The AILES Infrared Beamline
on the third Generation Synchrotron Radiation Facility SOLEIL

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Abstract

The design of a new infrared beamline (AILES) at the third generation Synchrotron Radiation source SOLEIL has been performed. This beamline utilizes infrared synchrotron radiation from both edge emission and the constant field conventional source. The expected performances including flux, spatial distribution of the photons, spectral range and stability were discussed and calculated. The optical system, spectroscopic stations and workspace have been described. The calculation and simulation show that the combined source with the adapted optics of the beamline design offers high flux and brilliance for all kinds of infrared experiments. We also review the main research themes and the articulation and developments of infrared at SOLEIL.

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1. Introduction

Infrared light is nowadays extracted and exploited in most synchrotron radiation facilities in the world [1-7]. Moreover, two new mechanisms for producing Infred have been evidenced and are now used: the Edge radiation [8-10] (ER) and the coherent synchrotron radiation[11-14] (CSR).

The project AILES (Advanced Infrared Line Exploited for Spectroscopy) aiming at developing a beamline dedicated to infrared spectroscopy was approved by the scientific SOLEIL council at the end of 2002.

In this paper, one finds the present status of the project. The choices concerning the beamline take into account the recent developments in infrared production and application. In particular, the extension towards the largest wavelengths was fulfilled via the use of edge radiation, modifications of the dipolar chamber and the use of adapted optics. This article is organised as follow, we summarize:

- the main research themes and the articulation and developments of infrared at SOLEIL,
- the expected performances in terms of intensity and spectral extent whose optimization is required and
- the experimental device allowing the beam to be carried all the way to the experimental stations.

2. Scientific Program and Articulation of the Infrared Beamlines at Soleil

The spectral domain of the Far infrared or terahertz (down to the millimetre-length waves) is where the interactions of medium and weak force absorb. These interactions prevail in many systems of practical and fundamental interest: thus complexes, aggregates, interactions on the surfaces and interfaces and their angular dependence, low frequency deformations of the polymers, intermolecular modes in nucleic acids and proteins, and generally collective modes in the condensed phases. By centering the scientific program on the spectroscopy of the moderate molecular interactions we confered a pluridisciplinary character to the research as exposed in the scientific themes developed in the first project and presented at the SOLEIL scientific council in 2002.

Since that, and following the various meetings and discussion from potential users, the themes were further defined, and the main themes can be summarised as follow : the study of intermolecular modes of micro confined liquids; the study of interstellar and atmospheric species by identification of their ro-vibrational modes; the study of the low frequency modes of biological molecules; the study of molecular dynamics in the reactional mediums in relation to the transfers of energy between reagents and solvents within the reactional mediums and - the optical studies of solids and materials.This list of research theme is clearly non exhaustive and new subjects will be included as the new spectral range will be made available to a wide community.

The beamline dedicated to Infrared Spectro-Microscopy with Synchrotron on SOLEIL (SMIS) will be exploited for the spatially resolved studies of the molecular composition of solid materials. The characteristics of SMIS are different and complementary of those of the AILES beamline as regards to the covered range in wavelength as for the type of experiments for which each of the two sources will be adapted. In spite of the difference of the scientific problems dealt with on the two instruments, their establishment in the same pole will allow complementary studies with one or the other. To stimulate this synergy, the development of the two beamlines is now done in parallel and allows designing standard elements of which the system of extraction is clearly a good example.

In addition to the now widespread use of the synchrotron radiation source for infrared spectroscopy and microspectroscopy, the coherent emission may constitute an intense source in the range of the submillimeter waves with a flux substantially higher than that of any other broadband source, including the synchrotron beamline such as AILES. At present, several teams (at Bessy, ANKA, ALS) detected and produce on a regular basis an emission in the large wavelengths range presenting an intensity proportional to the square of the number of electrons in a microstructure. This effect, due to space coherence of the emitted photons, should be observed for wavelengths of the same order of magnitude as the length of the micro-bunches of electrons. Despite the very low current circulating in the ring, the observed gain in flux was demonstrated for millimetre-length wavelengths [11-15].

According to some machine parameters calculations [16], the coherent part of the spectrum could even be extended to the complete range of far IR with the reduction of electron microbunches. Under the impulse of the machine group, we carry out a reflection so that the ring SOLEIL could allow the production of bunches of electrons compatible with the production of coherent radiation in Far IR by reducing the duration of the structures in the bunches to the hundreds of femtoseconds, thus corresponding to coherent emission of wavelengths of a few hundred microns. If this reduction proves to be realizable without sacrificing the stability of the beam in the ring, the beamline AILES could be exploited with this coherent radiation. There would then be two modes of exploitation of the beamline AILES : that of the standard synchrotron radiation for measurements not requiring these gains in flux and a mode exploiting the coherent radiation emitted coherently. This mode could clearly open new prospects for the exploitation of these very intense sources of Far IR.

3. Expected performances of the beamline

We show here how the beamline AILES, exploiting a wide solid angle of extraction corresponding to the natural opening of the photons in the Far IR, and placed on a ring of which stability should be very high, will be optimised.

The parameters discussed in this section (flux, Brilliance, spectral range and stability) are the "figures of merit" of the field of the infrared spectroscopy by interferometry.

3.a Flux

Thanks to the use as source of photons of a section of the dipole combining the edge of magnet and 50 mrad of dipole, flux available will extend to the Far infrared. The intensity of the source extracted on the two beamlines with SOLEIL is represented below with those of synchrotrons sources in service or in project: NSLS (Brookhaven), ALS (Berkeley), Diamond, ESRF). This intensity was calculated considering 500 mA injected into the rings.(Fig.1.)

3.b Brilliance

The Brilliance is a figure of merit even more important than the flux, in particular for measurements on samples of small size (intrinsic size of the sample, cell with diamond anvil) or on those for which the incidence must be precisely given: ellipsometry, measurement with grazing incidence of molecules on surfaces, attenuated total reflection (ATR).

The emission by the edge of a dipole field occurs in a smaller solid angle cone and therefore presents a higher brilliance than the classic dipole emission in most of the IR range. In the AILES sources, the advantages of the combined source are clear. However, the comparison between the brilliances of the various synchrotron sources is complicated due to the fact that no source collects the totality of the solid angle of emission for the largest wavelengths. Calculation thus consists in dividing the flux collected, by the solid angle that the geometry of the optics of extraction allows to extract. This calculation can have the paradoxical effect to result in a higher Brilliance for the beamlines whose solid angle is more modest. Moreover, the majority of calculations of brilliance do not take into account widening of the source caused by diffraction in the various optical elements. Therefore, the comparison between the brilliances of the various sources must be taken into account with care. One however evaluates grossly for the whole of the IR beamlines, a brilliance passing from 10^{19} photons/sec/1 % of BW/mm2 steradian for the near infrared (1 micron) to 10^{13} photons/sec/1 % BW/mm2 steradian for the far infrared (for a current of 400 mA injected). This brilliance has to be compared with that of a black body at 2800 K (internal source of the interferometers) which is close to 10^{17} for the near infrared (1 micron) to 10^{11} for the far infrared.

3.c Spectral range

The synchrotron radiation being a white spectrum, all the wavelengths (from the X-ray to the far IR) will be available without modification of the parameters of the machine. Coupled to two adapted interferometers, the beamline AILES will cover the range 1-3000 microns (that is to say 3 to 10000 cm-1) with an excellence range in the far infrared and the submillimeter for which no intense source of laboratory is available.In order to have a continuous spectrum, it is also necessary to minimize absorptions due to residual gases, by maintaining the vacuum in the beamline and spectrometers. For this purpose, the beamline will be under ultra-high vacuum from the extraction to the diamond window (see Section 2.D. the optical system), and in secondary vacuum in the interferometers.

Another factor affecting the exploitable range of energy may come from absorptions due to the optical elements and/or diffraction. The following considerations were taken into account:

- the dimensions of the mirrors and the enclosures allowing the transport of the beam will be compatible with the solid angles extracted in order not to constitute a limiting factor;

- the transition between the vacuum ring and the interferometer will be obtained by means of a natural diamond window not presenting any absorption except that due to the phonon from the diamond window.

- the size of the window and that of the openings towards the interferometers (diameter of 10 mm) will make it possible to extract the photons without total diffraction up to 3 cm-1.

- the diamond window will be wedged in order to avoid the multiple reflections, which appear in the interferogram as interference (this principle is described Section 2.D.).

- interferometers equipping the beamline AILES (described Section 2.E.) will be selected to ensure the complete spectral cover in the infrared. The specific optical elements (beamsplitters, detectors, filters, polarizer) will allow measurements with a relative noise lower than 10-4 in all the range of the infrared.

3.d Stability

The stability of the beam in position and intensity is essential in the infrared frequencies, because the modulations of intensity on the interferogram affect directly the spectrum obtained by its Fourier Transform. This stability is a parameter optimized for SOLEIL (drift in short periods: less than 1 microns /hour, slow drifts less than 10 microns /day). Longer-term stability (absence of drift of the beam) is essential for long measurements such as: systematic series of measurements, studies of chemical or biological systems evolving in time or any measurements with high resolution for which a scan lasts several tens of minutes. Moreover thermal stability (less than 1°) also has an important impact on the stability of the optics of the beamline and the spectroscopic stations. Therefore, the SOLEIL facility will provide photon and electron beams (specifications of the machine) remaining particularly stable. The absence of fluctuations in the intensity of the source will be accompanied by an extreme care given to the stability of the optics of the beamline and those of the interferometer.

In addition, a reflection on the interruption of measurement during the injections is under study. The correction will be implemented, in the following manner: correction of the intensity of the interferogram by using the measurement of current in the machine and automatic rejection of the data points measured throughout injection.

Another potential source of noise caused by changes in the optical set-up is brought about by heating of the optics. In order to avoid the overheating of the extraction mirror and to prevent vibrations on the mirror caused by water-cooling, we chose a geometry for the first collecting mirror including a slit letting pass the "hard part" of the radiation. Calculations of the power intercepted by the mirror of extraction were conducted by Oleg Chubar, for various dimensions of a central slit. It reveals that a slit of 3mm (± 1.5 mm) presents the best compromise between a low power deposited on the mirror (density of power of 7W approximately) and an acceptable loss of intensity in all the range of IR. Calculations of the spatial distribution of the photons show that this slit will cause a loss of photons collected by the slit mirrors between 20 % (in the mid infrared) to 10 % and less in the far infrared .

4. The experimental device

The infrared beamline AILES can be described as five main elements:

- the source made up of the Edge of a dipole magnet and the dipole magnet itself including the vacuum chamber modified to allow the extraction of a broad solid angle adapted to the emission in the far infrared.

- a system of extraction placed inside the ring chamber allowing the collection on a mirror and the redirecting towards the continuation of the beamline placed outside the enclosure ring.
- an optical system collecting and guiding the infrared photons starting from the enclosing wall to the spectroscopic stations.
- the spectroscopic stations especially adapted for the far infrared radiation, one for measurements at high resolution of isolated molecules, and the other for which the intermediate resolution is well adapted to the studies of sample in condensed phase (solid, liquid, soft matter...).
- a workspace for measurements preparation of the experiments and data processing.

4.a The source

The passage of the electrons in one complete period (including the intermediate zone between no field region and the maximum field region in the dipole, the dipole itself and the following intermediate zone) constitutes the source of photons of the infrared beamlines AILES and SMIS. The edge and dipole sources have rather different characteristics, such as their spatial distribution as illustrated in Fig.2: the source "edge of magnet" has an almost cylindrical symmetry whereas the dipolar emission is "constant" in the orbit plane. In the vertical direction (out of the electron orbit plane) the cone of emission of the two sources opens up with the wavelength with a slower spreading for the emission by the edge source. Thus, for the dipolar source, the angle RMS in the mid IR (1000 cm^{-1}) is close to 12 mrad whereas it is of 28 mrad for the far IR (100 cm^{-1}) and of 45 mrad in the submillimeter range (30 cm^{-1}). For the edge source, the vertical angle RMS passes from a value of 6 mrad in mid IR (1000 cm^{-1}) to approximately 18 mrad in the far IR (100 cm^{-1}) and approximately 35 mrad for the submillimeter range (30 cm^{-1}).

In the standard dipole chambers of SOLEIL, the limitations due to the hexapoles allow to extract angular openings of 33 mrad in horizontal and 8.9 mrad in vertical. As regards the edge source, the maximum openings are 33 mrad in horizontal and of 8.9 mrad in vertical. Without modifications on this room, it was thus difficult to envision a beamline adapted to far IR since the vertical opening would have caused a limitation penalizing strongly the natural cone of emission for the long wavelength. The intensity of the source was optimised thanks to modifying the dipolar chambers. The principal modifications consist in widening the slits of the dipolar chamber to 12 mm and the spacing of the hexapoles to 40 mm.With this modified dipole chamber, it is possible to extract 20 mrad in the vertical at 1350 mm from the point source, while in the horizontal direction, 78 mrad (-17mrad to +61mrad) are collected.

4.b The optical system within the ring wall

The system of extraction allows for the collection of radiation emitted in the dipolar chamber out of the ring (See Fig.2 and Fig.4). It consists of two mirrors (M1 and M2) placed in a vacuum chamber which will convey the beam of photons emitted by the dipole and the edge of the dipole magnet towards the outside of the ring wall. The choice of an optical system for extraction was dictated by:

i) the need for extracting IR radiation emitted in the dipolar chamber (approximately 20 X 80 mrad).

ii) the high power incident on the first mirror caused by the X/UV hard part of the radiation and creating an appreciable power.

iii) the possibility of isolating the extraction mirror from the ring chamber in the event of intervention on this last.

Two modes of retraction of the collection optics have been defined:

- the mirror will be placed at an intermediate position when experiments on the electron beam involve an excursion out of its normal orbit which could damage this mirror.
- the mirror will be placed at a high position which will allow an isolating valve to be closed and therefore to fully isolate the M1/M2 chamber, in the event of incident requiring an intervention on this chamber.

Considering each one of these requirements the choice of the system of extraction described here was made.The mirror of extraction is plane with dimensions 60 x 113 mm^2 and is placed at 1350 mm from the source. Oriented at 45°, it redirects the totality of the outgoing beam to the mirror M2. This mirror will be made out of Aluminium, and covered with a layer of gold of approximately 10nm thickness providing a maximum reflectivity, for an incidence of 45° (> 99,9999%). This material presents a very good thermal conductance (236 W.m^{-1}.K^{-1}), a possibility of obtaining, surface quality compatible with its use in the infrared and a weight compatible with the movements described hereafter.

The mirror M2 of dimensions 80 x 212 mm^2 will be toroidal and its orientation enables to redirect the beam out of the enclosure ring while passing the wall perpendicularly (relative to the orbit of the electrons). The mirrors M1 and M2 are interdependent and the alignment of the unit will be done on marble, with the alignment group. This unit will be adjustable, with collective movements of unit M1/M2 and independent movements for M2. The set of two mirrors will be removable as described above.

4.c The optical system outside the ring walls

This part of the optical system refers to the set of mirrors conveying the beam from the outside of the ring wall to one or the other of the interferometers.

The elements of the system must respond to the following demands:

- to transport the cone of radiation IR without important loss to the entrance port of the interferometers.
- to raise the beam above the "hutch" I02C.
- to focalise on a window establishing the junction between the ring UH vacuum and the secondary vacuum compatible with the spectroscopic stations.
- to minimize the multiple reflections within this window.
- to bring the beam in one or the other of the perimeters reserved to the IR spectroscopy
- to focus the beam on the entrance port of one or the other of the interferometers.

The choice of the optical system describes hereafter responds to these requirements. All optics are placed in chambers under ultra-high vacuum down to the diamond window. The first deviation of the beam is obtained by means of two plane mirrors M3 and M4 bringing the beam at the height compatible with its passage to the bottom of the hutch. This set of two mirrors will be enclosed in a radiation shielding made of thick walls of lead and polyethylene. Because of this unfriendly location these flat mirrors will be motor controlled and the alignment will be realised by camera controlled monitoring. One can notice that a first focusing, (necessary to limit the section of the beam) takes place between M4 and M5. Within the infrared workspace, the beam is intercepted by a toroidal mirror (M5) that redirects it towards the M6 toroidal mirror. This ensemble allows a strong focusing between M6 and M7. At this focus point, the reduced size of the image allows the insertion of the diamond window described in the section 4.e. Following this, the toroidal mirror M7 compensates for the strong divergence and redirects the beam towards the set of plane mirrors M8 and M9. This optics brings the beam at the height compatible with the entrance of one of the two interferometers while the plane mirror M9 is retractable in order to deviate the beam towards the second spectrometer thus allowing the selection of one or the other workstation. Notice that no actual collimation is made to carry the beam all the way to the two interferometers; however, the slowly converging beam is compatible with entering the intermediate resolution interferometer directly on the beamsplitter.

4d Spatial distribution on optics

The spatial distributions of photons of 100 microns (wavelength corresponding to the centre of the Far IR range) were evaluated using the Ray Tracing software SOLEMIO [17]. For each optical element and at each focusing point, the distribution allows determining the size of elements needed (mirrors, chambers). Spatial distributions at the focusing were also evaluated for photons of 300 microns (corresponding to the largest wavelengths conveyed effectively by the beamline). Moreover, the Software SRW [18] was also exploited to confirm results provided by SOLEMIO. This software allows evaluating the spectral, spatial and polarization characteristics of the radiation in the near field produced by a relativistic electron beam travelling through an arbitrary magnetic field. Although the agreement is generally excellent, the details provided by SRW consolidate the choice to avoid anamorphisation and suggest that the focusing envisaged for the diamond window does not correspond completely to the most reduced spot. Moreover, by using SRW, the computed wavefront of the radiation can be propagated through mirrors, apertures allowing a complete evaluation of the beamline including diffraction losses and therefore providing realistic numbers of photons and their distributions at any optical element. Accordingly, we have carried out a complete evaluation of the beam intensity at every optical element for the AILES beamline. Moreover the evaluation of photon flux at every main element of the beamline is presented for three wavenumbers (Fig.3). It illustrates the influence of the main optical elements.

4.e Geometry and window material

A window is the key element for delimiting the junction between the ultra-high vacuum of the ring and the secondary vacuum of the interferometers. The materials having a mechanical resistance enabling them to isolate the vacuum ring from the secondary vacuum of the beamline as well as a transmission adapted to all the range of the infrared and visible (important for alignments of optics) are rather few: natural diamond and artificial diamond (CVD).

Once the choice of material of the window is made, two principal drawbacks should be avoided:

- a size and or a position badly adapted to the geometry of the optics that precedes it,
- multiple reflections causing detrimental modulations for the quality of the spectra, especially in the far infrared.

The multiple reflections appear in the Fourier transform of the interferogram as interference structure in the spectrum with a period given by:

P (cm-1) = 1 /(2nd)

where d is the thickness of the optical element in cm, and n is the index of the transparent medium.

This modulation can be particularly intense for wavenumbers approaching 1/(2nd). For example, a window of CVD diamond, presents a thickness close to 3 mm and the index is approximately 2.3, it will therefore causes a modulation of visible period of approximately 0.5 cm^{-1} in the far and mid infrared.

A wedge of 1° in the window greatly minimizes this structuring of the spectrum: the measurement of the transmission of this window only presents interference fringes whose intensity is less than 3 % of the total signal for most part of the spectrum. The use of windows with submillimeter thicknesses widens these structures and thus authorizes an exploitation of the photons down to 5 cm^{-1}. This thickness combined with diameter close to 10 mm, is only mechanically resistant enough for natural diamond windows. Moreover, the somewhat limited dimensions for available natural diamond will dictate the positioning of the window after strongly focusing optics.

At AILES, the solution adopted is to re-cycle a diamond window developed by Drukker in 1998 for the LURE SIRLOIN beamline. This mechanically resistant window is mounted on a UHV flange, has a 10 mm usable diameter, is 200 microns thick, is cut with a 1 ° wedge and is made of natural diamond (2A quality). Compared with CVD diamond, this material has the additional advantages of being more transparent in the complete infrared range while minimizing phonons structures absorption at 1250 and 500 cm^{-1} and degradation of the beam optical quality caused by the scaterring of photons. As a last remark, it remains important to shift the position of the window off the focus (50 mm shift) and to take into account the modification of the trajectory of the photon beam introduced by this wedged optics (deviation close to 1.4 °). In order to optimize the position and the orientation of this window, the support on which will be assembled the window will be preceded and followed by flexible membranes allowing an alignment of its orientation but also of its side and longitudinal position.

4.f Spectroscopic stations

Once carried in the beamline, the photon beam is ready to enter the spectroscopic stations consisting in two interferometers dedicated to the condensed matter studies for one and to the gas phase experiments for the other as represented in figure 4. Two special "boxes" contiguous to the entry of each interferometer will allow a refocusing compatible with the optics of each of them. The interferometers that constitute the main element of the spectrometric part will cover the complete range of infrared between 1 mm (10 cm^{-1}) and 1 µm (10000 cm^{-1}). They are ideally used in conjunction with the broad spectral range available.

The first interferometer will allow an ultimate resolution (not apodized) of 0.0006 cm^{-1}. In order to reduce absorption due to residual gases, the vacuum reigning in the interferometer and the compartment sample will be better than 10^{-3} torr, The dimensions on the floor for this instrument can be as important as 6 m x 2 m, as the displacement of the beamsplitter is close to 5 m.

The second interferometer equipping the beamline is a Bruker model 55V installed in a vacuum chamber allowing a secondary pumping. It allows an ultimate resolution (not apodized) of 0.5 cm-1 (generally sufficient for measurements for material science). The ultimate vacuum in the interferometer and the compartment sample will have to be improved to reach 10^{-3} torr, in order to reduce absorption due to residual gases. This pumping will be carried out by a set of mechanical and turbo-molecular pumps. The floor space needed is approximately 1 m x 1 m.

Each interferometer will be supplemented by several beamsplitters (Silicon for far IR, KBr, Quartz) and detectors (MCT/InSb Sandwich, InSb, cooled bolometer with liquid helium and cooled bolometer with pumped liquid helium).

Various compartments samples will be developed either at the laboratory or by partner laboratories, the most required being accessories allowing measurements of reflectivity at variable angles, cryostat allowing measurements between 5K and 300 K, a cell for high pressure etc..

4. g Workspace

Many equipment being common to the two infrared beamlines, and in order to support the complementarities of those, the space allocated to the two infrared beamlines is placed in the same section of the ring. The arrangement of workspace is shown in Fig.5. Four cabins are planned for the experimental stations space: two will be used for spectro-microscopy (beamline SMIS), one will contain the medium resolution interferometer and the last will be developed for the high-resolution interferometer. The remaining space will include three rooms accessible to the two groups: a clean room for preparing samples in complex environment, a room for data treatment and a workshop.

Moreover, the high resolution being the object of collaboration with the molecular laboratory of Photophysics in Orsay (LPPM), a room contiguous to the high-resolution spectrometer with will be reserved to the preparation of gas phase experiments.

CONCLUSION

The AILES infrared beamline at Soleil has been designed in order to exploit the whole infrared range with as much as possible an extension in the ThZ range. The flux in various elements of the beamline has been estimated in the far and in the mid infrared.The beamline was conceived as a tool for both material and gas phase high resolution spectroscopic measurements. Planned Set-up will include IR reflection–absorption on samples under controlled conditions (temperature, pressure and magnetic field), attenuated total reflectance of thin films and membranes, fast kinetic studies and spectroscopy of reaction intermediates in solution as well as ro-vibrational studies of isolated molecules for atmospheric and astrophysics studies.

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Figure Captions:

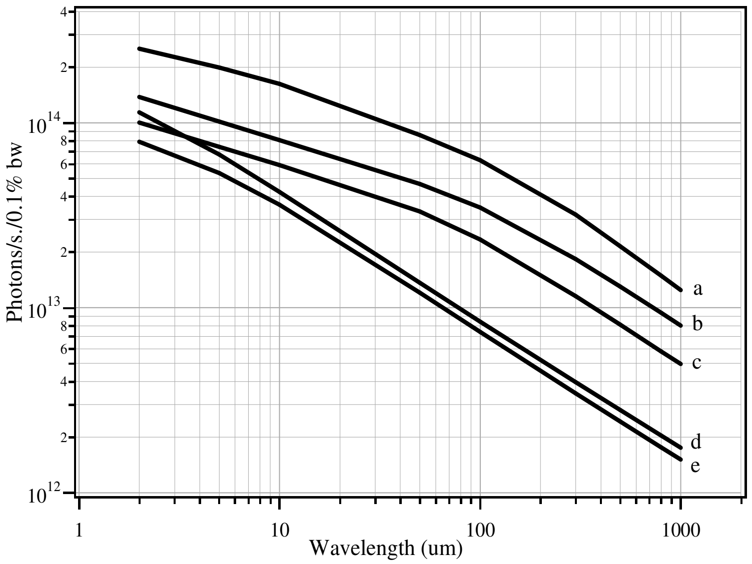
Fig.1. The comparison of calculated flux for different synchrotron source. a .**SOLEIL** (2.75 GeV, 500 mA, ER+BM, 20x78 mrad) ; b. **Diamond**, UK(3GeV,500 mA,BM,30x35 mrad); c. **U10B** , Brookhaven (0.8 GeV, 500 mA, BM, 40x40 mrad); d. **ALS, Berkeley,** (1.5 GeV, 500 mA, BM, 10x40 mrad); e. **ESRF** (6 GeV, 500 mA, ER, 8.5x16 mrad)

Fig.2. Spatial distribution of photons (a) $\lambda = 10\mu m$ (b) $\lambda = 100\mu m$ emitted from the source upon a "screen" of 26 mm x 103 mm placed at 1.27 m from the edge of the magnet, corresponding to the position of the extraction optics.

Fig.3. Photon flux at M1, M1 with slot, Diamond windows and entrance of interferometer IFS125 for 10µm,100µm and 1000µm calaulated by SRW.

Fig.4. The layout of the AILES beamline and station at SOLEIL.
M1,M3,M4,M5,M8,M9 are flat mirrors, M2,M6,M7 are toroidal mirrors, S1: interferometer Bruker IFS55V; S2: interferometer Bruker IFS125.

Fig.5. The workspace of infrared beamlines at SOLEIL including two spectroscopy stations IR2, two microspectroscopy stations IR1, the high resolution laboratory HR room, workshop and data treatment common space.



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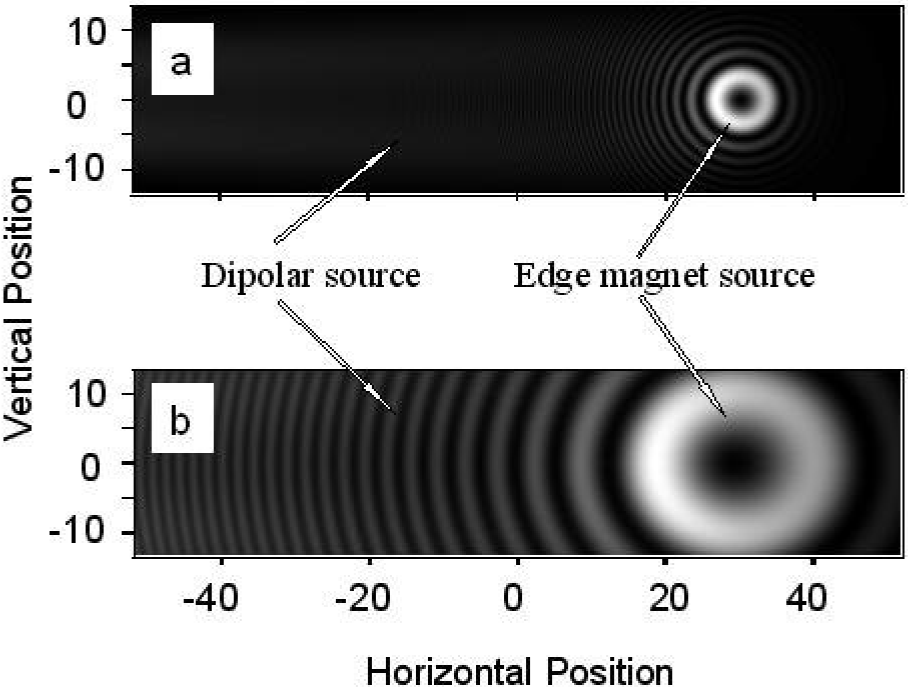

Fig.2. Spatial distribution of photons (a) $\lambda = 10\mu m$ (b) $\lambda = 100\mu m$ emitted from the source upon a "screen" of 26 mm x 103 mm placed at 1.27 m from the edge of the magnet, corresponding to the position of the extraction optics.

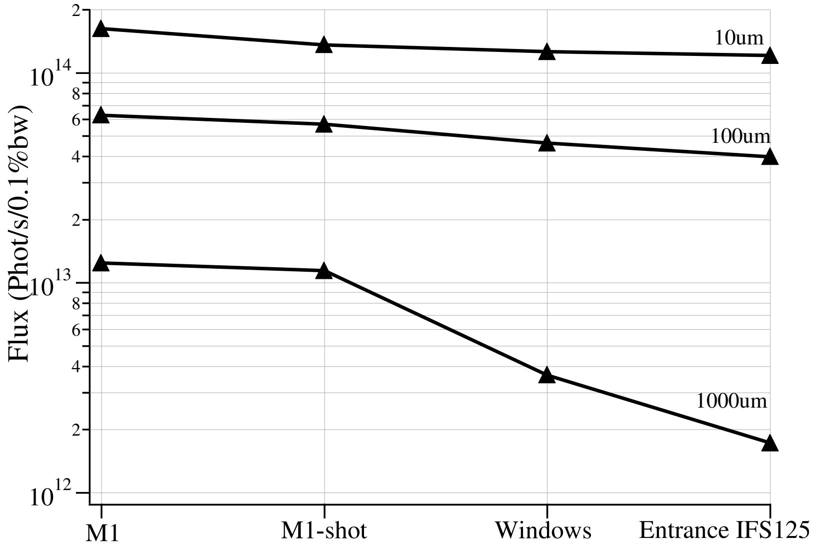

Fig.3 Photon flux at M1, M1 with slot, Diamond windows and entrance of interferometer IFS125 for 10μm,100μm and 1000μm calaulated by SRW.

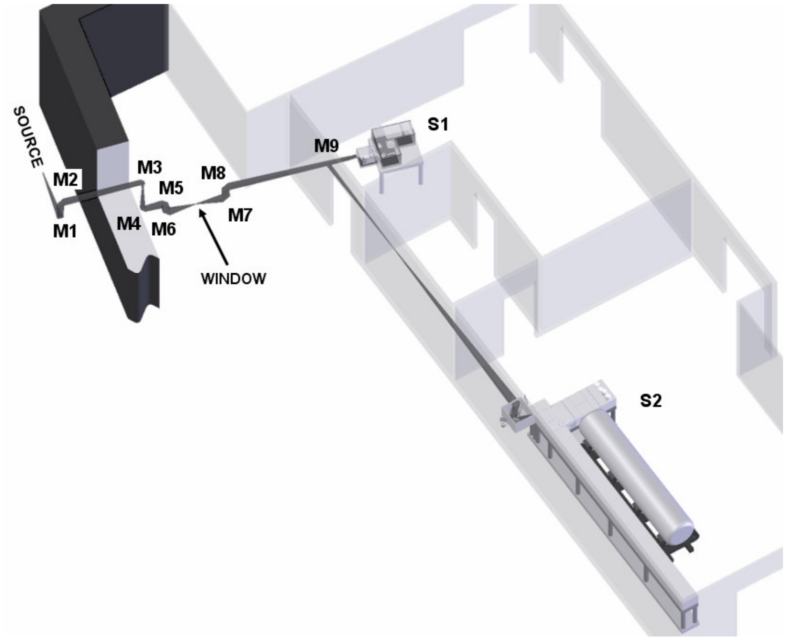

Fig.4 The layout of the AILES beamline and station at SOLEIL
M1,M3,M4,M5,M8,M9 are flat mirrors, M2,M6,M7 are toroidal mirrors.
S1: interferometer Bruker IFS55V; S2: interferometer Bruker IFS125

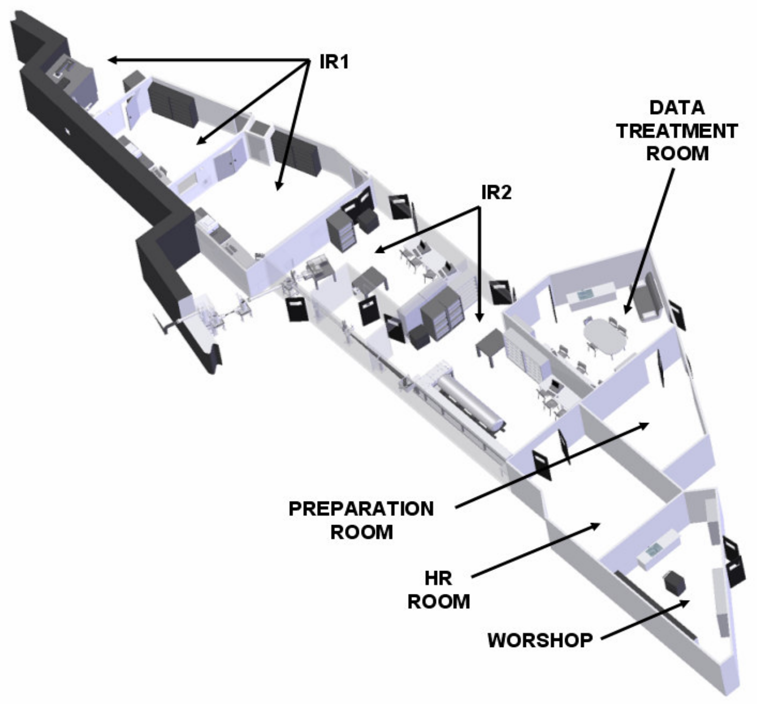

Fig.5 The workspace of infrared beamlines at SOLEIL including two spectroscopy stations IR2, two microspectroscopy stations IR1, the high resolution laboratory HR room, workshop and data treatment common space.