People behind PASQuanS

"The development of industrial applications based on quantum technologies calls for a genuine dialogue between hardware makers and industrial end-users. PASQuanS provides a platform for exchange that can help bridge these worlds."

Thomas Ayral
Atos BULL, France
Research Engineer, Industrial Partner

Could you briefly describe your institutional and personal role within the PASQuanS project: Which specific project activities are you involved in?

Within PASQuanS, I am involved in the work package dedicated to the development of applications of programmable analogue simulators. The scope of these applications ranges from physics to chemistry to combinatorial optimisation. The goal is to investigate and quantify the potential of the various quantum hardware platforms of PASQuanS – whether Rydberg atoms, ultracold atoms or trapped ions – for solving challenging problems in these fields.

Which results have already been achieved on your end and what will be the next milestones?

Our team at Atos focuses more specifically on the solution of combinatorial optimisation problems with Rydberg platforms. We developed high-performance classical simulation tools to simulate Rydberg platforms and their imperfections, and used them to quantify the success probability of an algorithm for solving a combinatorial optimisation problem called the "Unit-Disk Maximum Independent Set" problem, a difficult computational problem. Our simulations allowed us to define the conditions, in terms of number of Rydberg atoms and noise levels, that should be attained in order for this type of quantum hardware to outperform advanced classical computers in solving this problem.

For you personally, what has been most fascinating about the project so far and how do you think PASQuanS will impact your future career?

A key aspect of PASQuanS is that it brings together the most advanced experimental analogue quantum processors, theory groups and industrial partners. It thus allows for very enriching exchanges between very different fields of expertise. I find it very stimulating, and important for the future development of the field. Being part of it offers me the opportunity to broaden my views in all those fields.

How can the transition of quantum technologies to industrial applications be successful and in which way does PASQuanS help to achieve this aim?

The development of industrial applications based on quantum technologies calls for a genuine dialogue between hardware makers and industrial end-users. Their ways of thinking and the technical constraints they have to deal with are usually very different. Plus, the challenges they face on a daily basis usually leave them little time for exchange with the "outside world". PASQuanS provides a platform for exchange that can help bridge these worlds.

Atos BULL is the largest industry partner involved in the project. How would you describe the role of (European) research projects like PASQuanS for your company?

The goal of Atos BULL is to provide quantum-accelerated high-performance computing systems to its customers. This requires the identification of quantum computing platforms, whether gate-based (digital) or not (analogue), that can accelerate the solution of some of the most challenging computational problems. The goals of the PASQuanS project are completely in line with Atos's endeavour.

PASQuanS targets applications in material science, quantum chemistry, high-energy physics and optimisation. Which additional industries could benefit from programmable quantum simulators and what is their market potential?

In principle, all industries that are faced with solving complex and challenging computational problems could potentially benefit from quantum acceleration. One could think of weather forecasting, finance or machine learning, for instance. Yet, at this relatively early stage of development of quantum technologies, whether a quantum advantage can be obtained for these fields crucially depends on the characteristics of the hardware as well as on the programming paradigms and software stacks that allow for an optimal usage of this hardware. Careful and case-by-case investigations must be conducted in order to reply to this question in a quantitative manner, namely to put actual numbers behind the promises of quantum computing.