Two-rotation Mechanism for an in Vacuum Beamstop

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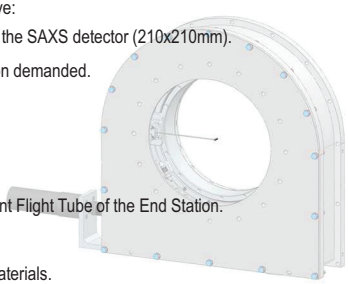
Abstract

At Small-angle X-ray Scattering beamlines (SAXS), beamstops are needed to block the intense primary beam that has not been scattered by the sample in order to protect the detector from any damage. Beamstops are usually confined inside a vacuum tube minimizing air space between the sample and the detector. For certain experiments, a motorized beamstop is required to achieve a precise positioning in different regions of the detector active area. ALBA has developed a new motorized beamstop consisting of a two-rotation mechanism inside vacuum that composes a movement able to cover all range of the active area of the detector. The presented solutions involves a main rotation reached by a gear and a worm drive actuated by a stepper motor and a second rotation relative to the main one produced by a piezo rotation stage. For each position appear two different solutions. This characteristic permits take two equivalent images in the detector with the same beamstop position but different orientation in the beamstop support; thus permitting the compensation of the support shadow on the active area of the detector.

Specifications

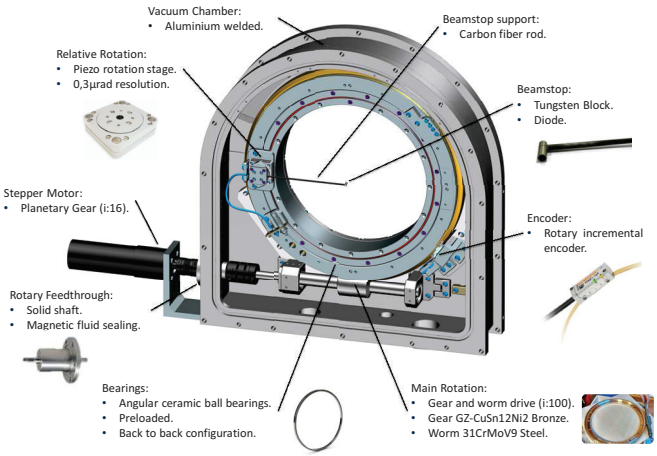
A motorized beamstop which must achieve:

- Cover all range of the active area of the SAXS detector (210x210mm).
- Obtain two solutions for each position demanded.
- In vacuum motorized movements.
- 5µm resolution.
- 1 rpm speed.
- Compact and integrated in the current Flight Tube of the End Station.
- Mounting interface DN320 ISO-K.
- Vacuum compatible (10^{-2} mbar) materials.

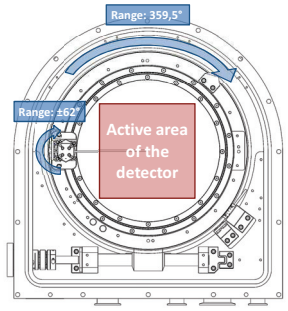


Design

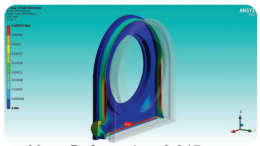
- More compact and with better stability than other conventional alternatives (linear stages) due to a shorter and stiffer beamstop rod and a more packed mechanism.



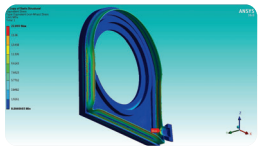
Movements



In vacuum chamber simulations

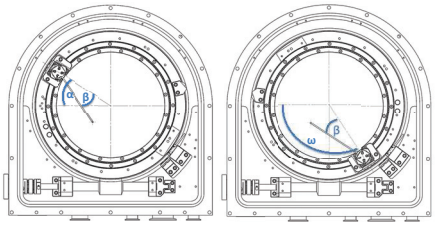


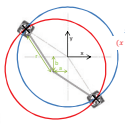
- Max. Deformation: 0,045mm



- Max. Stress: 23 MPa

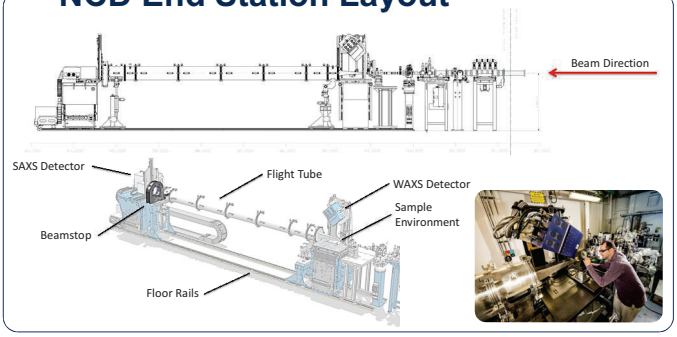
Two solutions for the same position





- For a given position (a,b) of the beamstop, the solutions of a system of polynomial equations of two circles, one with center in the main rotation (0,0) and other with center in the beamstop position (a,b), are the two points of intersection between them. With these intersections it is possible to resolve the two angles for each of two solutions.

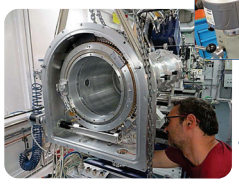
NCD End Station Layout

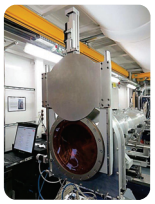


Assembly, Tests & Installation

- High Vacuum cleaning procedures during manufacturing and assembly.

- Pseudo motor tests using a laser tracker and a prism attached to a beamstop dummy.

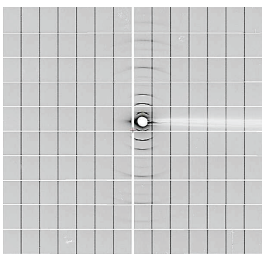


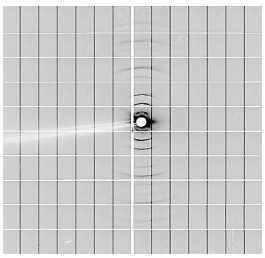


- Installation between segments of the Flight Tube of the End Station.

Results

- For each position appear two different solutions. This permits to take two equivalent scattering patterns in the detector with same beamstop position. Next figures show equivalent scattering patterns of the same collagen fiber:





J.B. González & C. Colldelram, “Dispositivo de tope para haces de radiación”, Spanish Patent and Trademark Office, No. P201631058, Aug. 1, 2016.

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