ISBN: 978-3-95450-188-5 doi:10.18429/JACoW-MEDSI2016-MOPE16

DEVELOPMENT OF THE RIXS MANIPULATOR

H.Joehri†, Leonard Nue, Thorsten Schmitt, Christoph Hess, Luc Patthey,

Sebastian Sonderegger, Paul Scherrer Institut, Villigen, Switzerland

Abstract

The RIXS Manipulator (RIXS = Resonant Inelastic X-ray Scattering) is a further development of the Carving Manipulator.

The carving manipulator has six independent degrees of freedom (three translations and three rotations). All three rotations are exactly in the middle of the sample surface.

The head of the manipulator is in UHV and the sample can be cooled down to 14K.

For the RIXS manipulator there is a new requirement to have a field of view from 0 – 180°. There are mainly two parts in the carving manipulator that set the probe in the shadow of the beam at small angles.

- A bellow
- The bearings

To solve these problems we shifted the bellow behind the pivot point. This gives some strange movements of the bellows and we had to analyse this in a separate test installation.

For the bearings, we developed a goniometer bearing with ceramic bearing shells.

Meanwhile the RIXS manipulator is implemented and in routine operation.

CARVING MANIPULATOR

The RIXS manipulator is a further development of the carving manipulator which is used to position solid samples. It has six degrees of freedom and the kinematics is designed in a way that all tree rotations can be executed without moving the center of the sample (Figure 1).

The head is in a vacuum chamber and the sample can be cooled down to 14°K.

All motors are outside of the vacuum chamber. The rotation of the sample and the movement of the tilt angle are transmitted into the vacuum.

The transmission is realized by shafts and gears (Fig 2).

For the rotation of the sample, one step of the transmission is done by a bellow (Figure 3)

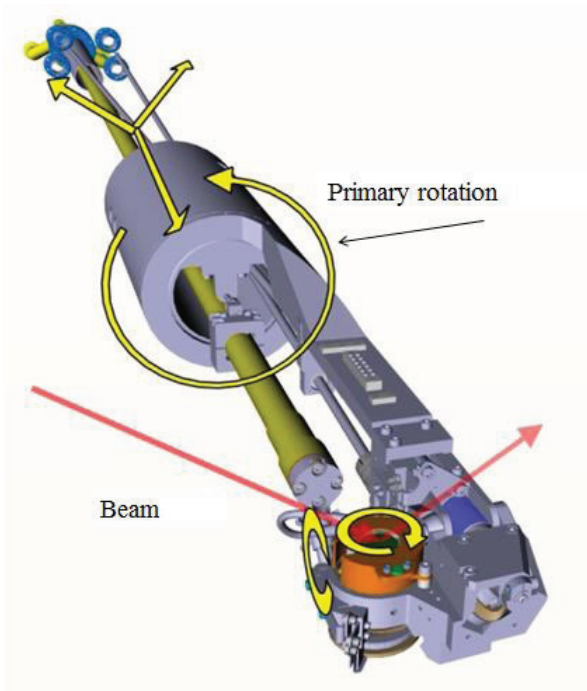

Figure 1: Carving manipulator with 6 degrees of freedom.

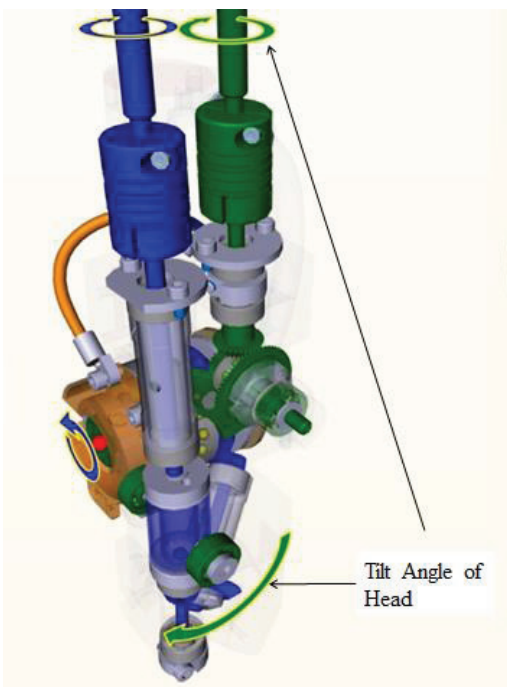

Figure 2: Transmission of sample-rotation (blue) and tilt angle of head (green).

† haimo.joehri@psi.ch

ISBN: 978-3-95450-188-5 doi:10.18429/JACoW-MEDSI2016-MOPE16

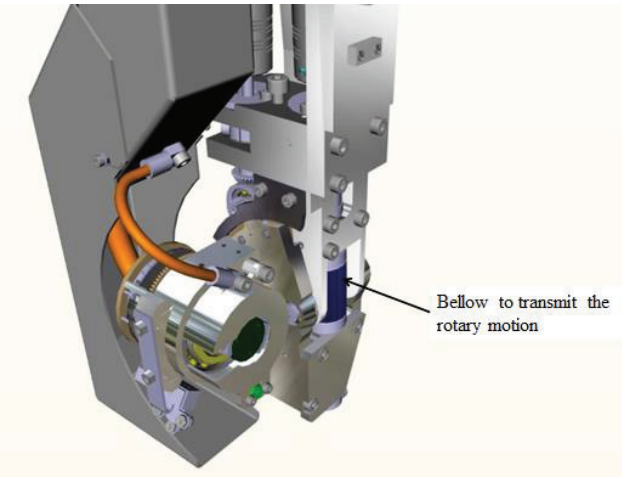

Figure 3: Bellow.

RIXS MANIPULATOR

For the RIXS Manipulator (Resonant Inelastic X-ray Scattering), an angular range of the primary rotation of 0° - 180° is needed. In the Carving Manipulator design, the bellow and the bearing obstructs the beam at small angles (Figure 4). To solve this problem, the bellow is shifted away from the axis and a goniometer bearing was developed.

For the goniometer bearing, shells and balls of ceramics are used (Figure 5).

For the bellow, the tilt rotation results in a combined lateral, axial and angular movement for the bellow, that have been tested in a separate test setup (Figure 6)

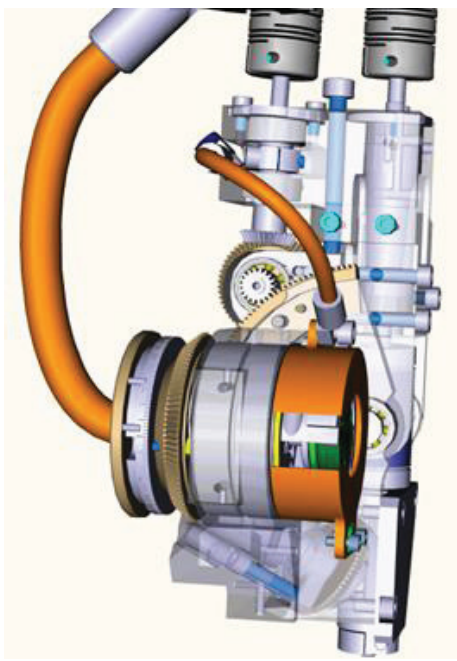

Figure 4: Obstruction of the beam at small angles.

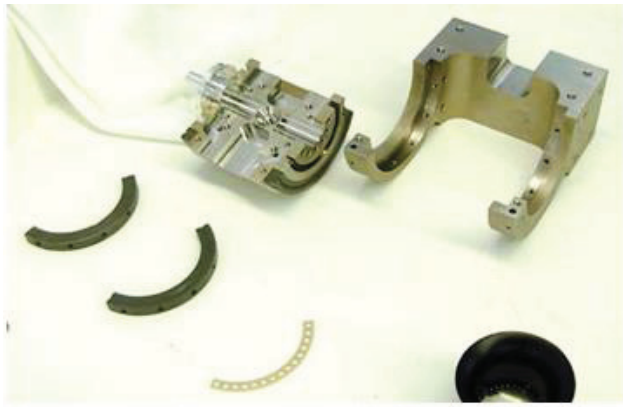

Figure 5: Goniometer Bearing.

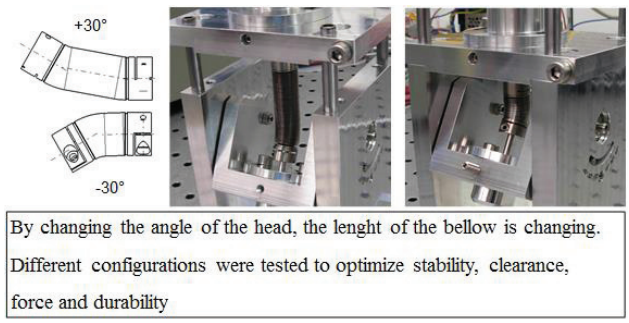

Figure 6: Test of Bellow.

MAIN PARAMETERS

6 independent degrees of freedom
Vacuum : <10E-10 mbar
Cryo : 14° K
Precision : 20µm
Non-magnetic
Gears in PEEK and Titan Grade 5
Mech. Parts : Titan Grade 5
Tilt Angle of Head : +/- 30°

CONCLUSION

With the new design, we realized a primary rotation of 0° to 180°. Photos of the realized manipulator in Figure 7 and 8.

ISBN: 978-3-95450-188-5 doi:10.18429/JACoW-MEDSI2016-MOPE16

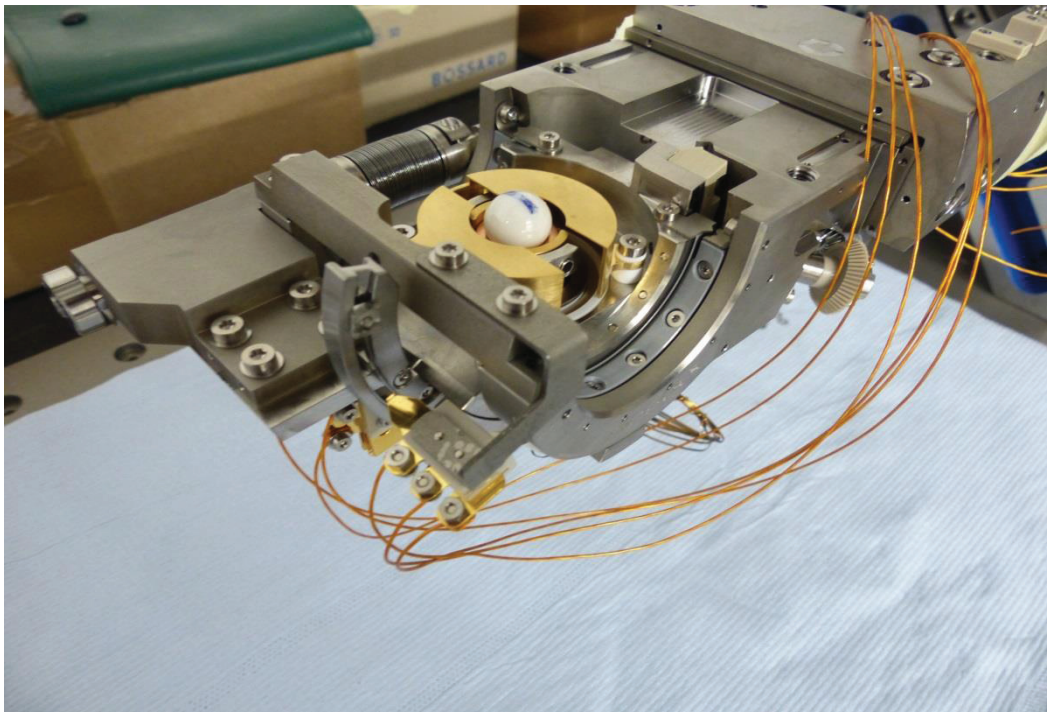

Figure 7: Head of manipulator.

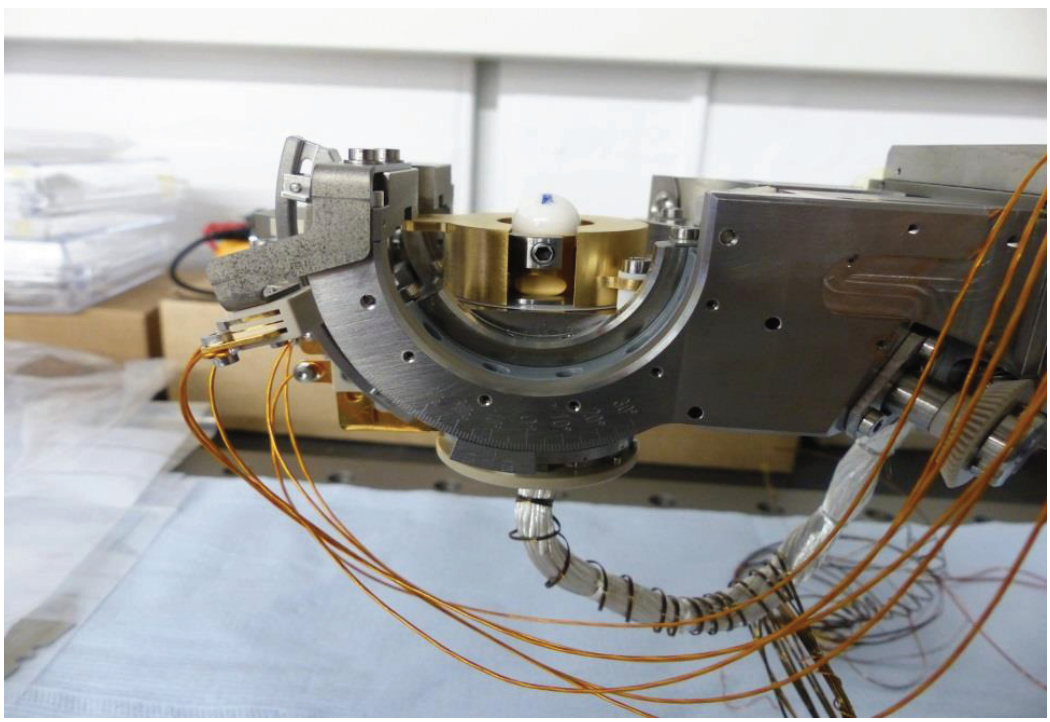

Figure 8: View from the side: No obstruction for the beam.

.

ACKNOWLEDGMENT

We want to thank the whole team, including the mechanics from the workshop for the manufacturing, assembling and measuring of the very precise and complicated parts.