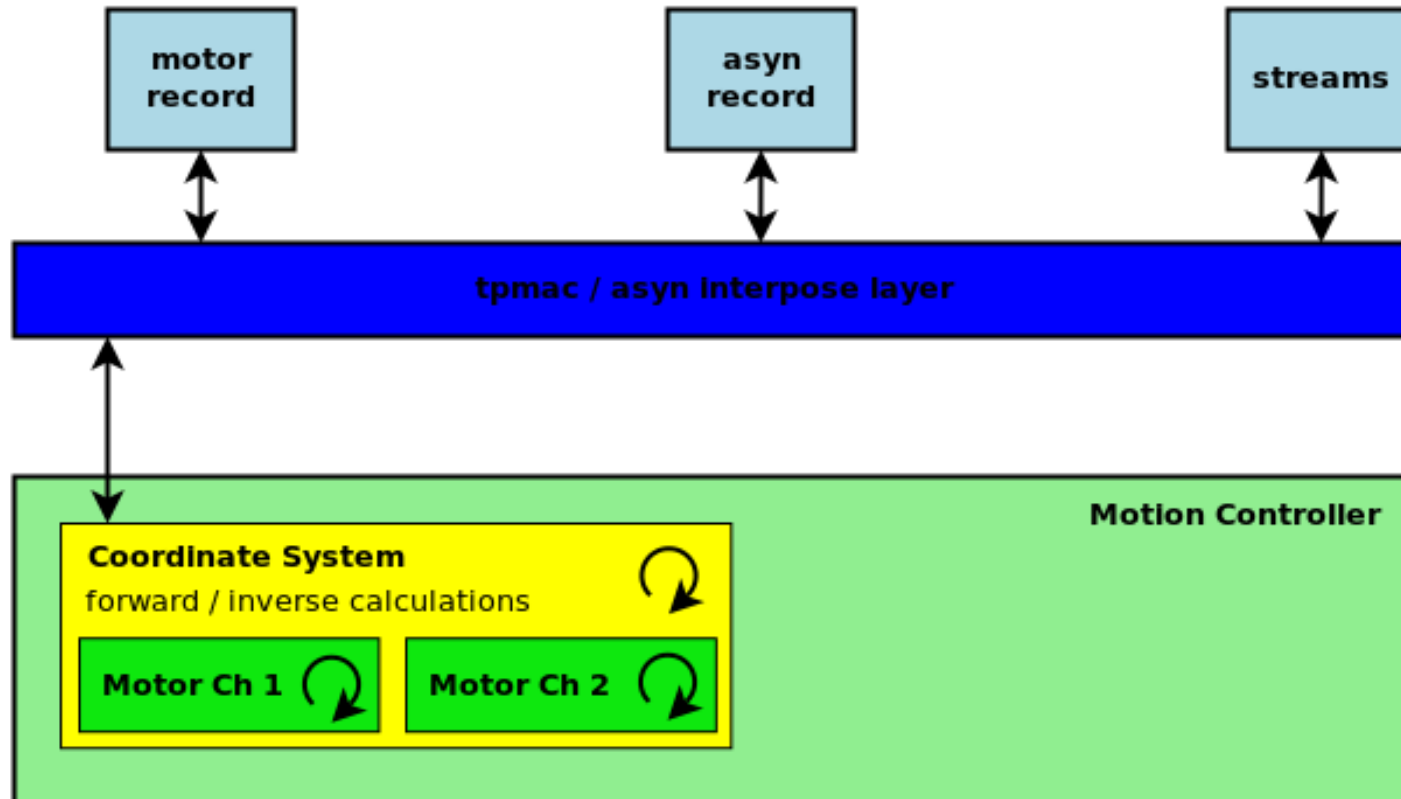
- complex trajectories
- hexapod control
- on-the-fly scanning



- Coordination of movements on controller level

*execution of movement
position and status readback
motor / encoder configuration*

*retrieve additional status information
control and diagnosis of homing procedure
control and diagnosis of protective functions*



Status Display

Operational Mode	c(ff)-Value	Grating l/mm	Actual Photon Energy
VLS / calculated c	1.310339232	800	2300.000 eV

Energy Stop Stop Scan On-The-Fly Scan

Optical Elements

Mirror	Decoupled	Grating	Decoupled
Mirror 1	<input type="checkbox"/>	Grating 2	<input type="checkbox"/>

On-The-Fly Scan

Status

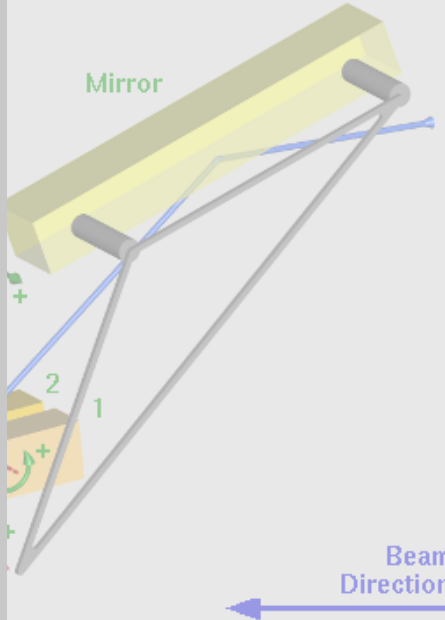
Scan State: **Energy Fly Scan** **Enable**

Parameter

Parameter	Setpoints	Readbacks	Unit
Start Energy	2300.000	2300.000	eV
End Energy	2500	2500.000	eV
Scan Speed	10.000	10.000	eV/s

Start **Stop** **Kill Motors**

BiICS.PGM **FMB Berlin**



Beam Direction ←

Grating Pitch	2.254000 deg	Positioned	Single Axis Panel	Access Mode	User Mode
Mirror Translation	1.000 mm	Positioned	Single Axis Panel	Interlock	OK
Grating Translation	71.000 mm	Positioned	Single Axis Panel	Temperatures	OK
				Emergency Stop	OK

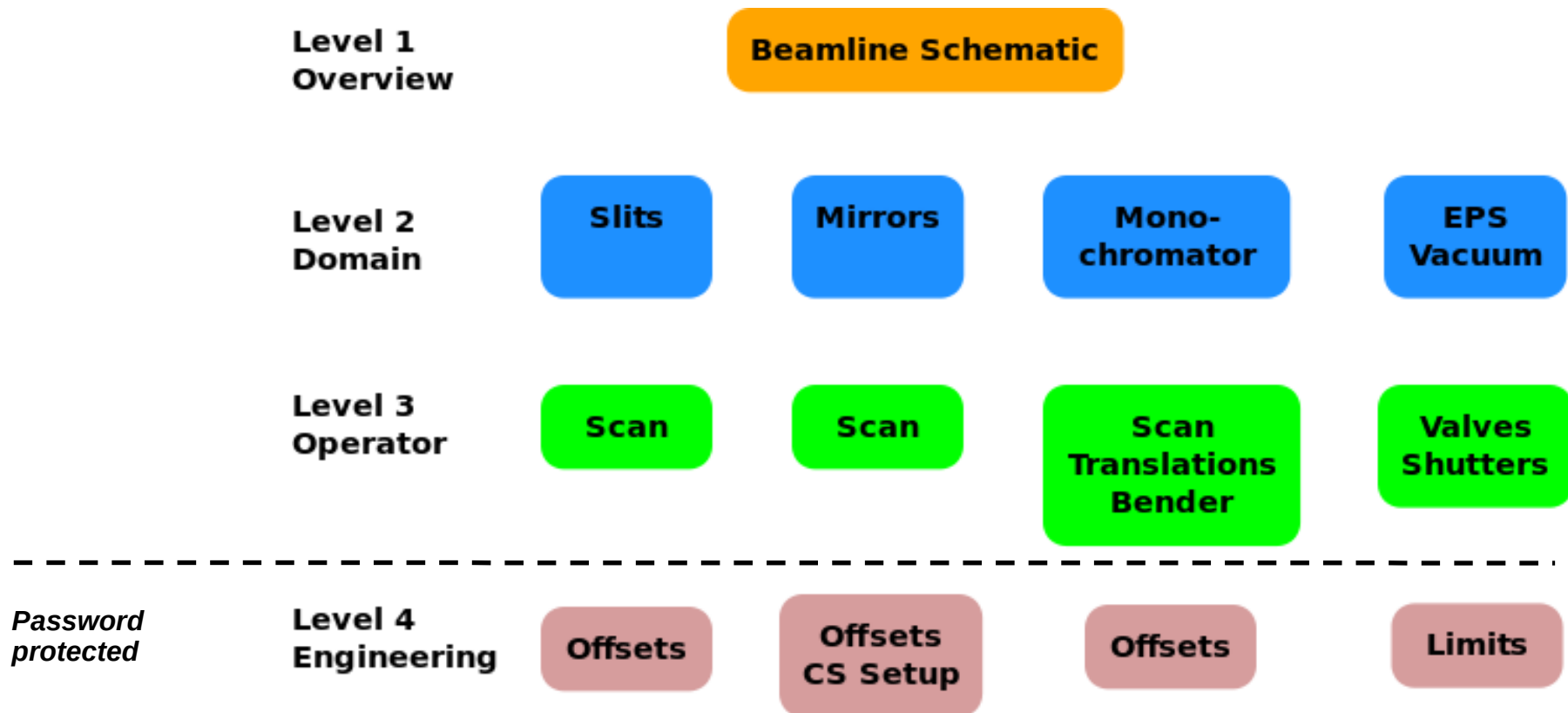
General Parameters **Enable Expert-Mode** Interlock Details Temperature Details **Kill Motors**

- Siemens PLC via **s7plc**
 - S7-300, S7-400, S7-1200
 - CP-343 or CPU PN/DP

- Codesys certified hardware via **modbus TCP**
 - synApps **modbus** module
 - For PLCs and couplers from:
 - WAGO
 - Beckhoff

The Siemens logo, consisting of the word "SIEMENS" in a bold, blue, sans-serif font.

Operator Interface



Operator Interface

Clear Mode | IOC System Health | EPS Digital I/O | EPS Status Flags | EPS Temperatures | **Beamline Ready** | Help | Generic Scan | BCM01 Keithley | BCM01 Plot | Beam Available

Enable Expert Mode ← Beam Direction

M4 - FEM

Pitch	0.0471 rad
Roll	0.0047 rad
Yaw	0.0007 rad
Lateral	0.0013 m
Height	0.0000 m

Exit Slit / Photodiode

SLV02 - Exit Slit	
Size	400.0000 mm
Translation	142.7833 mm
Photodiode In/Out Status	
Status	Undefined

M3 - FTM

Pitch	00.0000 rad
Roll	0.0000 rad
Yaw	-0.7812 rad
Lateral	0.0000 m
Height	0.0000 m

PGM

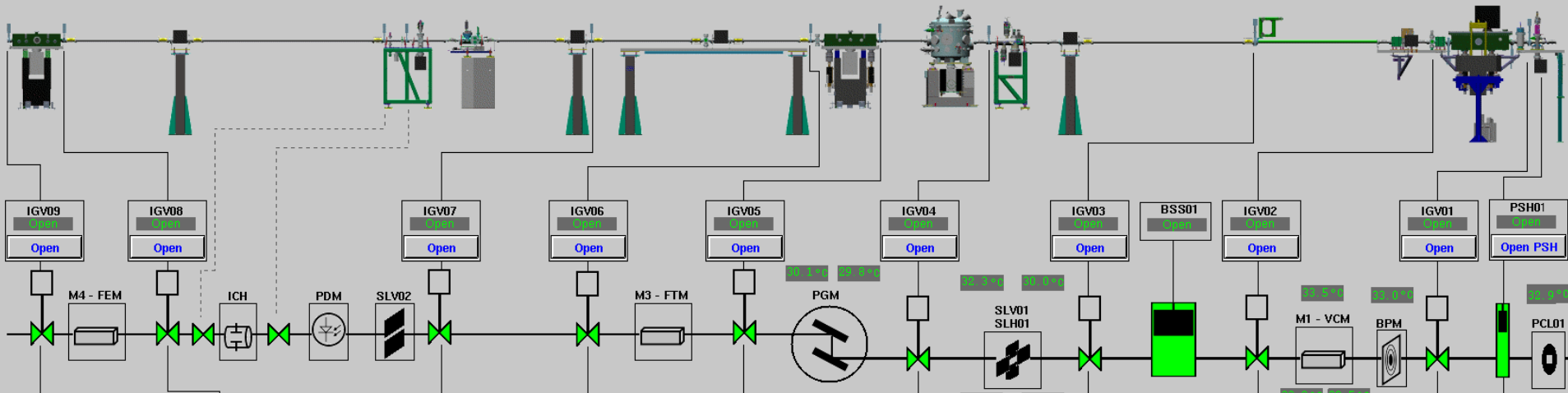
Mirror	Horizontal	Cf	0.000
Grating	Grating 2	Type	1200
Energy	800.000 eV	Status	Ready

SLV01/SLH01 - 4 Blade Aperture

H Size	4.0000 mm
H Offset	0.0000 mm
V Size	0.0000 mm
V Offset	0.0000 mm

M1 - VCM

Pitch	0.0000 rad
Roll	0.0000 rad
Yaw	0.0000 rad
Lateral	0.0000 m
Height	0.0000 m



Status

Pressure [mbar]

Ion Pump

Section 9	Section 8		Section 7	Section 6	Section 5	Section 4		Section 3	Section 2	Section 1
Pressure OK	Pressure OK	Pressure OK	Pressure OK	Pressure OK	Pressure OK	Pressure OK	Pressure OK	Pressure OK	Pressure OK	Pressure OK
4.0e-03	2.0e-03	2.0e-03	2.0e-03	4.0e-03	2.0e-03	4.0e-03	4.0e-03	4.0e-03	4.0e-03	4.0e-03
OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF	OFF

Touchpanel Control Mode: View and Control

Select Control Mode: Forbid Touchpanel Control

EPS Connection: Connected

Emergency Switch: OK

Fast Closing Valve: Ready Open

Valves Error Status: OK

Temperatures Status: OK

Vacuum Status: OK

Water Cooling Status: OK

Beamline Water Chiller: Healthy Flow OK

Frontend Water Chiller: Healthy Flow OK

FE Water Panel Flow: Flow OK

- Use of EPICS toolkit helps to create systems:
 - robust and cost efficient with small footprint
 - based on off-the-shelf hardware
- open source software
 - future-proof and scalable environment
- transparent communications
 - no proprietary protocols
- Migration of critical tasks to lower levels
 - use of real time OS not necessary

Thanks for your attention.

Questions?