EXPERT PORTRAIT

RYUTARO NAGAOKA, HEAD OF THE "ACCELERATOR PHYSICS" GR

With a PhD in theoretical nuclear physics from the University of Tokyo, Ryutaro Nagaoka very quickly decided to specialize in accelerator physics. A change of direction that reflected his desire to work in a scientific field that applied more directly to society. In his view, the work of his nuclear physicist colleagues was too «solo». Synchrotrons have allowed him to work as part of a group, and SOLEIL even asked him to head one. The career path of an accelerator globetrotter.

What led you to work at SOLEIL?

When I decided to leave the nuclear physics field for that of accelerators, that is to say after my PhD, I started at the RIKEN laboratory in Tokyo. I joined SPring-8, but I quickly left Japan for Europe, where my career took off: in Italy at Elettra for six years, then to France at the ESRF for another six years and finally SOLEIL since 2002. Each time I moved following a proposal to join a group. These successive posts have allowed me to intervene each time at a different stage of the synchrotron: the SPring-8 storage ring complex had not yet been built when I worked on its lattice design and optimization, I participated then in the commissioning of the machine at Elettra, then was asked to improve the performance of the ESRF ring. It was while I was at the ESRF that I met Jean-Marc Filhol. Shortly after leaving to form part of the SOLEIL project, which had not yet been built, Jean-Marc proposed me to join the "Accelerator Physics" group here.

So what was your task at SOLEIL?

My role, as I was already doing in part at the ESRF, was to study the instability of the electron beam: determine its level of interaction with the environment, simulate the beam dynamics... all this in order to ensure that the intensity of the beam could ultimately reach 500 mA. It was in this context that I was put in charge of the development of the transverse feedback system (see Rayon de SOLEIL N° 19, p. 11). This maintains, by means of continuous corrections, a stable high-intensity beam, by keeping the transverse beam sizes very close to the theoretical values. This system, necessary in continuum for the beam's performance to remain

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optimal, is now routinely used. To develop it, several SOLEIL groups were brought together: Diagnostics, Radio Frequency and Design Engineering.
Then, in 2011, I replaced Amor Nadji, who had been appointed Director of the Sources and Accelerators Division on Jean-Marc Filhol's departure. I became head of the Accelerator Physics group.
This management role was a big change and a novelty for me as, until then I had just concentrated on my own projects. I am now committed to also monitoring and supervising those in my group!

And now, what are the challenges?

When I started working with synchrotrons 26 years ago, no 3rd generation machines were yet in operation. At that time the main concern was how to store the electron beam.
When this was met, the next was to characterize the machines and improve their performance. SOLEIL, which was built a few years later than the first 3rd generation synchrotrons such as the ESRF, represents a state-of-the art 3rd generation light source, of which we can be proud. But we must think of the future.
Now, physicists have a new challenge: to push the performance of synchrotron storage rings to their limits – referred to as «Ultimate Storage Rings» or USRs. The goal is to reduce the horizontal emittance, which is the key parameter in greatly increasing the flux density of photons emitted and achieving transverse coherence of the beam.
This emittance is aimed to be reduced by an order of magnitude from 4 nm, currently at SOLEIL, down to a value of 400 pm! Studies are already under way; several models are now feasible thanks to advances in technology, especially in magnetism. Very high fields are required, provided by electromagnets that are not superconductors but very thin and placed close to the electron beam.
This in turn requires designing smaller vacuum chambers, to tolerate fewer errors on the beam path ... In other words, there will be an impact on the entire machine.
Such USRS are already under construction in Sweden (MAX IV) and Brazil (Sirius). These synchrotrons have been designed from the outset to be USRs. In the case of SOLEIL - but also the ESRF, Diamond or SPring-8, who are working on it as well – what is involved is an upgrade of an existing machine.
Such an adaptation is more complex to implement than designing from the start and also risks closing access to users. Modifications must be carried out in such a way as to minimize as much as possible the duration of shutdown.
For the ESRF, the upgrade is planned to take effect by 2020 with a year of shutdown, and Diamond and SPring-8 are considering similar timetables. To maintain SOLEIL “in the race”, a lot of work therefore lies ahead of us.
And that's not all: a theoretical study is underway, initiated by Amor Nadji with an interest of laboratories such as the ESRF, SLAC, and MAXLAB. This concerns the production of a completely round beam in a straight section of the ring. The study uses the 12-meter long straight section of SOLEIL as a test bench, in which are arranged “skew quadrupoles”, a solenoid and an insertion device to produce the radiation. Preliminary calculations show that an emittance of 200 pm could be locally achieved. We would like to go further by showing the experimental feasibility of such a scheme when undertaken in a collaborative venture among the four laboratories.

And looking back at 11 years at SOLEIL?

They have flown fast...
And I would like to express my gratitude to SOLEIL because I felt integrated into the project as soon as I arrived. I much appreciated the open-mindedness of all of my colleagues. And with these new challenges, the coming years will no doubt pass very quickly too!

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