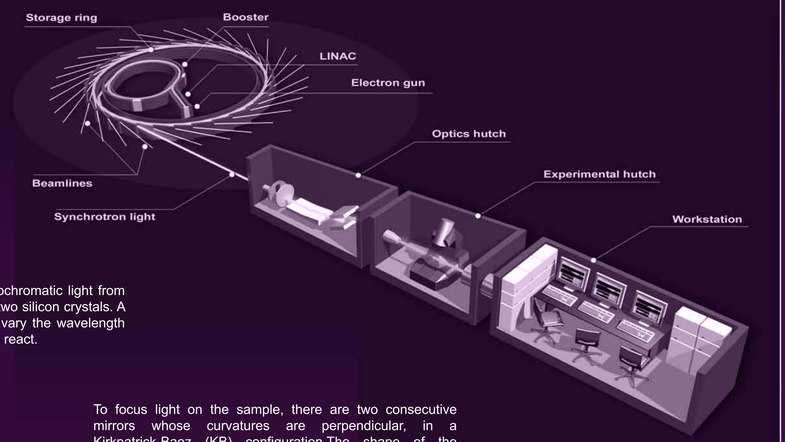
OPTICAL INSTRUMENTS SUITED TO THE LIGHT OF THE SOLEIL SYNCHROTRON

TO GUIDE AND FOCUS LIGHT AND TO SELECT A WAVELENGTH, THE SOLEIL SOURCE USES MIRRORS, NETWORKS, AND LENSES, AS IN THE VISIBLE SPECTRUM. BUT THE MATERIALS AND OPTICAL CONDITIONS VARY ACCORDING TO THE WAVELENGTHS USED. THAT IS WHY SOLEIL BEAMLINES ARE EQUIPPED WITH A WIDE VARIETY OF OPTICS.

OPTICAL DEVICES TO 'PREPARE' THE BEAM

In each beamline, the optical instruments give the beam the characteristics that are required for the experiment. They direct it, select a wavelength, and concentrate the greatest possible number of photons on the sample.

EXAMPLE OF A BEAMLINE IN THE X-RAY DOMAIN:



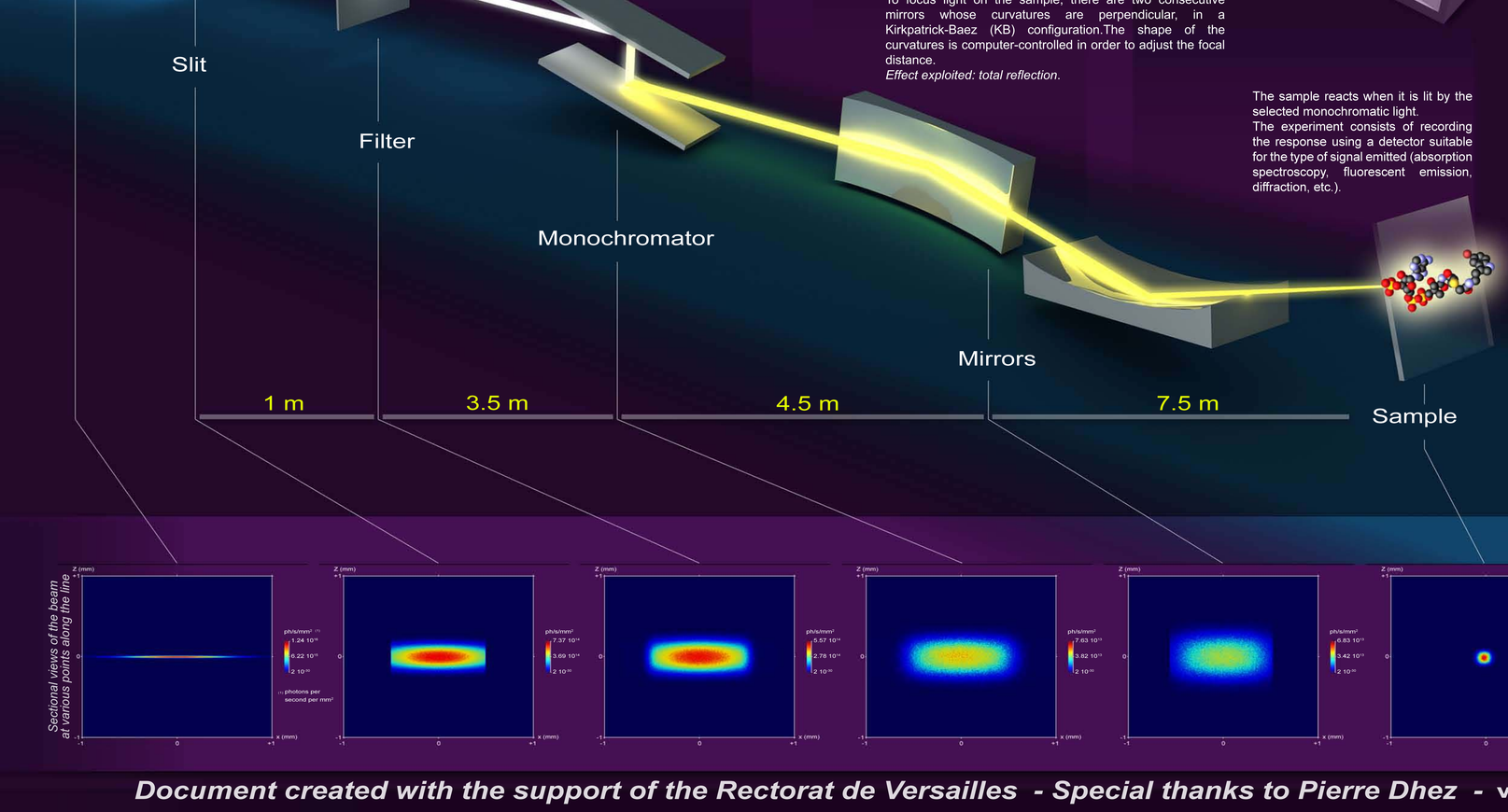
Two perpendicular slits are interposed on the optical path to delineate the light beam (only one is shown here). These slits can be in copper, steel or tungsten, but any x-ray absorbent material is suitable.

The filter absorbs low-energy photons, particularly infra-red and visible. It is a sheet of aluminium, carbon, or copper, or even a diamond, which eliminates some of the power of the beam. This prevents the overheating of the optics positioned downstream.
Effect exploited: selective absorption by atoms.

The monochromator selects a type of monochromatic light from the initial 'white' beam. It is an assembly of two silicon crystals. A computer controls their angular position to vary the wavelength and select the one that will make the sample react.
Effect exploited: Bragg diffraction.

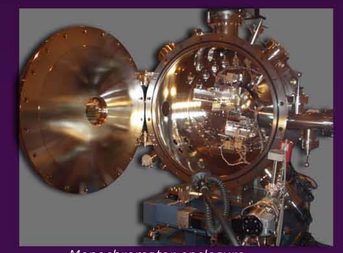
To focus light on the sample, there are two consecutive mirrors whose curvatures are perpendicular, in a Kirkpatrick-Baez (KB) configuration.The shape of the curvatures is computer-controlled in order to adjust the focal distance.
Effect exploited: total reflection.

The sample reacts when it is lit by the selected monochromatic light.
The experiment consists of recording the response using a detector suitable for the type of signal emitted (absorption spectroscopy, fluorescent emission, diffraction, etc.).

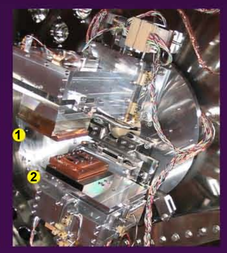


THICK STEEL ENCLOSURES

Because the beam propagates in a vacuum, the slightest deformation of the mechanisms can result in its misalignment. To ensure adequate stability of the line, the optical devices are placed in thick stainless steel enclosures.



Monochromator enclosure



The two crystal supports

CRYSTAL MONOCHROMATOR
In this monochromator, the wavelength is continuously adjusted as the angular position of the crystals is varied (Bragg diffraction). To cover a more complete energy domain, different crystals are mounted on water-cooled supports ❶ and ❷ : silicon 111, beryllium, etc. Each support can contain up to five crystals. They are selected by simply applying a translation to the device.

KB mirror enclosure

The pair of perpendicular KB mirrors

KIRKPATRICK-BAEZ (KB) MIRRORS
The Kirkpatrick-Baez (KB) assembly consists of two perpendicular mirrors ❸ & ❹ whose longitudinal profiles are adjusted by computer-controlled 'benders'. By applying bending forces to each end, the benders can give an elliptical shape to flat or toric mirrors.

Document created with the support of the Rectorat de Versailles - Special thanks to Pierre Dhez - www.synchrotron-soleil.fr - Tel. +33 1 69 35 90 20