Upgrade of the Super Advanced X-ray Spectrometer (SAXES) of the RIXS endstation for better resolution and larger detector size

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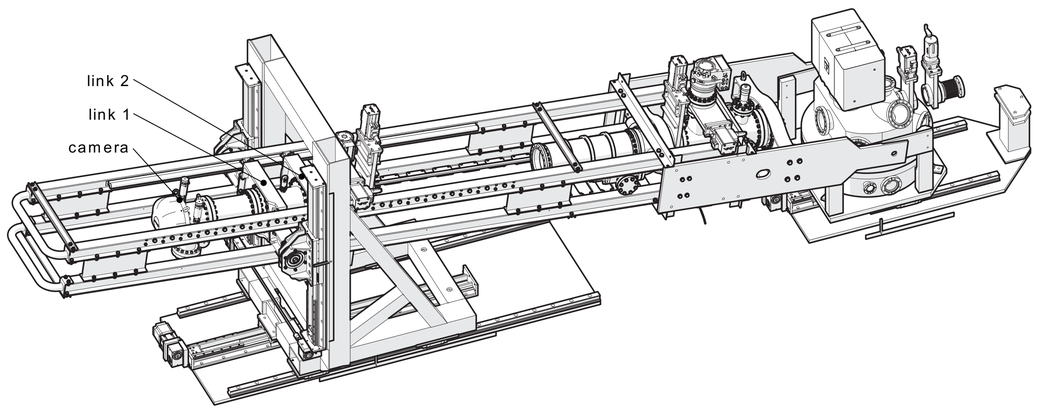
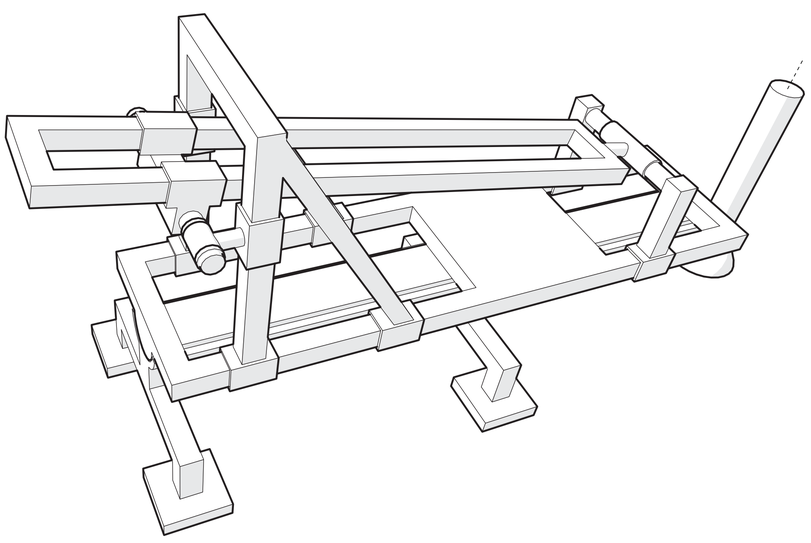
Abstract

The RIXS endstation of ADRESS beamline at Swiss Light Source (SLS) is equipped with an ultrahigh resolution X-ray spectrometer. In the scope of a CCD camera upgrade, the modification of the vertical alignment of the guiding structure and larger ultra-high vacuum tanks became necessary. The new camera features a higher resolution and a larger detector size. The redesigned spectrometer is shown on the right.





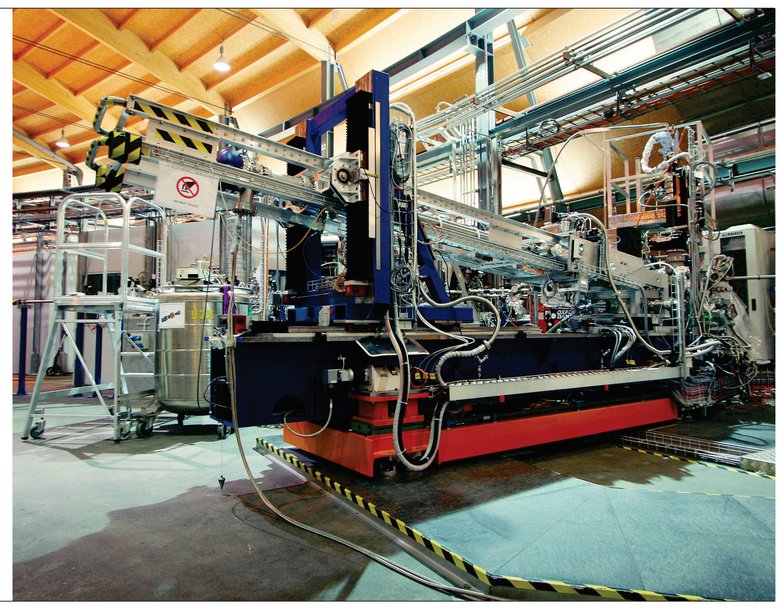
Kinematics

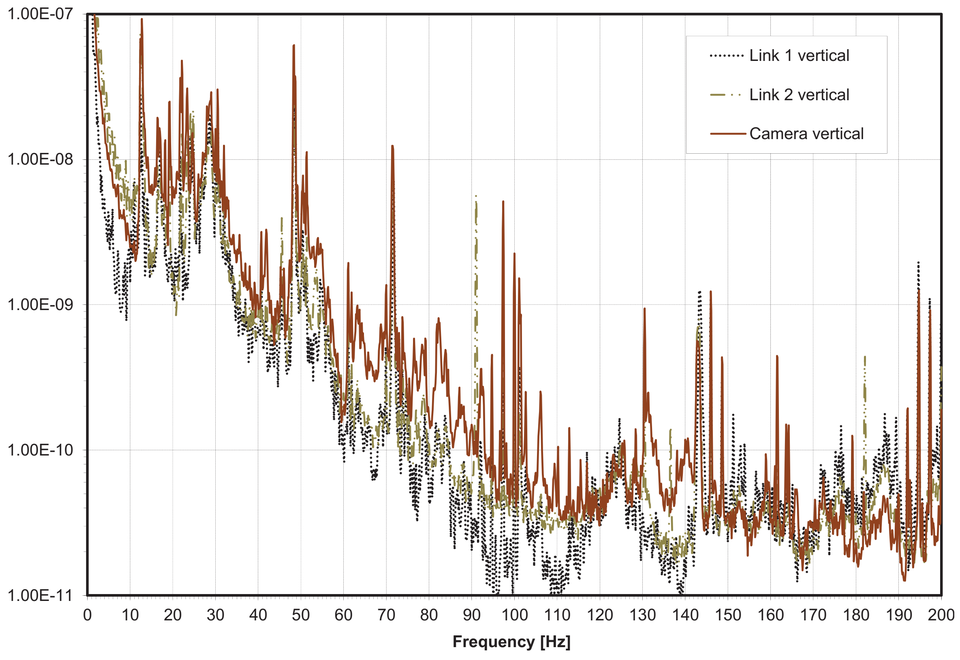
According to the requirements, the Instrument parameters, the range and the drive elements shouldn't change. The rotation axis of the camera support had to be moved closer to the vertical guiding structure, to improve stability and the natural frequency of the supporting structure. The given kinematics were highly over determined, which lead to a poor regularity in operation. A new bearing concept was indispensable to remove overdeterminacy, without compromising stiffness and stability. Manufacturing tolerances and thermal elongations during bake out at 150 °C were consistently solved and are overcome with this redesign.

Design

To support the new and bigger vacuum chambers, the carrier structure had to be redesigned. The vacuum chambers are carried by two aluminium cross links to optimise weight. Four new aluminium beams build the spectrometers arm to compensate for the additional weight of the chambers and the new pumps. The vacuum system is split in three sectors for easier maintenance with the large bellow obtaining a separate sector.

The new bellow has a diameter of 150 mm (DN150) and enables an elongation of 1700 mm. Therefore a new guiding system was designed for it. The final spectrometer after the upgrade can be seen on the right.





Direction	Before Upgrade	After Upgrade
Vertical	4	3.2
Horizontal	4	2.5

Displacement Amplification Ratio from Girder to Camera

Measurements

The displacement behaviour on the camera and articulation can be seen on the left. The eigenmodes of the structure are barely visible due to the low amplification. The RMS displacement vertical to the beam from 5 to 200 Hz is below 100 nm and around 100 nm in horizontal direction. The specified camera movement of 2 microns is fulfilled. The girder itself shows low frequencies and a relatively high amplification ratio. Since the girder was outside of the scope of this project, its vibration remains determinative for the overall stability behaviour of the system.

For the comparison of the two situations, the amplification ratio between the camera and the girder has been evaluated as shown in the table on the left. The amplification ratio from the camera to the girder, especially in transversal direction, is much lower after the upgrade, manifesting the stiff structure and improved stability of the new camera support.

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