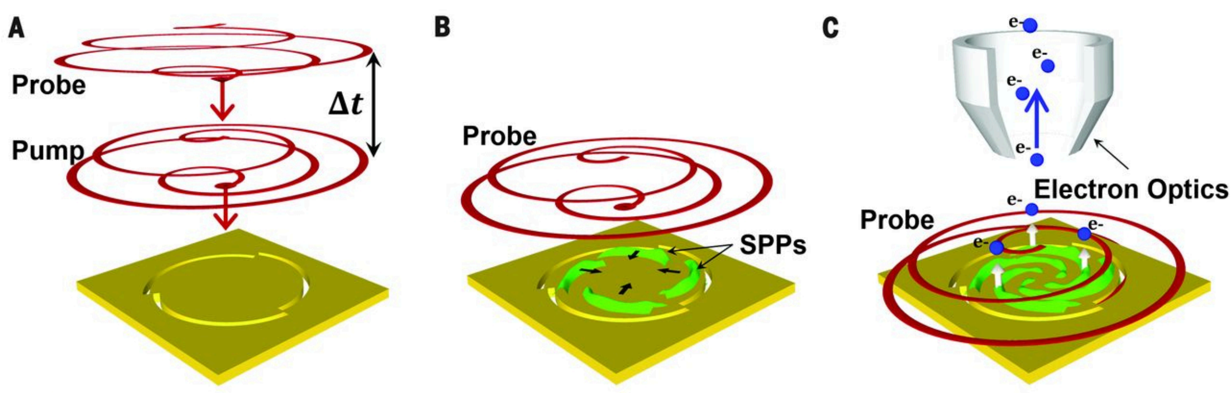
Researchers launch plasmons with controlled amounts of angular momentum

March 17 2017, by Bob Yirka



Schematic experimental methodology. Credit: (c) *Science* (2017). DOI: 10.1126/science.aaj1699

(Phys.org)—A team of researchers with members from institutions in Germany and Israel has developed a way to launch plasmons with controlled amounts of angular momentum using spiral-like structures fashioned into a smooth layer of gold plate. In their paper published in the journal *Science*, the group describes their technique and why they believe it could one day provide the basis for a new type of storage device.

Prior work had shown that it was possible to use orbital angular momentum of photons as a way to store data in the air (because of their different phase advances—each could be used to represent an individual character), which in practical use would be optical fibers. In this new effort, the researchers have found a way to do much the same thing, only on a chip, which allows for it to be confined, making it much easier to port to an actual application.

To accomplish this feat, the researchers turned to plasmonics, which are oscillations in quantum particles or quasiparticles. In this case, it was the oscillation of electrons that occurs when photons strike a metal surface. The idea, the researchers noted, was that plasmons allow for confining light, which meant that it was possible to make its wavelength conform to a metal surface. They found they were able to kick off plasmon waves with angular momentum by etching spirals into a gold plate—that allowed for monitoring its motion using an electron microscope.

Using it, they were able to see that firing photons at the spiral in the plates caused electrons to be ejected, which was an indirect way to "see" plasmons, which were controlled by the angular momentum of photons. This meant it was possible to use the initial wave advances to represent characters within the confines of a computer chip. That day is still a long way off, of course— the work was more a proof of concept than a finished product. But if a way can be found to mass produce chips using the technique, end users could see a huge increase in the amount of data storage. The work also suggests, the team notes, that it might be possible to do some things with light that have never been possible before.

More information: G. Spektor et al. Revealing the subfemtosecond dynamics of orbital angular momentum in nanoplasmonic vortices, *Science* (2017). DOI: 10.1126/science.aaj1699

Abstract
The ability of light to carry and deliver orbital angular momentum (OAM) in the form of optical vortices has attracted much interest. The

physical properties of light with a helical wavefront can be confined onto two-dimensional surfaces with subwavelength dimensions in the form of plasmonic vortices, opening avenues for thus far unknown light-matter interactions. Because of their extreme rotational velocity, the ultrafast dynamics of such vortices remained unexplored. Here we show the detailed spatiotemporal evolution of nanovortices using time-resolved two-photon photoemission electron microscopy. We observe both long- and short-range plasmonic vortices confined to deep subwavelength dimensions on the scale of 100 nanometers with nanometer spatial resolution and subfemtosecond time-step resolution. Finally, by measuring the angular velocity of the vortex, we directly extract the OAM magnitude of light.

Citation: Researchers launch plasmons with controlled amounts of angular momentum (2017, March 17) retrieved 19 July 2024 from https://phys.org/news/2017-03-plasmons-amounts-angular-momentum.html