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DEVELOPING WHITE BEAM COMPONENTS OF TPS BEAMLINE 24A

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ABSTRACT

The TPS 24A, Soft X-ray Tomography (SXT) beamline, is one of the beamlines in the second construction phase at the Taiwan Photon Source (TPS). This bending magnet (BM) beamline has high flux in the range between 260 eV and 2600 eV. It is designed for transmission full-field imaging of frozen-hydrated biological samples. At the exit slit, the beam flux optimized in 520 eV is 2.82×1011 photons/second with resolving power 2000, the beam size is 50×60 µm2 (V×H, FWHM) and the beam divergence is 1.73×1.57 mrad2 (V×H, FWHM). By contributions of the generic beamline components project in recent years, modular mechanisms would be used in this beamline such as mask, X-ray beam position monitor (XBPM), photon absorber (PAB), and screens. However, these beamline components were designed for ID beamlines, so they should be redesigned for BM beamlines. This paper generally introduce these beamline components decided and redesigned for the TPS 24A. They will play important roles at the BM beamlines in the future.

BEAMLINE LAYOUT

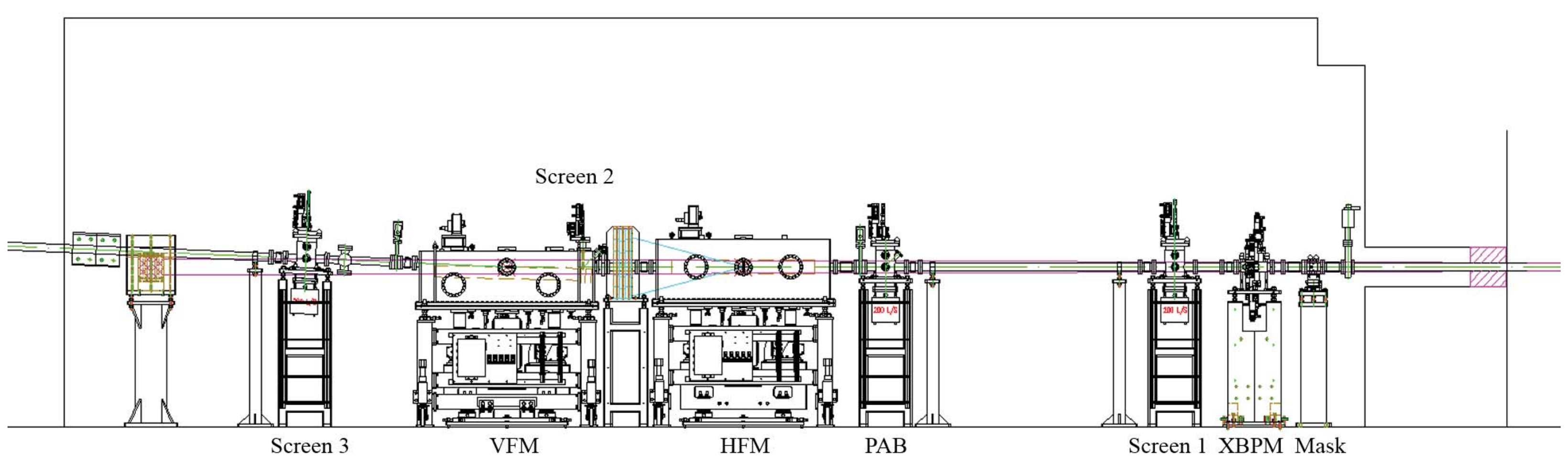

Fig. 1 White beam components layout of the SXT beamline.

MASK

The mask is used to confine the beam size of 21 mm (H) × 20 mm (V) with small range adjustment. A local shielding which contains of lead and Polyethylene (PE) was added to the mask to prevent the bremsstrahlung radiation.

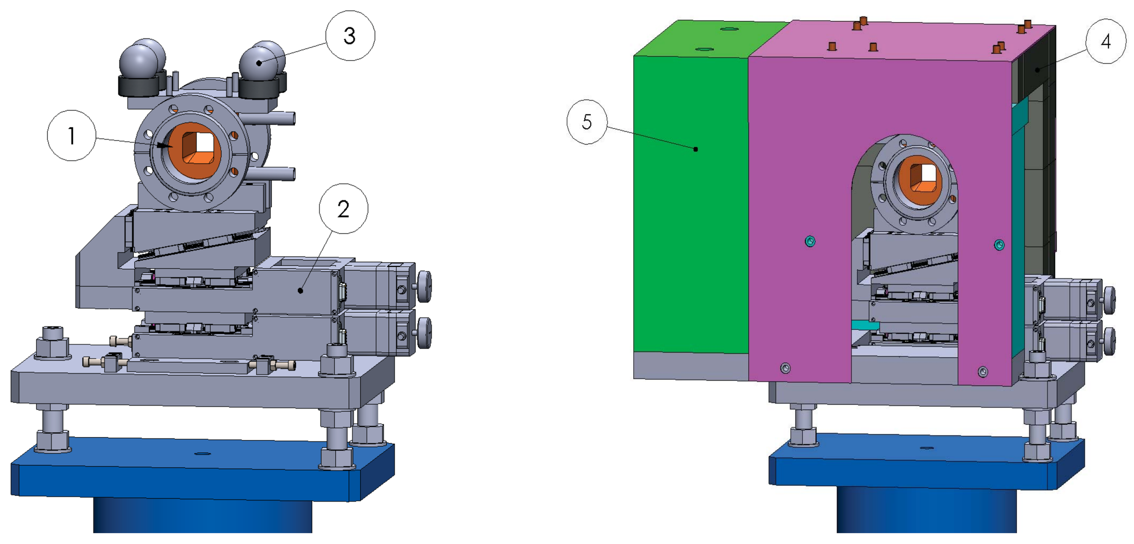

Fig. 2 The schematic drawing of the mask and local shielding.
(1) UHV water-cooling chamber, (2) Motorized XZ stage, (3) Laser tracker target, (4) Lead, (5) PE.

XBPM

The XBPM with high precision and current detecting function is used to confine the beam size and observe the beam fluctuation. Optionally, eight M16 × 2.0 screw holes made on the granite stand could be used if a bremsstrahlung stopper is needed.

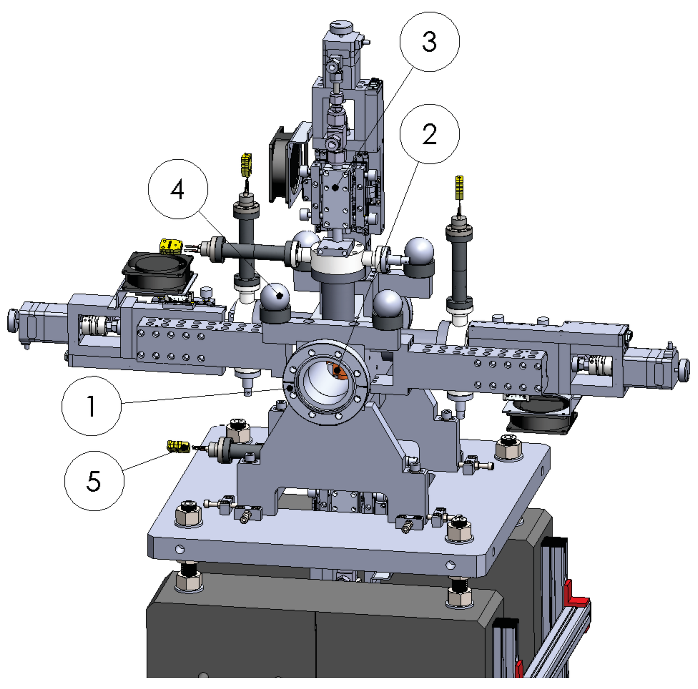

Fig. 3 The schematic drawing of the XBPM.
(1) UHV chamber, (2) Blades with cooling unit, (3) Motorized linear stage, (4) Laser tracker target, (5) Thermocouple.

WHITE BEAM SCREEN

The screen is designed to observe the beam size and position.

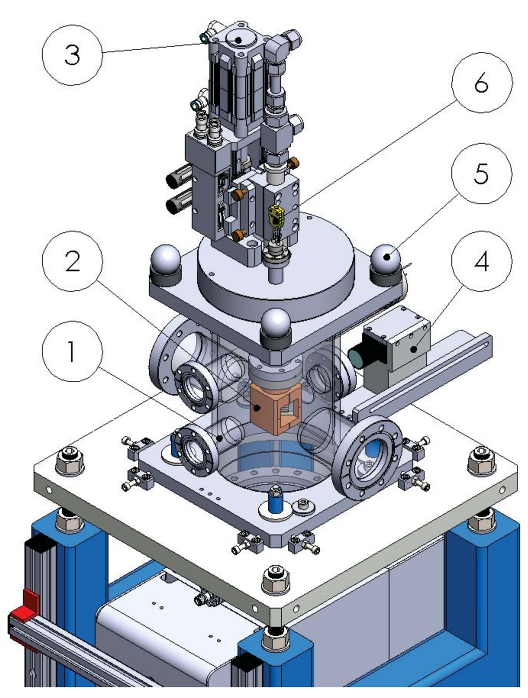

Fig. 4 The schematic drawing of the screen 1.
(1) UHV chamber, (2) Screen with cooling unit, (3) Linear stage, (4) CCD, (5) Laser tracker target, (6) Thermocouple.

PAB

The PAB is used to block the beam temporarily when user need. A tungsten local shielding could be added into the chamber if it is needed.

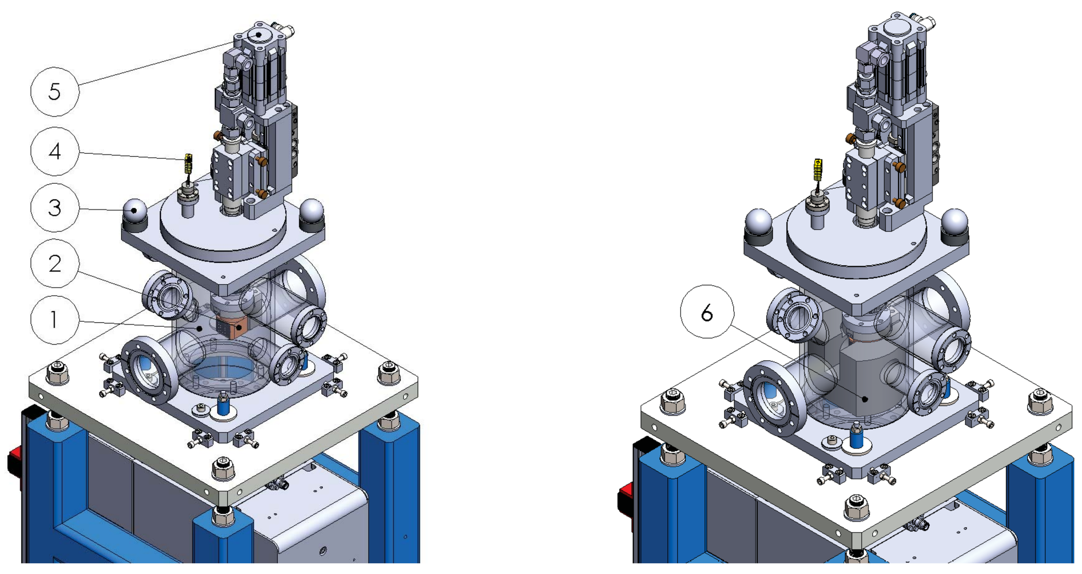

Fig. 5 The schematic drawing of the PAB.
(1) UHV chamber, (2) OFHC with cooling unit, (3) Laser tracker target, (4) Thermocouple, (5) Linear stage, (6) Tungsten shielding.

THERMAL SIMULATION

Thermal Simulations were done to calculate the temperature and thermal stress of the white beam components by SOLIDWORKS Simulation.

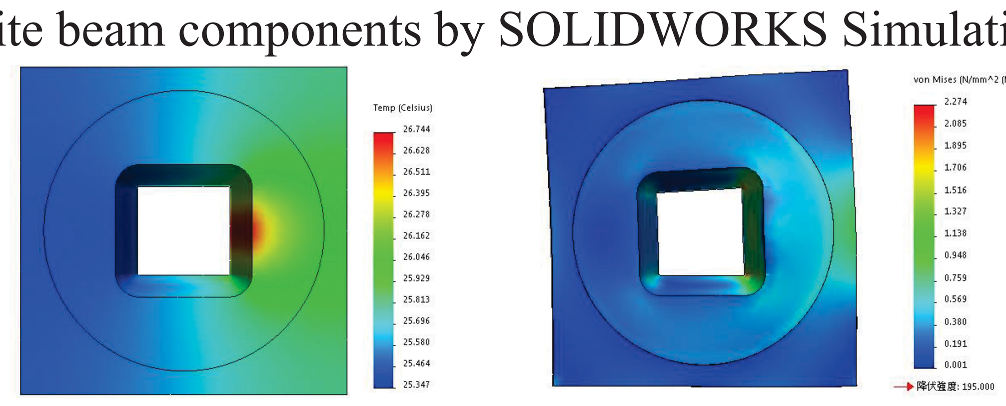

Fig. 6 Temperature and thermal stress of the mask.

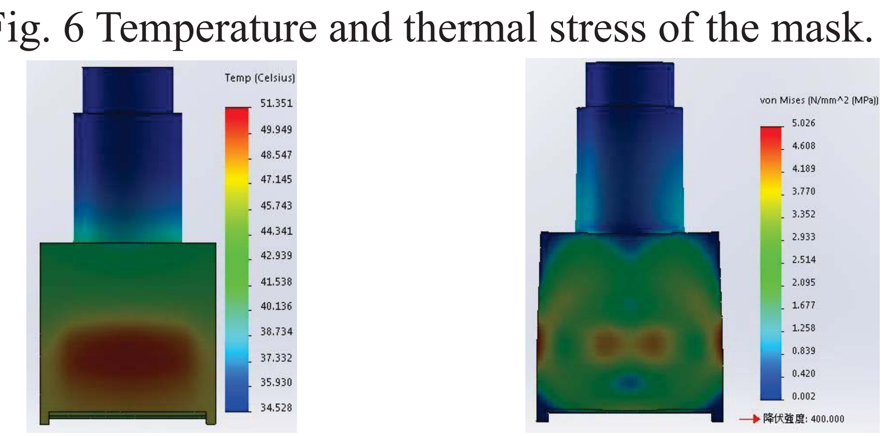

Fig. 7 Temperature and thermal stress of the XBPM.

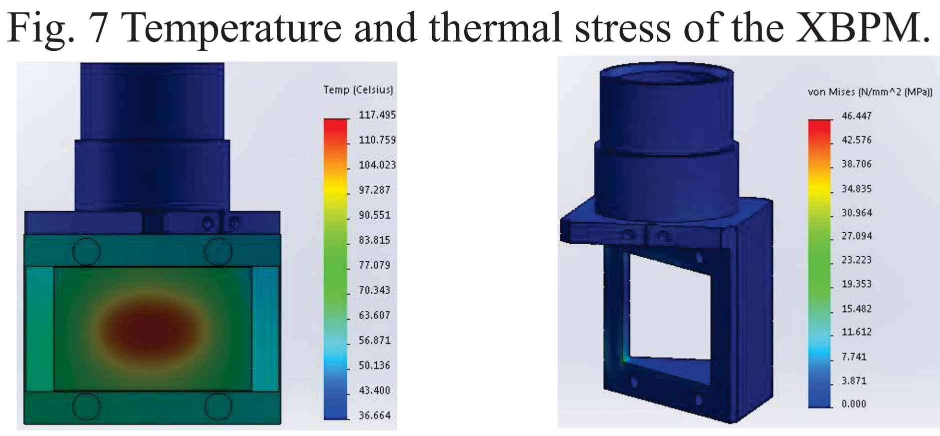

Fig. 8 Temperature and thermal stress of the screen.

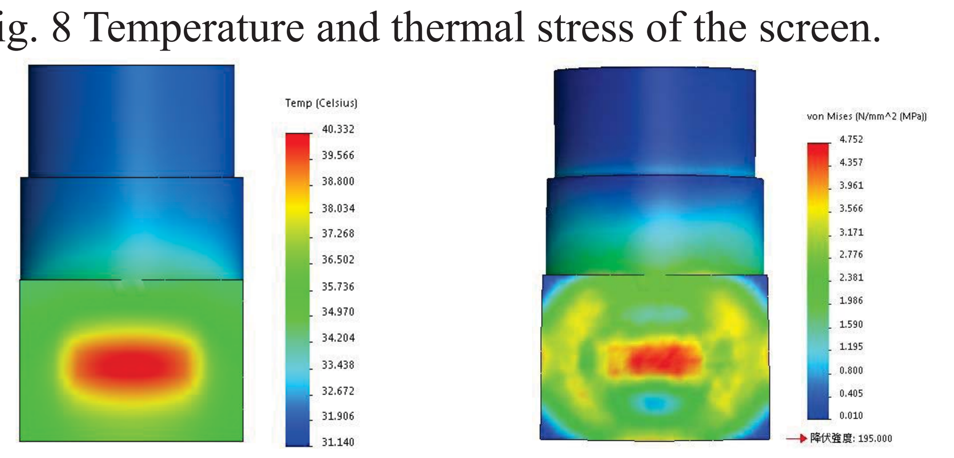

Fig. 9 Temperature and thermal stress of the PAB.

CONCLUSIONS

- All these white beam components have not been tested online and the test is scheduled in October, 2016.
- The bremsstrahlung radiation of the mask and the PAB is needed to be observed continuously.
- 30 mm is the maximum beam size due to the chamber inner space of generic beamline components, bigger chambers should be designed for larger beam size.
- We would keep developing the design for getting more accurate beam size and position.
- To determine the flow rate of cooling water needs more experiments and data, especially the pressure loss of long pipe.