FOCUS ON

An in-vacuum wiggler for the PSICHE beamline

The PSICHE beamline, expected to be available to users in 2012, will be partly dedicated to high energy X-ray diffraction under extreme conditions and partly to microtomography. Its light source will be an in-vacuum wiggler, designed and built at SOLEIL.

How to obtain a photon energy of 70 keV , the upper limit of the spectral range available at SOLEIL? For insertion device specialists, the answer seems obvious: a wiggler is required, as undulators do not allow such high energies to be reached . However, even with a wiggler, producing such hard X-rays is far from being conventional.

Superconductor or in- vacuum technology?

When it came to choosing the PSICHE light source, two technical solutions were explored: the technology of superconductors, used especially in the DIAMOND synchrotron in Britain and the CLS in Canada on wigglers in comparable energy ranges, and in-vacuum insertion technology, for which there were no reference points. Both approaches were explored right up to the setting up of the tender, the time required to evaluate the impact of both solutions on the infrastructure, the investment and the running costs and, on the other hand, the expected performance levels. This comparative study showed that the manufacture of an in-vacuum wiggler at SOLEIL was less restrictive and less costly than a superconducting wiggler, despite a slightly lower flux. The final choice was validated in July 2006.
But everything remained to be done!

A solid in-house experience

Olivier Marcouillé then tackles the task. His advantage: three years experience, with his colleagues in the "Magnetism and Insertions" group at SOLEIL, on in-vacuum undulators. Most of them are already installed on six beamlines and two additional ones are planned to be installed in the next two years. Innovation does not really appear in the technology, similar to that used for undulators, but rather in the engineering required to design the carriage that underpins this particular insertion device. Indeed, the magnetic forces are 4 times larger than those produced in the undulators, due to the increase of the magnetic field. The forces reach 10 tons, which unusually constraints the carriage and mainly the girders. To overcome this difficulty, Keihan Tavakoli and SOLEIL's engineering group proposed an original compensation solution consisting of springs installed between the wiggler girders, in order to cancel the forces.

The permanent magnets of the PSICHE wiggler, before being put under vacuum.

Olivier Marcouillé is already busy designing new magnetic devices for SOLEIL

Ready for 2012

The permanent magnets equipped with their holders, girders and carriage were made separately by outside companies. SOLEIL was responsible for integrating the various components and for carrying out the magnetic measurements and corrections. Particular attention was paid to the tools used to assemble the parts due to the large magnetic forces that required heightened safety considerations. The wiggler was installed on the machine last June. Initial tests showed that its operation matched with specifications, except for one unexpected effect – now understood - of the wiggler on the beam lifetime. Olivier Marcouillé is currently working with the "Machine Physicists", to correct this default.
The first experiments on PSICHE beamline will be carried out in 2012!

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