



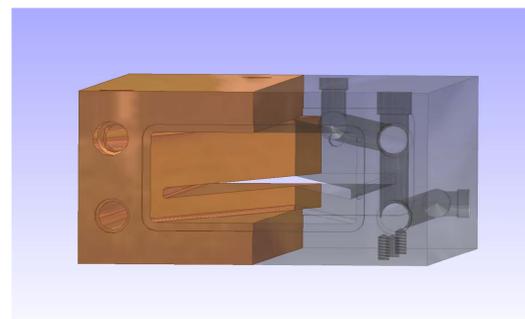
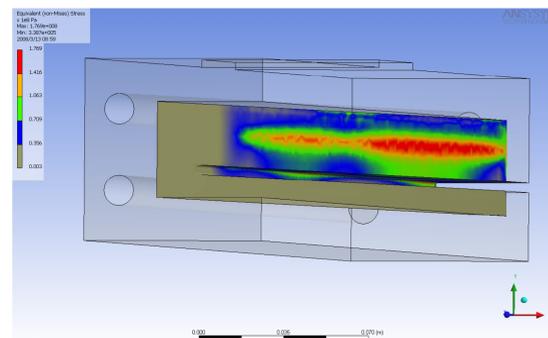
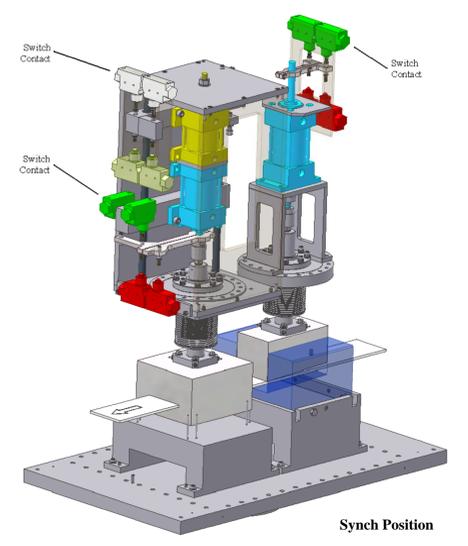
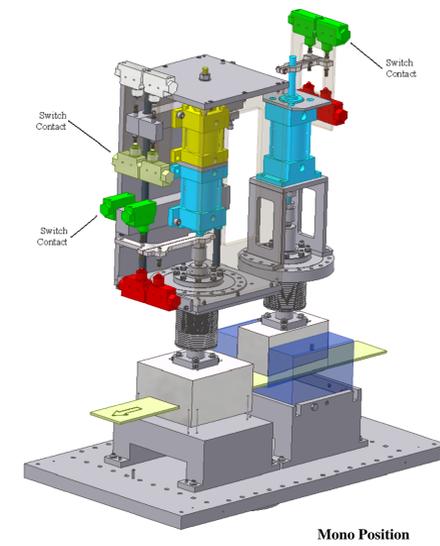
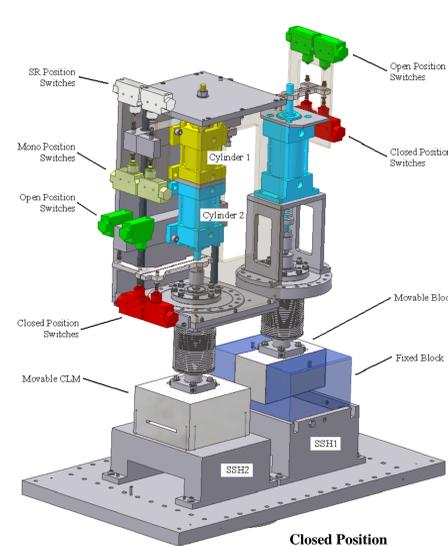
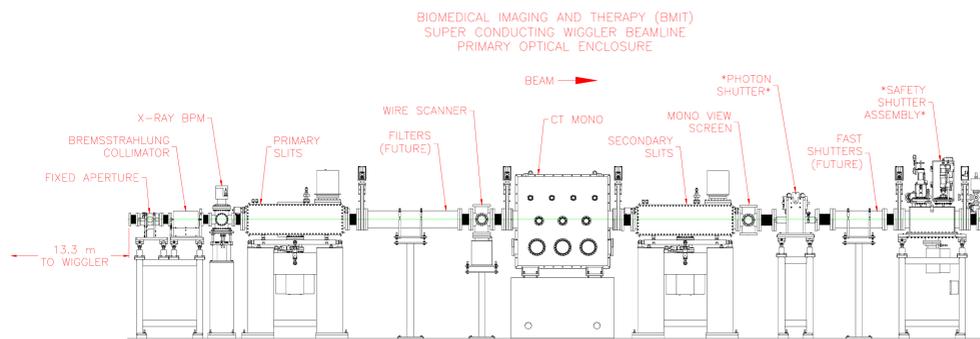
Canadian Light Source
Centre canadien de rayonnement synchrotron

CLS Biomedical Imaging and Therapy (BMIT) Beamline First Hutch Multi-Position Photon and Safety Shutters

CLS BMIT Beamline First Hutch Multi-Position Photon and Safety Shutters Design

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The Canadian Light Source (CLS) Biomedical Imaging and Therapy Beamline (BMIT) will use Photon and Safety Shutters at the end of their first optics hutch (POE1) to terminate synchrotron and bremsstrahlung radiation allowing access to downstream hutches. In POE1 BMIT will also require an in-vacuum bremsstrahlung collimator to reduce the scattered radiation dose during Computer Tomography Imaging and other forms of imaging which will eventually be used on animals and humans in POE2. This collimator must translate vertically between photon beam and mono beam which is located 15mm below.



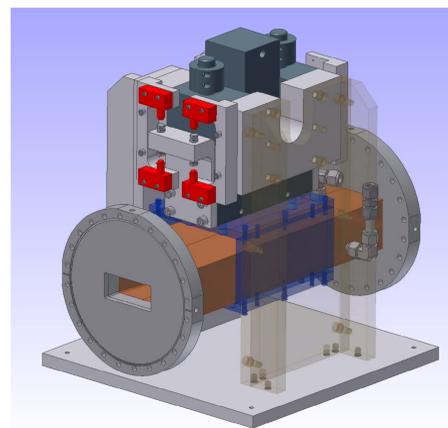
Photon Shutter Assembly

The purpose of the BMIT Photon shutter assembly is to absorb Synch beam, protecting the downstream Safety Shutter assembly. The Photon Shutter has 2 positions controlled by a pneumatic cylinder:

- 1) Open - Synch beam through
- 2) Close - Synch beam blocked, Mono beam through.

This assembly is also fail safe as loss of air or power will cause the assembly to drop into the synch beam.

The Photon Shutter assembly is made from Copper, 2 halves (split vertically) vacuum brazed together. A 7 degree horizontal incidence angle is used to spread the synch beam along the 360mm absorbing length. The Synch beam source is a 4T Super Conducting Wiggler, 31 KW total power at 500 mA ring current. The PSH is 20.0 m from the Wiggler source, sees approximately 12.5 KW of power and 56 Watts/mm² power density at normal incidence. The cooling is accomplished with 1/2" ID cooling lines, 3 m/s cooling water velocity resulting in 15 KW / m² °C, 46 L/min total flowrate in 2 channels. The Photon shutter design is fail safe, and meets the CLS maximum temperature limits (300°C) and maximum Stress limits (300 MPa) for Copper.



Safety Shutter Assembly

The CLS standard for safety shutter assemblies is redundant shielding blocks. Due to space limitations in POE1 it was necessary to combine the functions of the second safety shutter block with the in-vacuum collimator. This results in a movable Tungsten block which must be translated accurately (± 0.25 mm) to 3 positions. The CLS standard for position switches is redundant (2) switches per position. The upstream SSH1 design is an example of the CLS standard design for SSH assemblies (normally 2 SSH blocks like this).

Other mechanical requirements for the standard CLS SSH design are as follows:

- 1) The SSH block shall translate between the open and closed positions in 1 second or less without causing damage to the assembly or excessive vibration;
- 2) The SSH assemblies shall be "fail safe", defined as:
 - a) A loss of air pressure shall cause the SSH block to drop to closed position,
 - b) A loss of power shall cause the SSH block to drop to closed position,
 - c) vacuum load and block mass shall cause the SSH block to drop to closed position.

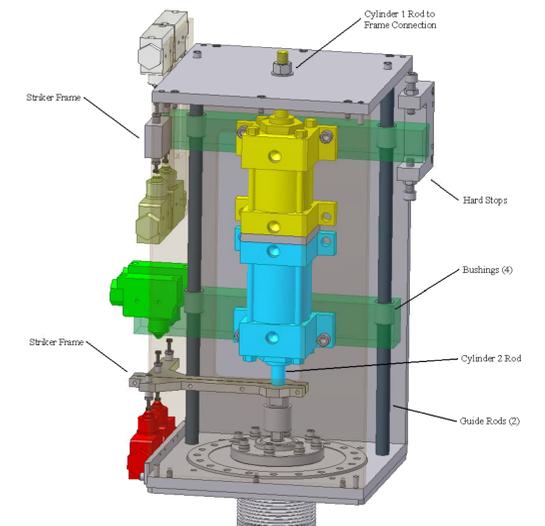
The BMIT SSH2 design must meet the requirements of the standard CLS design, and in addition provide 3 SSH2 block positions. The 3 positions are as follows:

- 1) Open - SR (block aperture at 1400mm centerline elevation),
- 2) Open - Mono (block aperture at 1385mm centerline elevation),
- 3) Closed (block aperture at 1370mm centerline elevation).

A back to back pneumatic cylinder design was chosen. Two cylinders mounted back to back are used to create 3 positions. The top cylinder, cylinder 1, is used to translate between the SR and mono beam positions when cylinder 2 is in the open position. Cylinder 2 drives the SSH2 block to the closed position, bottoming out on the SSH block frame.

Cylinder 2 must be in the open position for cylinder 1 to actuate. When cylinder 2 is in the open position the striker frame maintains contact with the open position switches and cylinder 1 can actuate between the SR and mono positions. When cylinder 1 actuates, the whole cylinder assembly, including the cylinders themselves move on the guide rods. Cylinder 1 can be in either the SR or mono beam positions and cylinder 2 will have enough stroke to close the SSH2 block. When cylinder 2 actuates only the cylinder rod translates, thus moving the striker frame between the closed and open switches.

Each cylinder in this SSH assembly will have a solenoid valve. The solenoid valve for cylinder 2 will be part of the Beamline Access Control and Interlock System (ACIS), as this system is only concerned about whether the SSH2 block is closed or not closed. The solenoid valve for cylinder 1 will be part of the Machine Protection System as this system is concerned about whether the upstream photon shutter has to be in the SR or mono beam positions.



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