

# The Infrared Beamline at the Swiss Light Source: A tool for Chemical Microanalysis

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The Infrared beamline at the Swiss Light Source (beamline X01DC) has been conceived as a multidisciplinary facility for spectroscopy and spectromicroscopy using infrared synchrotron radiation. The beamline layout accommodates four different branches, each dedicated to a specific experimental setup (Figure 1).

An infrared microscopy branch is operated at the beamline as a service to the national and international scientific community, and has been opened to external users since January 2009. The endstation consists of a Bruker Hyperion 2000/3000 microscope coupled to a Vertex 70 interferometer (Figure 2).



Figure 1. IR Microscopy hutch of beamline X01DC at the Swiss Light Source

The microscope takes advantage of the brightness of synchrotron emission in the mid infrared region to overcome the throughput limitation of IR microscopes when used close to the diffraction limit (Figure 3). Focusing of a synchrotron IR beam provides a diffraction-limited light spot (Figure 4). As such it is an effective tool for performing spectromicroscopy experiments on small samples, in the micrometer size range. Furthermore, high flux and brightness in the far infrared region are used for both spectroscopy and high resolution microscopy.

## X01DC Beamline Performance

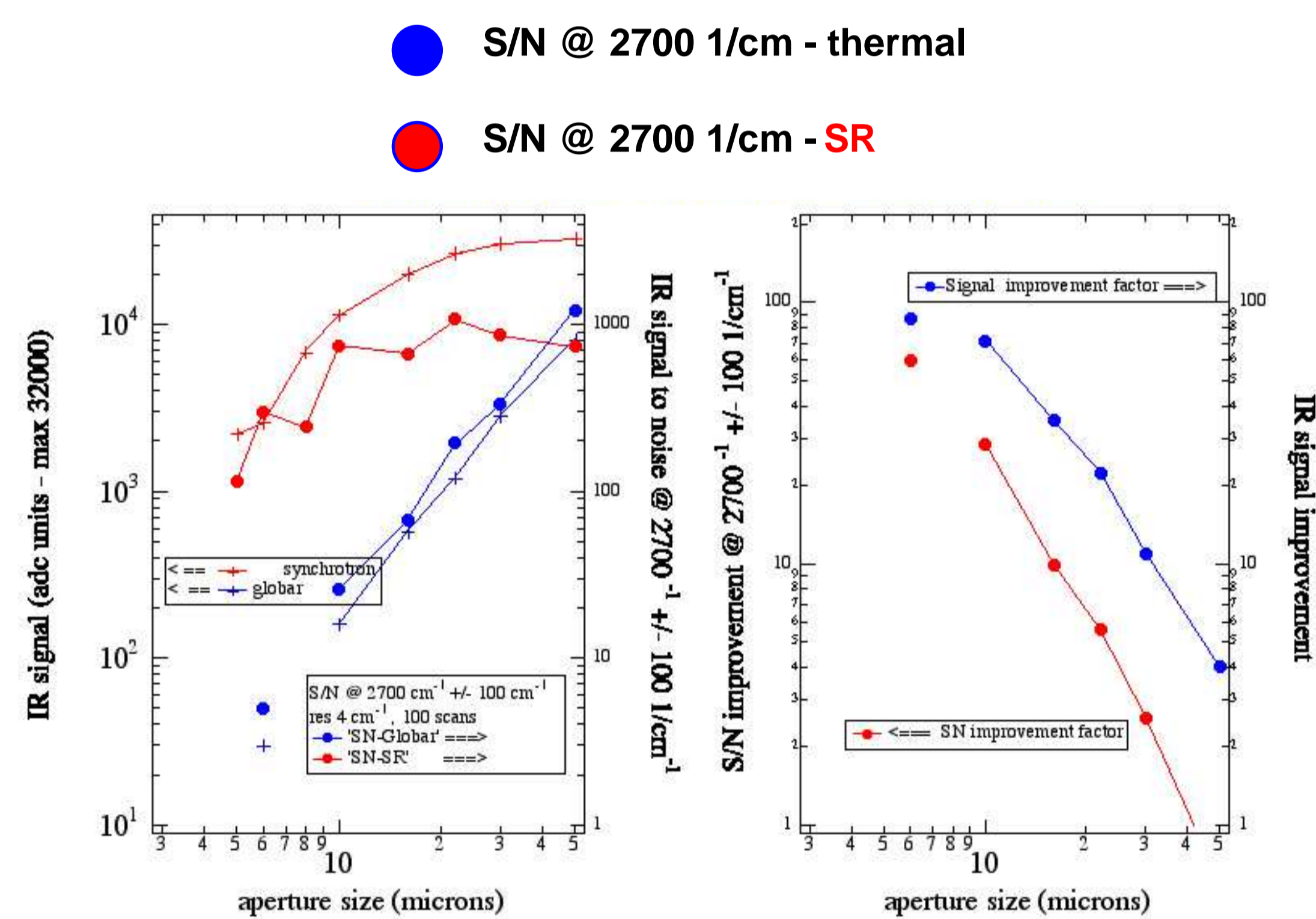


Figure 3. Gain in signal-to-noise for a synchrotron microscopy measurement over a thermal source measurement.

Figure 3 shows the gain from synchrotron light versus global in terms of total signal and signal-to-noise ratio in a spectromicroscopy experiment where the size of the confocal aperture is progressively changed. At apertures below 10  $\mu\text{m}$  there is a clear advantage in using a synchrotron source. The data are reported for Beamline X01DC at the Swiss Light Source.

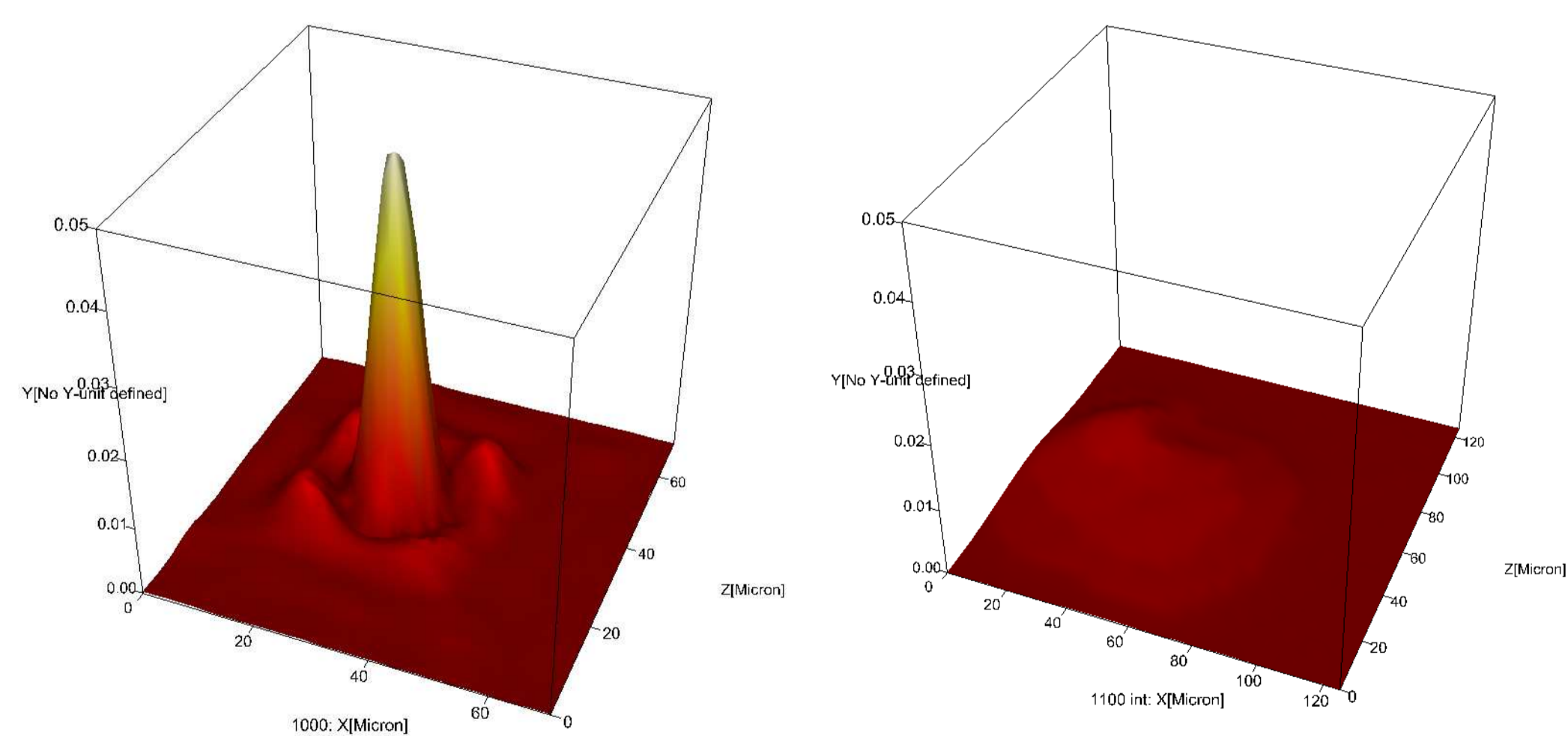


Figure 4. Diffraction-limited intensity profile of a focused synchrotron IR beam (left) compared to a focused global beam (right).

Figure 4 Compares the light intensity distribution at a wavelength of 10  $\mu\text{m}$  in the focal plane of an IR microscope using a 36x objective. Although the total integrated intensity is larger for the global light, the intensity integrated over a  $\mu\text{m}$  diameter spot is larger for synchrotron light. The latter clearly shows the diffraction-limited light spot profile. The data are reported for Beamline X01DC at the Swiss Light Source.

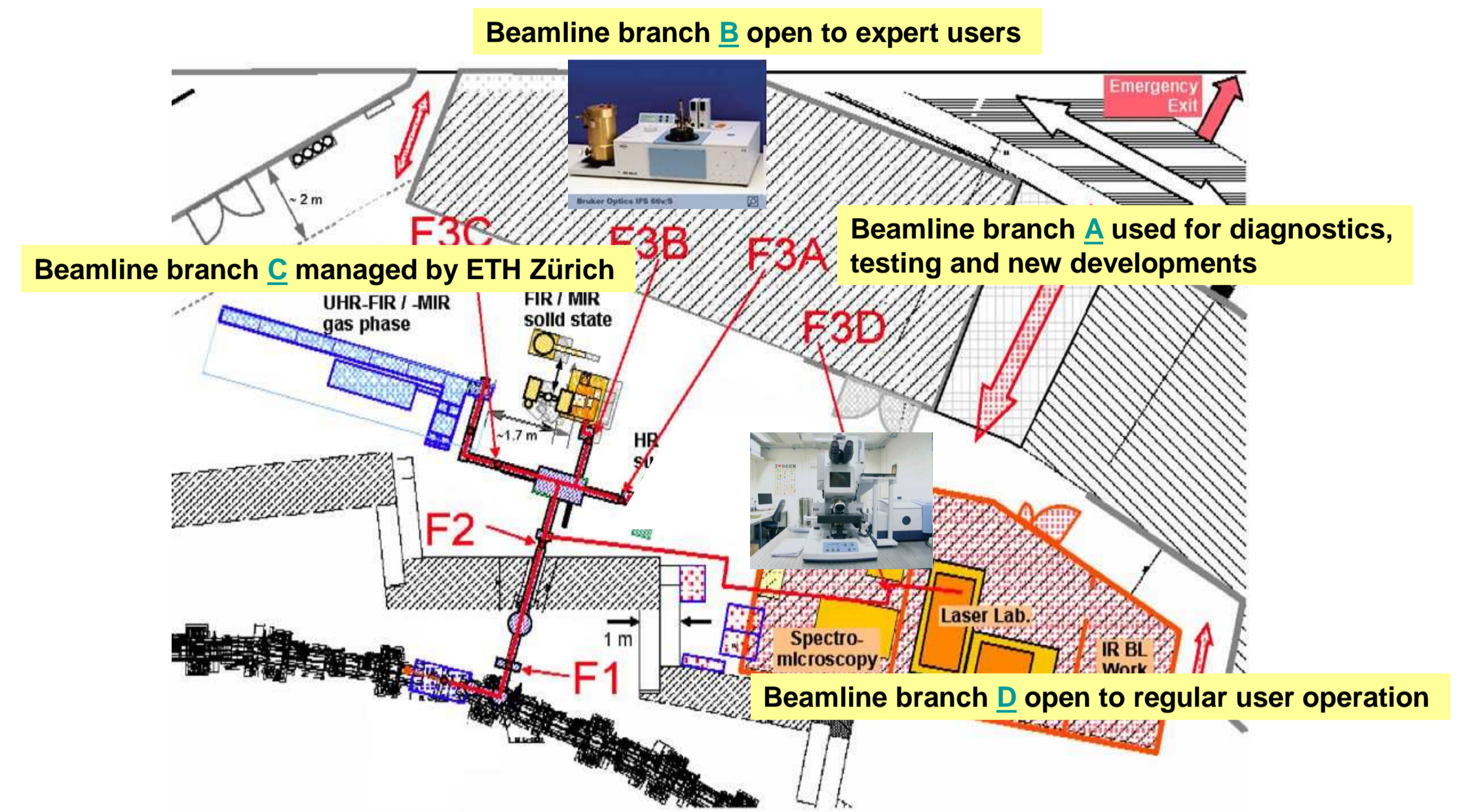


Figure 1. X01-DC Beamline Layout

## X01-DC Light Source

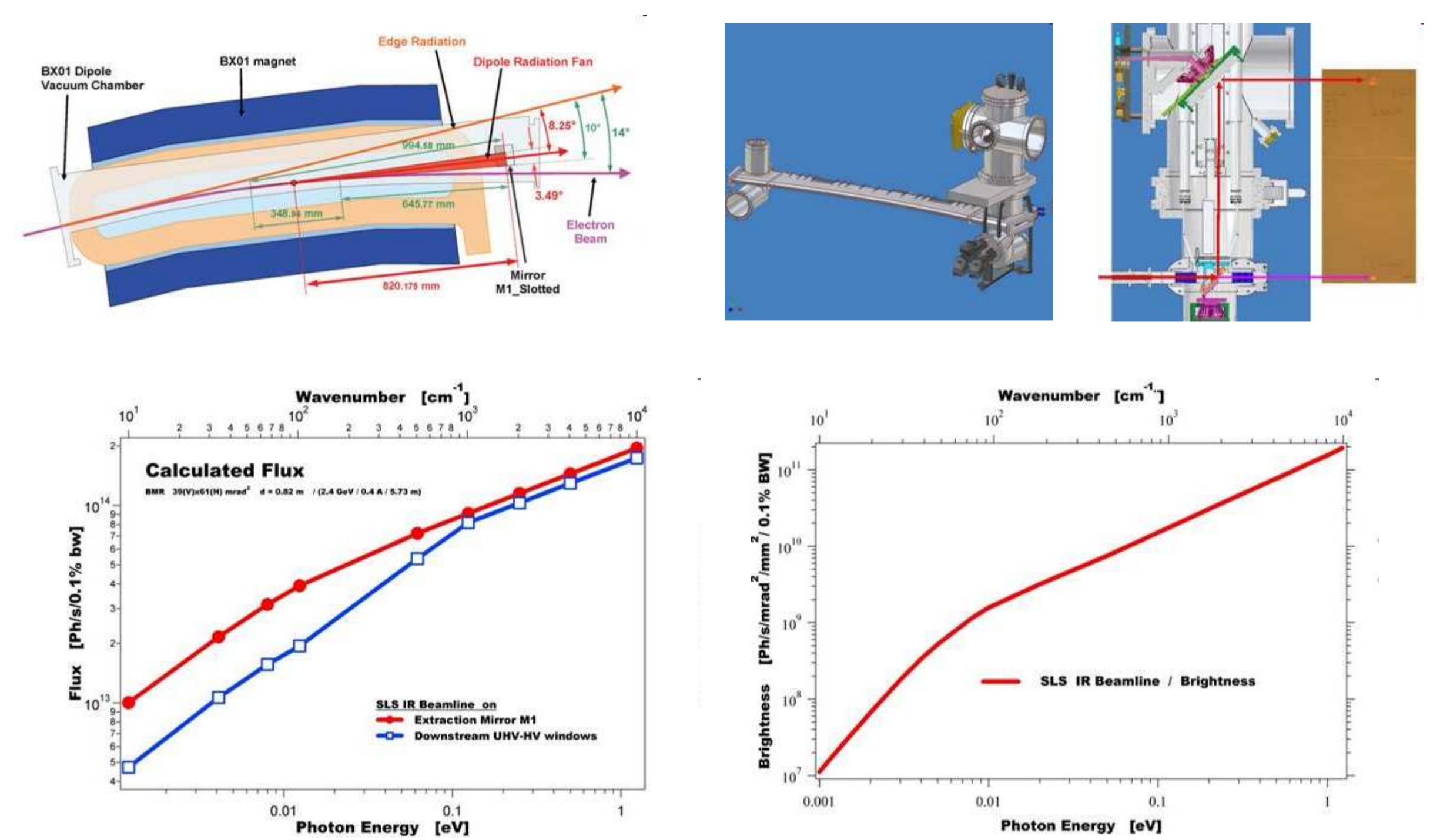


Figure 5. Optical extraction setup and calculated emission for beamline X01DC.

Figure 5 shows the light extraction setup and calculated emission parameters for Beamline X01DC at the Swiss Light Source. The light is obtained from the constant field emission of a bending magnet. A modified chamber allow for the insertion of a slotted extraction mirror in the proximity of the light source. The mirror reflects the IR and visible components in the vertical direction and excludes the X-rays by allowing them through the slot to a photon absorber.

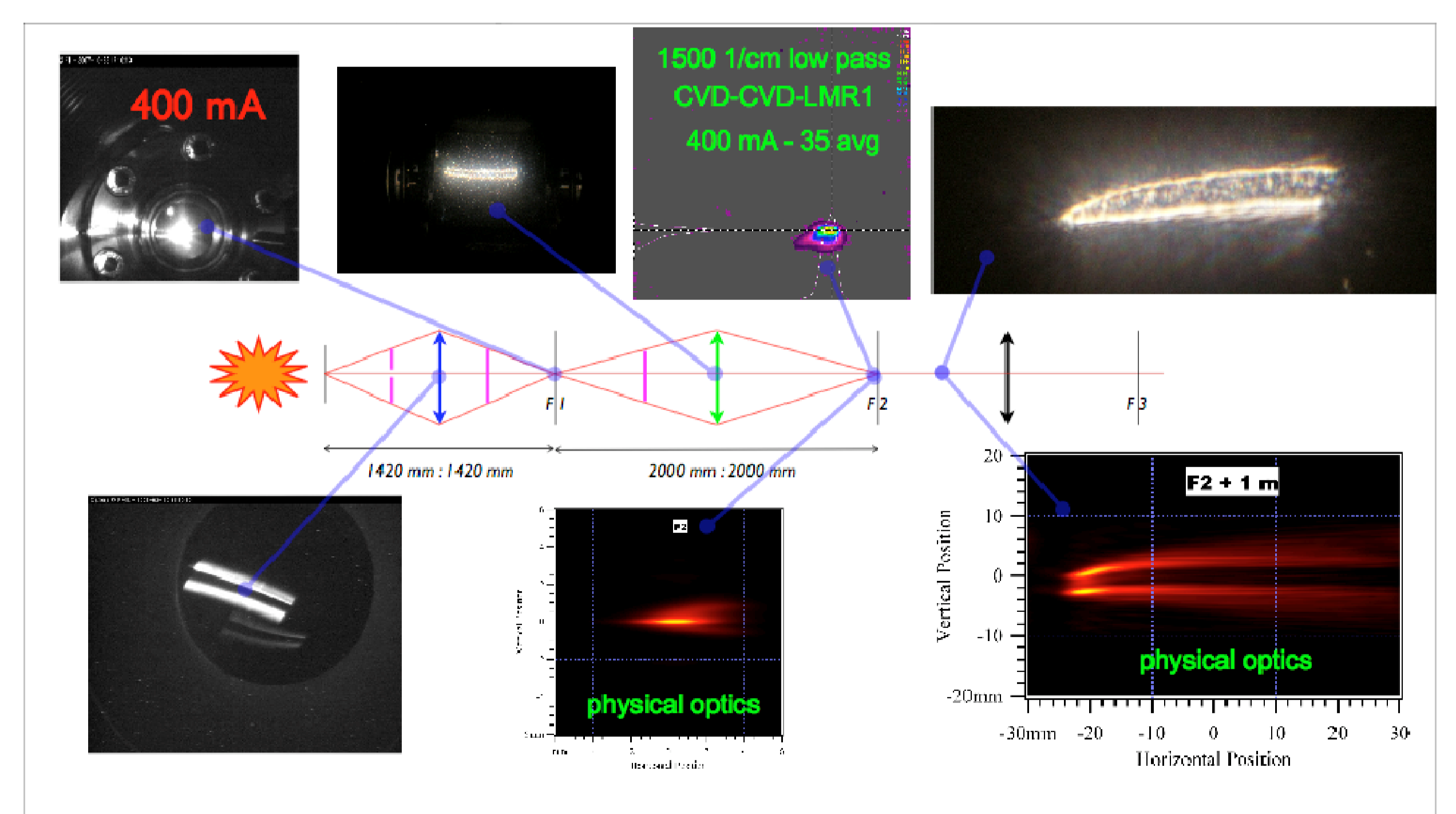


Figure 6. Optical train of the beamline and images of the visible light components at various points.

Figure 6 shows the evolution of the light spot through the various optical elements of Beamline X01DC at the Swiss Light Source. The light is obtained from the constant field emission of a bending magnet. The projection of the light beam appears as a double slot due to the darkening of the central part because of exclusion of X-rays.