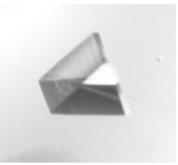
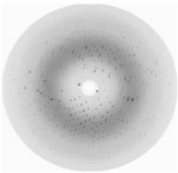
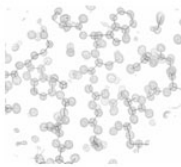


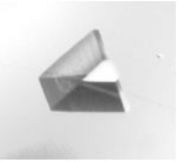



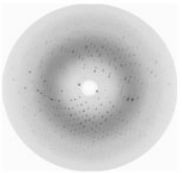
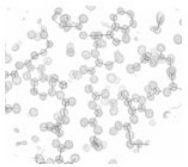
Labview and Tine at the EMBL-Hamburg

Uwe Ristau
Petra III Instrumentation EMBL-Hamburg

Tine Workshop 26th September 2007

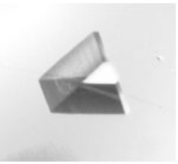
Outline Beamline control

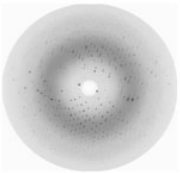


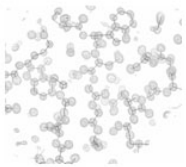



- **The start of TINE at the EMBL-Hamburg**
- **Implementation of TINE in existing device server**
- **Graphical user interface**
  - **Labview and the Vision library**
- **BW7B EMBL –HH Sample Changer**

Start of TINE at the EMBL-Hamburg







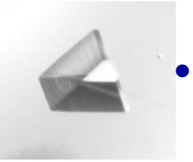
ICALEPCS
The 10th International Conference on Accelerator and Large Experimental Physics Control Systems 2005

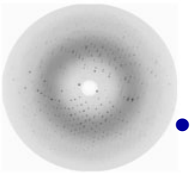
EUROPhysics Conference

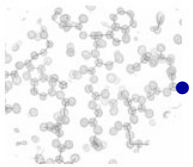
International Conference Center Geneva . CICG
Geneva 10-14 Oct. 2005

- support offered by the DESY/MCS group.
- Tine more than 15 years of accelerator control with TINE
- TINE as the HERA CS. HERA was (6/2007) one of the world largest accelerators
- Computer for Beamline control at the EMBL:
  - 50% of the Beamline control computers were Windows machines using PCI DAQ
- Status Control Software: 80% of EMBL beamline control software was Labview code. The control system had to be integrated
- It was important for us to easily be able to add Control system functionality to the existing Control Software

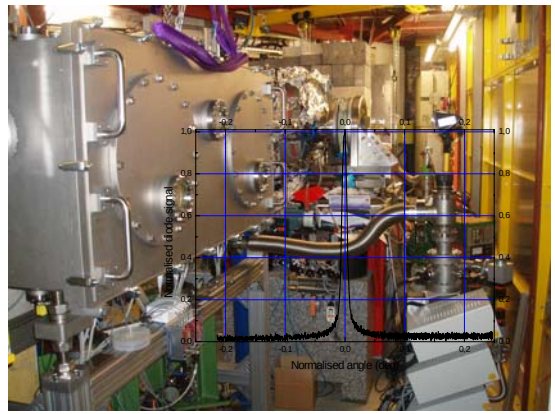
Status of TINE at the Doris beamlines



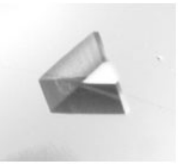


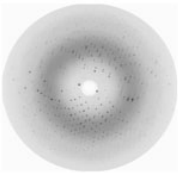
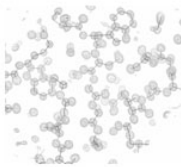


- The robotic Sample Changer at BW7B is integrated in TINE
- The Multilayer Monochromator of BW7A is integrated using TINE/CDI
- The EMBL operates 5 PX beamlines, one SAXS X33 and one EXAFS beamline.
- The PX beamlines BW7B, BW7A are controlled by TINE
- X33 and X11 are partly TINE controlled
- FOR PETRAIII EMBL WILL BUILD 2 PX AND ONE BIOSAXS BEAMLINE

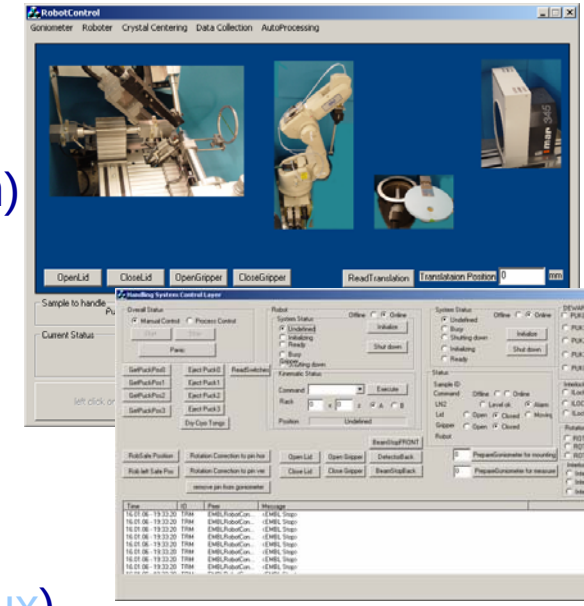


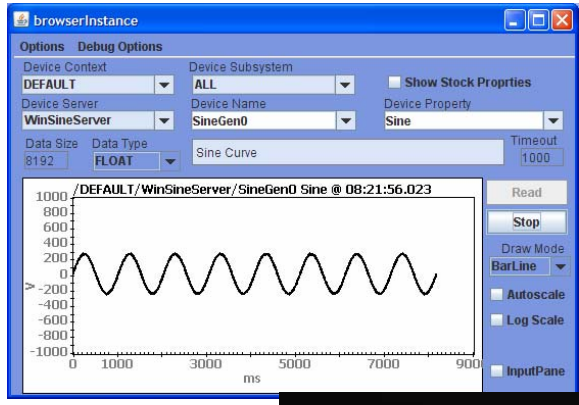
Device Server for TINE



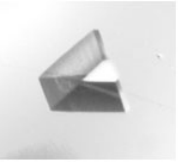



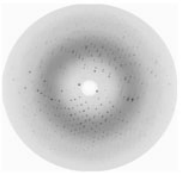
- UV-light source TINE Server (Labview , Win)
- Phytron Motor Controller (VC++ , Win)
- Mclennan Motor Controller (VC++ , Win)
- Goniometer Server (VC++ , Win)
- Mar345 Image Plate Server (VC++,Linux)
- Sample Changer Tine Server (VC++ , Win)
- machine parameter Tine Server (VC++, Linux)
- XREC Server (VC.Net, Linux , Win)
- Heidenhain digital encoder Server (Labview)
- Adept Robot Server (C++, Linux)
- Beckhoff CDI server (Group MCS ,Win)
- CANOpen ExpStat (VC.Net, Win)
- ……
- ANY DEVICE CONTROL PROGRAM CAN EASYLY BE EXTENDED TO CREATE A TINE DEVICE SERVER

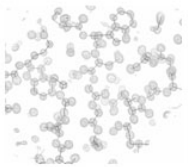




Labview





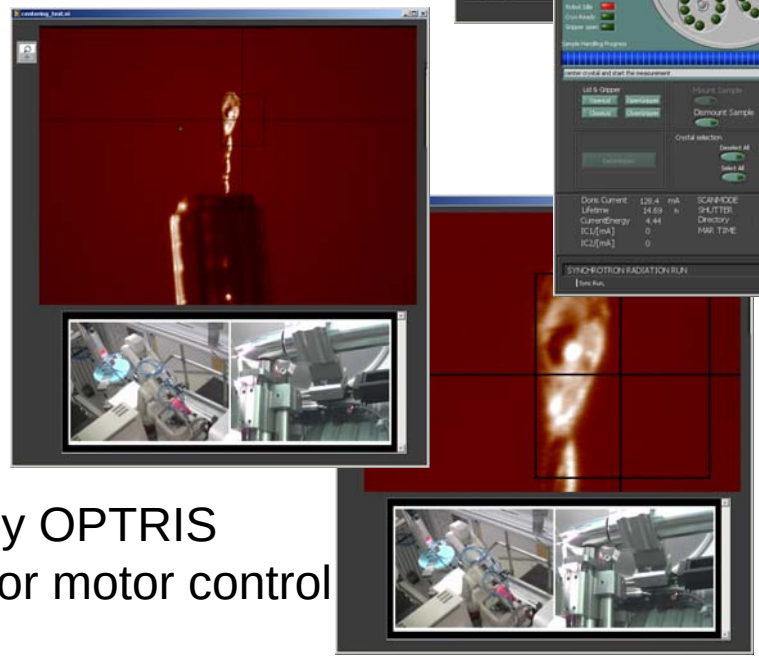


Sample changer Labview GUI
Running on LINUX and WINDOWS
Using the Labview Vision library to
Detect the crystal center.

Barcode reading of the samples
Is performed with a CCD camera using
A Labview Vision library

Display of the sample changer status
Will be implemented as soon as the
TINE Video Server Web Cam tools
Are available by Stefan Weisse

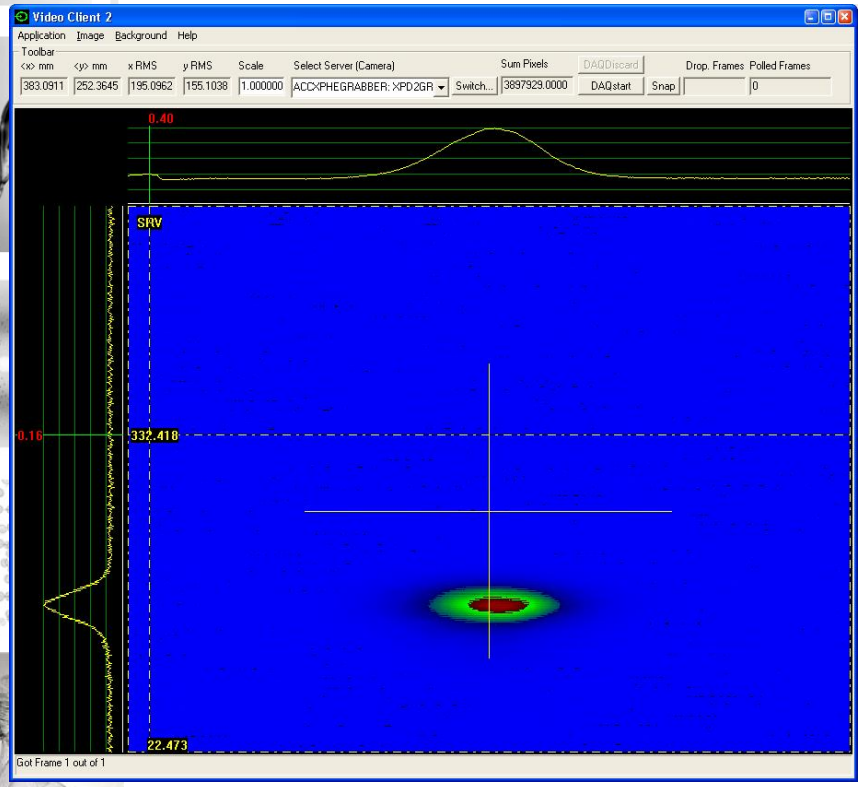
Digital zoom option

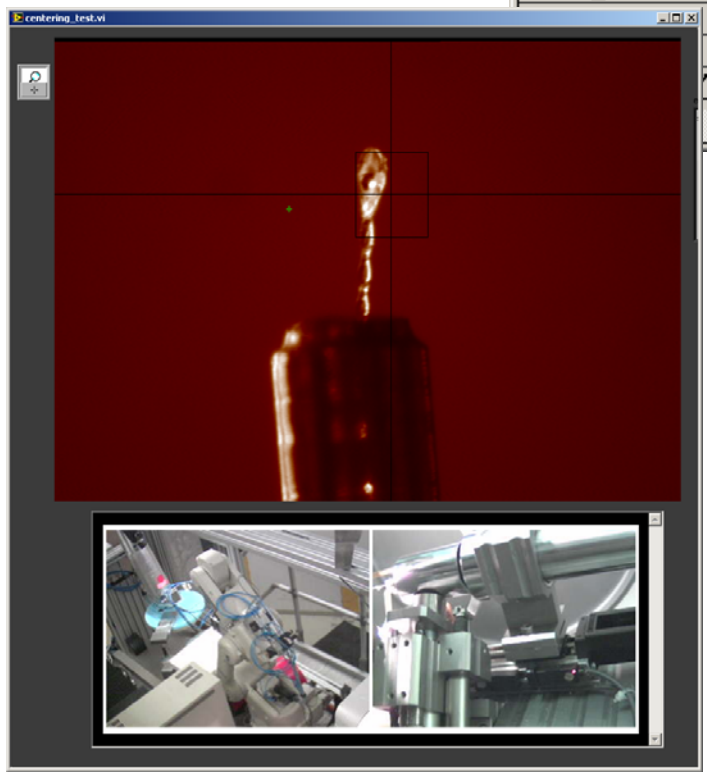


A optical microscope of the company OPTRIS
Will be implemented soon. Drivers for motor control
are Labview code

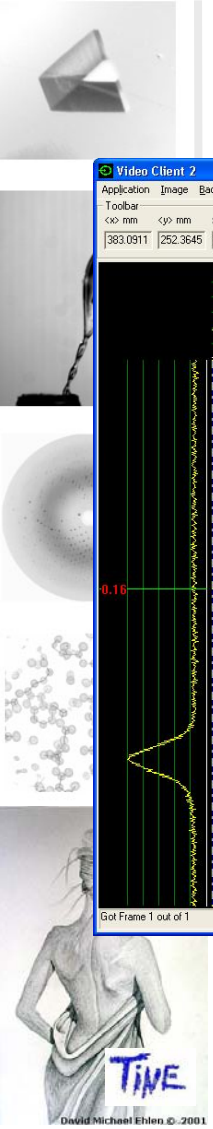
Video grabber with TINE server integration

•Video Server / Client Application by Stefan Weisse DESY/Zeuthen
The NI-1410 National Instrument Frame grabber card has been adapted
Is able to switch between 4 cameras.

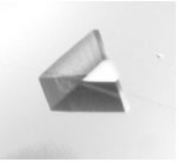


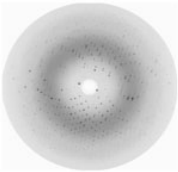


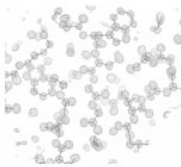
500KByte @ 5Hz in multicast
Mode via TINE



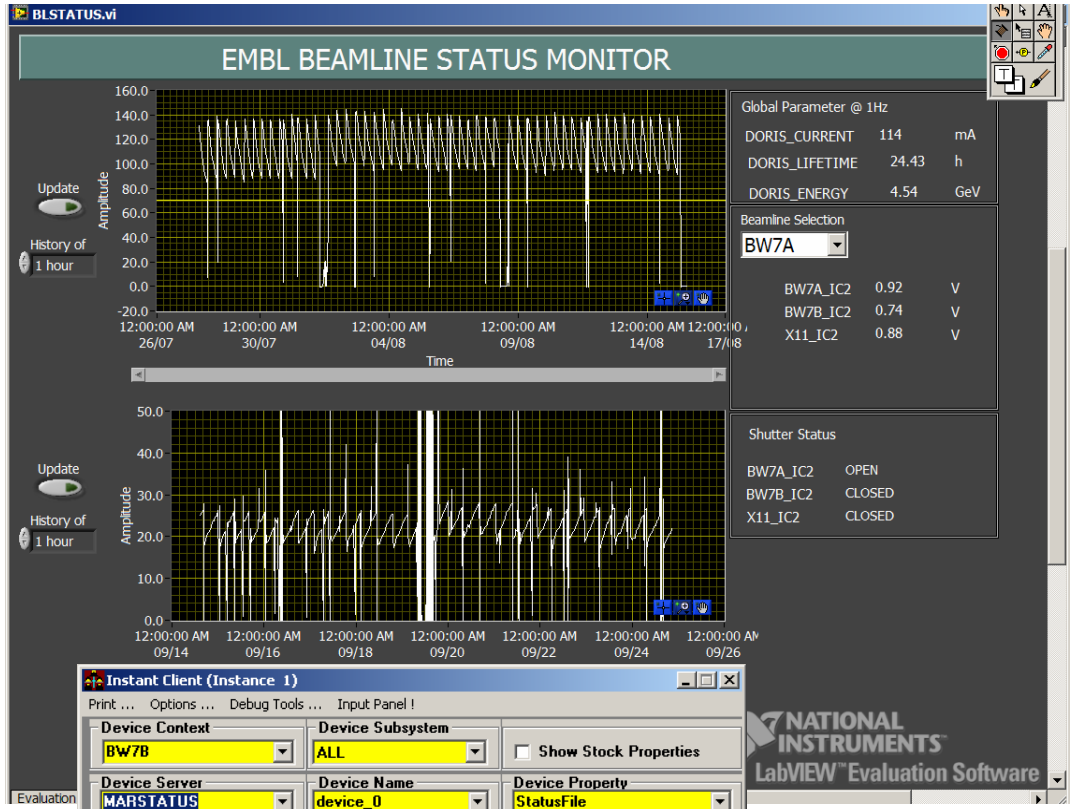
EMBL - Doris Gateway



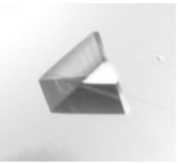


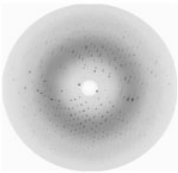


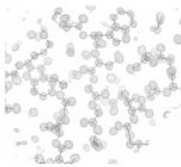
EMBL local
History reader
Almoast as fast as the
One of MARK Lomperski

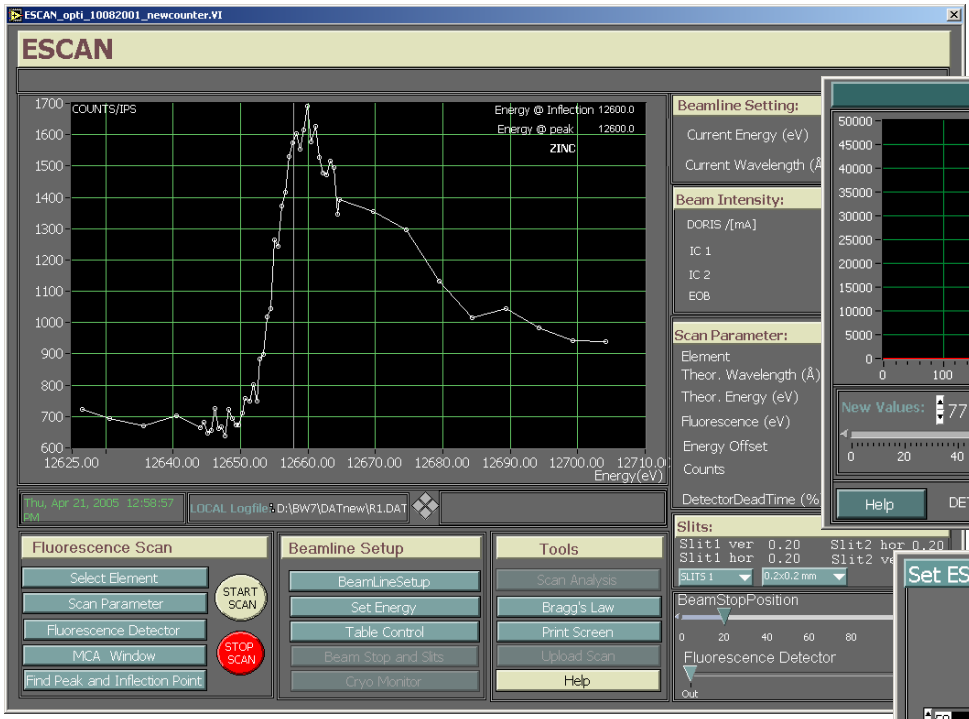


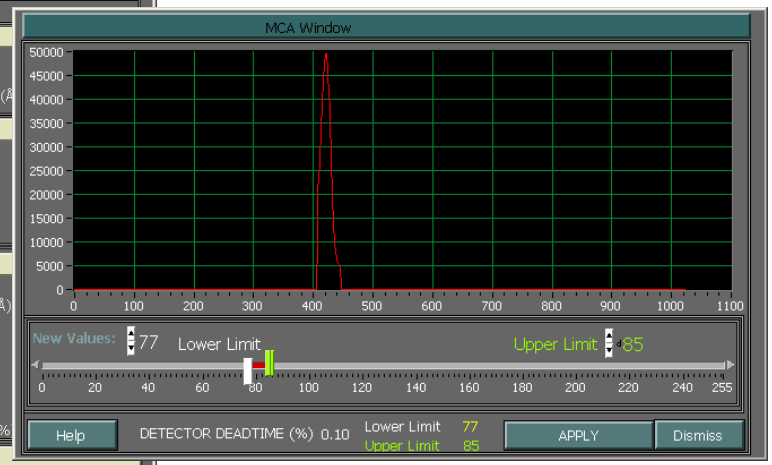
BW7A ESCAN Labview Software

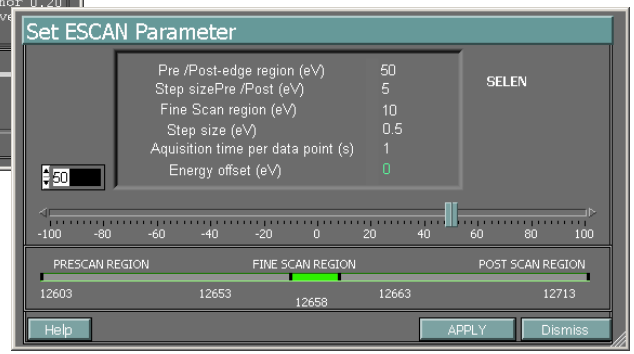


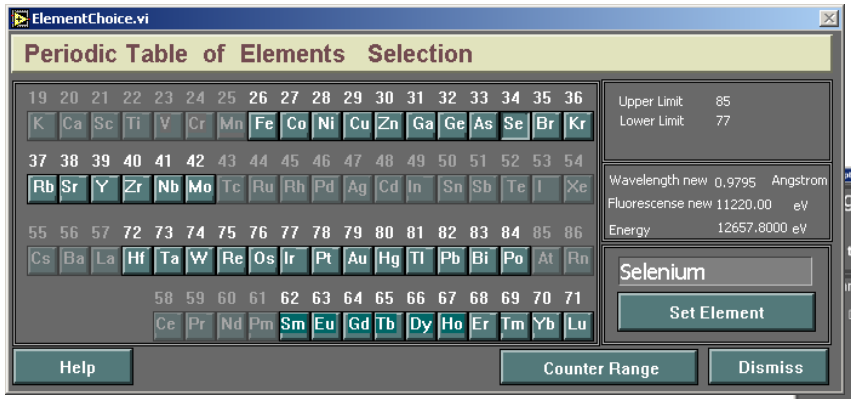




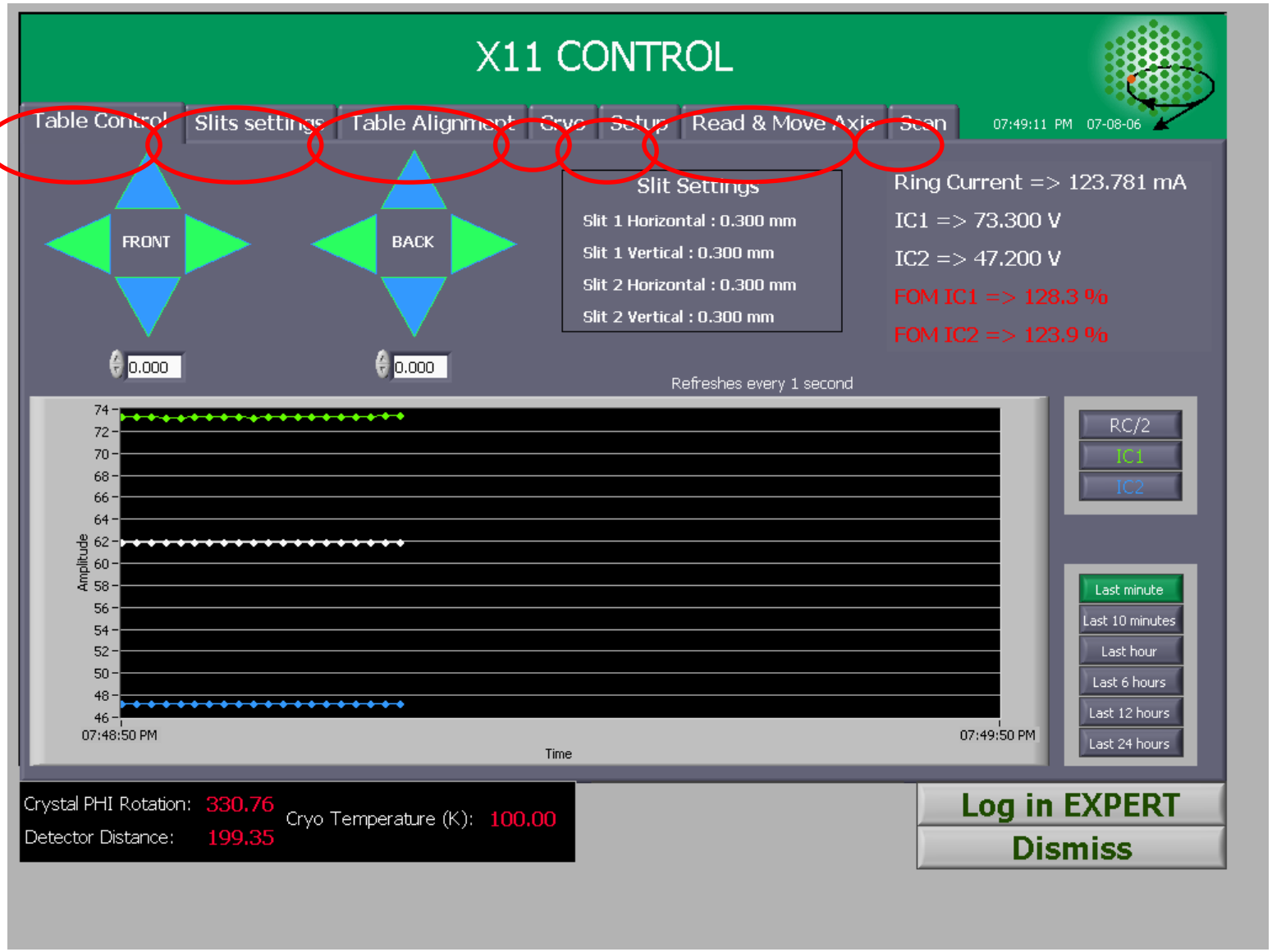






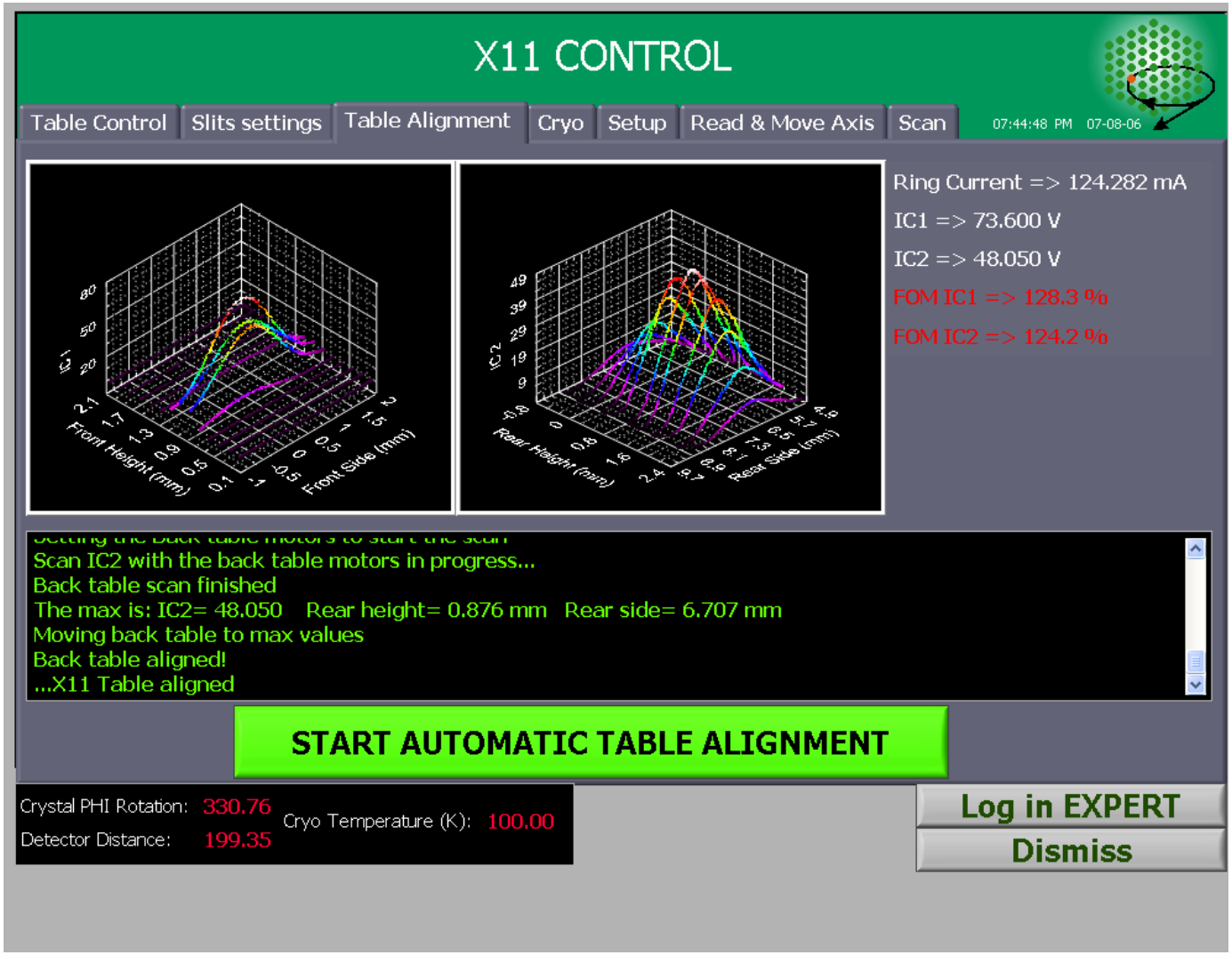


Graphical User Interface



By Christoph Hermes

Graphical User Interface



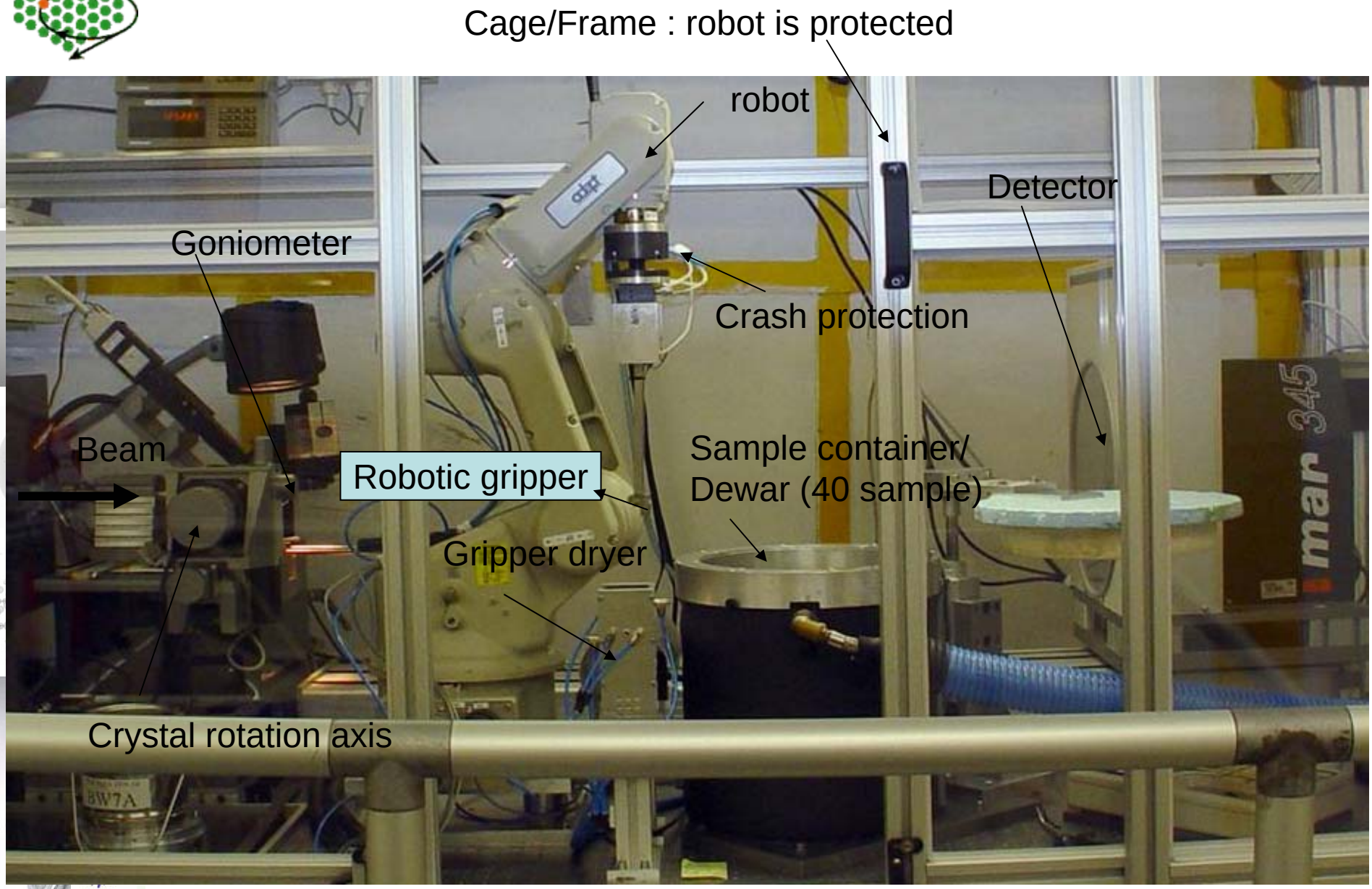
By Christoph Hermes

Labview and standard devices

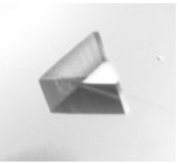
- Device control software for many standard devices like oscilloscopes (Tektronics, HP,LeCryo, etc..) ,function generators, meter (Fluke, Agilent, Keithley,…)

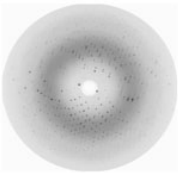
- Spectrum analyzeres are available at the NI Webpage as download.
- It is straight forward to generate a TINE device server out of this device control software

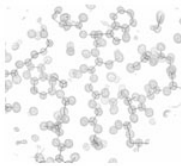
The EMBL-BW7B robotic sample changer



Automation: MX pipeline



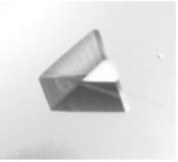


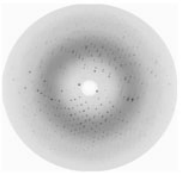
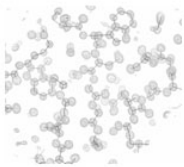


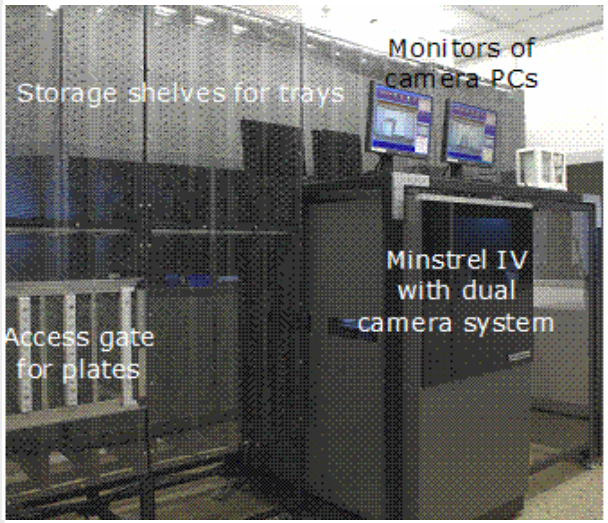
- **High Density Fermentation Facility**
  Protein purification, characterisation
- **High Throughput Crystallisation Facility**
- **Automatic beamline alignment**
- **Automatic sample handling**
- **Automatic crystal centering (XREC)**
- **Automatic data collection (BEST, DNA)**
- **Automatic model building (ARP/wARPAutoRICKSHAW)**

At the EMBL-Hamburg Outstation we have established Europe's largest high-throughput crystallization facility which is open to the general user community. The facility has the capacity to generate up to 10,000 crystallization experiments in an 8h day and to store and image 1,000,000 experiments. Users have access to their results through the internet. All steps of a crystallization experiment from screen preparation to experiment setup and monitoring are executed by two completely integrated modules.

Automation: MX pipeline





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Automation: MX pipeline

- High Density Fermentation Facility
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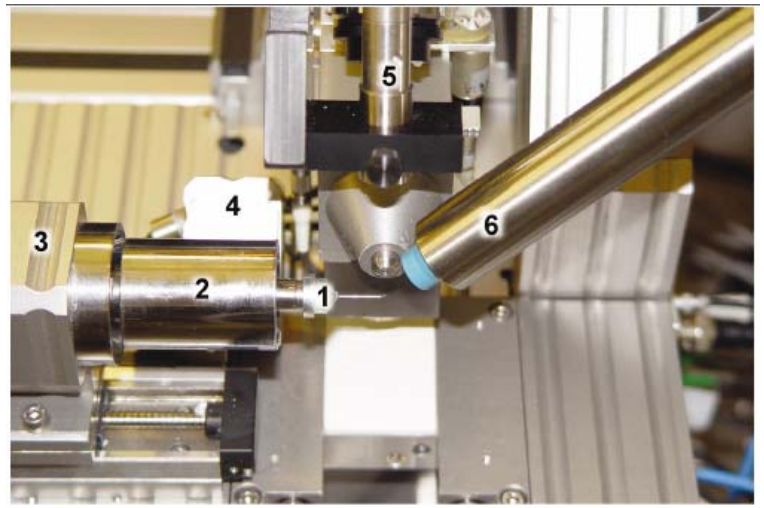
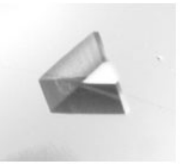
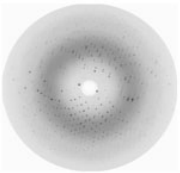
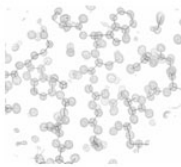
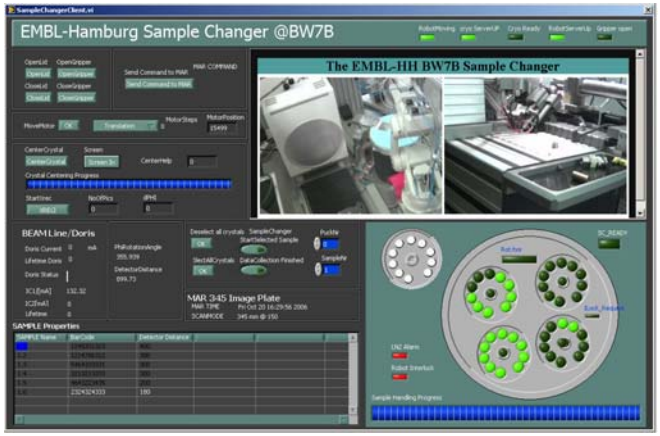


Automation: MX pipeline





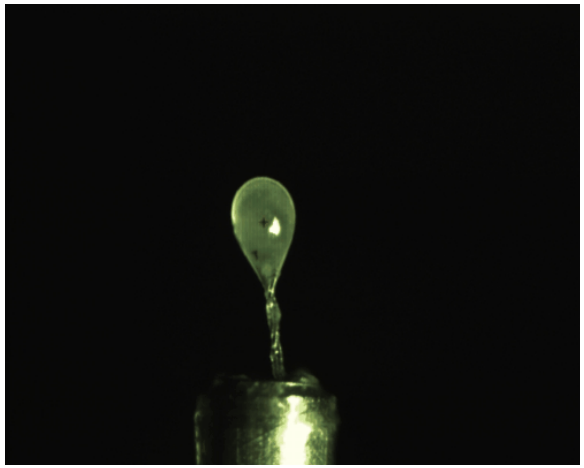




- **High Density Fermentation Facility**
  Protein purification, characterisation
- **High Throughput Crystallisation Facility**
- **Automatic beamline alignment**
- **Automatic sample handling**
- **Automatic crystal centering (XREC)**

Automatic data collection (BEST, DNA)
Automatic model building
(ARP/wARPAutoRICKSHAW)

Automation: MX pipeline



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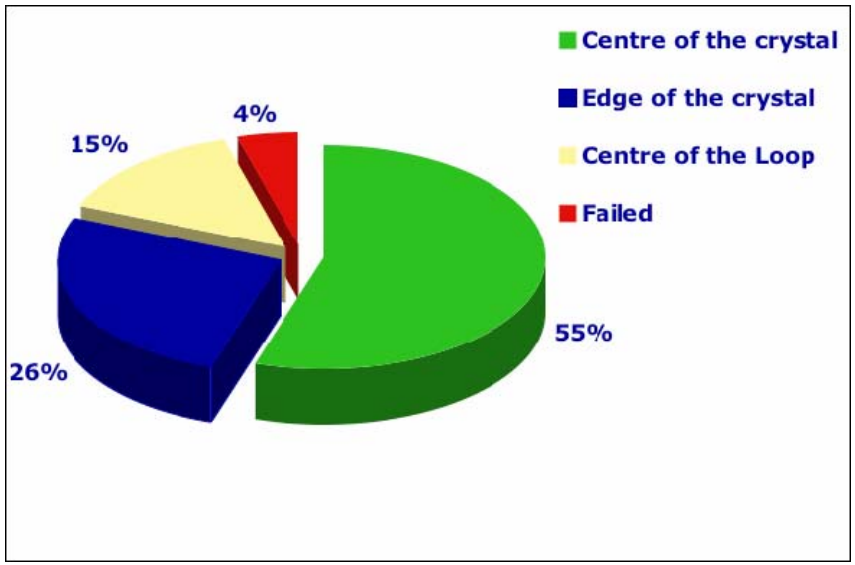
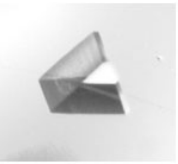
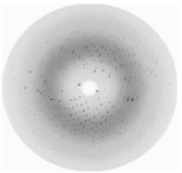
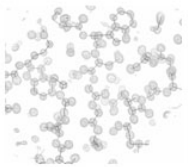


XREC

Automation: MX pipeline







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- **Automatic beamline alignment**
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- **Automatic crystal centering (XREC)**
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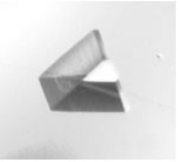
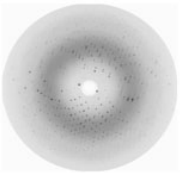
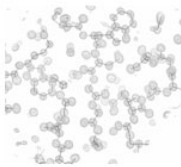
  (ARP/wARPAutoRICKSHAW)

Sample changer pipeline

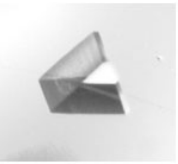


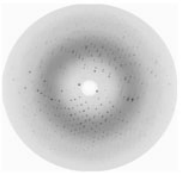
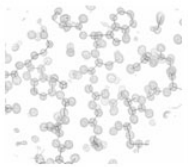




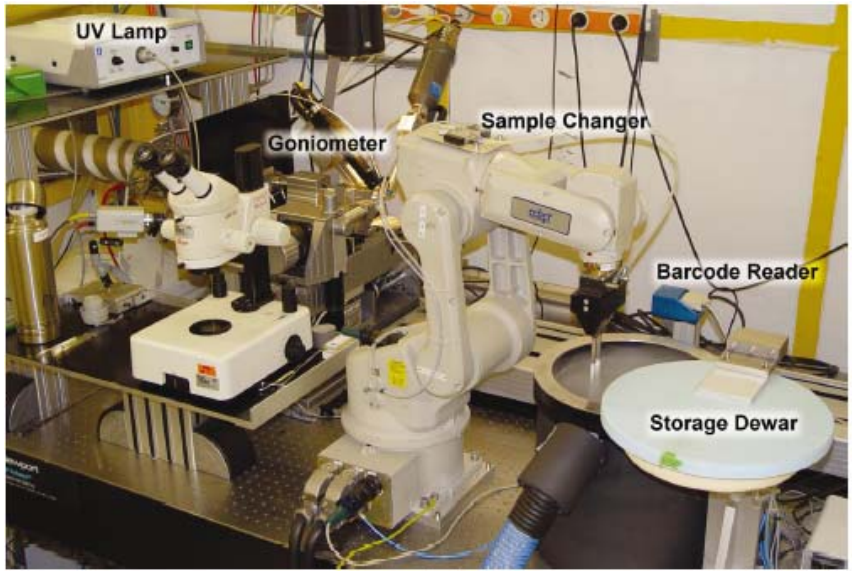
- Mounting of the samples on the goniometer head
- Centering the sample/crystal with respect to the beam
- Start of the experiment
- Dismounting of the Sample
- Allow Screening and ranking of Samples

Sample changer hardware



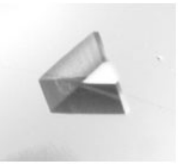
Beam

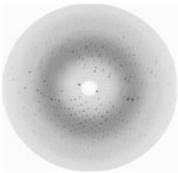


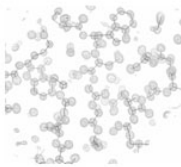
Robot Interlock system

Detector

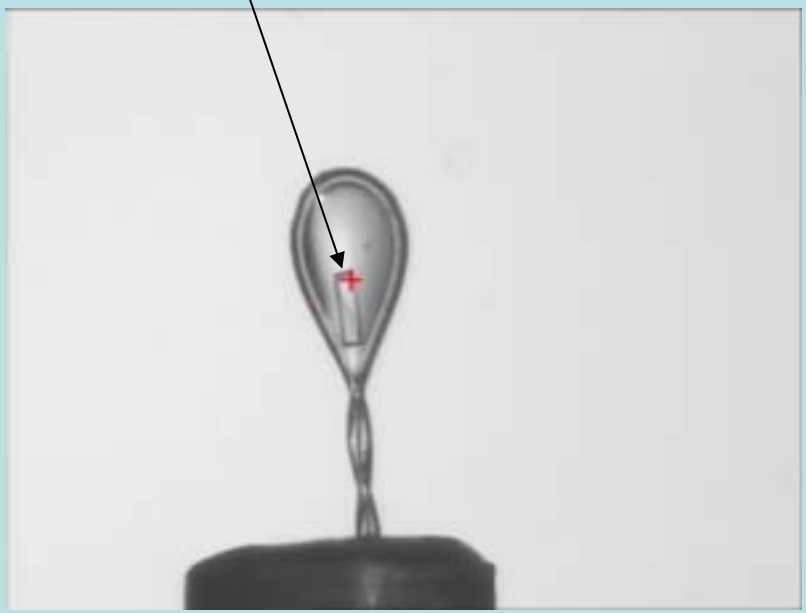
EMBL-Hamburg BW7B Sample Changer



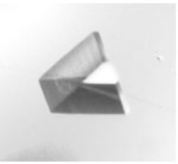


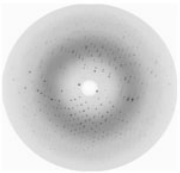
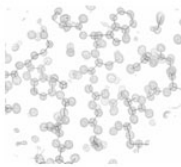


There he is the – crystal -

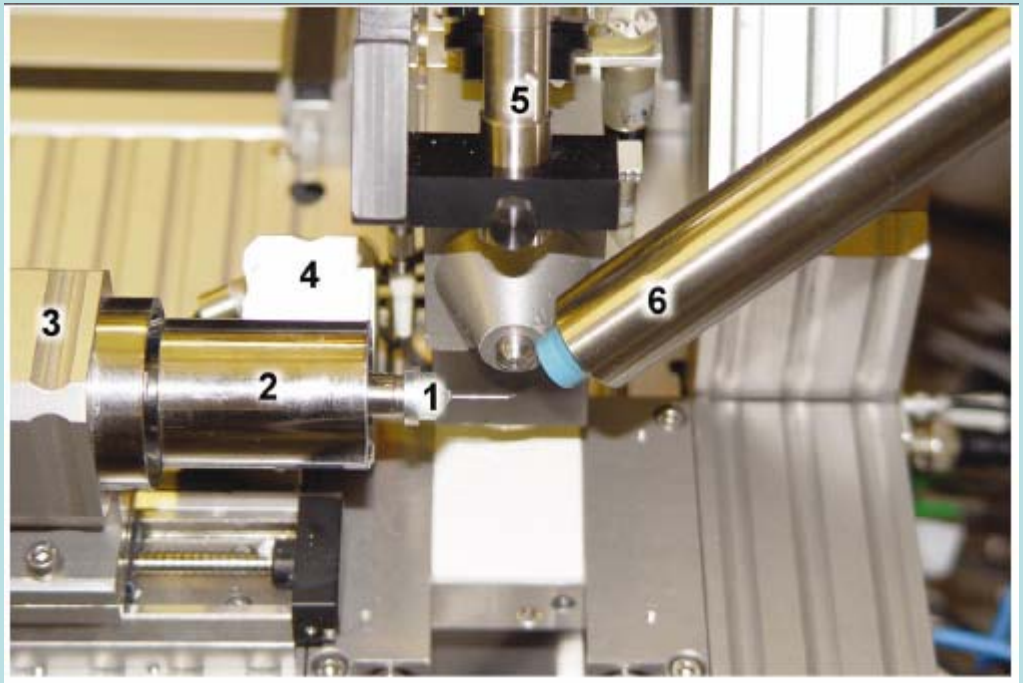


EMBL-Hamburg BW7B Sample Changer

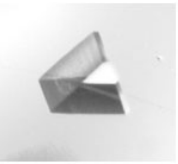


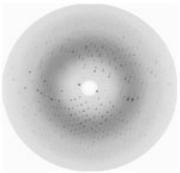
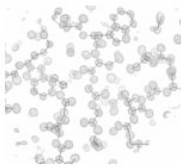



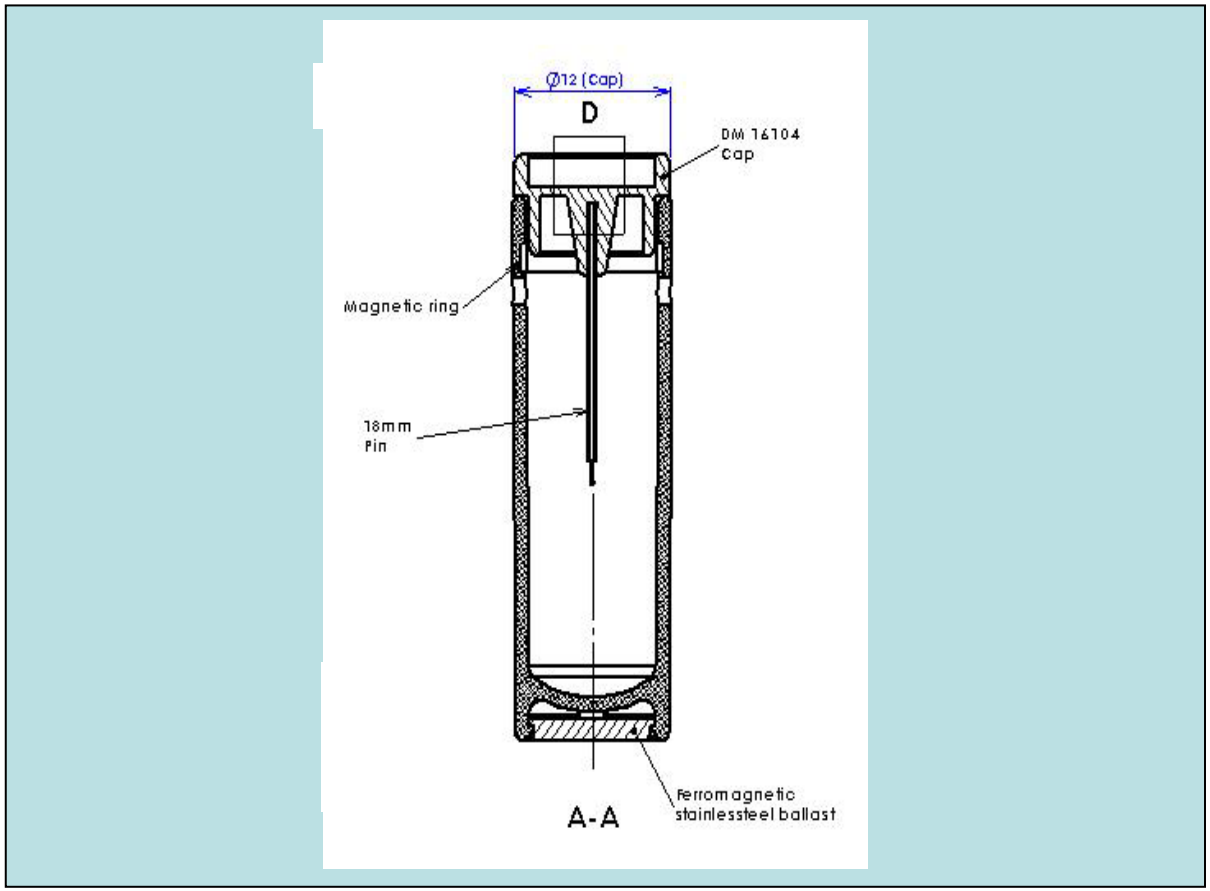
Goniometer with centering mechanic and cryo



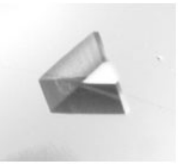
EMBL-Hamburg BW7B Sample Changer

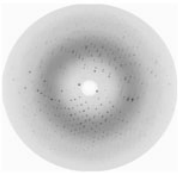
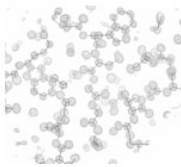




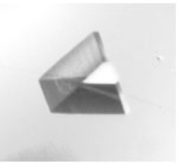
EMBL-Hamburg BW7B Sample Changer

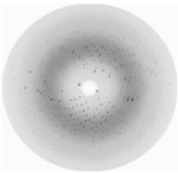
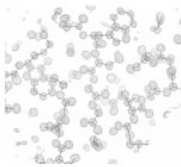


EMBL Grenoble puck system for 10 samples

EMBL-Hamburg BW7B Sample Changer



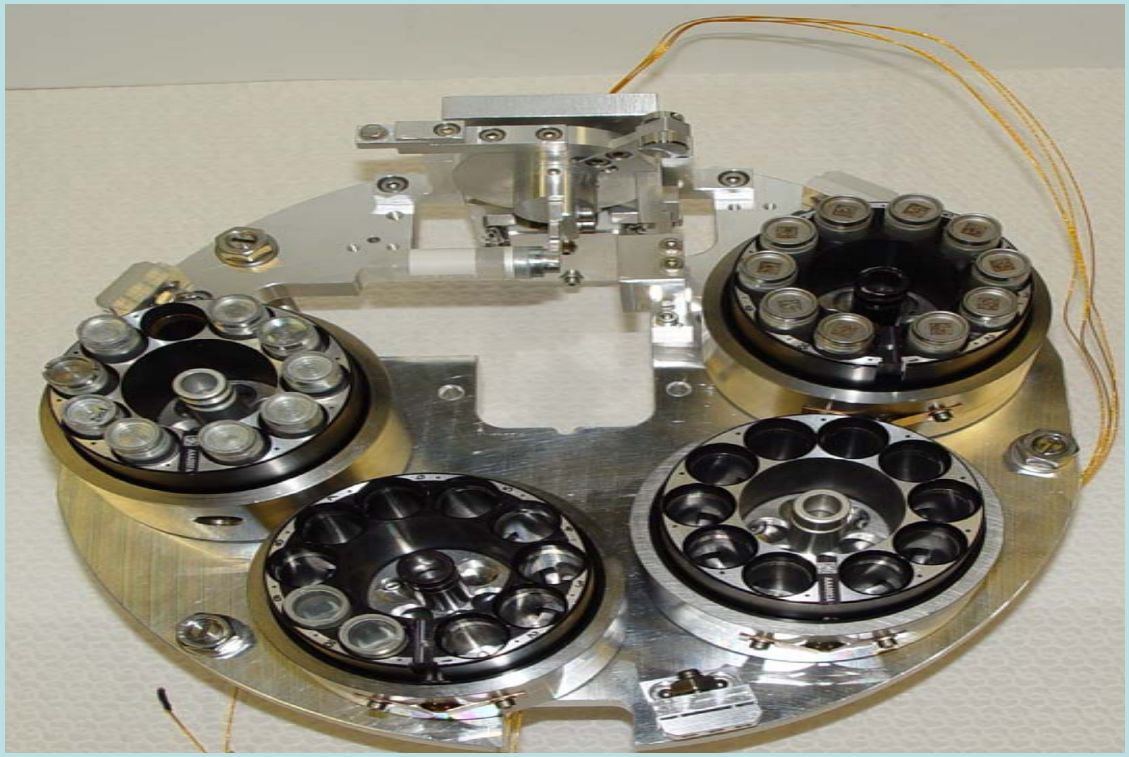



Cp100 Transport dewar
For max 50 samples

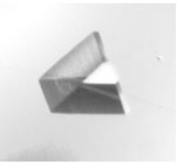
Transfer tool

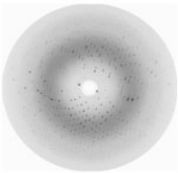
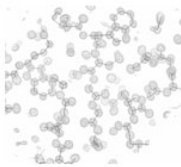
EMBL-Hamburg BW7B Sample Changer

Assembly of a whole dewar unit of 40 Samples

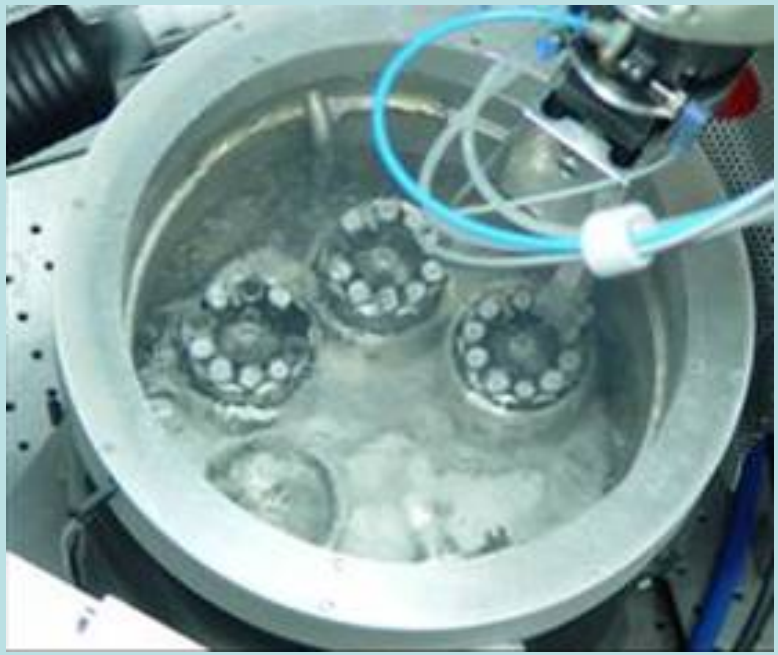


EMBL-Hamburg BW7B Sample Changer



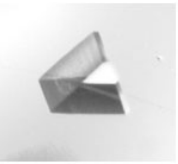
Main dewar assembly
-filled with nitrogen

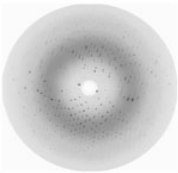
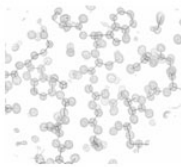


EMBL-Hamburg BW7B Sample Changer

Industrial
ADEPT six axis Robot

EMBL-Hamburg BW7B Sample Changer



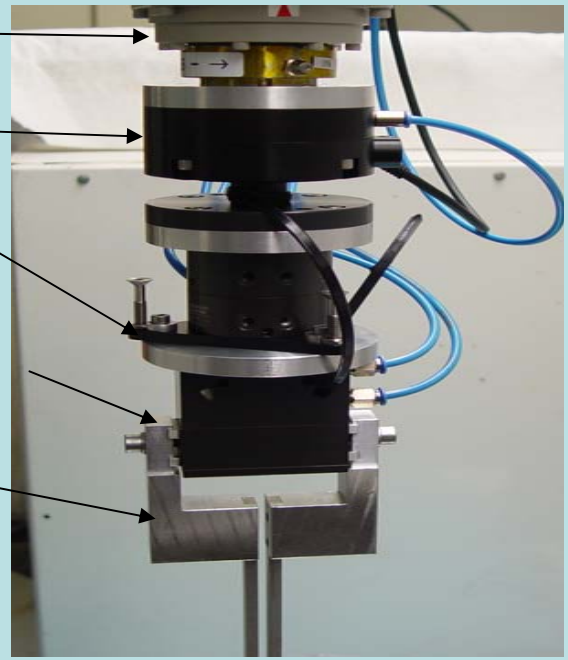
Robot arm

Crash protection

Tool changer

Pneumatic Gripper

Gripper

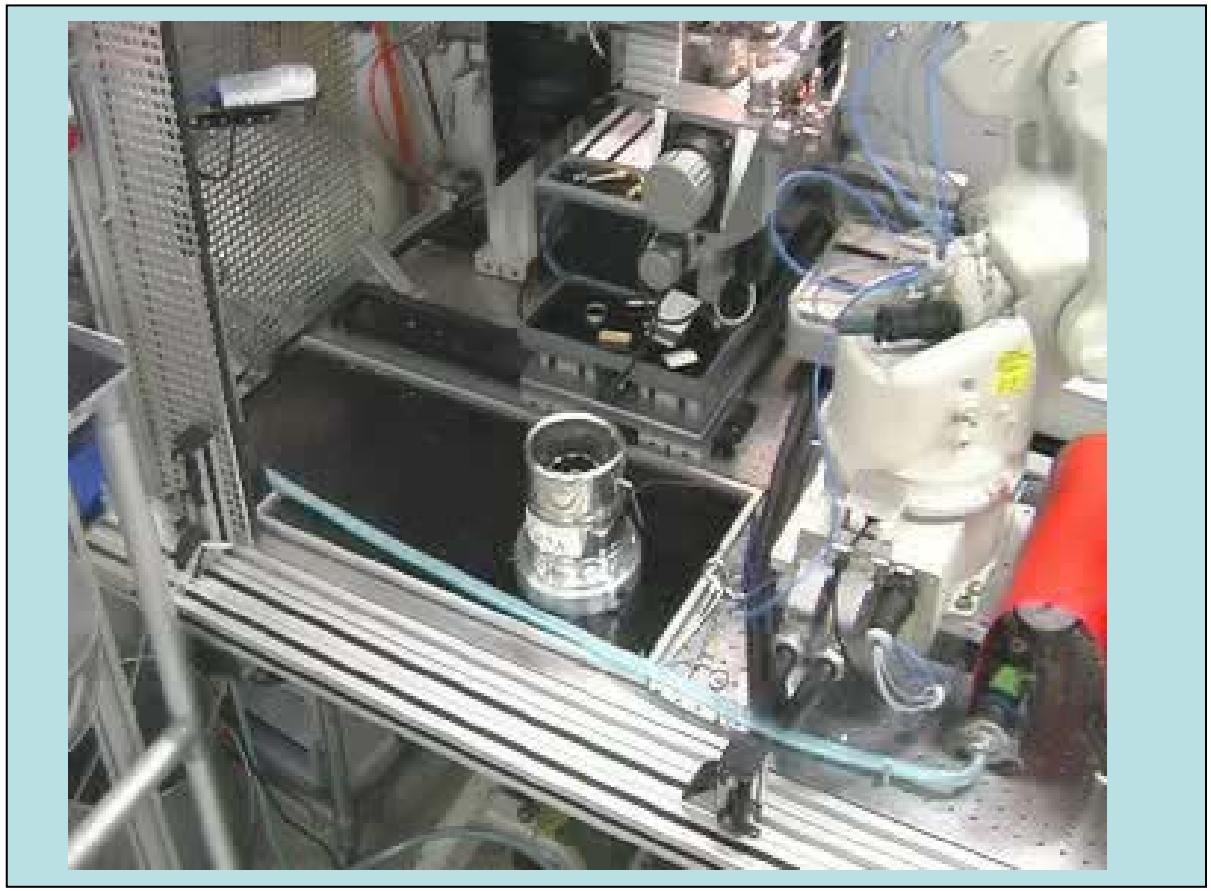


EMBL-Hamburg BW7B Sample Changer

Pneumatic Gripper with 2 gripping orientations

EMBL-Hamburg BW7B Sample Changer

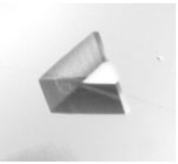
Loading of the puck from the preparation dewar into the main dewar

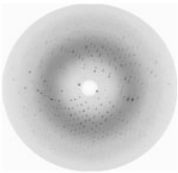
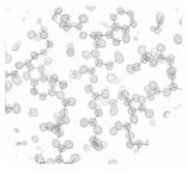


EMBL-Hamburg BW7B Sample Changer

Mounting and dismounting of samples on the goniometer

BW7B Controls



To DNA etc

Computer Room

Tine Name Server
Tine central archive

Tine Name Server
Tine central archive

MAR 345

TCP/IP

Tine Client

BW7B Beamline user Area

Experimental Hutch

TCP/IP

SC-PC

PCI Heidenhain 220
PCI DAQ Multi I/O
PCI FrameGrabber NI

Exp Hutch Client

TCP/IP Connection to Mar

dedicated TCP/IP to ADEPT

FrameGrabber IP-engine

Lablink

RS-232

CCD - Camera

UV-Light

Sample Identification Scanner

SONY

PHI Translation Pusher Distance to Beamaxis

ADAM 4017

ADAM 4050

DI/DO AI/AO Modules

Heidenhain ND 281

PHI Rotation

Encoder for the PHI Rotation Axis

Heidenhain ND 281

Detector Distance

Encoder for the Detector Distance

MC Lennan 8 Motor Controler

Pusher, PreAlign Crystal, PHI Translation, Slits 1 Slits 2, BeamStop, PHI-Rotation, Detector Distance

ADEPT Controler

V+ Language

Goniometer

PHI

SONY Encoder

Prealig

Magnet

Pusher

Heidenhain Pneumatic Encoder

PHI Translation

Beam Stop

Sony Encoder

ADEPT ROBOT

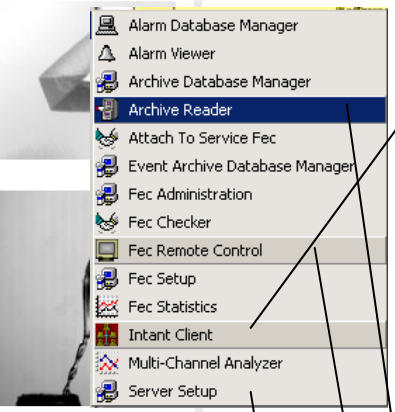
Deicing

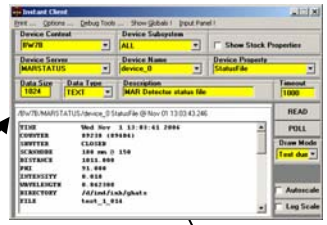
Scanner

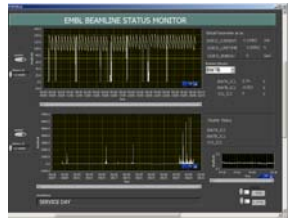
Mar 345 ImagePlate Detector

Cryo-Dewar

Tine Control System Software Suite DESY/MCs







Will be developed for PetraIII

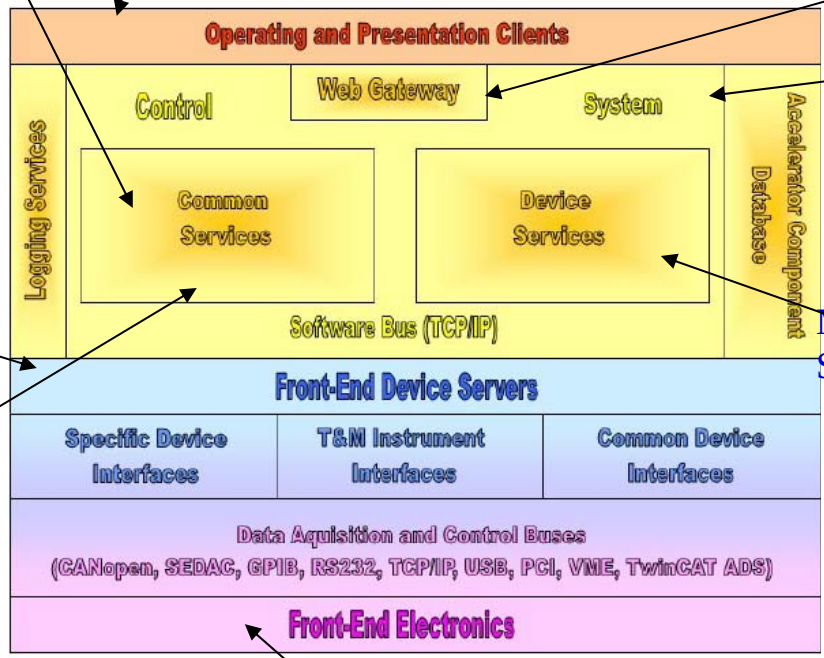
Control System Architecture

Java, MatLab, HTML, Script

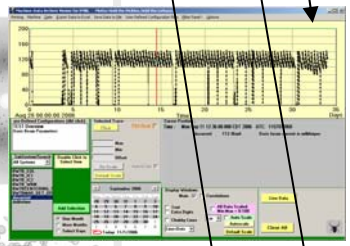
C/C++, Java, VisualBasic

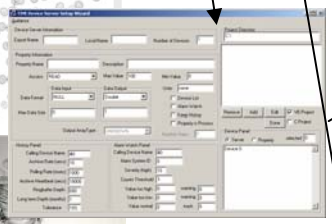
C/C++, Java, VisualBasic, LabView

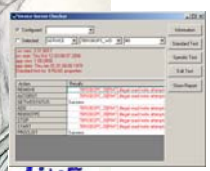
C, Assembler



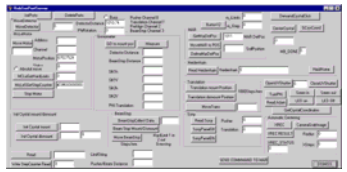
Translators to EPICS, DOOCS
Plan to build a TANGO and Spektra translator







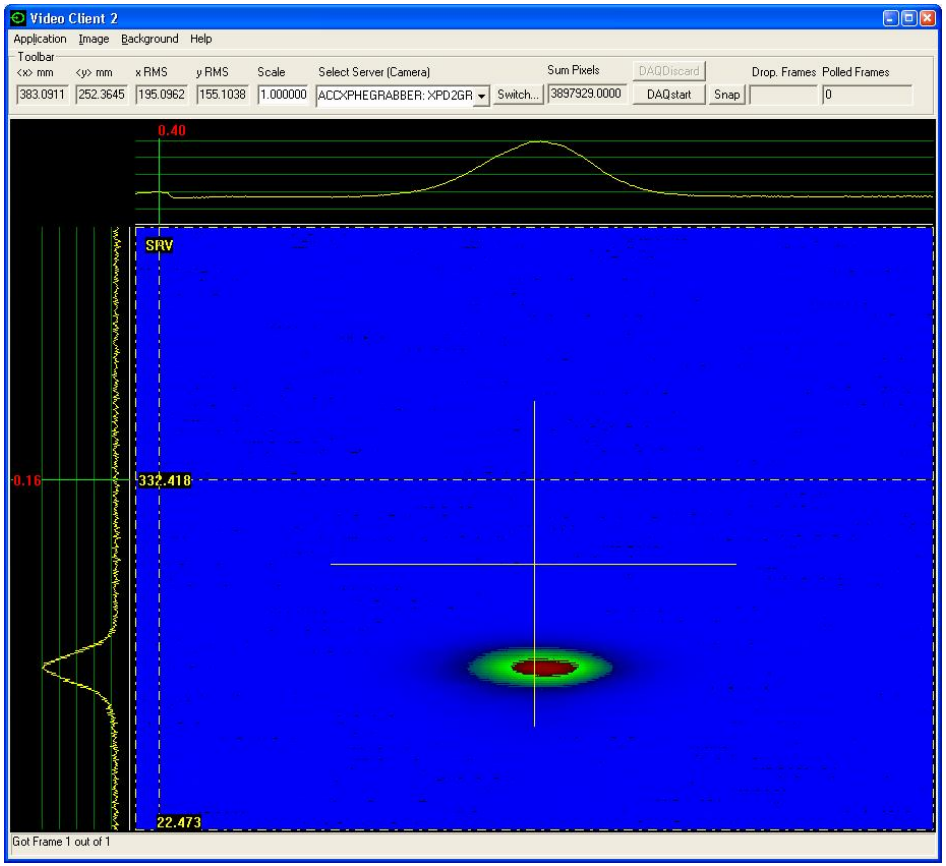
Monochromator, Mirror, Sample Changer, etc



Stepper Motors, DAQ, Counter,AI/AO, DI/DO Robot,etc

Video grabber with TINE server integration

•Video Server / Client Application by Stefan Weisse DESY/Zeuthen
The NI-1410 National Instrument Frame grabber card has been adapted
Is able to switch between 4 cameras.

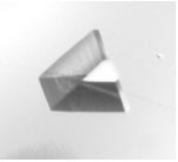


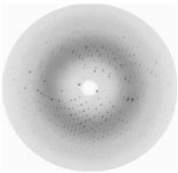
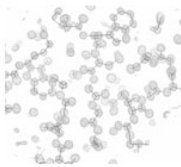
500KByte @ 10Hz in multicast Mode via TINE

Globals

Parameter	Value
DOENERGY	4.442441
DOCURRENT	102.7221
DOLIFETIME	17.49137
BW7B_IC1	0.000
BW7B_IC2	-0.005
BW7A_IC1	-0.009
BW7A_IC2	-0.001
BW7A_EOB	2.617
BW7A_ENERGY	12168.195

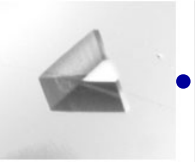
Control system at the EMBL



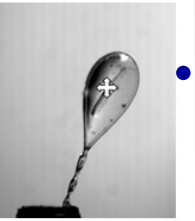



- During the development of the beamline automation on BW7B 6 computers with different operating systems were involved in the control of the system.
- To combine all relevant data and information a control system was needed which also enables reliable and fast operation.
- In 2005 we have decided to use TINE as Control System.
- Since than many device server were developed and lots of experience collected.

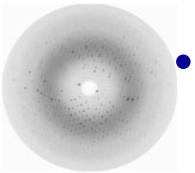
Future Control system requirements



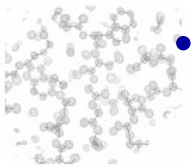
- Researcher, developer and administrators accesses data from their offices and from home



- Users require remote access and do not travel to the synchrotron for standardized experiments any more (saving of travel costs and time etc)



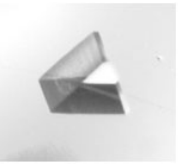
- All data of the beamlines, detectors, the data processing, automation, robotics are linked together.

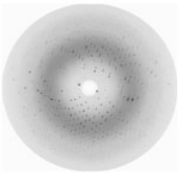


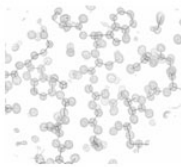
- The network traffic will increase with the new type of detectors and overall improve of automation

- **The Control system has to fulfill a tough job!!!!!!**

The DESY Control System TINE

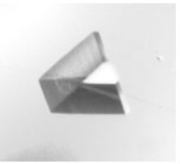


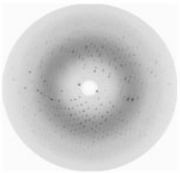
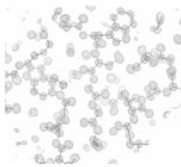




- TINE SUPPORTS MULTICAST
- WIN_CE
- TINE offers a fast history data base
- TINE offers Labview server support
- TINE offers SECURITY tools for data access BEAMLINE CUSTOMER LIKE THAT
- The TINE protocol is based on Sockets (used on all systems and will always stay) not 3rd parity products (that products are than also socket based).
- THE COMPLETE KNOWLEDGE OF TINE AND ITS TOOLS IS AVAILABLE BY DESY/MCS
- The group MCS of Reinhard Bacher gives great support
- Regular programming trainings offered by MCS
- TINE is as Open source code free available, the installation takes less than 5 minutes
- EMBL participates in small quantity in TINE tool development
  - TANGO2TINE AND TINE2TANGO TRANSLATOR (COSYLAB/DESY)
  - TINE COMPILATION FOR WINCE SUPPORT (embedded developments) Andres Pazos/Phillip Duval

Multi client problem for servers



Client

Client

People like watching video

5MB/sec

5MB/sec

5MB/sec

SWITCH

5MB/sec

Client

SWITCH

10MB/sec

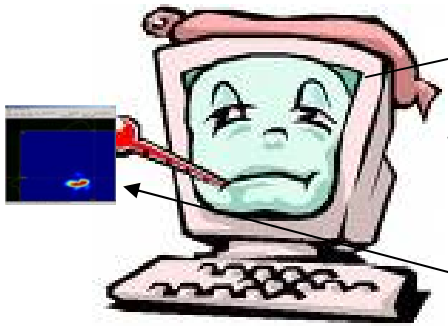
Client

5MB/sec

15MB/sec

Client

SWITCH

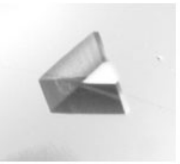

5*5MB/sec=25MB/sec

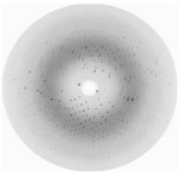
Server

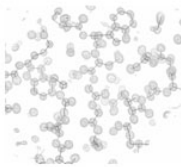
Result: High server and Network load !!!

Video application/ Stefan Weisse Desy/Zeuthen

Too high Server load? Too much network traffic?







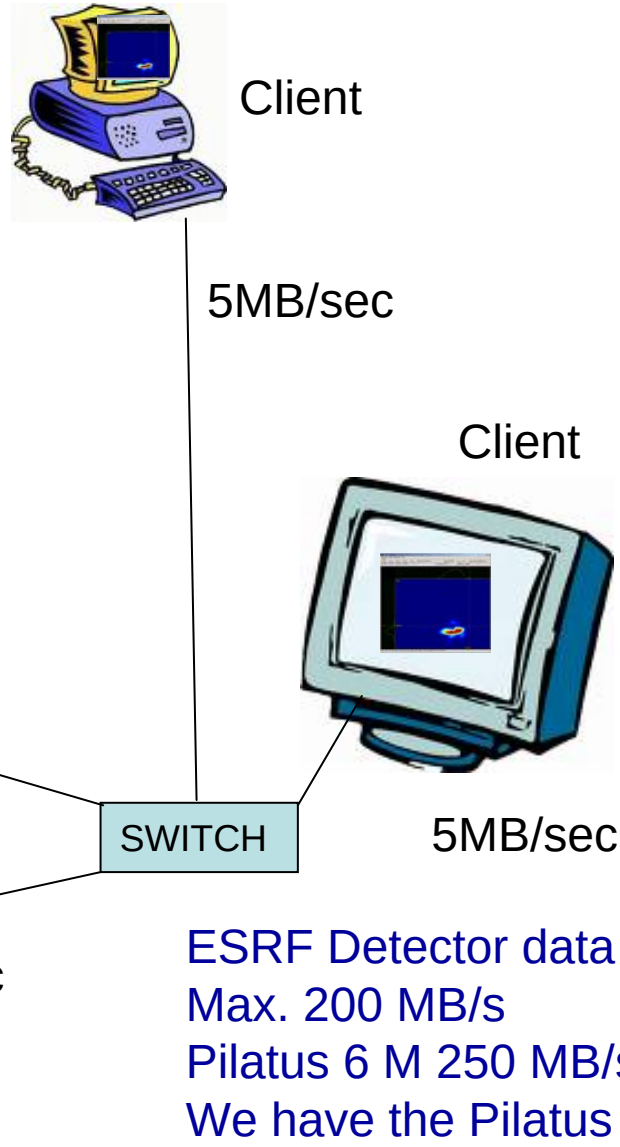
Don’t do it !!!

TINE offers Multicast and Publisher subscriber possibility to reduce server and network load

MULTICAST and Publisher Subscriber

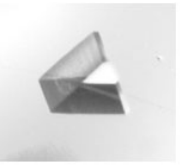
EMBL software using of TINE multicasts

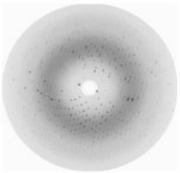
- Doris Parameter (current, status of beamline etc) all EMBL user can start this client.
- Robotic sample changer 3 click centering min 2 Clients

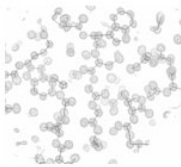


ESRF Detector data streams
Max. 200 MB/s
Pilatus 6 M 250 MB/sec ?!?!?!?
We have the Pilatus 2M with max 60 MB/s

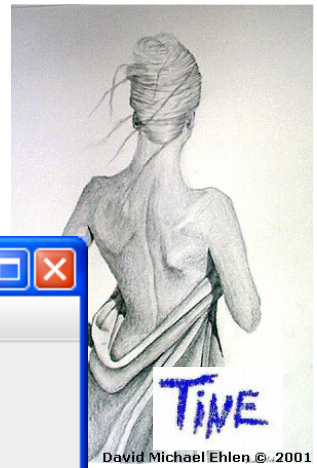
TINE JAVA Tools of the TINE4 Release

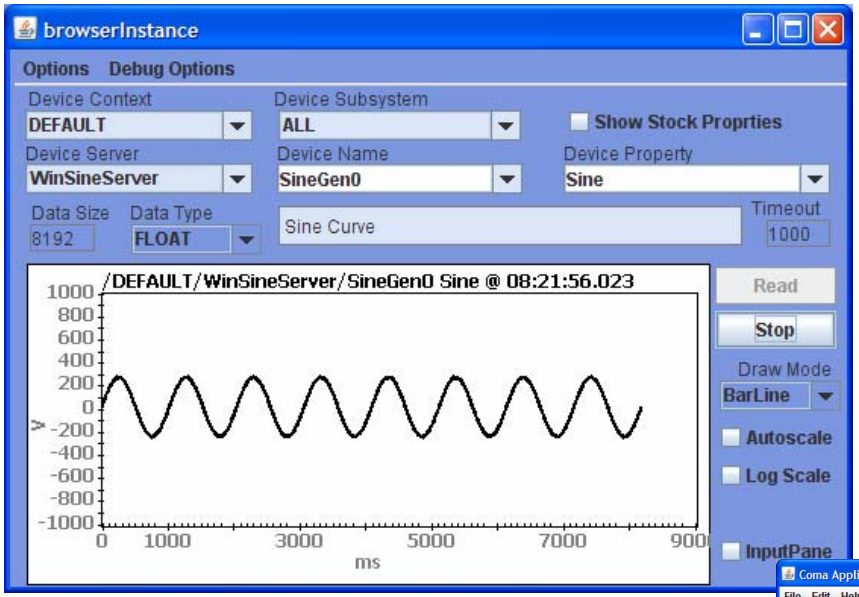


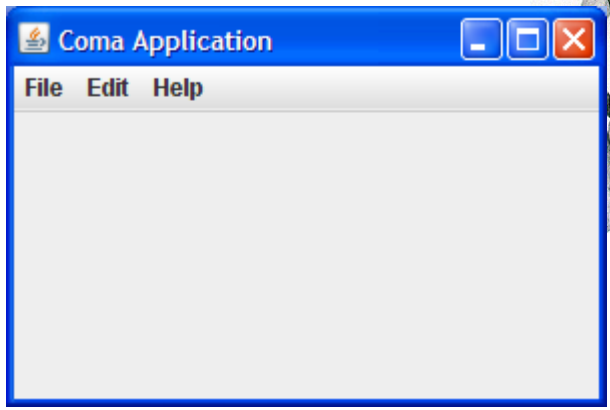


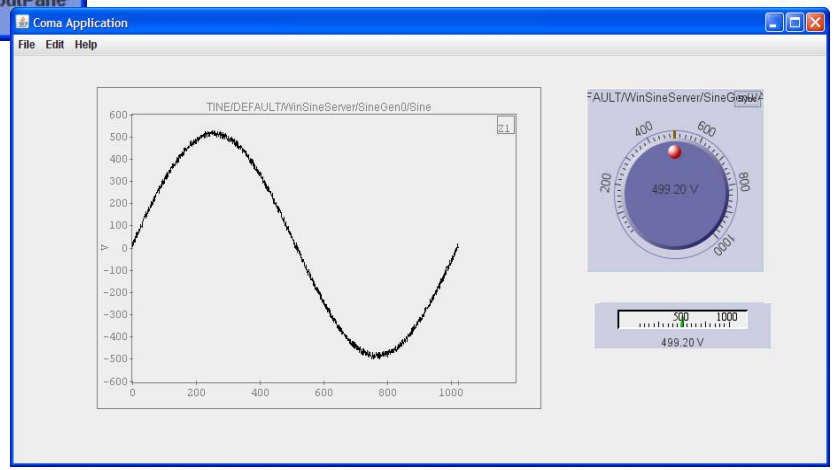


TINE
Instant
Client







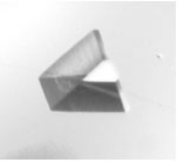


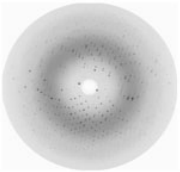
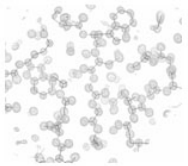
TINE JAVA
COMA TOOL

RUNTIME
Client generation!

Platform independent Control system Tools are important

Tango2Tine Translator

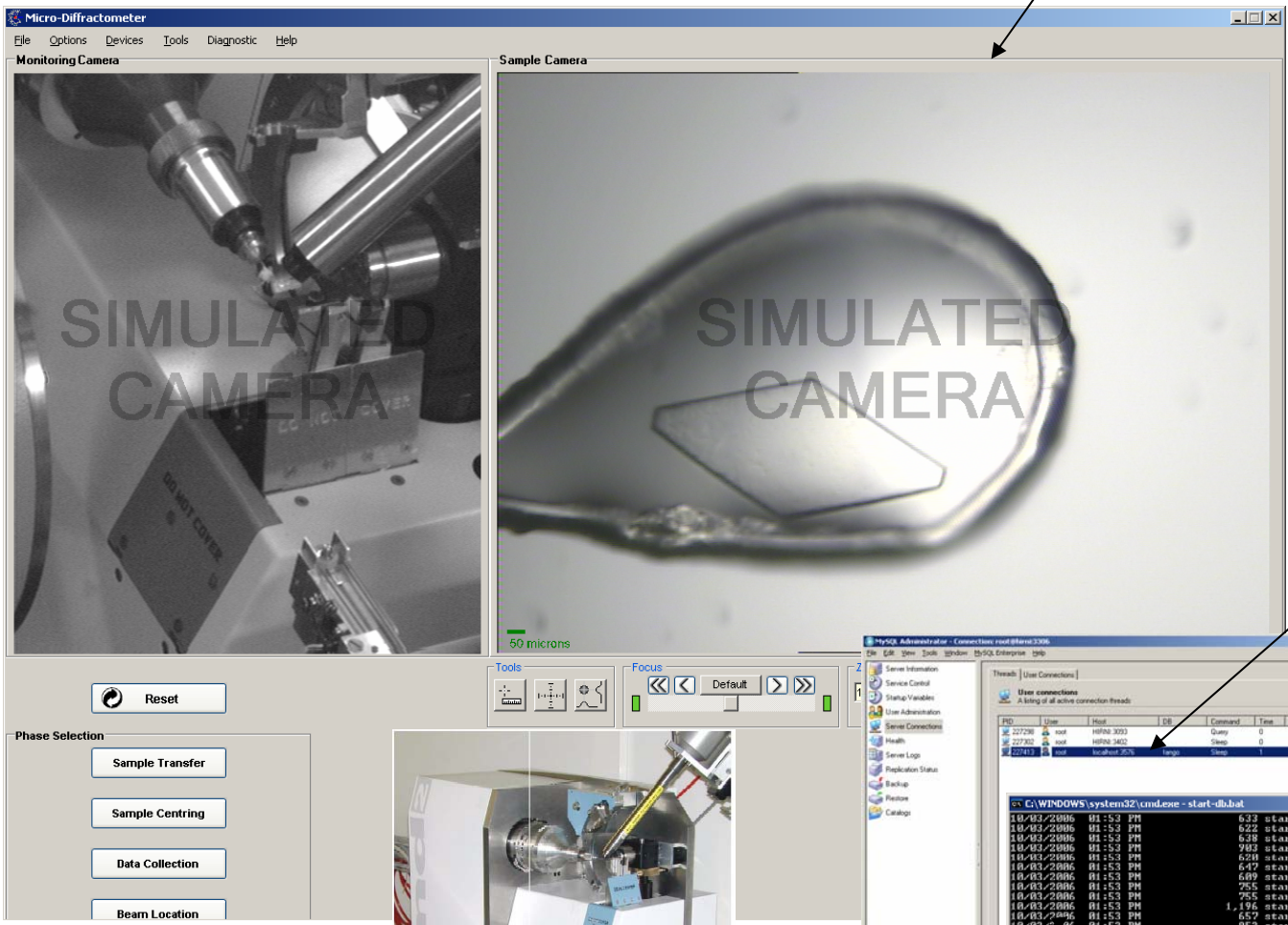


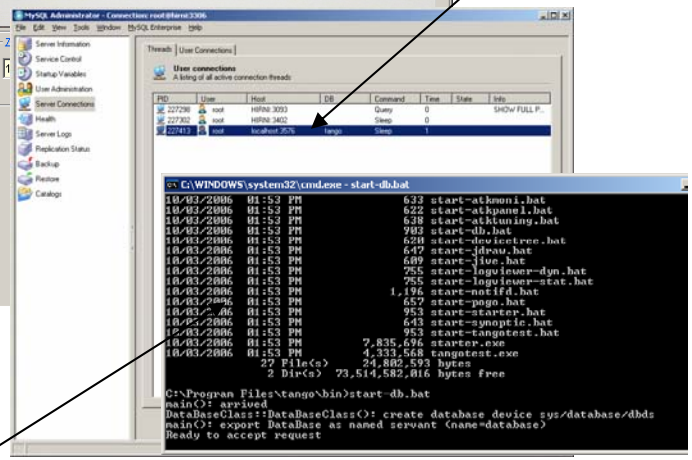
- Tine 2Tango gateway enables TINE to operate on Tango Device Server
- The generic Tango2Tine Gateway was developed by COSYLAB/EMBL and DESY.
- EMBL paying the COSYLAB part.
- The generic gateway is available for Windows and Linux (SUSE 10.2) and will be available at the TINE Website http://tine.desy.de and at www.embl-hamburg.de/tine
- All Tango data types are supported.
- First Test applications with the EMBL simulated MD2 device server are started.

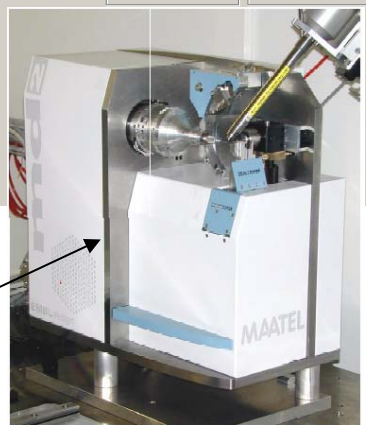
MD2 Simulated Server

Simulated MD2 server (No hardware)



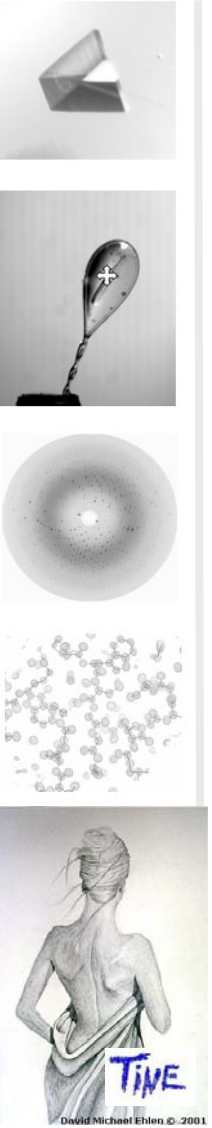
Tango/ Jive





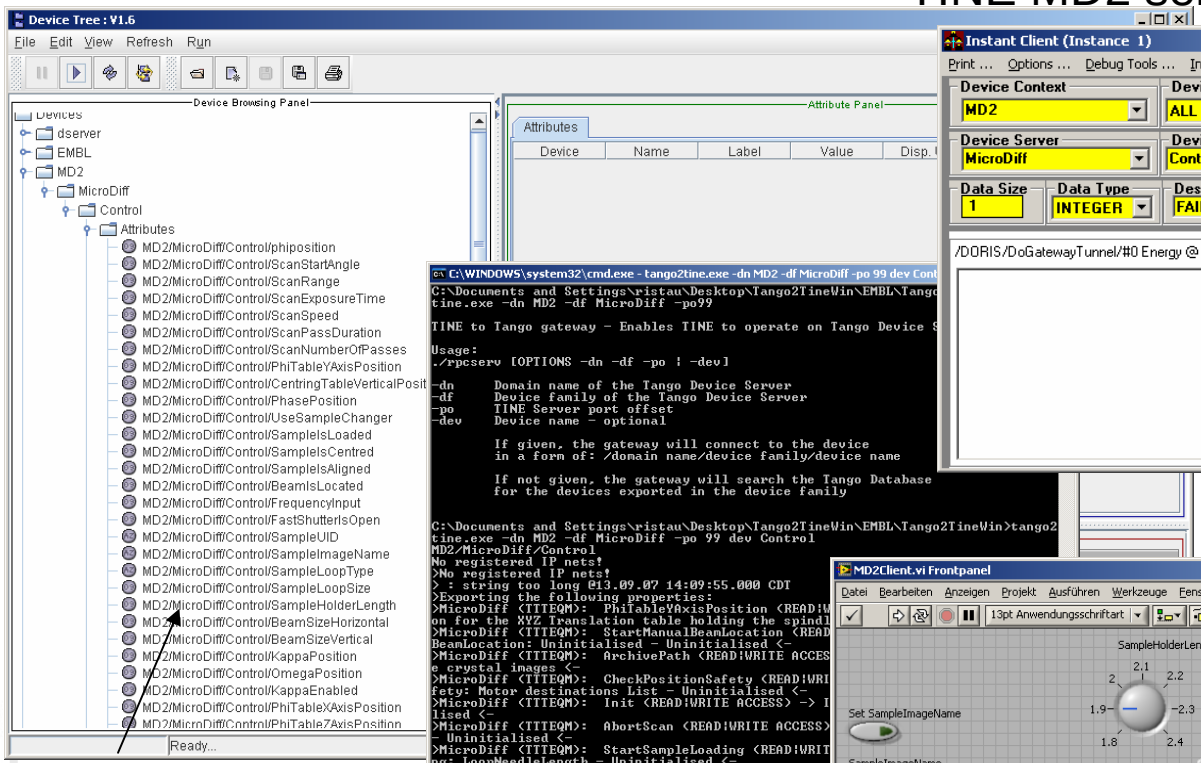
The simulated server simulates this hardware

Tango2Tine Translator



First MD2 Client test application

By the Translator automatic created TINE MD2 server

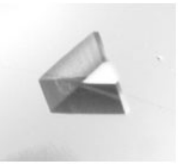


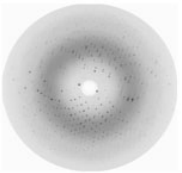
Tango Jive with all exported Attributes

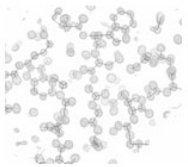
Translator running on Win/Linux

Labview MD2 Client

Generic TINE2TANGO Translator

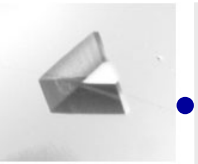
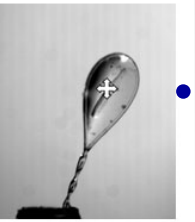
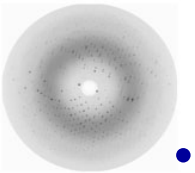
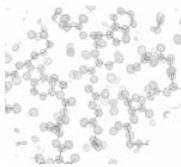




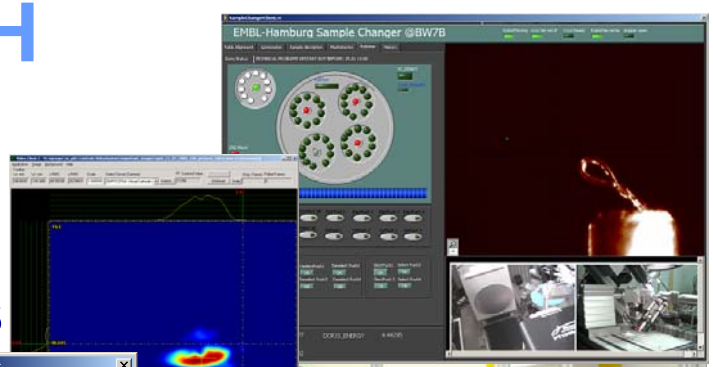


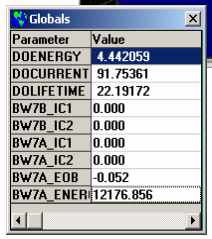
Scince the 20th of September and until the 4th of October Rok Stefanic (COSYLAB) and Phil Duval (DESY) will work on the development of the TINE2TANGO Translator which was started in June 2007.

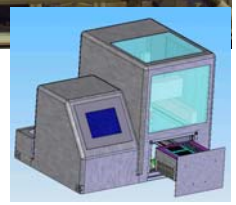
Control of the EMBL-HH beam lines at DORIS

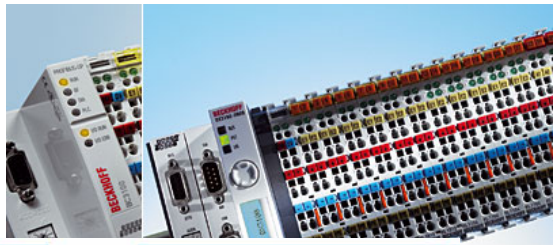





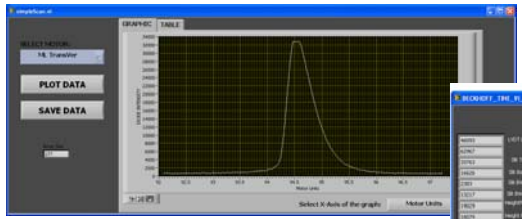
- **Control System of the EMBL is TINE (DESY/MCS)**
- Highlights
  - Robotic Sample Changer BW7B
  - X33 Sample Changer
  - Mulitlayer Monochromator Beckhoff/EtherCat
- Next Projects
  - Generic TINE Detector server for the Pilatus 500k and the MAR 555 Flat panel Detector
  - PXI integration of a Fast digitizer 1GS/s and a FPGA (NI)

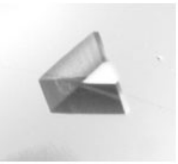


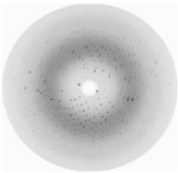
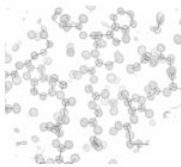










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