100 times more data: New material boosts digital storage

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Impact in a nutshell

We have created a new material that can store 100 times more information than today's technologies in the same amount of space. With this material, you could save 600 Ultra High-Definition movies in the space of a postage stamp!

In 5 to 10 years, our research could make data storage 100 times better, resulting in smaller and cheaper storage devices for everyone. In the long term, it could boost the European economy by making it more competitive, in a world where a few countries have big control of the computer chip market.

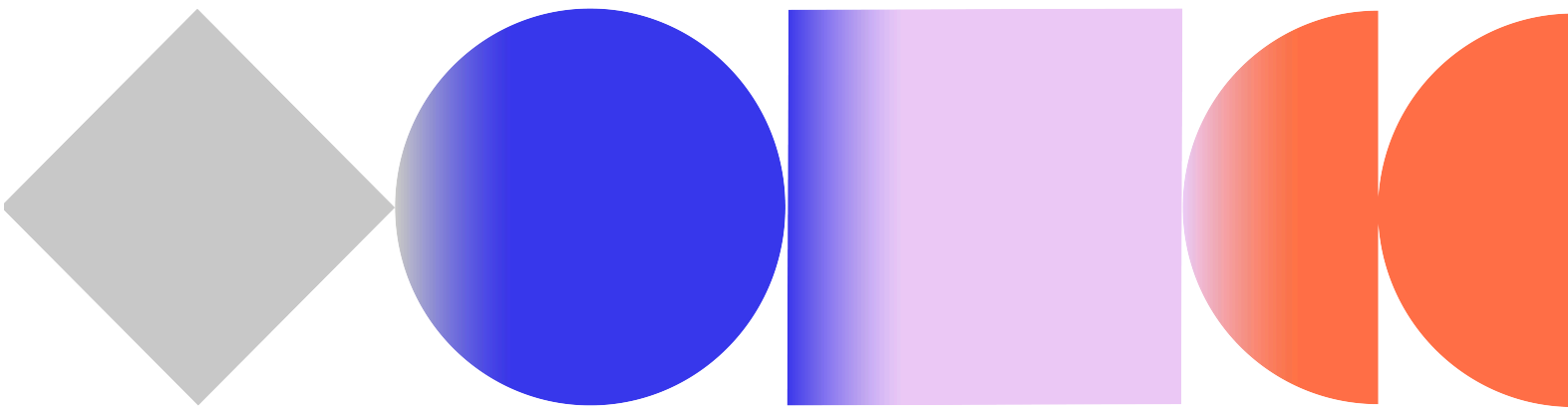
Research details

My work as a PhD student has helped to create a new material that can store 100 times more information than today's technologies in the same amount of space.

As our society generates more and more data, chip manufacturers are working to store more information in smaller devices, using tiny switches. One family of materials used for these devices is called ferroelectrics. These materials have at the atomic scale two poles: positive and negative. Just as a magnetic force can flip a magnet, electric forces can change the poles of ferroelectric materials. In theory, this means that we can apply an electric force to a few atoms of a ferroelectric materials and "write" a 0 (negative pole) or a 1 (positive pole) to store information. This way we could create a memory holding a lot of information.

But a problem arises when controlling these tiny poles. When you flip one, the nearby poles tend to flip too, making precise control difficult.

To solve this, we put together two layers of a ferroelectric material, each layer just a few atoms thick and with one layer slightly rotated. This creates a special state, formed by tiny whirlpools, where the positive and negative poles swirl in circles. This swirling state allows us to control the poles of these atoms with precision.



What is or will be the impact of your research?

This discovery could have a major technological impact, as it makes possible the design of a new type of high-density memory. Now, the best digital memory can hold about 1 terabit (1 trillion bits, a one followed by 12 zeros) per square inch. We can create 5 x 5 atom 'whirlpools' to store 1 bit. Doing some maths, this leads to 100 terabits per square inch, 100 times more than today.

We expect these devices to be on the market in about 5 to 10 years. This will provide more memory at a lower price, making information access easier for the public. But the more memory we have, the more we might use, so responsible use is important.

Long-term, this discovery could have important economic effects. We believe this work will make European industry more competitive. This aligns with the Una Europa Focus Area 'Europe and the World'. Developing these technologies makes the European economy more stable in a world where only a few countries dominate the global chip market.