L-07

SOLEIL: A THIRD GENERATION SYNCHROTRON FOR MATERIAL, ENVIRONMENTAL AND LIFE SCIENCES

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SOLEIL is a 2.75 GeV intermediate energy storage ring designed to cover the full energy range from VUV up to hard X-rays by using undulator sources. Despite its moderate 354 m long circumference, it will incorporate 24 straight sections among which 21 are available for insertion devices. Three 12 m long straights can house long period insertion devices (ID) for VUV radiation. Ten medium size (7 m) straights are available for soft x-rays ID's and eight short ones (3.8 m) for hard X-rays. About 22 bending magnet sources could also be used, allowing a total number of 43 beam-lines (BL). Presently, 24 BL's are funded, leaving the possibility for future extension.

The low electron beam emittance (3.7 nm.rad), the high stored current (500 mA) and the high beam stability will make SOLEIL one of the best machines in the world. The facility will be operated using the topping up mode which has demonstrated to yield unprecedented beam stability at the Swiss Light Source. Great care has been taken to insure high transversal and longitudinal beam stability. The design of the synchrotron tunnel and of the experimental hall, the mechanical design of the girders and the 0.1 degree control of the temperature in the synchrotron tunnel should provide a micron transverse stability. Two two-cell superconductive RF cavities will be used to store the 500 mA beam current; they have been designed to ensure high longitudinal beam stability.

The facility is presently in construction. All the buildings will be available by February 2005, but part of them will be delivered earlier to allow the installation of the accelerators. The commissioning of the LINAC and that of the Booster will start this autumn and in March 2005, respectively. The first electrons will be injected in the storage ring in May 2005. The commissioning of the 11 first BL's, the so-called Phase I BL's, will start in October 2005 with the goal of being opened to external users in Spring 2006. Up to now, this tight planning has been respected.

Four types of undulators for the phase I BL's are under construction. For hard X-rays, we choose a permanent magnet undulator with hybrid design and with a 20 mm period, with magnets in the vacuum chamber, which will be operated with a 5.5 magnetic gap, allowing high harmonics to be efficiently used. Brightness in the range of a few 10^{19} photons should be available up to about 15 keV. Soft X-rays will be provided by two types of quasi-periodic helicoidal undulators with variable polarisations, electromagnetic ones with a 256 mm period for the low energy range and permanent magnet APPLE 2 ones with a 80 mm period for higher energies. A 640 mm period helicoidal quasi-periodic electromagnetic device will be used for VUV and very soft X-rays, down to 5 eV. Their performances will be briefly discussed.

The scientific programme includes funding for 24 BL's; the scientific cases of 18 ones has already been approved. Four other BL's are under consideration, so that the funded experimental programme is already widely defined. The first SOLEIL BL, LUCIA, is already presently in commissioning at the Swiss Light Source and will be operated there, before being moved to SOLEIL in 2008. It is devoted to X-ray absorption micro-spectroscopy BL in the range 1 to 7 keV, with a 0.4 by 1 μm focus, mainly for environmental and matter sciences. The 11 Phase I BL's, which are listed in table I, are already in construction and should be operated in 2006. About 50% of them will work in the X-ray range (beyond 2 keV) and 50% in the VUV and soft X-ray one, with also two BL's in the infra red range. Their main characteristics, as well as those of the 6 BL's for phase II which have already been selected, will be presented in the talk. Information is also available in the SOLEIL web site:

http://synchrotron-soleil.fr.

Table 1. The 11 first Phase I beam lines.

3 Hard X-rays BL on in vacuum U20:	
PROXIMA I (3,5 - 17 keV)	Protein Crystallography; MAD; large cells
CRISTAL (3 – 30 keV)	Condensed Matter Cristallography; 3 stations: 2 single crystal and 1 powder diffractionSAXS for Biology, Soft Condensed Matter and Material Sciences; WAXS in a second stage
SWING (3 - 17 keV)	
3 Hard X-rays BL on bending magnets:	
DIFF-ABS (3 – 25 keV)	Coupled Absorption-Diffraction; very High Temperatures
SAMBA (4 – 40 keV)	Energy scan Absorption Spectroscopy, Quick-Exafs; material science and chemistry, Energy dispersive Absorption Spectroscopy
ODE (3.5 – 23 keV)	High pressure; time resolved chemistry
2 Infra Red BL:	
AILES (BM Dipole edge + constant field)	Far IR Spectroscopy (10-200 μm)
SMIS (BM Dipole edge + constant field)	Mid IR Microscopy (2.5-50 μm); two branches with one for industry
1 VUV BL on a 640 mm helicoidal undulator:	
DESIRS (5 - 40 eV)	Spectroscopy and photochemistry in dilute matter Ultra high energy resolution 200000
2 Soft X-ray BL with two helicoidal undulators:	
CASSIOPEE (HU 256 + HU80) (10 - 1000 eV)	Electr. Spectrosc.: High Energy resolution, Spin resolution; resonant photoemission
TEMPO (HU 80 + HU40) (100 - 1500 eV)	Elect. Spectrosc.: Time resolved, magnetization dynamics, surface reactivity (ms-> fs)