TINE@EMBL

Uwe Ristau

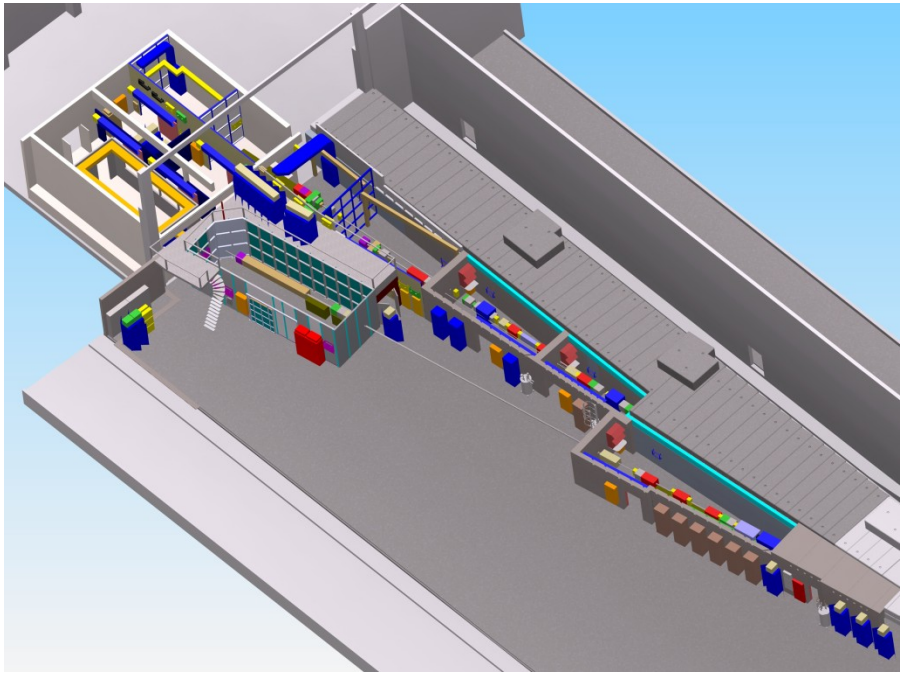
Overview

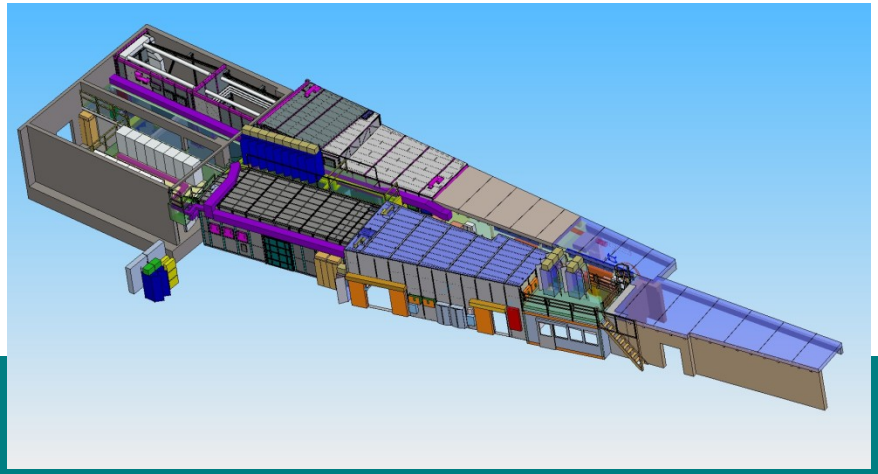
- Development Tools
- Control Electronic
- Motor/Scan Server
- MotorPlug TwinCat NC
- Example
- Outlook

EMBL @ DESY

- Petra 14 Beamlines
  - EMBL :3 Beamlines @ Petra
    - 7 Beamlines @ Doris

- 3 Beamlines @Petra
  - 2 Protein Cristallographic beamines
    - MX1,MX2 Hasylab:P13/P14
  - 1 Small Angle Scattering Beamine
    - BioSaxs Hasylab: P12





- P12 and P14 in friendly user operation scince summer 2011
- P13 first experiment today

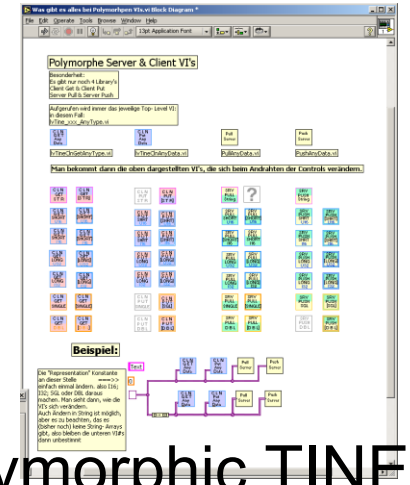
  hopefully

Software

- Hasylab Frontend
  - Vacuum
  - Slits
  - Petra Parameter
  - Undulator
  - Flourescence screen
- Optical Hutch
  - Diagnostic/Viewer
  - Monochromator
  - Mirrors
  - Slits
  - QBPM's
  - Vacuum
  - IPS
- Experimental Hutch
  - Exp. Table
  - BCU
  - SampleChanger
  - Detector Table
  - Detector
  - ..
- External Devices
  - Detector Tube GKSS
  - MD3
  - MD2
  - BioSaxsSC
  - ..

Instrumentation Software Framework/Tools:

- Labview framework
- TINE DESY/MCS
- TwinCat ADS Lib
- RIO/EtherCat master
- Vision
- Vibration
- Motion
- Mathlab
- PID TOOL
- TCP/IP (Robot)
- ...



Polymorphic TINE API

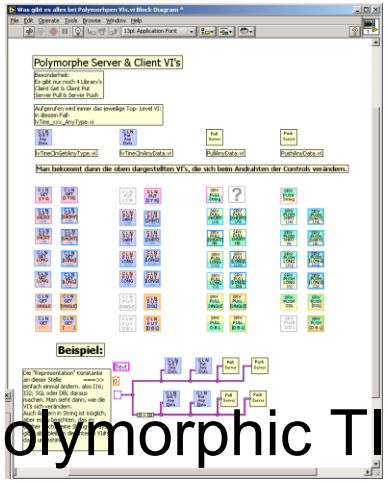
- TINE Common Device Interface CDI
- TwinCat (TwinCat, DIO, DAQ)
  - Beckhoff/TWINCAT
  - TINE Motor Server
    - TwinCat NC
    - PI- E815
    - Attocube
    - PMAC (in progress)
    - Robot (in progress)

Instrumentation Software Framework/Tools:

- Labview framework
- Tine D
- TwinC
- RIO/E
- Visior
- Vibrat
- Motio
- Scripting
- Mathlab
- PID TOOL
- TCP/IP (Robot)
- ...

- TINE Common Device Interface

National Instruments
EMBL 13.12.2011 Seminar room 1st floor Building 48e
(Petra Building EMBL Part) 13 Uhr



- Attocube
- PMAC (in progress)
- Robot (in progress)

Polymorphic TINE API

Control Electronic

- GOAL
  - Distributed electronic
  - All Signals, Monitors, Motors synchronized to each other
  - Achieve as good as possible synchronization / timing

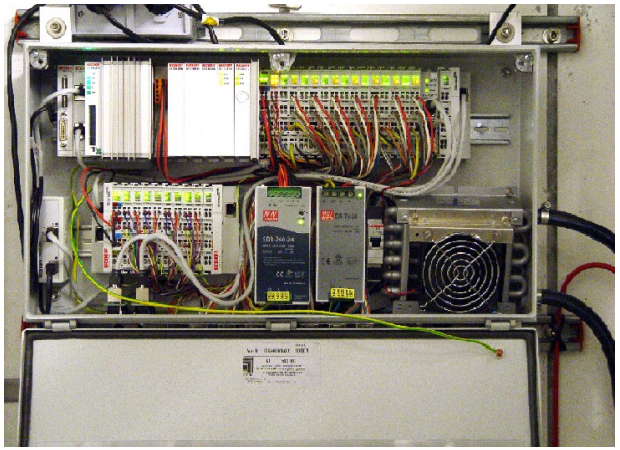
  Best synchronization is available at the realtime hardware level of the Beckhoff PLC system

- PLC Electronic
  - Connect all devices to the deterministic realtime System TwinCat
  - Scan sychchronization and timinig
    - Signal synchronization <1ms
    - Acquisition cycle <1ms
    - Timing <10 us

Control Electronic Monochromator DCM

Software installation:
TwinCat, TINE, Labview
PtalkPro, watchdog for Server restart/maintenance

Controller/Computer Hardware:
- Computer Pentium 2 GHz Processor
- 8GB RAM/ROM
- 2x USB
- 4xEthernet
- UPS
- EtherCat hardware
- Temperature Regulated Fan

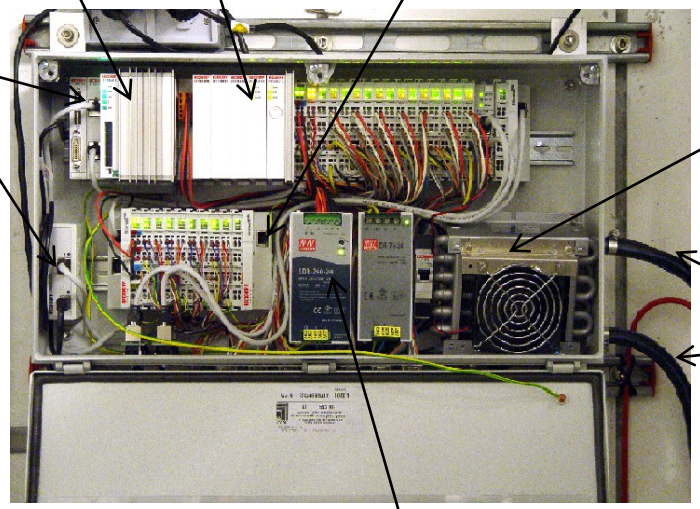


- 16 of 24 Units installed and running

Local EtherCat Master installation

Electronic:
- EL7041 Stepper motor controller
- Counter/Encoder
- AI/AO
- Di/Do
- Rs232
- Temperatur
- Communication

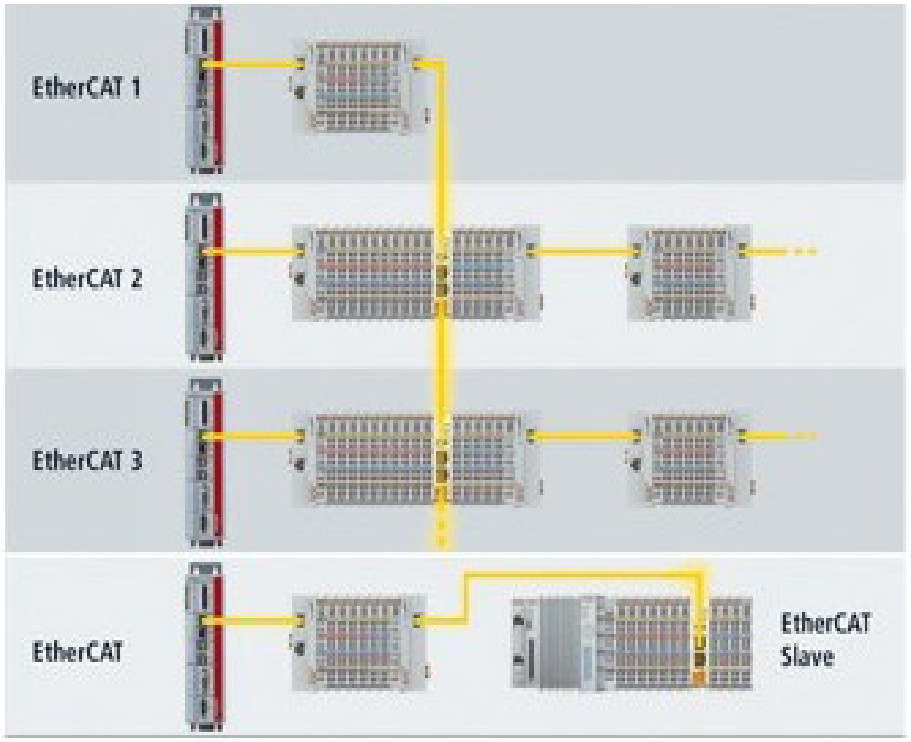
Profibus Coupler



Applications:
Slit Control,HDM, VFM, Bimorph mirrors, BCU,
Sample Changer, Experimetal Table, Monochromator double size

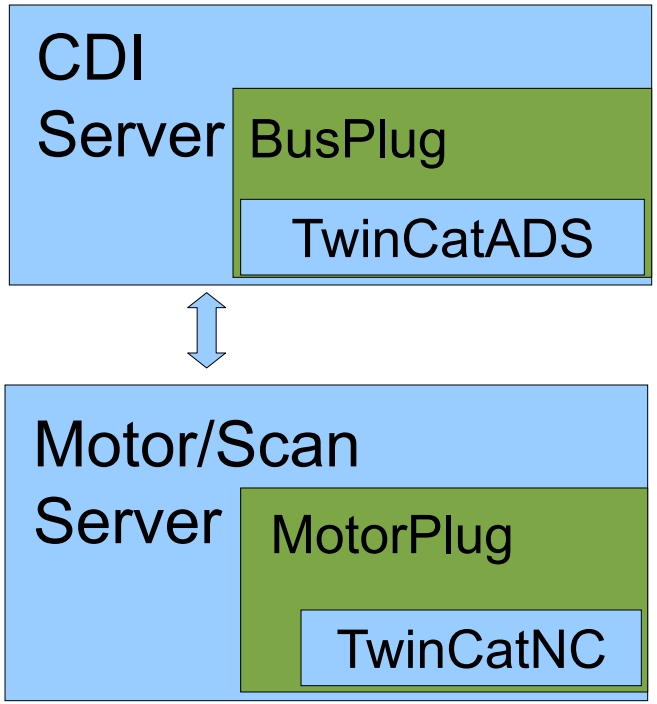
Master to Master synchonization and communication

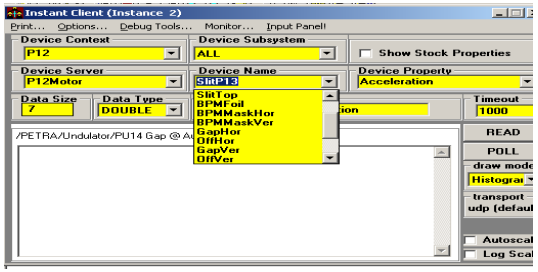
Solution: Software synchronization via realtime network variables and hardware Synchronization via EL6692



Motor/Scan Server Architecture

- Build on Top of the low level CDI TINE server
  - Bus plugs:
    - TwinCatADS
    - RS232
    - ...
- Generic server with Support of 'Motor Plugs'
  - Motor plugs:
    - TwinCat NC
    - TwinCat k-Bus
    - PI – 815 serial
    - Attocube TCP/IP
    - PMAC TCP/IP OCX (in progress)
    - Robot (in progress)





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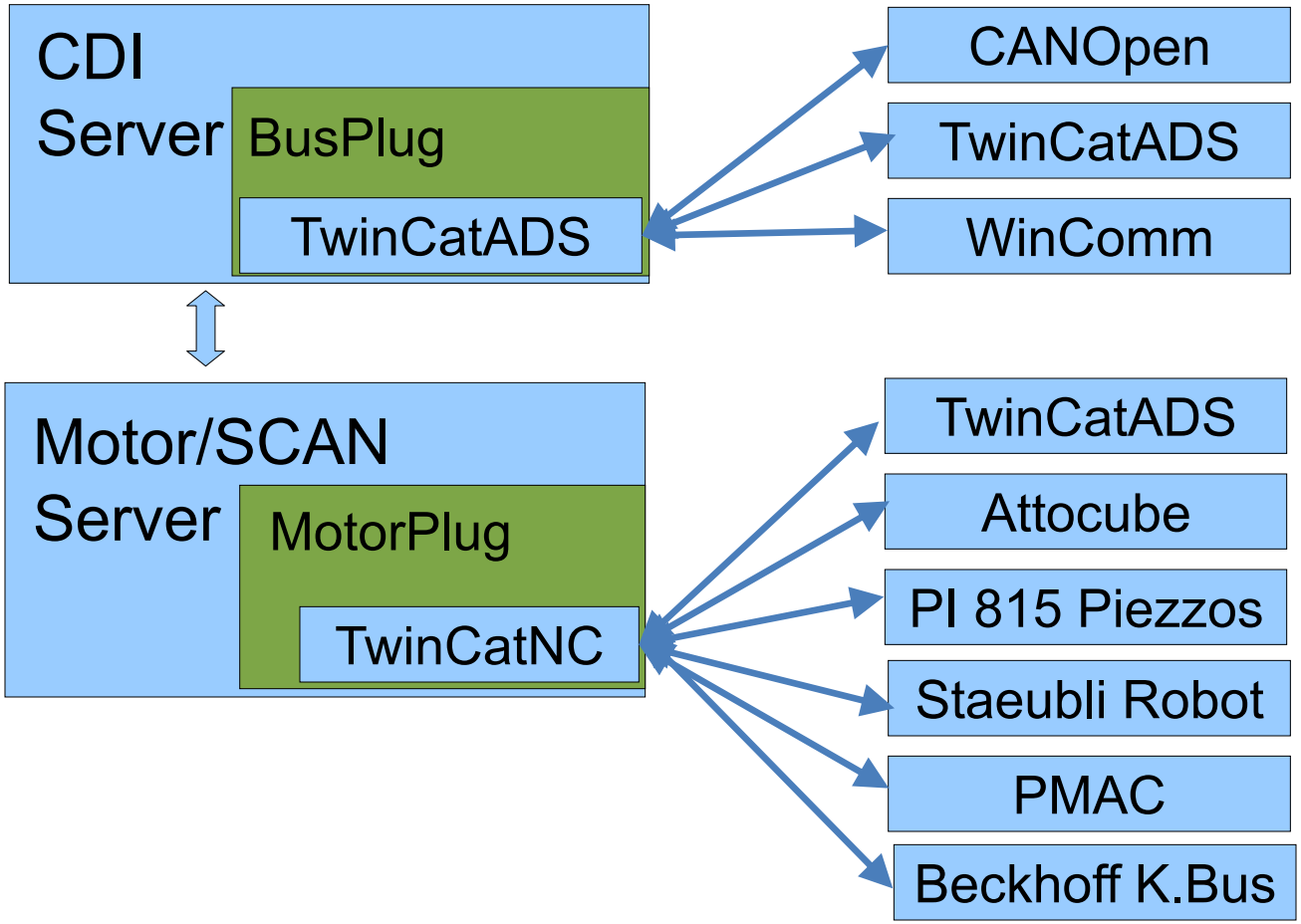
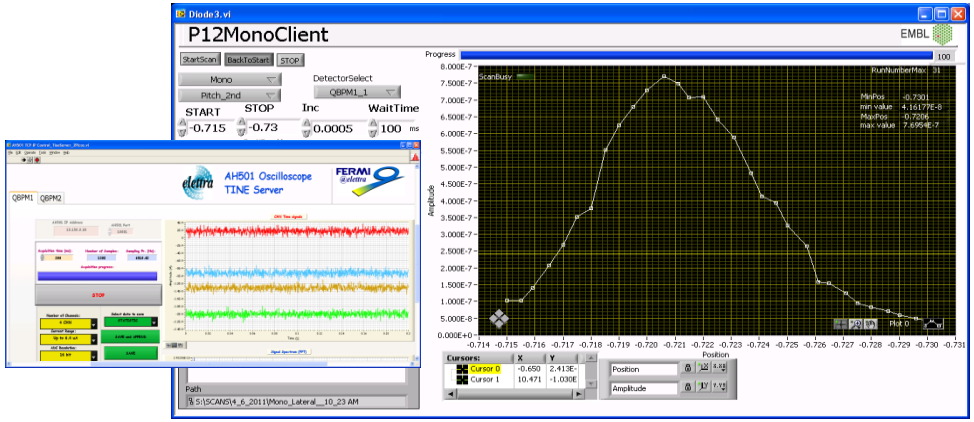
Motor/Scan Server Architecture



Motor/Scan Server Features

- Scans
  - Single axis step scan versus a monitor signal which needs to be available as TINE call. Synchronized by the motor/scan server
  - Multiple axis step scan against single or multiple monitor signals. Synchronized by the motor/scan server
  - Step scans or on the fly scans synchronized by the PLC of TwinCat.
  - Saving/loading of the scan files via motor server property



Motor Server

- Motor :

  -Velocity: Min- Max- default

  -Acceleration: Min – Max –default

  -MicroSteps – Steps/Millimeter –Steps/Radian

  -Reset

  -Status

- Axis:

  -Steps/mm Steps/Radian

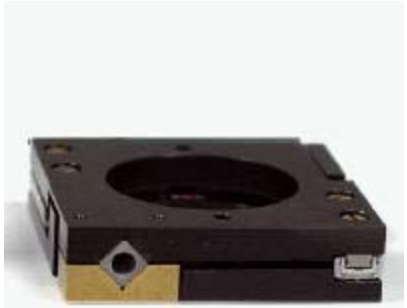
  -Online

  -Calibrate

  -Position ->/ Offset /Scale

  -StatusInfo

  -TargetPosition



Piezzo Motor
Attocube ANT200
Translation table
Travel: 0-5mm
Resolution: 10nm

Motor/Scan Server Movements

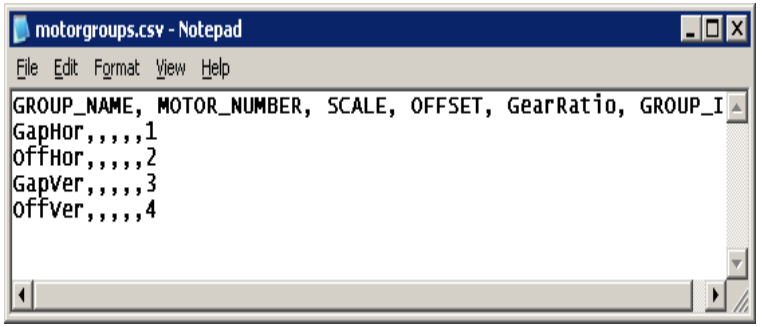
- Absolut Move:
  Move.Start/Move.Stop/Move.Status/Move.Resume/Move.Progress/Move.PAUSE
- RelativeMove ->IncrementMove
- Continous Move -> Free Move

- Combined Motor motions / pseudo axis / Grouped Motions:
- GroupMove
- IncrementGroupMove
- Free Move-> Continous Move

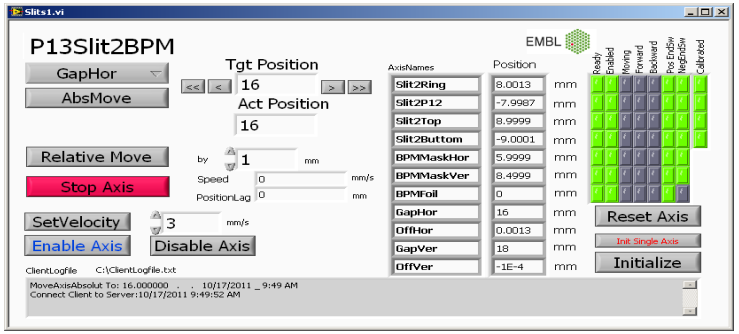
- GroupMoves of multiple on the fly grouped motors

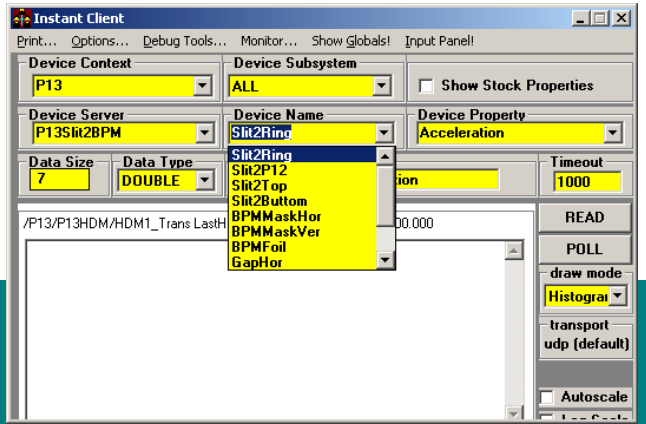
TINE Motor/Scan Server Group Moves

- On the fly defined group moves
- Move.Start -> Mot1,Mot2,Mot3,10,10,20
- Synchron Coupled Axis move synchronized
- by TwinCat defined in motorgroups.csv



- Pseudo axis move Pseudo axis defined in
- motorgroups.csv. Calculations of Positions
- and movements to be implemented into the PLC of TwinCat per case.





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Motor/Scan Server Scan Options

- One motor per axis 1..n monitors
- N-Motors per axis defined as „pseudo axis“ 1..n monitors

- Scan of single motors against n-monitor signals

- „Fast Scan“ On the fly Scan
  - Start Motor and get every PLC cycle (1ms) Motor position and monitor signal

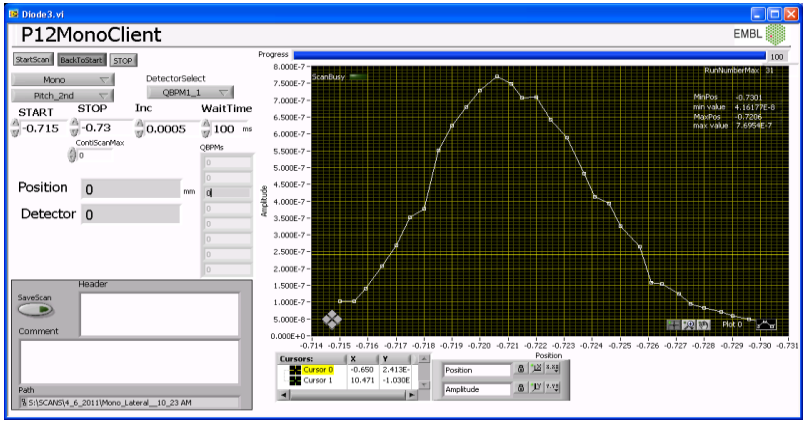
- „Slow“ Step Scans
  - Start Position– integrate Intensity monitor signal – Move by increment – integrate Intensity monitor signal

Step Scan performed by the Scan Server

- StepMove.START/STATUS/PARAMS/PAUSE/RESUME/START/STATUS/STOP/.X/.Y/SAVE/PPROGRESS
- ScanMonitor.START/STATUS/PARAMS/PAUSE/RESUME/START/STATUS/STOP/.X/.Y/SAVE

  Mon scan move m=tgtName p=pos g= gr s=size f=fmt t=tmr

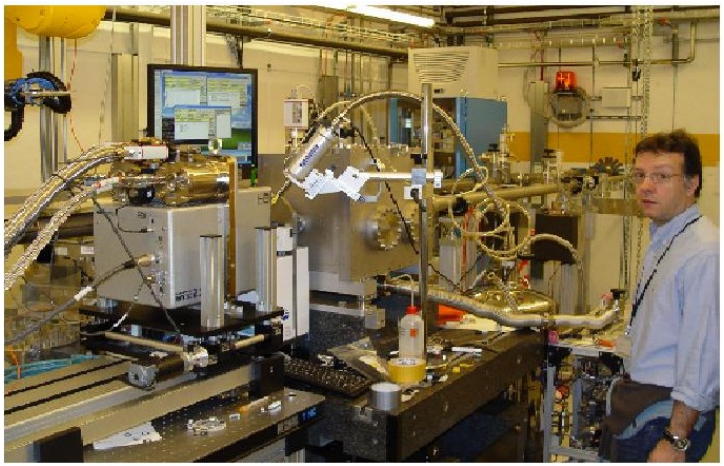
- Which ScanFiles are available Property-> ScanFile.List
- Read the Scan File-> ScanFile.X ScanFile.Y
- Save Scan-> ScanSave

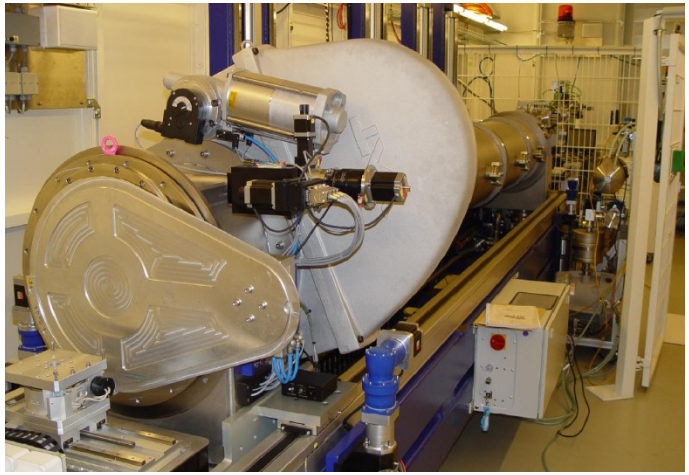


TwinCat NC MotorPlug specific

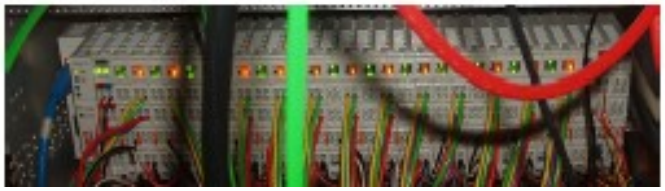
Closed loop motor control for stepper/servo and other motors

- Group moves synchronized by the Beckhoff PLC as coupled motors
- Group moves synchronized by the Beckhoff PLC.
- Scan of Group motors on the fly or StepScans - synchronized by the Beckhoff PLC (1ms)



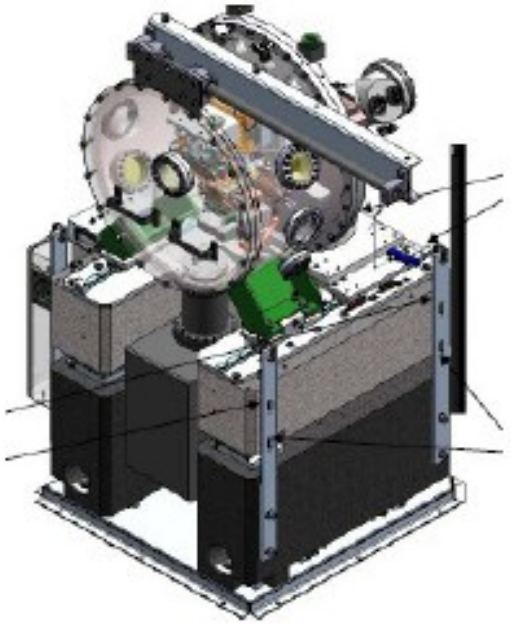


EMBL – FMB Oxford Monochromator



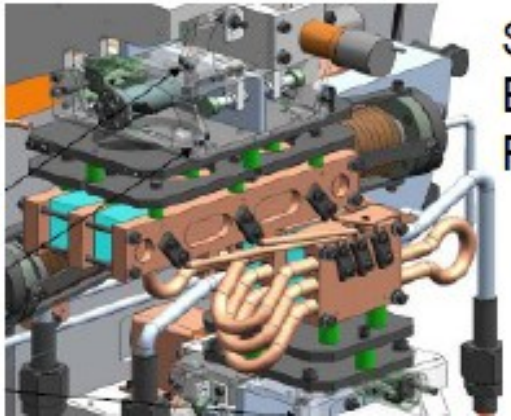
FMB Oxford
Bragg axis: PMAC

Fine adjustment :
Piezo motors,
PI controller



Crystal stage

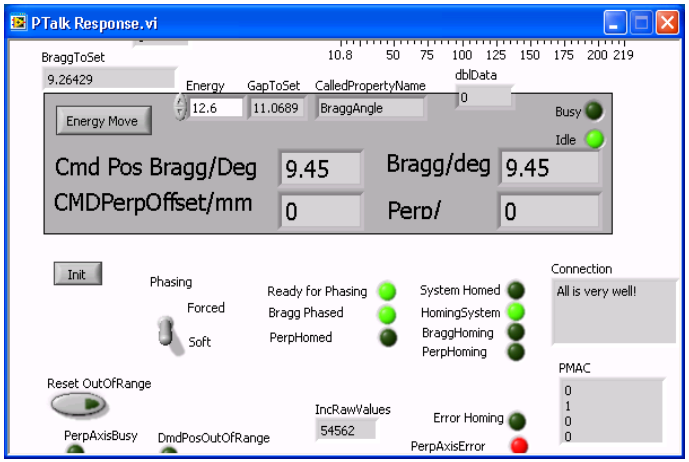
Motor



Stepper Motor control
Ethercat motor contro
Renishaw encoder

Monochromator Server Applications

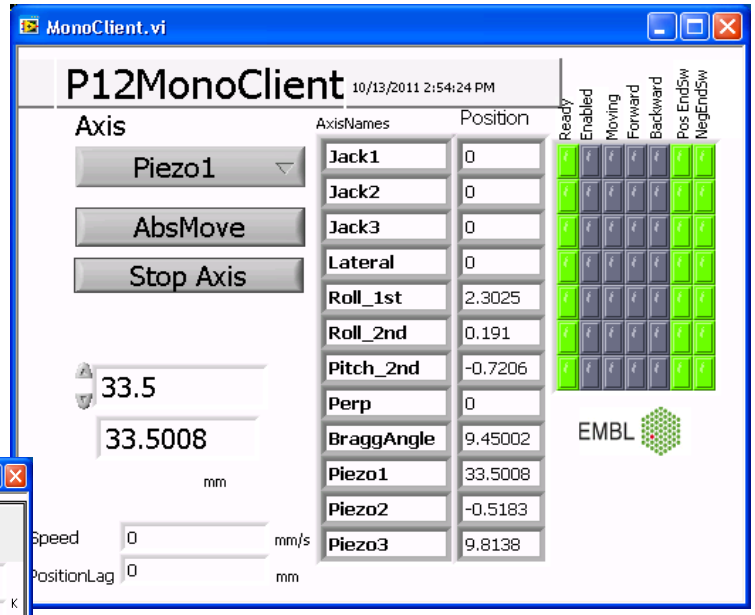
- PMAC Server
  - Bragg angle
  - Perp motor
- Beckhoff Motor Server
- Piezo Motor Server
- LIPS Server
- Undulator
- Cryo Cooler Server
- Server for Energy change of Undulator Gap and Bragg angle and Perp motor Position

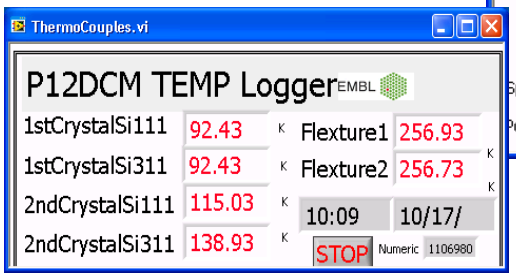


EMBL

Monochromator Server Applications

- PMAC Server
- Beckhoff Motor and CDI Server
  - Motor control
  - Temperatur readout
  - LIPS
- Piezo Motor Server
- LIPS Server
- Undulator
- Cryo Cooler Server
- Server for Energy change of Undulator Gap and Bragg angle and Perp motor Position

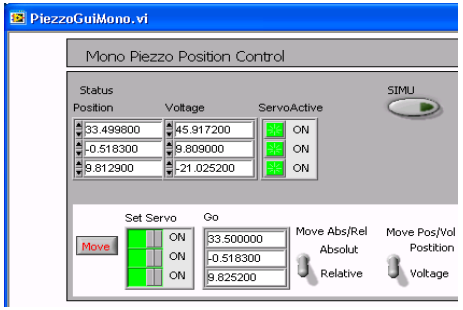




EMBL

Monochromator Server Applications

- PMAC Server
- Beckhoff Motor and CDI Server
- Piezo Motor Server
  - Fine Pitch
  - Fine Roll
  - Fine Perp
- LIPS Server
- Undulator
- Cryo Cooler Server
- Server for Energy change of Undulator
- Gap and Bragg angle and Perp motor Position



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Monochromator Server Applications

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- Beckhoff Motor and CDI Server
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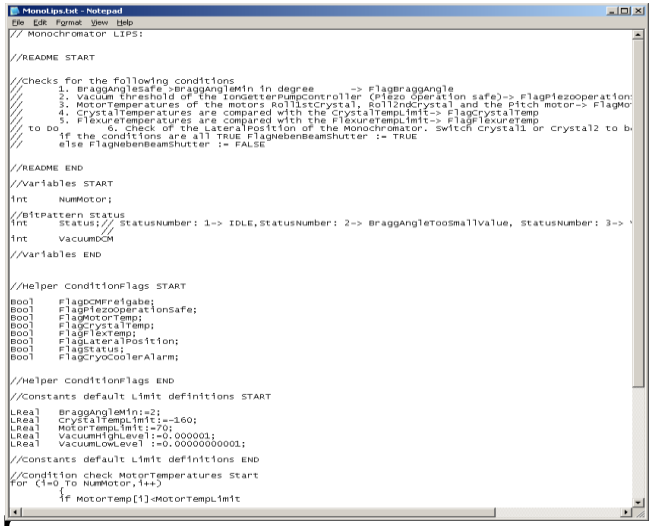
- LIPS Server
- Undulator
- Server for Energy change of Undulator
- Gap and Bragg angle and Perp motor Position



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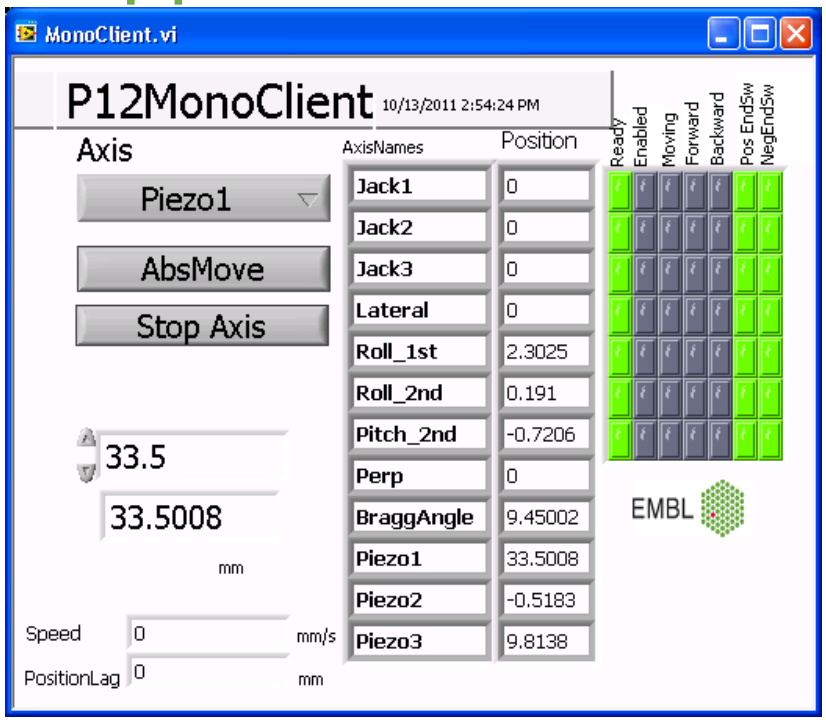
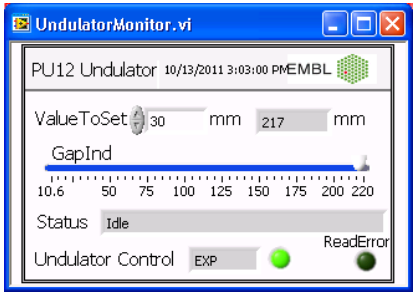
Monochromator Server Applications

- PMAC Server
- Beckhoff Motor and CDI Server
- Piezo Motor Server
- LIPS Server
- Undulator
- Cryo Cooler
- Server for Energy change of Undulator
- Gap and Bragg angle and Perp motor Position





EMBL

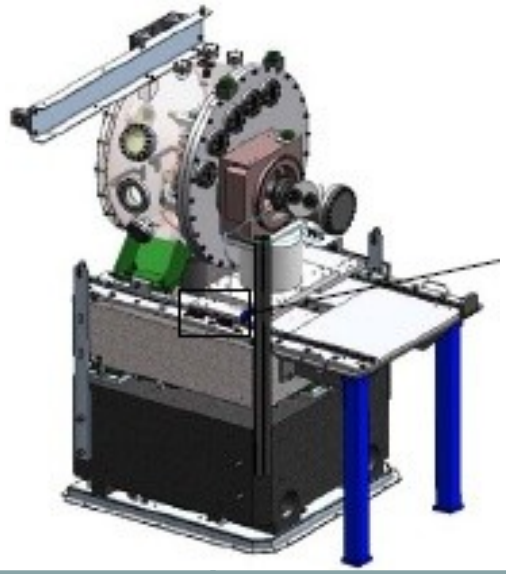
Monochromator Undulator synchronization

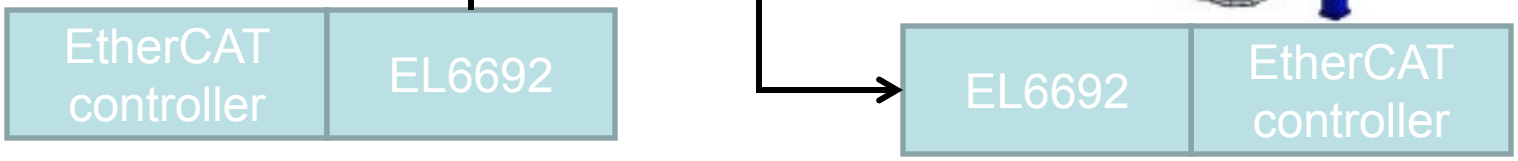
Undulator
Hasylab/Desy control network

PLC Cycle precise synchronization

Cat5 cable

Oxford DCM
EMBL control network





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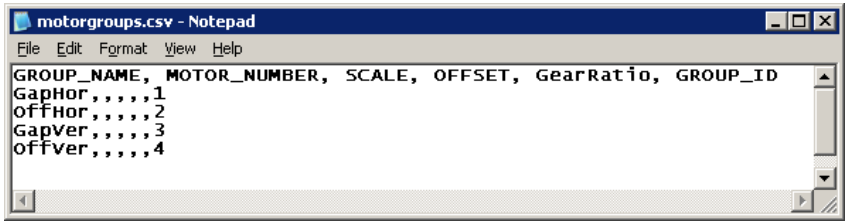
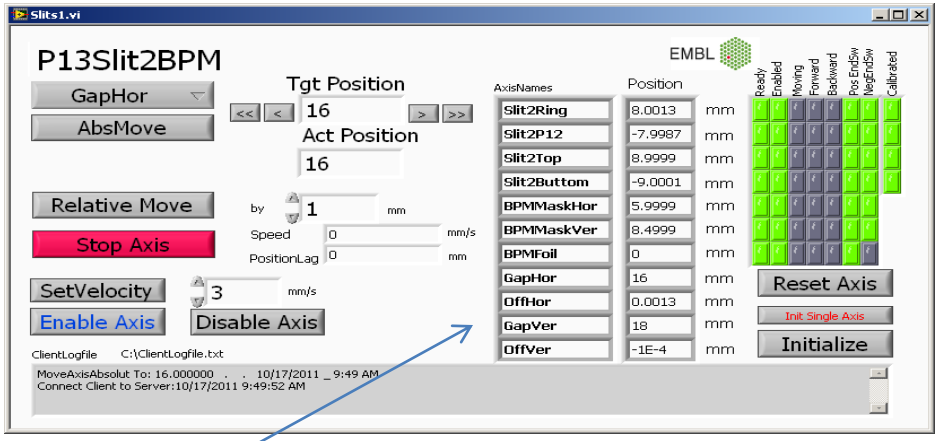
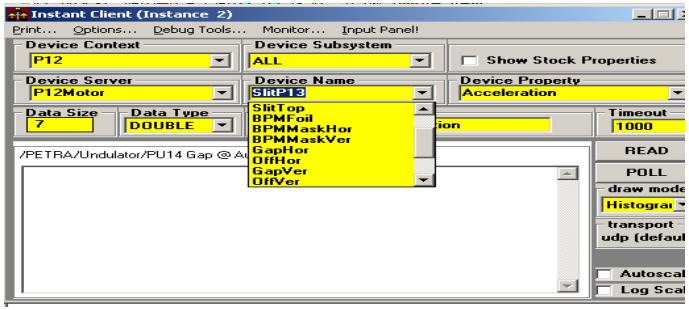
SLIT Application

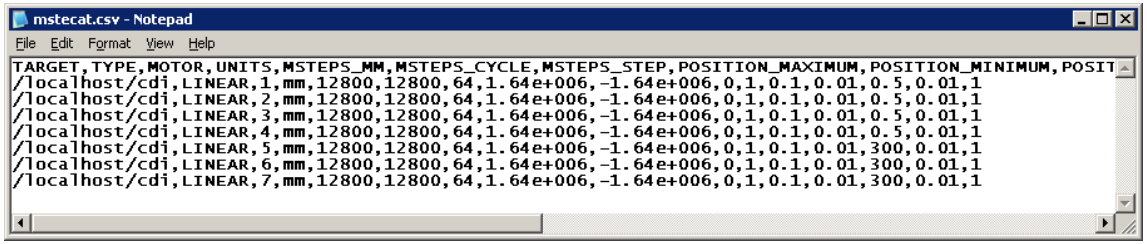
- TwinCat/PLC
- CDI
- EtherCat Motor Plug
- Universal Motor Client
- (Init,Setup,Log,History,Alarms)





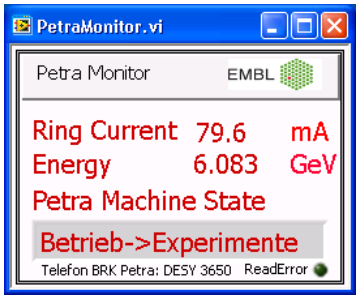
Grouped move-> Gap Vertical = Motor Top Slit and Motor Bottom Slit Gap to be Scanned

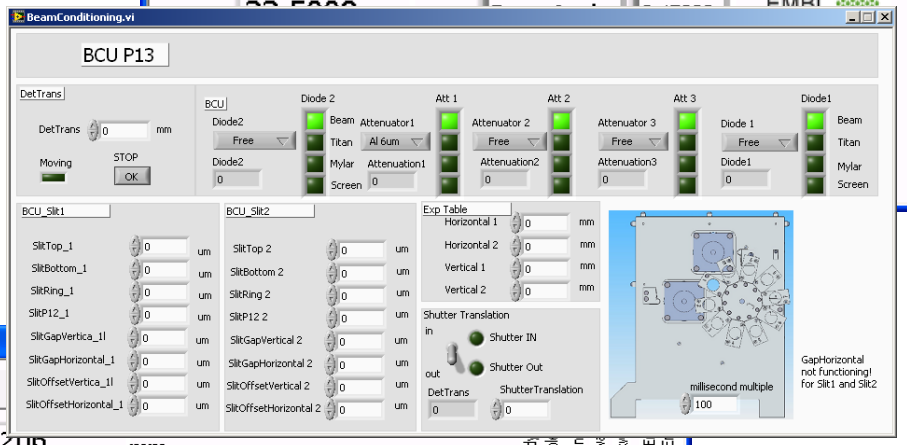


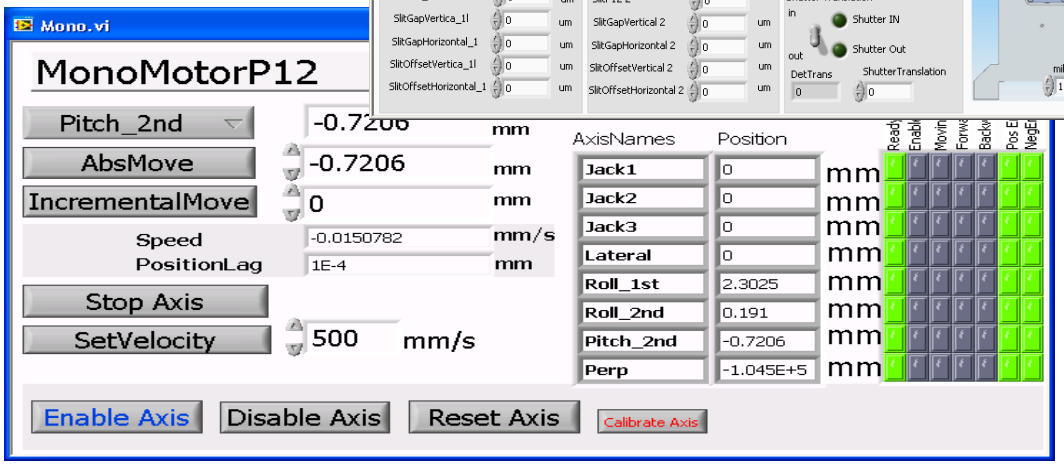


Software

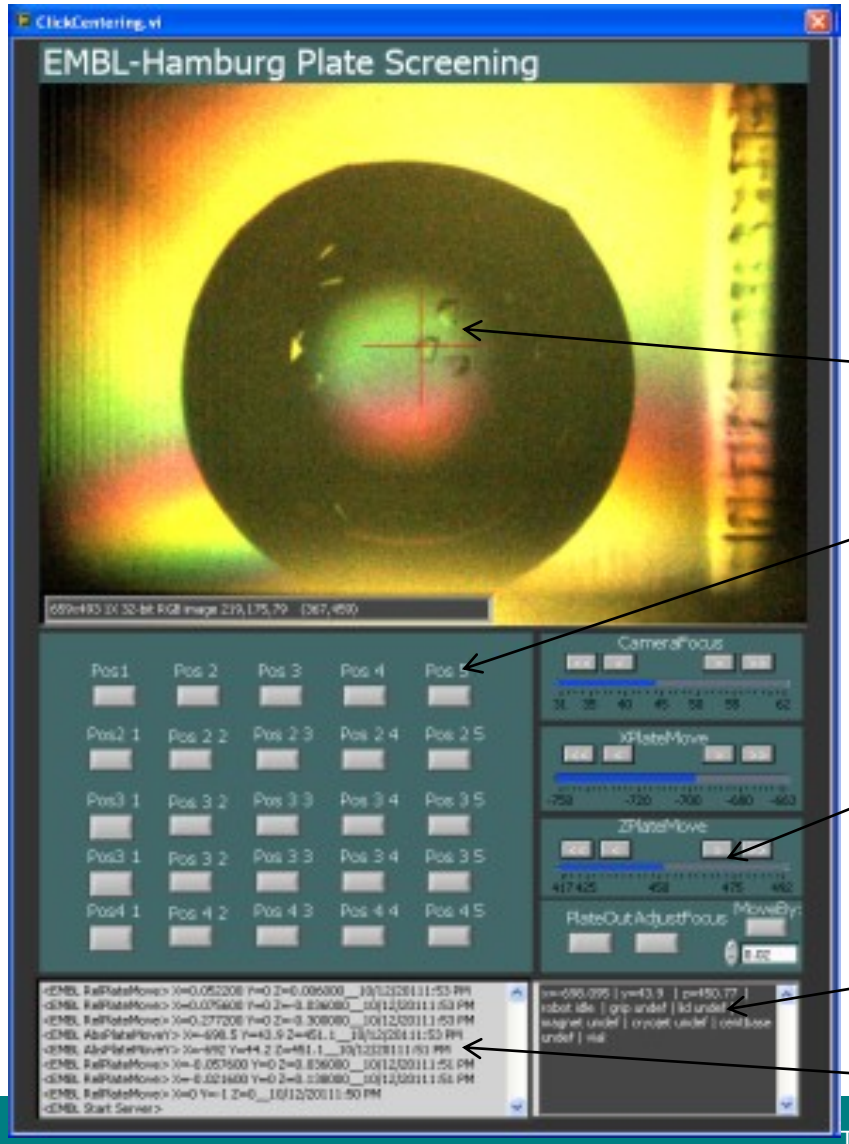
- Undulator
- Vacuum Frontend
- BeamConditioningUnit
- …
- Mono
- QBPM
- HDM







EMBL Hamburg Plate Screening



Commands:
<EMBLMoveAbsPlateScrY>

Click Centering tool

MoveAbsPlateScrY(x,0,z)
Range check(x,y,z) of move command

Move AbsolutePosition
Relative Z
Robot World Z

RobotStatus

ServerLogFile

Outlook

- Finish AttoCube MotorServer integration
- Finish PI-Piezzo MotorServer integration
- PMAC MotorServer integration ?
- Staeubli Robot MotorServer integration ?

Acknowledgments

- Stefan Fiedler
- Marina Nikolova Software Engineer
- Jochen Meier Electronic
- Daniel Franke
- PETRAIII Instrumentation Team
- MCS