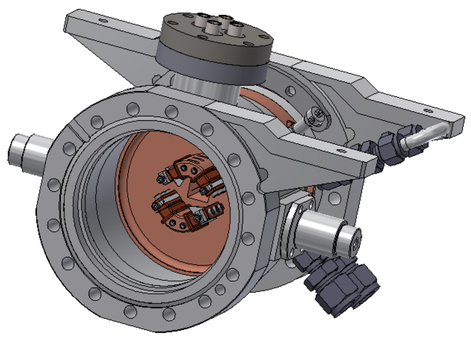
# High Heat Load Front Ends for Sirius

Laboratório Nacional de Luz Síncrotron

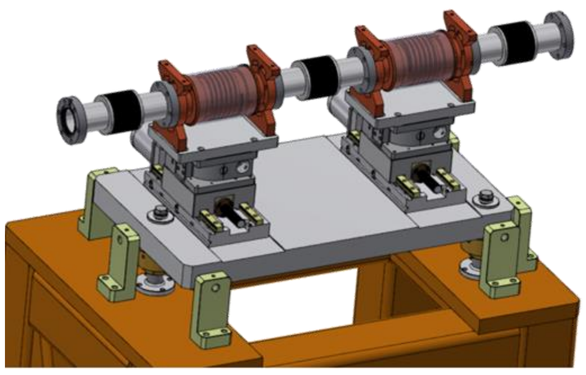
L. M. Volpe, P. T. Fonseca, M. Saveri Silva, H. F. Canova, P. P. S. Freitas, A. S. Rocha, A. A. Gilmour, H. G. P. Oliveira, G. L. M. P. Rodrigues, L. Sanfelici, H. Westfahl Jr.

✉ lucas.volpe@lnls.br – Brazilian Synchrotron Light Laboratory - LNLS



## XBPM

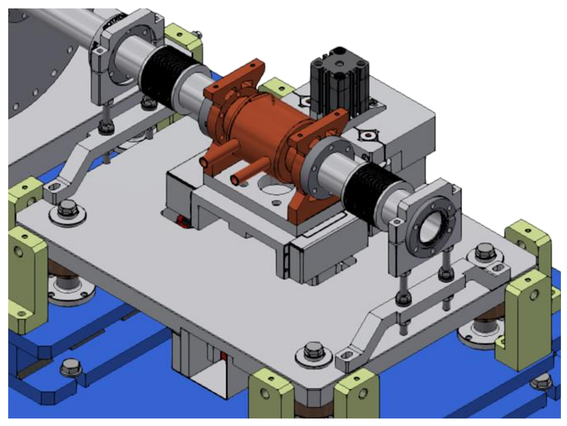
The X-Ray Beam Position Monitors detect the photon-beam position with micrometric resolution. Two XBPMs are foreseen in order to provide both position and steering angle information. They will be based on W-blades, that compare the electric current observed in each one of them, by photoelectric effect, in order to derivate the beam position.
This device is an improvement of the XBPM used at Soleil. It was developed in a collaboration between LNLS and Soleil.
A more detailed description of this topic can be found in the conference article.



## High Power Slits

The High Power Slits are located downstream the Fixed Mask and upstream the Photon Shutter. Each slit has the internal aperture being composed of four surfaces with 4° grazing incidence angle, resulting in a maximum power density of 8.8 W/mm².
Each one has two tungsten blades on the exit side to define the final format of the beam, being intercepted only by a very small portion of it. These blades can be aligned perpendicular, one to the other, and define a square photon beam. The use of these blades is also favorable to minimize the beam scattering.

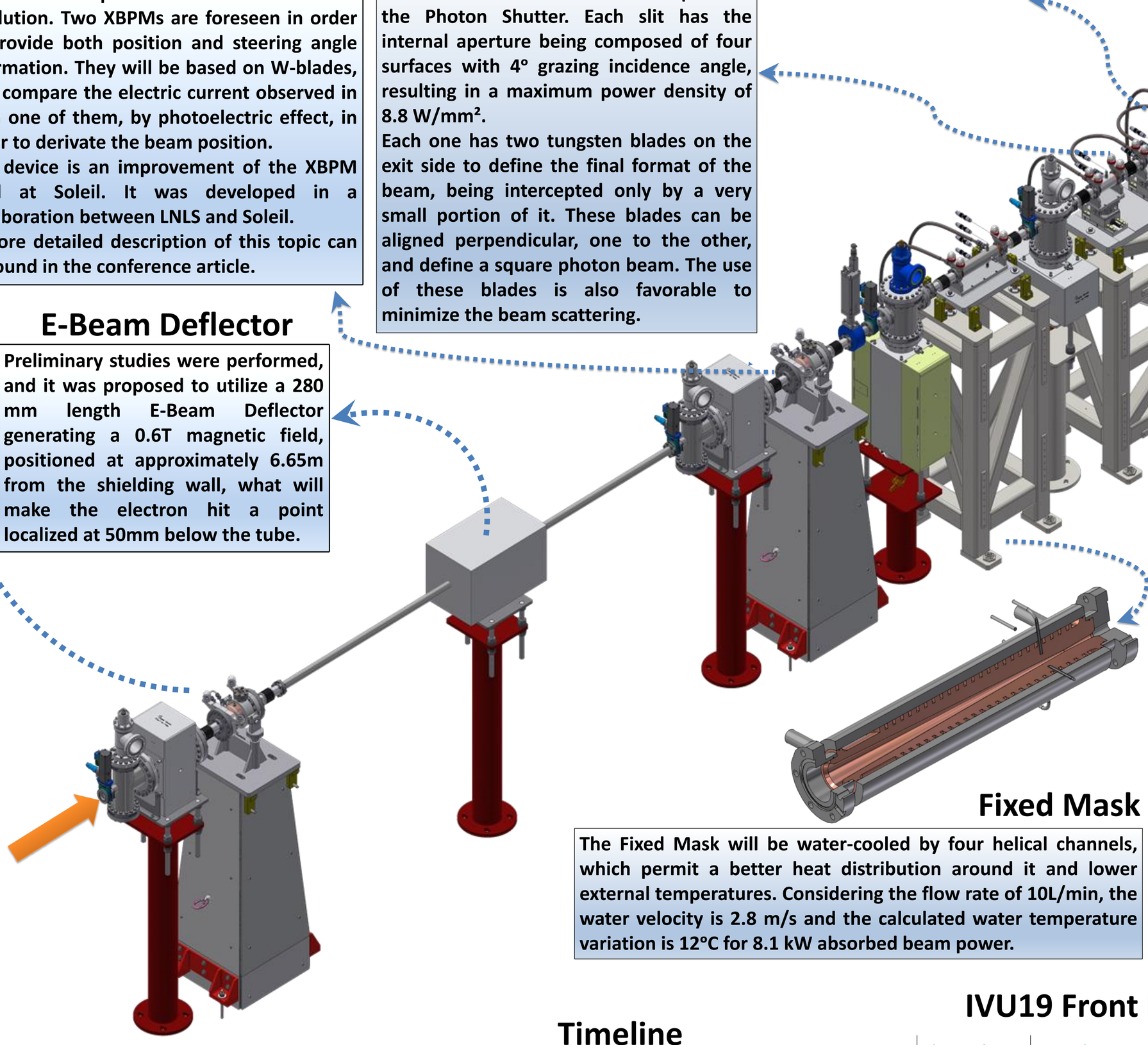
## Photon Shutter



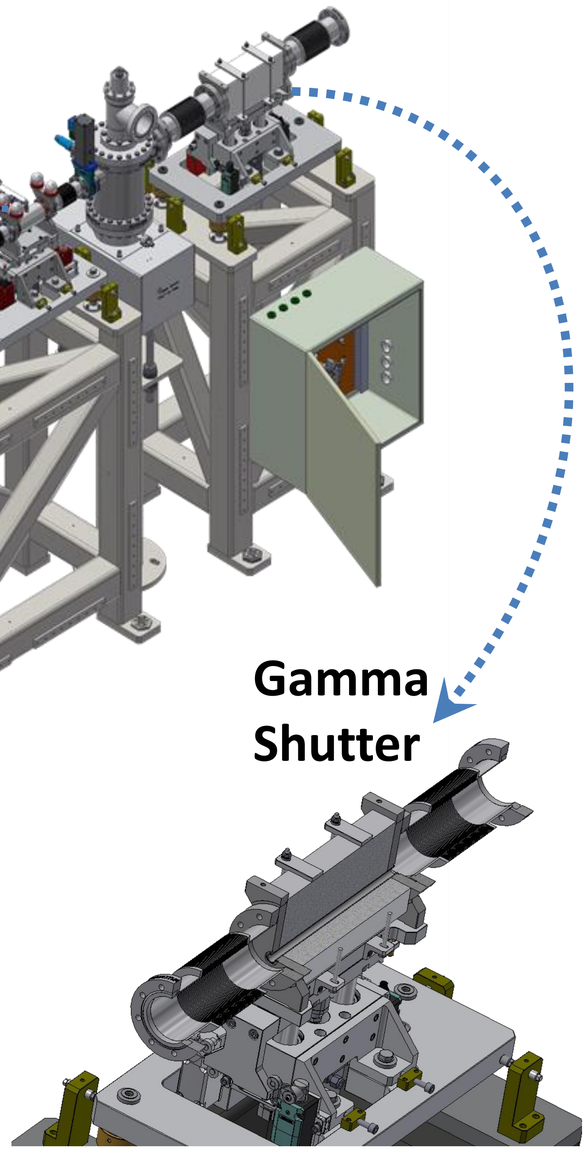
The Photon Shutter has a grazing incidence surface with 9° angle that will intercept the photon-beam when closed, resulting in a maximum power density of 17.4 W/mm². Considering a flow rate of 2.7 L/min, the water velocity is 3 m/s and the calculated water temperature variation is 4.8°C for 900 W of total beam power. The pressure drop calculated by CFD simulation is 0.75 bar.
It moves 15mm down by a pneumatic actuator to shut the beam off. A thermocouple is placed inside the Photon Shutter to acquire its temperature for the interlock system.

## E-Beam Deflector

Preliminary studies were performed, and it was proposed to utilize a 280 mm length E-Beam Deflector generating a 0.6T magnetic field, positioned at approximately 6.65m from the shielding wall, what will make the electron hit a point localized at 50mm below the tube.



## Gamma Shutter



The Gamma Shutter is made of Tungsten. The thickness to block Bremsstrahlung radiation to a safe level is 244 mm. To close the Gamma Shutter, the block is moved down in 2 seconds with a stroke of 30 mm. There is a hole of 10 mm diameter to permit the photon-beam to pass when the Gamma Shutter is opened, because of that, the Gamma Shutter has also the functionality of a Collimator.

## Fixed Mask

The Fixed Mask will be water-cooled by four helical channels, which permit a better heat distribution around it and lower external temperatures. Considering the flow rate of 10L/min, the water velocity is 2.8 m/s and the calculated water temperature variation is 12°C for 8.1 kW absorbed beam power.

## Beam Power Density Profile




Power distribution of the IVU19 ID at 10 m from the source. Only the beam contained inside the black square box is transmitted to the beamline optics.

## Timeline

- Jan/2015: Concept ready
- Jan/2016: Preliminary Design ready
- Nov/2016: First prototype Assembled
- Nov/2017: Installation of the first 5 Front-ends

## IVU19 Front End Aperture Table

| Component | Distance from ID source [mm] | Beam Size HxV [mrad] | [mm] | Aperture Size [mrad] | [mm] | Incident Power [kW] | Absorbed Power [kW] |
|---|---|---|---|---|---|---|---|
| XBPM1 | 15626 | 2.00x1.00 | 31.2x15.6 | 1.01x0.94 | 15.8x14.6 | 9.25 | 0.18 |
| EBD | 17000 | 1.01x0.94 | 17.2x16.0 | ø2.35 | ø40 | - | - |
| XBPM2 | 19143 | 1.01x0.94 | 19.3x18.0 | 1.10x1.02 | 21x19.6 | - | - |
| FV | 19429 | 1.01x0.94 | 19.6x18.3 | ø2.06 | ø40 | - | - |
| FM | 20417 | 1.01x0.94 | 20.6x19.2 | ø0.152 | ø3.1 | 9.07 | 8.11 |
| HPS-1* | 21190 | ø0.152 | ø3.22 | 0.38x0.38 | 8x8 | 0.96 | 0.96 max |
| HPS-2* | 21516 | ø0.152 | ø3.27 | 0.37x0.37 | 8x8 | 0.96 | 0.96 max |
| PS | 22136 | ø0.152 | ø3.36 | 0.68x0.68 | 15x15 | 0.96 | 0/0.96 |
| GS | 22803 | ø0.152 | ø3.47 | ø0.44 | ø10 | - | - |

## Acknowledgement

The design and construction of Front-Ends is a collective work that involves the entire LNLS Engineering team. We would like to acknowledge everyone who has been contributing to the development of this project. Finally, we would like to thanks to J.C. Biasci (ESRF), N. Béchu (Soleil), S. Forcat (MAXIV) and H. Schulte-Schrepping (DESY).

MEDSI 2016 – MECHANICAL ENGINEERING DESIGN OF SYNCHROTRON RADIATION EQUIPMENT AND INSTRUMENTATION

MINISTÉRIO DA CIÊNCIA, TECNOLOGIA, INOVAÇÕES E COMUNICAÇÕES

BRASIL GOVERNO FEDERAL


Sirius (August 2016)