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Sylvain Schwartz

### Training in Academia--and Industry

Elisabeth Pain  
France  
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When French physicist Sylvain Schwartz started his university studies, he already knew he wanted to pursue a Ph.D. But "I also wanted to keep contact with real-world applications of physics instead of being too ... fundamental," he says. So when the time came for Schwartz, 29, to choose a Ph.D. program, he utilized a [CIFRE agreement](#), a funding mechanism supported by the French science ministry through which young researchers are employed by a company and obtain a doctorate in partnership with a public lab.

When doing a Ph.D. across academia and industry, "everything could go wrong, and it is only outstanding people who can juggle between the two worlds, at least in ... basic research," says Schwartz's academic supervisor, Alain Aspect. But the challenges are far outweighed by the advantages of a dual professional experience, says Schwartz, who last year received recognition for his scientific achievements from both worlds.

A CIFRE agreement "is a good way of ... doing research and keeping other doors open," says Sylvain Schwartz.

#### LAYING SOLID FOUNDATIONS

After studying in *classes préparatoires* for 2 years in preparation for the nationwide, competitive examinations for entry to the French *Grandes Écoles*, Schwartz won an invitation to join the prestigious [École Polytechnique](#) in Palaiseau, near Paris. During the 3 years he spent at the *Polytechnique*, he gained broad multidisciplinary training with an emphasis on maths and physics. Inspired by his teachers, he decided to specialize in physics and spent 3 months at the [physics department](#) of [Stanford University](#) in Palo Alto, California, working in the group of atomic physicist Steven Chu, one of the three scientists who jointly received the 1997 physics Nobel Prize for methods they developed to cool and trap atoms with laser light.

Schwartz obtained his *ingénieur* diploma from *Polytechnique* in 2001 and continued studying for a *Diplôme d'Etudes Approfondies* (the French equivalent, at the time, of a master's degree) from the [École Normale Supérieure](#) (ENS) in Paris. He carried out his research in the [Laboratoire Kastler Brossel](#) with 1997 Nobel Prize co-recipient Claude Cohen-Tannoudji, this

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time studying the hydrodynamics of ultracold quantum gases.

## WORKING ACROSS TWO WORLDS

After graduating from ENS cum laude in 2002, Schwartz went to the [École Nationale Supérieure des Télécommunications de Paris](#) (TELECOM ParisTech) to get yet another *ingénieur's* diploma. This time, he carried out his research project in the labs of aerospace, defense, and security information systems company [Thales Research and Technology France](#) in Palaiseau, with one of his TELECOM ParisTech professors, Jean-Paul Pocholle. Schwartz was offered the opportunity to stay for a Ph.D. "I could measure his great ability and [his] sharp mind," Pocholle writes in an e-mail to [Science Careers](#). Together with [Polytechnique](#) professor Aspect, leader of the [Atom Optics Group](#) at the Laboratoire Charles Fabry in the [Institut d'Optique Graduate School](#) in Palaiseau, Schwartz and Pocholle applied for a CIFRE agreement.

Schwartz spent the first 2 years of his Ph.D. at Thales working on a new generation of ring-laser gyroscopes, devices able to measure movement. When placed inside planes, these devices can tell pilots exactly where they are. Long-distance flights already rely on similar sensors as a supplement to the global positioning system. The novelty in Schwartz's project was replacing the gas component of a gyroscope with a solid-state medium. "From an industrial point of view, this would result in a more reliable device that would be less expensive and last longer. From a physical point of view, those two [components] are very different, and it required a lot of theoretical and experimental work to successfully make the substitution," Schwartz says.

When, in the last year of his Ph.D., Thales decided to build a prototype based on his experiments, Schwartz moved over to his academic lab to work on a related but more fundamental project focused on the use of atoms--instead of photons--to detect movement. "The difficulty here was that he had almost two different subject[s]," Philippe Bouyer, Schwartz's direct supervisor during the second part of his Ph.D., writes in an e-mail. "Only [s]mart people like him could go on with high-level industrial development and still investigate more theoretical aspect[s] of future inertial sensors with atoms."

### **The CIFRE Agreements (*Conventions Industrielles de Formation par la Recherche*), in a nutshell**

To get a CIFRE agreement, you must find a company willing to hire you and an academic lab willing to cosupervise you. Ph.D. students may be of any nationality, and the partner academic lab may be based abroad, but the company must be a French legal entity. For more details about how to apply, click on the [Association Nationale de la Recherche Technique](#) (ANRT), which manages the agreements on behalf of the French science ministry.

CIFRE agreements were established more than 25 years ago. According to ANRT, 94% of CIFRE students get a job immediately after graduation, in a company in 80% of the cases.

## THE PROS AND CONS OF A DUAL TRAINING

Schwartz sees many advantages to doing a Ph.D. in the context of a CIFRE agreement. "What I like most is to make the bridge between fundamental physics and practical applications, and for this the CIFRE is a great opportunity," he says. Also, "when your experiments [are] going well, then the industry has a capacity to put more and more funding on the project," Schwartz says. They may also provide "other people to help you with the project," so results can come very quickly, says Schwartz, who interacted regularly with engineers, technicians, and business people within Thales.

Another advantage: CIFRE students get paid more than most Ph.D. students in France, and they have a company contract. They receive a minimum salary--€23,484 in 2007--and company benefits like any other employee.

A CIFRE agreement also comes with some constraints. "You can't do whatever you want. It

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has to be a component of the project" agreed to by industry, Schwartz says. That's just what he was seeking: "My goal was to [bring] physics in agreement with the needs of the industry. If you are motivated by this, then you don't feel restricted at all."

Schwartz found the publishing restrictions more bothersome. Publishing "is very important for [a] Ph.D. student" but not always in the direct interest of the company, "so you have to fight for this," he adds. "You have to carefully write your information so you don't put confidential information in it," and you can't publish anything before having the right agreements from higher-ups, he says. It's a struggle, because, as for any scientist-in-training, "you have to pay attention to publishing enough," Schwartz says.

Working across two labs can also be challenging, especially when both demand your attention. But Schwartz found it helpful to have another lab to go to if things were not going so well in the first lab. Still, "maybe also you are a little bit further from the academic world. You have to be a little demanding," Schwartz says. "A difficulty was that I tended to forget about him because he was not in my lab but in Thales lab. But he knew exactly how to provoke meetings with me and P. Bouyer from the academic side, and his industry advisors," writes Aspect in an e-mail.

### WINNING CAREER PROSPECTS

Two first-author articles in peer-reviewed journals and nine patent applications filed from his Ph.D. have given Schwartz a head start in both academia and industry. And he has won prizes from industry and the academy. From the *École Polytechnique* and [ParisTech](#), a consortium of 10 of the French *Grandes Écoles*, he won prizes for his doctoral thesis, and from Thales and the *Aéro-Club de France*, he won prizes for his technological achievements.

A CIFRE agreement "is a good way of ... doing research and keeping other doors open," Schwartz says. Within their company, CIFRE Ph.D. students get to know a lot of people in different roles, and "if you are curious, you have a lot of opportunities to learn," Schwartz says. Already knowing how things work in industry makes you a good hiring candidate there, he says.

After his Ph.D., Schwartz accepted an offer to stay at Thales, where he still does research full-time, pursuing a commercial product out of his doctoral project and working to transform new, promising matter-wave-sensor technologies into concrete, practical applications.

A company like Thales has many motivations to hang on to an employee like Schwartz. He has "a valuable combination of skills that are not often found in one individual," Pocholle says. His scientific and technical expertise allows him to link "the very latest ideas of the theoreticians and basic science researchers to the practical realization of device structures that meet the criteria that the world of industrial production demands." Also, "he is able to take complex scientific material, to analyze, distil, and refine it in order to explain and discuss, in very clear terms, the main points and issues involved."

But don't rule out that other world. "He has all the qualities to come back to academia, if he wants to do it," Aspect says.

"For the moment, the projects are interesting, so I will stay" in industry, Schwartz says. But in the longer term, "basic research is not excluded. ... Anything is still possible."

<p>Elisabeth Pain is contributing editor for South and West Europe.</p>	<p>Comments, suggestions? Please send your feedback <a href="#">to our editor</a>.</p>
<p>Photo courtesy of Sylvain Schwartz</p>	<p>DOI: 10.1126/science.caredit.a0800094</p>

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