Scientists' 'recipe' to help build a quantum computer

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Scientists have come up with a "recipe" to help build the world's first quantum computer – a new generation of super-fast machines set to revolutionise scientific discovery.

Quantum technology could be used to crack codes – valuable for national security – and is already used in some bank transactions. Future developments could involve understanding chemical reactions creating medicines, ultra-fast communications systems and seemingly impossible simulations, such as the creation of our universe.

A quantum computer would use the seemingly magical properties of tiny particles such as atoms to hold, process and transport the vast amounts of information – and all in the fraction of the time it would take a conventional computer.

The atoms would first need to be isolated from the billions around us, then converted into ions (charged atoms) and manipulated to perform tasks by use of electric fields. This is done using an ion trap. Scientists have so far trapped single atoms, but the real challenge lies in being able to orchestrate the millions of atoms needed to build a quantum computer.

Dr Winfried Hensinger, Lecturer in Atomic Molecular and Optical Physics at the University of Sussex, was part of a team in the USA that has developed a new way of mass-manufacturing ion traps using microchip technology.

This technique means that the traps, which need to be the size of a human hair to make a quantum computer of feasible scale, can be made quickly and sophisticated enough to allow useful computations. Details of the research, led by Professor Chris Monroe at the University of Michigan, are published in the science journal Nature Physics.

The process – photolithography – produces a 3-D "nano sculpture", chemically etched out of gallium arsenide (a semi-conductor material similar to the silicon used in microchips).

Dr Hensinger says: "Making a nano sculpture to trap single atoms and control their motion is very difficult. What we have done is to refine the recipe used in microchip manufacture to make traps for single atoms. Now we could make any kind of trap we need, in the quantity needed. This takes us a step nearer to building the first quantum computer."

Quantum computers are important, says Dr Hensinger, because they will help to unlock some of science's biggest secrets, not only by processing information faster, but giving far more accurate results. He says: "A quantum computer would allow us to solve some very big physics problems, where before the scale of the computer needed, and the time it would take to process data, would make the experiment unfeasible. It will have a huge impact on areas such as chemistry and in understanding nature as we know it. It will revolutionise all of science."

Dr Hensinger now intends to continue his research into the development of a quantum computer at Sussex, where he has set up the Ion Quantum Technology Group. He says: "This is an exciting time for quantum physics, and for physics at Sussex, where I hope to work with colleagues in developing this work further."

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