RESEARCH NEWS

Quantum computing

We have the applications know-how

Prof. Manfred Hauswirth, director of the Fraunhofer Institute for Open Communication Systems FOKUS in Berlin, talks about the opportunities, applications and potential roadblocks for quantum computing.

When will quantum computing become relevant for industry?

Prof. Hauswirth: We're only just starting to investigate possible application scenarios, but it would be wrong to think that it's all a long time in the future. Although we have only few practical results at the moment, the technology and the application know-how are developing very quickly. Every Euro invested into developing practically usable quantum computers will pay off in many ways. It will enable new projects here in Germany, help to create new jobs and help to innovate new forms of value creation. Therefore it's important that industry gets ready right now. And, of course, this must be supported by strategic investments by the state.

Google, IBM and Alibaba are all building quantum computers. China launched the first quantum satellite back in 2016. What can Europe and Germany do to fight the competition from China and the USA?

Prof. Hauswirth: Europe has a lot to offer here. We have a lot of expertise in the actual quantum processes that underly quantum computing. And more importantly still, we have an in-depth understanding of the potential applications of quantum computing. In other words, we're familiar with the production processes, and we have the necessary know-how in material sciences and logistics. That's what counts in the current phase, where research is now focusing on the potential applications of quantum technology. There's a reason why IBM and Google now have locations in Germany. It's because they both need this knowledge.

Fraunhofer and IBM are getting the first quantum computer to Germany. Why is this so relevant?

Prof. Hauswirth: Firstly, it's to investigate technical feasibility and applications potential. You can't just run any algorithm on a quantum computer. We need to test which algorithms are suitable and then find an easy way to make them usable for industrial applications. The translation process is a prerequisite for the practical applications that we want to develop with partners from industry. Another key issue is to ensure our

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digital sovereignty. Having a location in Germany will mean that all the data is processed according to European law and our European data-protection standards.

What are your hopes for current developments in quantum computing and the impacts it will have on the economy and society?

Prof. Hauswirth: Many areas today already depend on massively complex computations – take simulations in materials research, for example, or traffic flow models, or algorithmic trading and other complex stock-market transactions. This requires huge computing resources and consumes a lot of processing time. Quantum computers will make it much more efficient to carry out many of these simulations – meaning that we can develop new materials more quickly, increase the predictive accuracy of forecasts, control traffic more efficiently, or model the chemical processes required for battery development and acceleration of the transition to a sustainable energy system.

Are there any problems that quantum computers cannot solve?

Prof. Hauswirth: Quantum computing is not really suitable for processes in which the next step depends on the result of the previous one – i.e., where computations build on one another – which is the case in classic business processes. Day-to-day data-processing applications require computation on a much smaller scale for which traditional computers will always be more efficient and more economical. Quantum computing will complement conventional computing for some types of problems but will not replace all computers. In many areas, it will also make sense to use a hybrid solution of conventional and quantum computing.

Are there any concrete hurdles that still prevent a breakthrough of quantum computing?

Prof. Hauswirth: The stability of Qubits and the stability of entanglement are vital for the performance of a quantum computer. Today's quantum computer hardware is still extremely sensitive, and the technical requirements are very high. For example, a quantum processor must be cooled to a temperature approaching absolute zero; and it must be protected against any form of radiation and vibration. At present, a lot of research in this field is focusing on how to reduce the technical efforts required to achieve this.

How long do we have to wait until we see the beginnings of a widespread commercial use of quantum computing?

Prof. Hauswirth: It's going to take at least 10 years, if not 20, before quantum computers emerge from the lab and find widespread applications. What's more important, however, is that when we reach this point, we are ready with the necessary software and expertise. We already know where the journey's heading, because we're

helping to draw the map. Fraunhofer has a key role to play here. Our job is to help bring industry and applied research into the best position and ensure they are ready.

The interview was conducted by Mandy Bartel.

Picture 1: Prof. Manfred Hauswirth, director of Fraunhofer FOKUS.

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