The quantum computer already exists, but is not all that powerful

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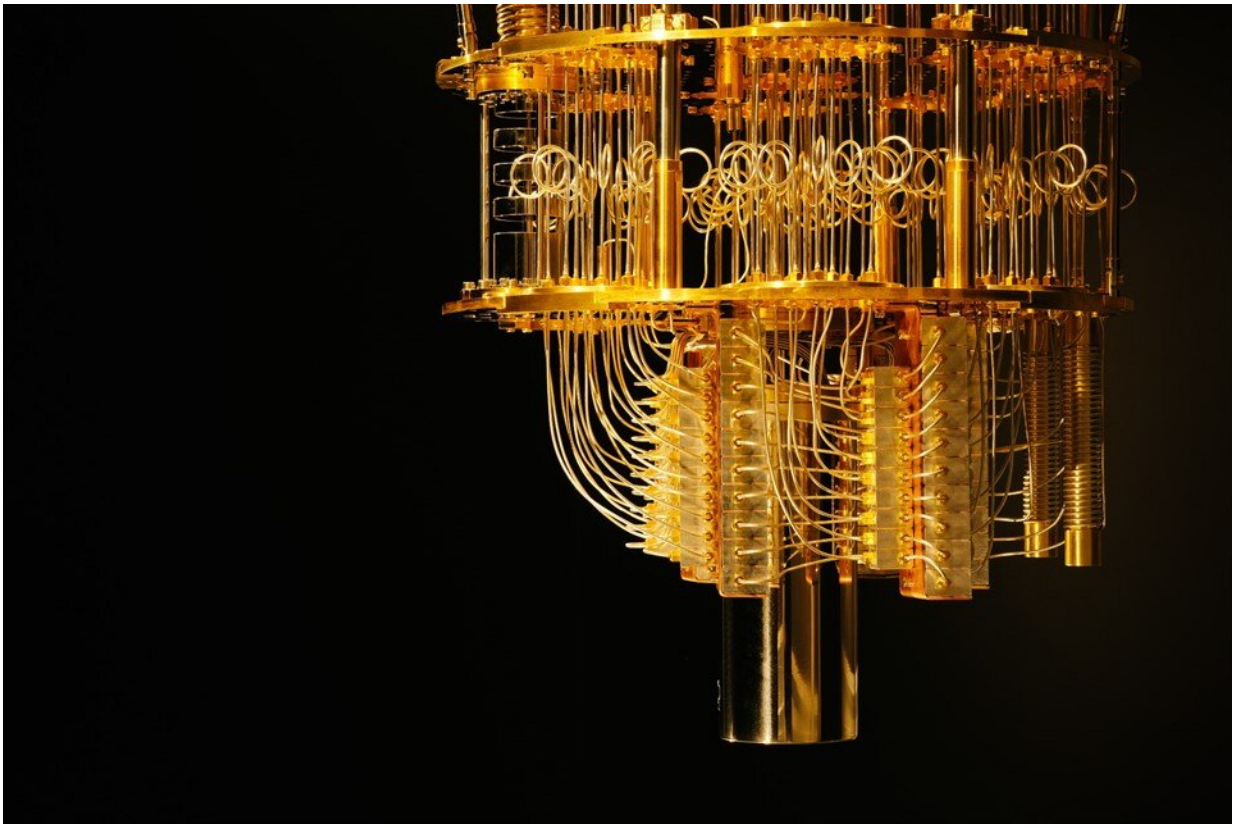

Quantum computer. Credit: IBM

You may be one of those waiting for the quantum computer, the arrival of which we have been told is imminent for several years. Already at this point, DTU Associate Professor Sven Karlsson begins to look a little

strained, because among his partners are the two European companies AQT and IQM which produce and sell quantum computers.

"It's a common misconception that the quantum computer doesn't exist yet. It does already exist, so it's not something we need to wait for. However, the current quantum computers aren't yet all that large, which obviously limits how complicated the calculations can be, but they exist and are being used," says Sven Karlsson.

One example is IBM's quantum computers, which anyone can access via the internet. In addition, there are quantum computers in scientific laboratories, in supercomputer centers, at universities, and so on—worldwide. These are also among the customers to which AQT and IQM sell their products.

Mostly for experiments

It has not yet been possible to build quantum computers with many quantum bits. Quantum bits are used to process the information in the computer, and a low number of quantum bits therefore limits the complexity of the calculations the quantum computer can perform. Sven Karlsson therefore characterizes the current use as primarily experimental, making it possible to play with and understand the technology.

"The technical level of the current quantum computers is somewhat similar to the first stage of our current computers. When they first appeared in the 1950s, there were only a limited number of them, and, back then, they couldn't make larger calculations than those any calculator can perform today."

However, there are examples of calculations performed using a quantum computer. One of the calculations known to Sven Karlsson was done

during the coronavirus pandemic. The Italian football league needed to know how best to schedule the matches so that the different football teams came into contact with each other as little as possible to reduce the risk of infection. Likewise, travel distances for the players had to be limited, as travel by air was banned.

"A quantum computer is well suited for calculations of this type that will take too long for an ordinary supercomputer. The quantum computer can examine many solutions simultaneously and is therefore more efficient at such calculations than a supercomputer," says Sven Karlsson.

Connects to supercomputers

Sven Karlsson and his colleagues' collaboration with AQT and IQM includes developing the hardware and software needed to connect the quantum computer to supercomputers.

"The future quantum computers will initially largely be connected to the relatively few high-performance computing centers with supercomputers that exist worldwide. The centers have already built an infrastructure with the right competences to operate the quantum computers, and it also makes sense to invest in relation to the existing centers. Today, a quantum computer costs around DKK 150 million, so it's a relatively large investment," says Sven Karlsson.

The quantum computer will not replace supercomputers. Instead, it will supplement them and be used for highly specific calculations. Nor will the quantum computer have its own user interface, but must be accessed via the supercomputers.

Standardization

As a result of the current budding production of quantum computers worldwide, large-scale standardization work is being initiated. It includes standards for all the hardware and software parts that make up a quantum computer. The hope is to prevent inexpediencies that we struggle with in other technological areas, such as only being able to use one charger type for our mobile phone.

"We would like to develop joint standards so that, throughout the world, we have the same understanding and use of the different components that make up a quantum computer. This must be done already at this early stage, so that we don't risk individual countries or parts of the world introducing different standards," says Sven Karlsson.

Sven Karlsson leads a group of researchers and practitioners with in-depth experience with and knowledge of quantum computers, who will meet in the coming years to create recognized standards that can be used in future production.

Provided by Technical University of Denmark

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