



Institute of High Energy Physics Chinese Academy of Sciences

DESIGN OF A LONG VERSATILE DETECTOR TUBE SYSTEM FOR PINK BEAM SMALL-ANGLE X-RAY SCATTERING (SAXS) BEAMLINE AT HEPS

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Introduction

X-ray scattering experiment vacuum camera device is the first set of high-energy synchrotron radiation light source applied to powder small angle scattering experiment pipe system, which has

multiple experimental modes, can be WAXS, SAXS and USAXS experiments alone, can also be SAXS/WAXS/USAXS combination experiments.

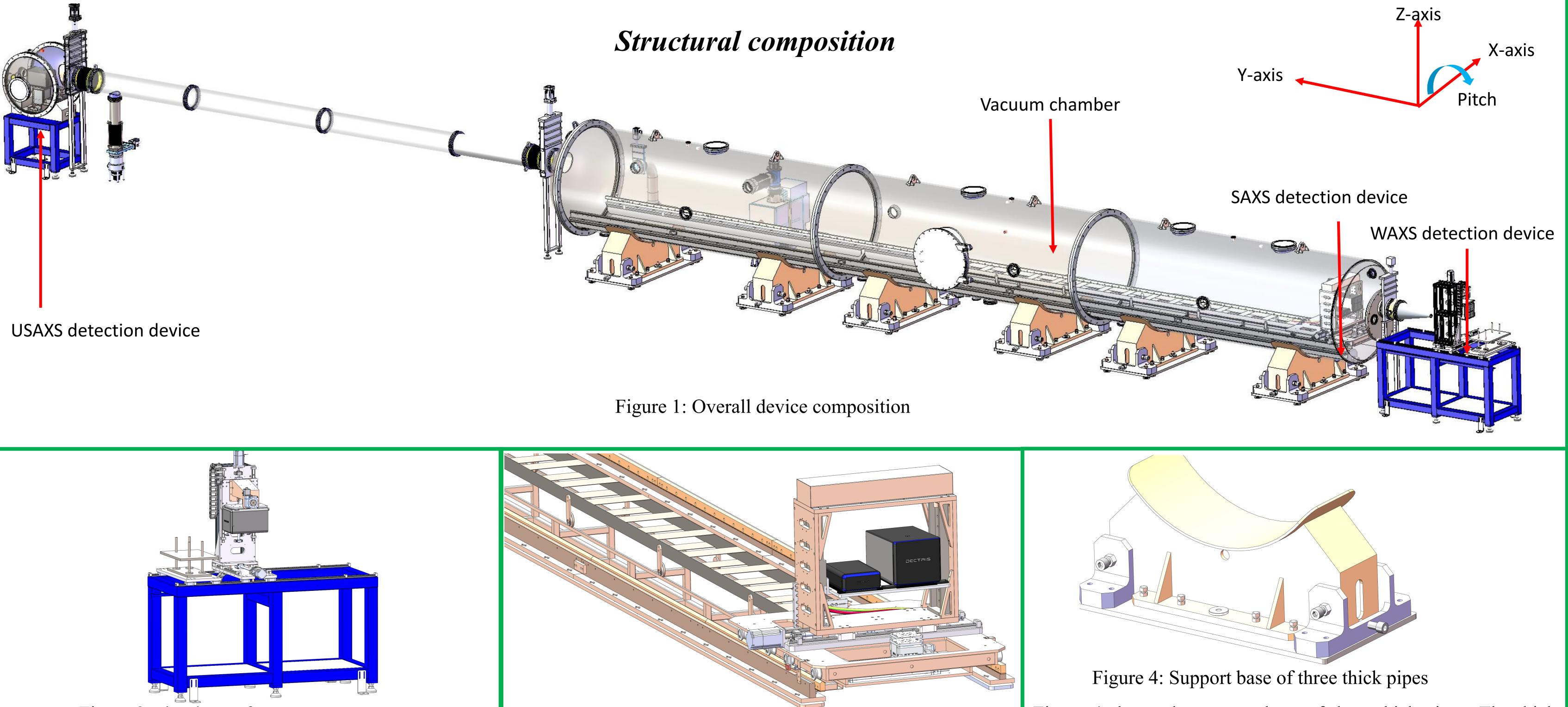


Figure 2: The device for WAXS experiment

The WAXS device is located in the atmosphere and moves in a straight line in three directions of the detector. The probe's projection angle motion range is 55°. The lifting displacement table and the horizontal displacement table are spliced by processed aluminum alloy steel plates, and this structural design effectively reduces the weight of the device and effectively helps to improve the stability of the equipment structure. The base of the device is composed of square steel pipes. After the welding of the base is completed, it is treated with stress relief process, and then finished to effectively reduce the influence of welding deformation on the motion accuracy of the detector. The shelves used for the hoisting of the detectors are made of welded steel plates, which are subjected to a strain relief process of heat treatment after welding. Then drill the holes, which can ensure the concentricity of the two holes, and effectively reduce the error of detector installation.

Figure 3: The device for SAXS experiment

The SAXS device is located in a vacuum environment, as shown in Figs. 1 and 3, and most of its structure is selected as a vacuum-specific material in order to achieve the vacuum level. The device allows the detector to achieve a continuous motion stroke of 12.5 meters in the Y-axis direction. Therefore, we adopt the form of V-shaped track and flat track matching to solve the parallelism error problem of ordinary linear guide rail. In addition, in order to reduce the track straightness error, we add an adjustment mechanism to realize the adjustment of the lifting, swing angle and casting angle of the track. The lifting movement of the detector adopts the gantry structure to ensure the stability of the front and rear movement. In addition, by using a single motor to drive two ball screws, the synchronization of the lifting and lowering movements of the detector is realized.

The design concept of SAXS device is: remove overdefinition, prevent the phenomenon of cable jamming, and ensure the smoothness of the movement of the mechanism. Figure 4 shows the support base of three thick pipes. The thick pipe has the characteristics of large mass and high center of the pipeline. There is a moving mechanism inside the pipeline, so the stability of the three-section thick pipe is required by higher requirements. Combining the above characteristics, the base of the pipe is designed as a saddle type.

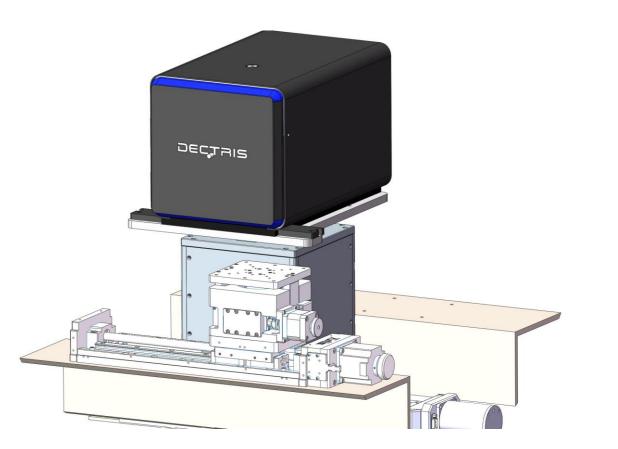


Figure 5: The device for USAXS experiment

The device of USAXS experiment nly has two functions: lifting and lateral displacement. Its structure is relatively simple. Again, it is located in a vacuum and is used to do USAXS experiments.

Design parameters and indicators

Conclusion and contact

The total length of the device is 26700 mm.

The inner diameter of the thick pipe is 1500 mm and the inner diameter of the thin pipe is 300 mm.

The length of the inner track of the thick pipe is 14000 mm.

The vacuum degree of the vacuum chamber is 0.5Pa.

The SAXS detector has a straightness of 1 mm in the Y direction.

The stability error of each detector is $15 \mu m$.

The repeatable positioning accuracy of the detector in the X-axis and Z-axis directions is 10 μ m and the resolution is 5 μ m

The resolution of the pitch angle of the WAXS detector is 0.06

For radiation protection, the thick pipe cavity has a wall thickness of 20 mm



The X-ray scattering experiment vacuum camera device is a device that takes into account vacuum, radiation protection, ground profile, structural stability and functional design at the same time. If the requirements allow, more structural designs can be added for experiments. The design presented in this article leaves something to be desired in many areas and needs to be improved in the future.

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