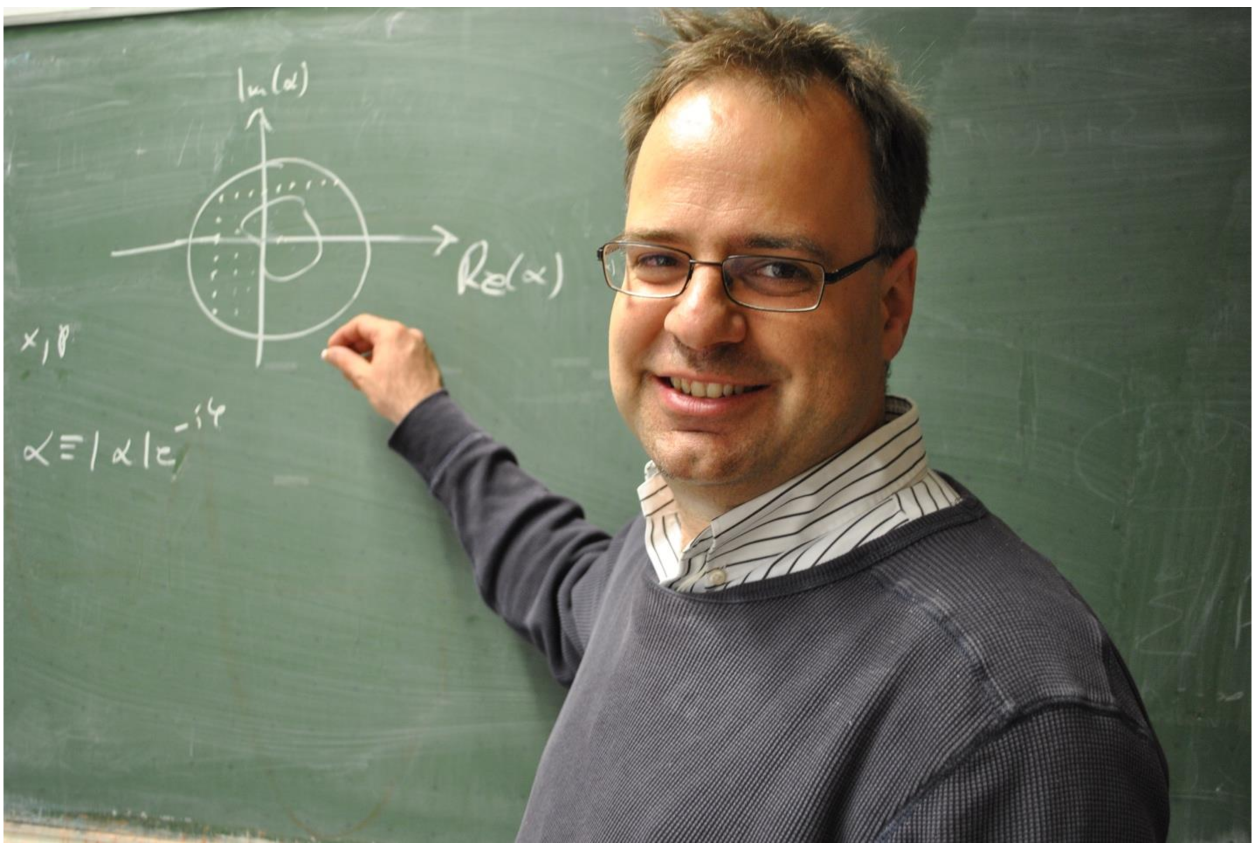
Quantum computing is currently coming out of the starting blocks of fundamental research and making headlines as a promising and disruptive technology

An interview with **Prof. Dr. Frank Wilhelm-Mauch**, Prof. Saarland University, Quantum technology researcher by Alain Chancé.

Prof. Dr. Frank Wilhelm-Mauch

Frank is an influential physicist at Saarland University. The German government has just published a study written under his Quantum and Solid State Theory Group's leadership [1]. Frank has testified at the Digital Agenda Committee of the Bundestag, the lower house of the German Parliament on 6 June. He was a speaker at the Conference Adiabatic Quantum Computing Conference 2018 (AQC-18) on 25 - 28 June.



1/ What is your vision of quantum computing in the next 10 years?

Quantum computing is currently coming out of the starting blocks of fundamental research and making headlines as a promising and disruptive technology. In the next ten years, we can make the transition from technology demonstrator to something that makes a difference in at least some applications. In fact, we are close to the singularity of having a quantum computer that in at least one task outperforms the largest current supercomputer. The main steps here are not so much expanding size but rather to lower the error rate of quantum operations in that size frame. In order to reach the full potential of quantum computers, we need a technology called active error correction, which will probably take more than ten years to establish.

2/ What are the most important priorities right now?

At the moment, lowering error rates is crucial as this will open the path to more and more complex and powerful applications. This is a big exercise in engineering that enables new discoveries and applications. As we get into a space of having larger and larger quantum computing demonstrators, we can also engage with more and more pilot users in order to develop new applications and clarify the potential for real quantum speedup relative to classical computers.

3/ Which quantum technologies research domains are you interested in?

I am a theoretical physicist by training and I work on quantum computers within the currently leading hardware platform, superconducting integrated circuits. What that means from a practical perspective is that we try to bring together applications and hardware design by engaging with both worlds. In the early stage of quantum computing where we are now, hardware is so limited that deep understanding of both worlds can make a difference.

4/ What are practical applications of quantum computing?

So, there are a few where we are sure that there can be quantum advantage. These include modeling of materials and chemicals, some problems in machine learning and data analysis. It is also possible to attack current cryptographic infrastructure with quantum computers – which requires a very powerful error-corrected quantum computer. The German government has just published a study written under my group’s leadership that analyzes this possibility [1].

There are a range of further, broader applications such as optimizations, analysis of networks and solving large equations – computational problems that are at the core of many supercomputing applications. In these applications, the degree of quantum speedup that can be gained has not been fully classified yet, which is an important priority to work on right now.

5/ With whom are you collaborating?

So as a physicist at a public university, I am always happy to collaborate. I am part of a large European doctoral training network named Qusco (Quantum-enhanced Sensing via Quantum Control) and I have collaborations with IBM, the University of Southern California, and groups at the University of Wisconsin and Syracuse University. I am also part of QSA (Quantum Coordination and Support Action), a coordination action that is involved in preparing the quantum technologies flagship program of the EU.

[1] Frank Wilhelm-Mauch et al., Entwicklungsstand Quantencomputer, May 2018, https://www.bsi.bund.de/SharedDocs/Downloads/DE/BSI/Publikationen/Studien/Quantencomputer/P283_QC_Studie.pdf?__blob=publicationFile&v=4