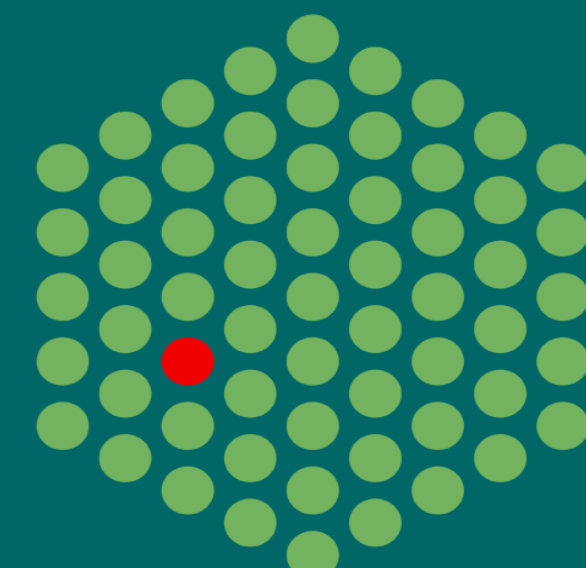# Marvin Update –

the EMBL – Hamburg Robotic Sample Changer

EMBL

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Abstract

In this article we give an overview about the controls of the robotic sample mounting system Marvin in user operation at the DESY Petra III synchrotron Beamlines of the EMBL. Two protein crystallography Beamlines each equipped with the in house build robotic sample mounting system are in user operation. The controls of the sample mounting system 'Marvin' and especially new developments to decrease down times as well as system recovery routines will be described in detail.

Marvin Sample Mounting System

The Marvin sample changer is in user operation since 2014 and the second system since 2016. In 2017 about 30000 samples have been mounted with this two systems. Here we describe the controls of this system which is part of the BICFROK framework of the EMBL Hamburg instrumentation group.
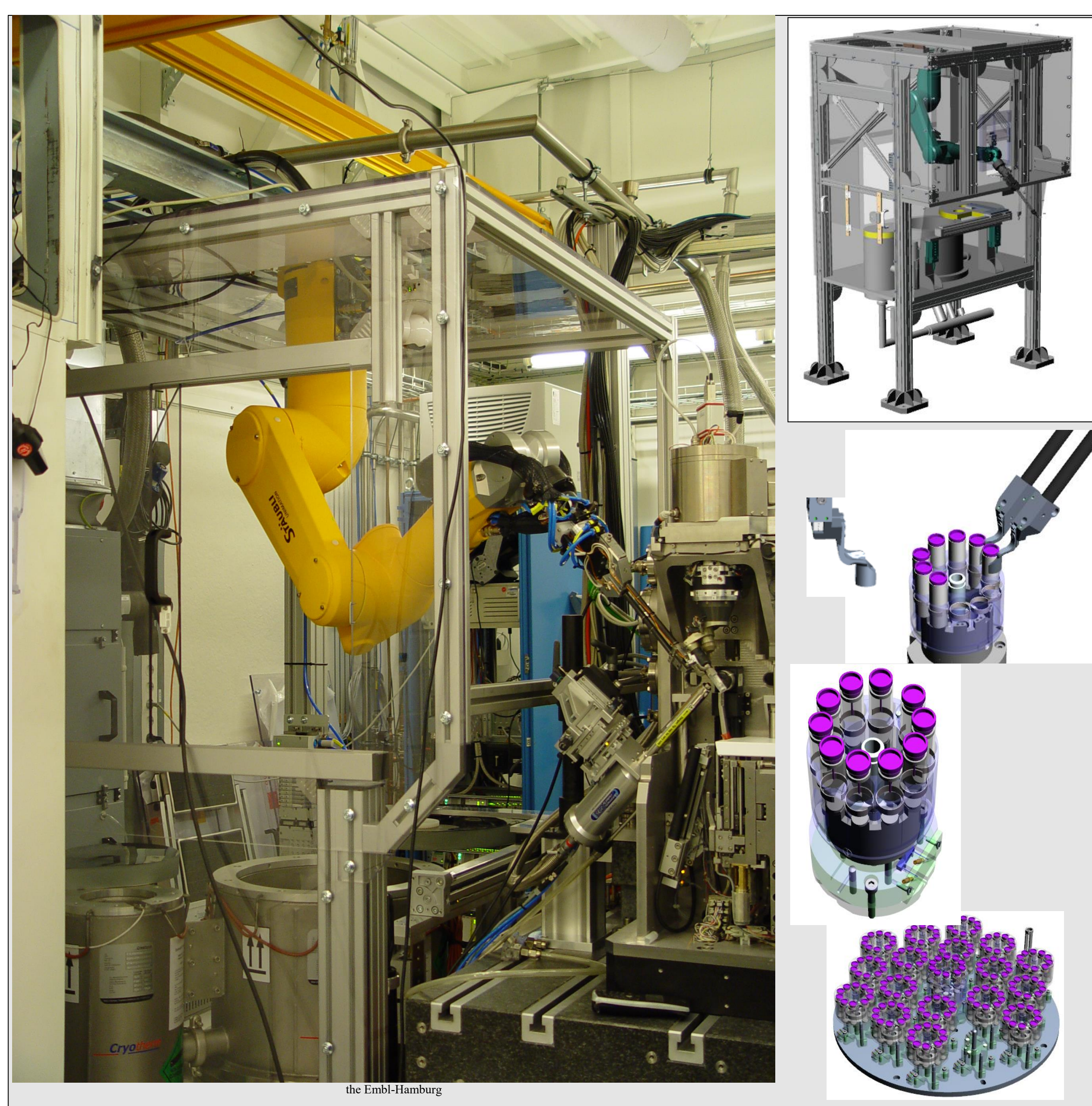

Figure 1. Marvin mounting a sample at the Beamline called P14 MD3 Goniometer.

The system has a capacity of 170 SPINE samples stored in 17 Spine standard pucks inside of the nitrogen cooled storage dewar which is equipped with an automatic nitrogen refilling system. The Robot is mounted in a cage to have stable humidity conditions and to allow user access inside the experimental hutch during robot motions inside the cage.

Marvin Controls

The control concept at the EMBL Petra beamlines is based on the described approach [2] of a hierarchical structured server architecture. Heart of the controls is the TINE control system. In the layered control structure the CS8C robot server is the low level control [1].

Figure 2. A sketch of the Controls involved in the Marvin Operation. Shown are the devices to be controlled and the Software controlling the devices

Servers are written in Val3 for the robots and in G-Code using LabVIEW for the Marvin TINE Server. The server is part of the framework of the EMBL instrumentation framework BICFROK. Clients programmed with LabVIEW, the PLC programming of the Beckhoff fieldbus system is in structured text.

Marvin Control Software

The Marvin TINE server is acting as a sequencer which coordinates the I/O signals and provides the sequencing of the commands called on the CS8 controller.
The low level device server of the robot is executed on the robot controller itself.
The code is grouped in separated tasks of defined priority where each of the tasks can execute n programs.
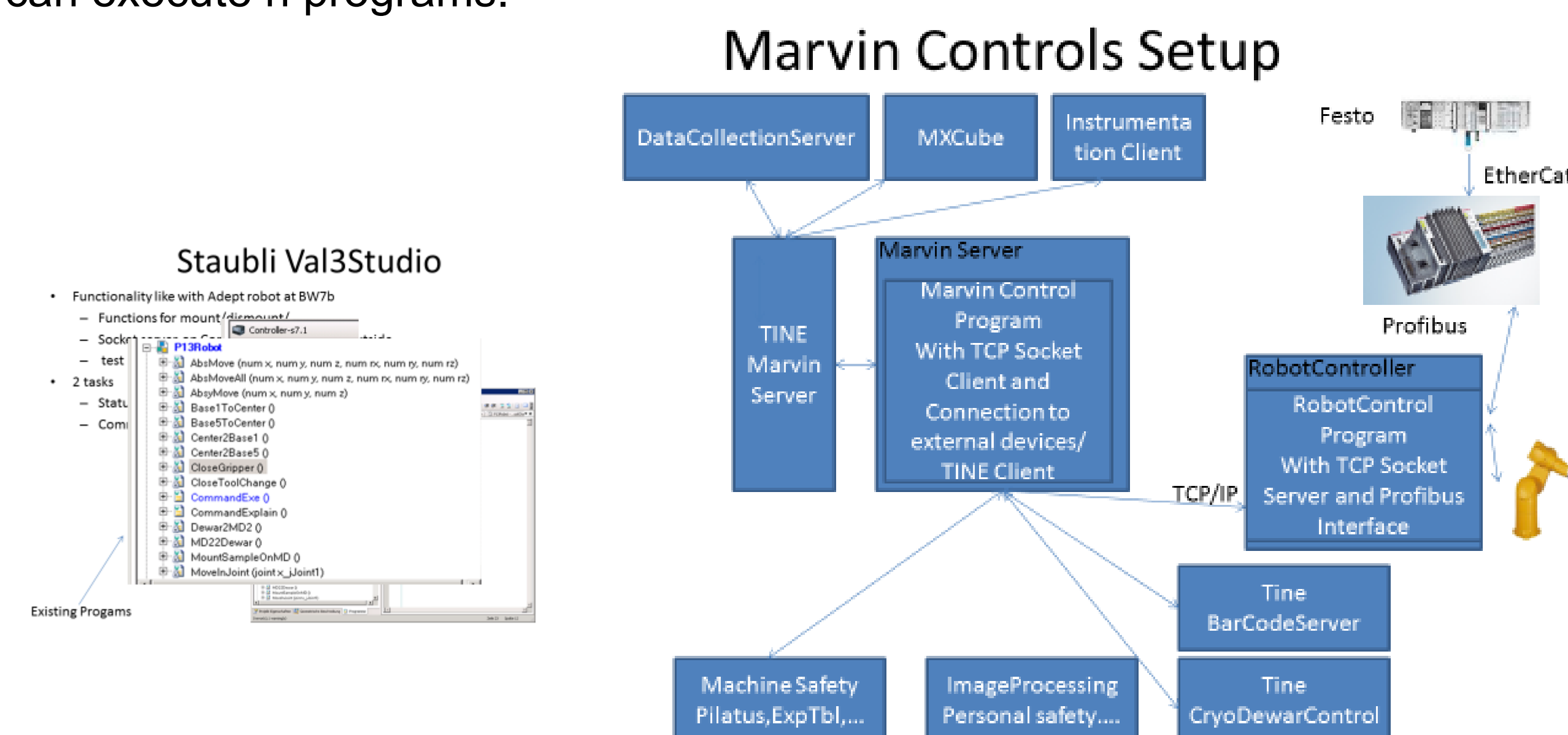

Figure 3. Software involved to do a data collection with samples mounted by Marvin

Server and Client GUIS In Use

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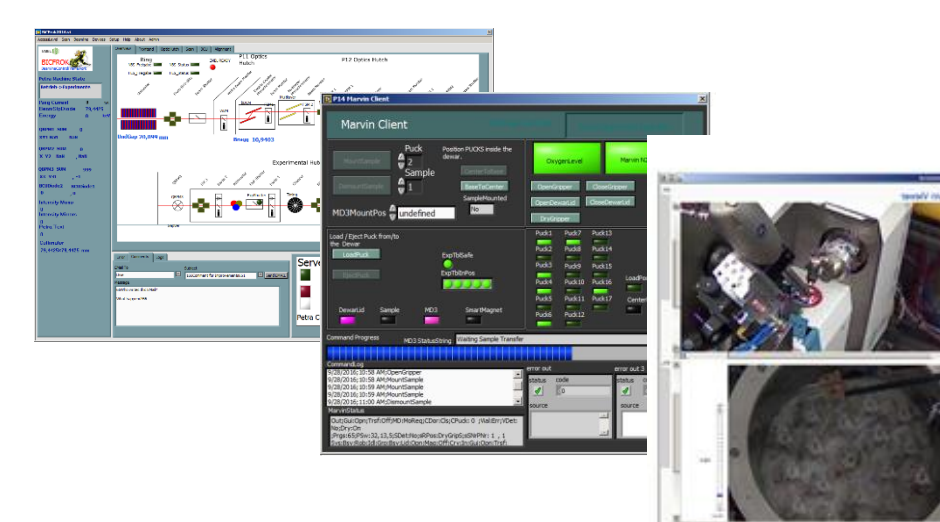

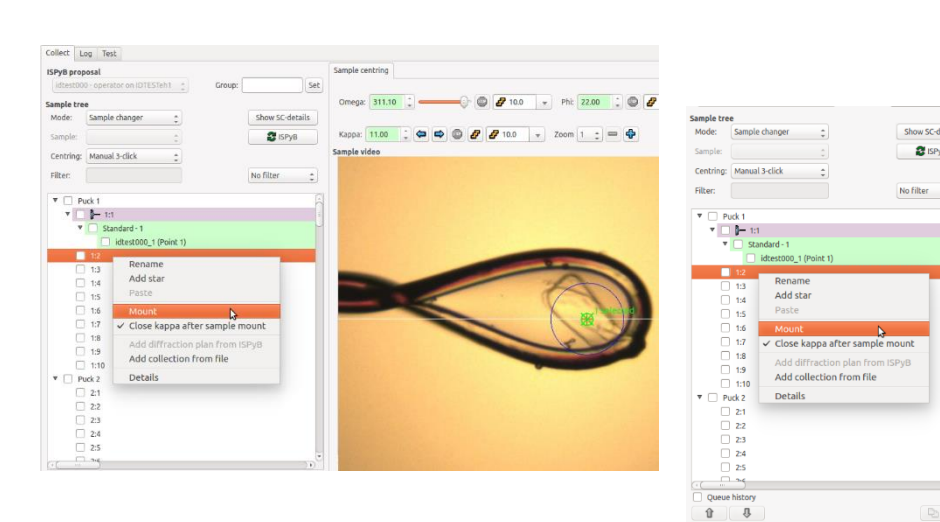Figure 4. Software involved to do a data collection with samples mounted by Marvin

Figure 5. MxCube Client interacting with the sample changer control software

Conclusion

Both EMBL Marvin sample changer at the PETRA III beamline are doing their daily work. Increase of the sample through put due to shorter cycle times and Integration of new Pin standards like the mini Spine standard are future development possibilities some already in progress.
Optional the integration of a robotic plate screening which is available as a prototype presented for the MD2 at Beamline P13 are implementations possible.
In order to fulfil the requirements on machine and personal safety it is planed to progress in this field too. At the moment the EMBL- Hamburg are developing a new robotic system which will work at the crystallization hotel together with SPC.
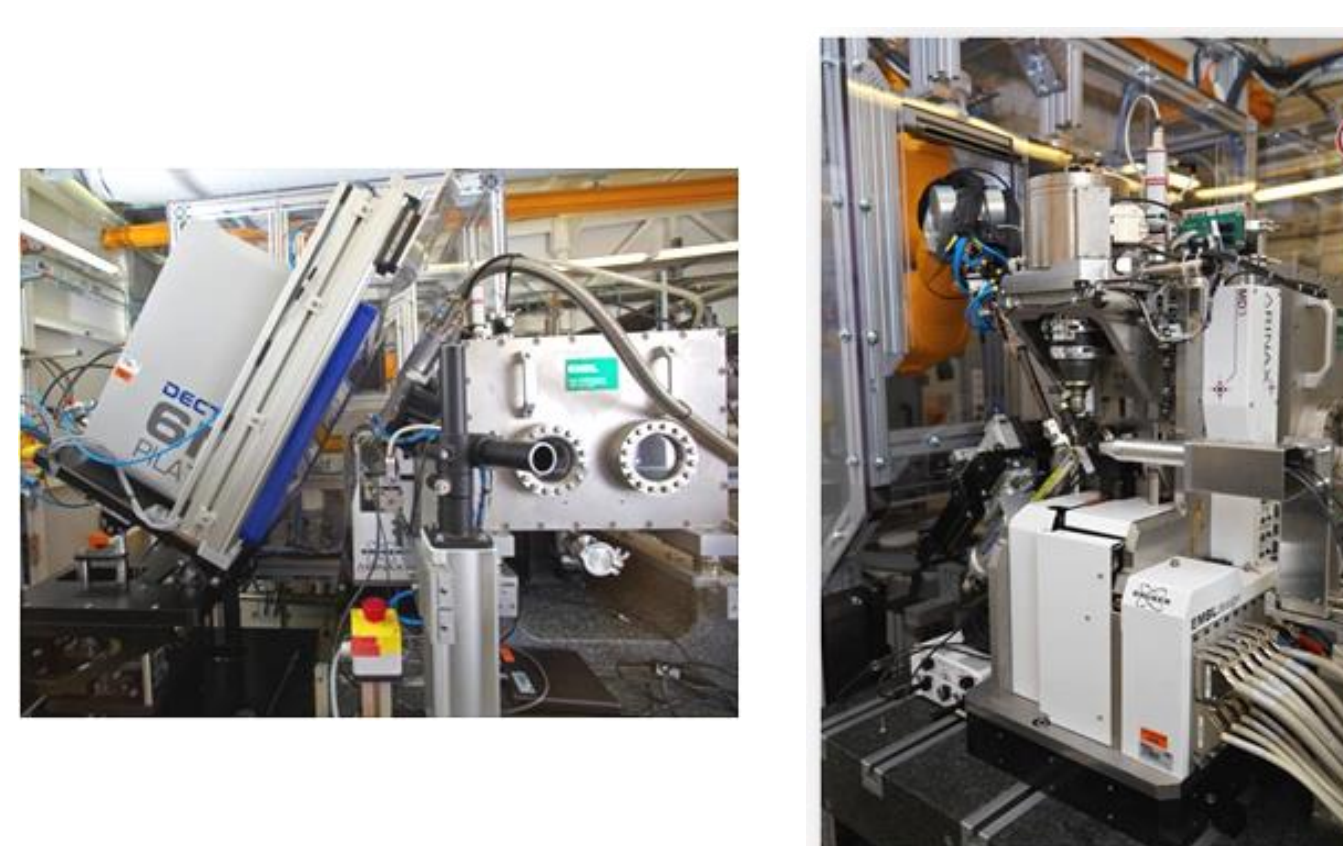

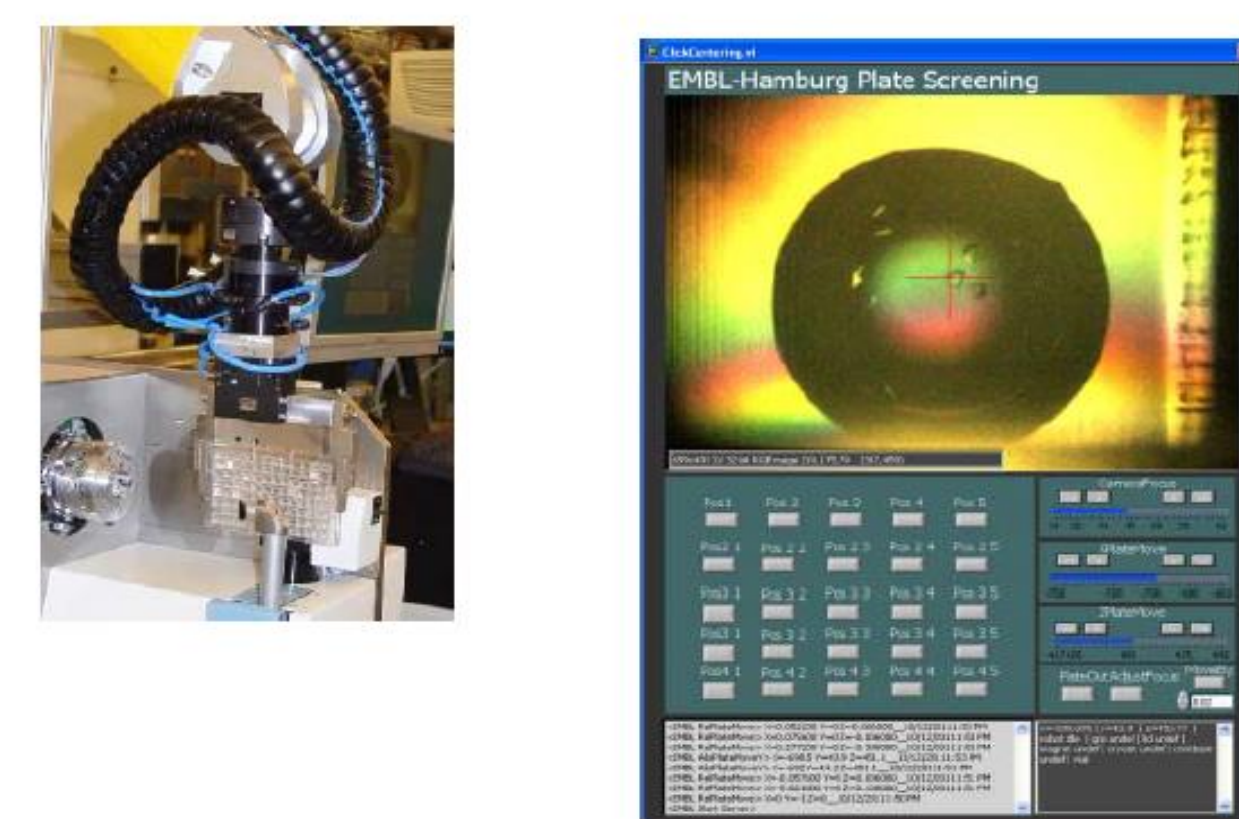Figure 6. Left: Detector on detector translation infront of the goniometer. Right: Mounting sample on the MD3

Figure 7. Prototyp of a Plate screening setup with Marvin and the MD2 data collection at P13

References

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[3]   Site of the Beckhoff Company: http://www.beckhoff.com/
[4]   National Instruments Corporation: http://www.ni.com/labview
[5]   U. Ristau et al., "Control Concept of the new EMBL-Hamburg Sample Changer", WEP019, Proceedings of PCaPAC08, Ljubljana, Slovenia
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