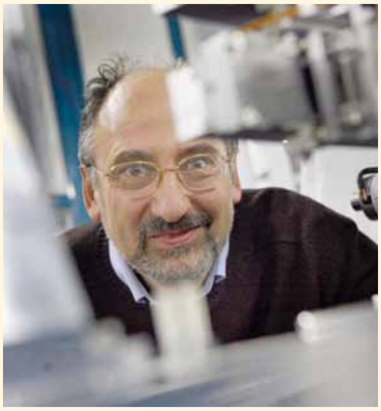

Towards the end of the 1970s, François Polack became part of the scientific adventure linked to the conversion of the ACO[1] collider into a synchrotron radiation source. Since then, this optics researcher has never left the professional world of synchrotrons. Involved in the rejuvenation of LURE[2] then, from the early1990s, in the design of SOLEIL beamlines, he is now Head of the Optics group at SOLEIL.

EXPERT PORTRAIT

FRANÇOIS POLACK, OPTICS RESEARCHER

Tell us how you became involved in the SOLEIL project

During the last years when LURE was operational, we were able to prepare for the construction of SOLEIL.
My colleagues and I were able to take advantage of our years of practical experience working on synchrotron radiation instruments, on the rejuvenation of LURE in 1995 and on other synchrotrons, such as ELETTRA in Italy, with the design of the APE beamline.
A beamline is based on the project of one research group and must meet its scientific objectives. Our job is then to provide the equipment that is best adapted to the needs of future users. We are particularly motivated to find these appropriate solutions. Another interesting aspect for me is to be able to add innovation to new beamlines. In all cases, close cooperation with the scientific head of the line is very important.

Can you describe a few innovations on the optical side?

The first stems from the observation that the gratings from soft X-ray monochromators are only effective in a narrow spectral range determined by the line groove depth: when constant, this limits the spectral range and requires a larger number of gratings. During our work on APE, this observation led us to design beamlines with two depths of gratings. We refined this concept by installing, with the help of the company Jobin-Yvon, gratings with continuous variable groove depth along the lines. This improved the performance of the beam in relation to wavelength and minimized harmonics.
The monochromators on the XUV line at SOLEIL (TEMPO, CASSIOPEE, PLEIADES and ANTARES) were designed to use these gratings.
Moreover, at SOLEIL, the photon beam of a few square millimeters that lights up the grating is still more or less parallel twenty meters from its source. We managed to exploit this quality by designing monochromators in which the beam is uniquely focused by the grating. This avoids the need to insert a supplementary focusing surface that would reduce the final resolution of the instrument. Such monochromators now equip the CASSIOPEE, PLEIADES and ANTARES beamlines.
Finally, we are asked what is the maximum energy at which these gratings can be used, knowing that the higher the energy, the lower the angle of incidence of the beam required to preserve reflectivity. This results in a small range of adjustment. On one mirror, it is possible to increase this angle of incidence using a multilayer treatment, but requires a change of angle to change the wavelength reflected.
In a monochromator, wavelength selection is done precisely by modifying the angle of incidence. If the multilayer treatment is applied to the grating, calculations have shown that under certain conditions (of incidence and deviation), a phenomenon is produced of selective coupling, comparable to a resonance effect, which, as a consequence, produces a large increase in reflectivity. This is being developed at the present time and several beamlines should benefit from this.

How would you define your post at SOLEIL?

A beamline requires well-designed optics, but also good mechanics, as well as a good control system.
Our group has the role of “integrator” on these three points. It is important to check that the specifications for the optical surfaces, but also of the moving parts and their coding, have been adhered to. The optical systems at SOLEIL are always stretched to their limits, so it is imperative that they are fit for purpose.
This forms part of our job. Confidence has built up between the beamline groups, suppliers and our team and we all have a common aim: the best optics for SOLEIL. This collaboration is necessary and experience shows that this is a much more efficient way to obtain the expected results than by using a penalty system. This team work will continue over future months, with notably, the big challenge of the ambitious NANOSCOPIUM beamline and the instrumental developments that this will entail.

NOTES:

1. ACO: Anneau de Collision d’Orsay, which operated from the 1960s. Dedicated at the start to particle physics experiments, beamlines were gradually added around the ring to utilize part of the synchrotron radiation.
2. LURE: Laboratoire d’Utilisation du Rayonnement Electromagnétique, the French synchrotron radiation source that preceded SOLEIL. Installed as part of the Orsay Faculty, it stopped operating in 2003.