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Sample positioning device

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<i>Deliverable Type</i>	
R = Report DEM = Demonstrator, pilot, prototype, plan designs DEC = Websites, patents filing, press & media actions, videos, etc. OTHER = Software, technical diagram, etc.	DEM
<i>Dissemination Level</i>	
PU = Public, fully open, e.g. web CO = Confidential, restricted under conditions set out in Model Grant Agreement CI = Classified, information as referred to in Commission Decision 2001/844/EC	PU



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We have developed the Roadrunner IV goniometer for fast scanning of fixed targets under UHV conditions and capable of scanning speeds of up to 70 mm/s.

The main element of the Roadrunner IV goniometer is the fast scanning axis which is shown in Figure 1. The fast scanning axis is oriented in the horizontal direction and operated with a high power linear motor in order to achieve fast acceleration of the targets and realize fast scanning speeds. The travel range in horizontal direction is 50 mm, the positioning accuracy of the axis is better than 100 nm. The stage is equipped with an incremental encoder for positional feedback and typically operated in closed loop.

This fast scanning linear axis is mounted on stepper motor operated x,z- translation stages enabling to position the scanning axis in two directions perpendicular to the scanning fast axis. These axes provide a travel range of 15 mm each and can be operated at speeds of up to 1 mm/s. These three axes are mounted on a rotation stage which can be used to investigate the fixed targets at different orientations with respect to the incoming beam. The rotation stage allows tilting of the samples by +/- 70 degrees. The stage is equipped with an encoder and operated in closed loop with a servo motor. A technical drawing of the entire Roadrunner IV setup is shown in Figure 2.

During the experiment the fixed target is scanned with a high speed using the fast scanning axis in horizontal direction. After a line is finished the target is moved vertically to switch to the next line of targets, which is then scanned in reverse direction. In this way the entire target is scanned in very efficient way in a meander scan.

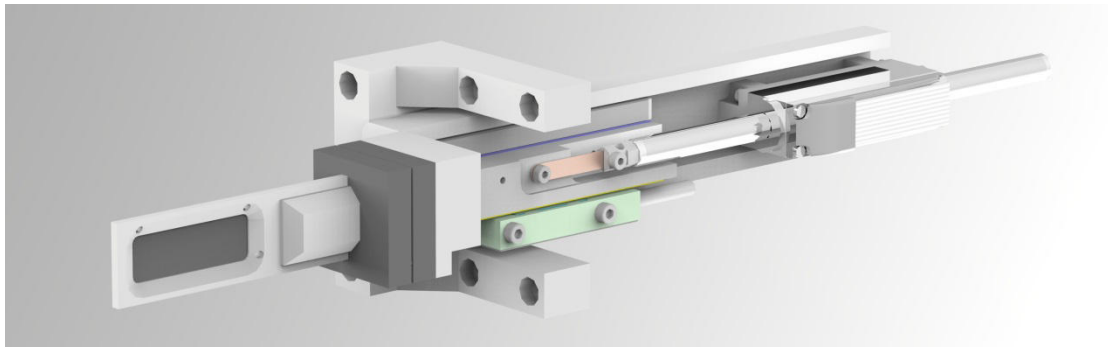


Figure 1: Technical drawing of the horizontal translation axis operated in closed loop with a linear motor used for fast scanning of the fixed targets in horizontal direction. The target carrying the sample is shown on the left side of the image and mounted on an aluminium frame.

All motors are operated with a Galil DMC-4080 controller and fully integrated in the TANGO control software.

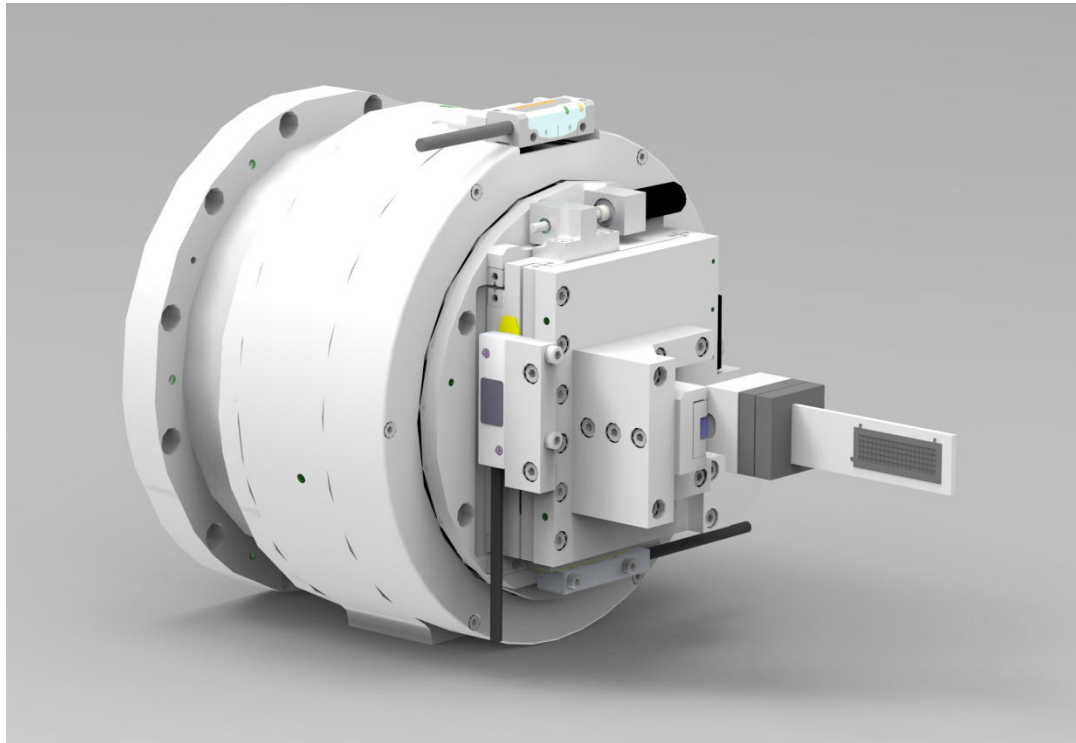


Figure 2: Technical drawing of the Roadrunner IV goniometer for fast sample positioning under UHV conditions. The fixed target can be seen on the right side of the image. The linear axis is mounted on two translation stages and inserted into the open bore of the outer rotation stage in order to build a more compact device.

For first experiments at the Linear Coherent Light Source (LCLS) in Stanford USA we have developed a first prototype (Roadrunner II) of the setup for in-air operation. Serial crystallography experiments with different sample have been performed very successfully under proposal numbers LN11 and LN78 in November 2016. The setup allowed to scan large fixed targets with dimensions of $32 \times 12 \text{ mm}^2$ with the full repetition rate of LCLS in less than 30 minutes. A picture of the experimental setup used at LCLS is shown in Figure 3.

All parts for the in-vacuum version of the Roadrunner IV have been ordered already or are currently being manufactured. Due to technical challenges and unexpectedly long delivery times the goniometer could not be fully assembled and tested yet under UHV conditions. We expect this part of the deliverable to be completed in September 2017.

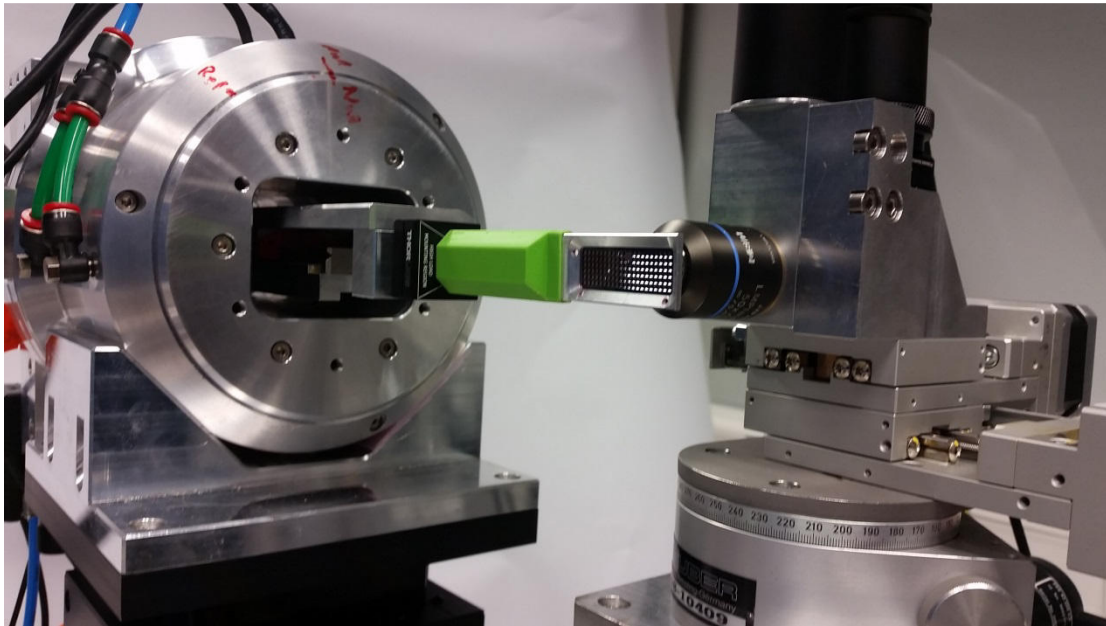


Figure 3: Roadrunner II goniometer for high-speed fixed-target serial crystallography experiments under atmospheric pressure as used at the MFX beamline at LCLS in Stanford USA.