When atoms are surfing on optical waves

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In order to build an optical computing device the surface plasmons, which are useful for data transfer, must be coupled to data storage elements, such as atoms. This is what the research team lead by Dr. Sebastian Slama is working on. The junior scientist developed techniques at the chair of Prof. Claus Zimmermann which are crucial for positioning cold atoms very close to surfaces such that they can interact with bound light waves. For that atomic gases are cooled in a vacuum chamber down to temperatures as low as a few hundred Nanokelvin.

At such low temperature the atoms no longer behave as a classical gas. They form a so-called Bose-Einstein condensate, in which all atoms are in the same quantum state. The condensate can be regarded as a single huge super-atom and can be shifted by external magnetic fields to the surface, where it feels the influence of the plasmon. "We can generate plasmons which attract the atoms and others which repel them. By structuring the surface we can tailor almost arbitrary potential landscapes for the atoms," says Dr. Slama.

Recently, the scientists published their results in Nature Photonics magazine. First author Christian Stehle, who is working on his PhD thesis and has measured the data (together with Helmar Bender, who is now postdoc at the University of Sao Carlos in Brazil) is enthusiastic: "Our results had a great impact. We managed to get on the title page of the August issue, and the magazine values our work in a comment." However, with this success the scientists' work is not terminated. "Our goal is to build hybrid devices for optical computing and quantum information. We were now able to set a milestone, but there is still a lot to do," says Dr. Slama. In his opinion these goals can only be achieved in cooperation with other scientists. Beside already existing cooperations like the one with the nanotechnology group of Prof. Dieter Kern and Dr. Monika Fleischer, who fabricated the gold structures, Slama has made contact to further scientists in Tübingen, Europe and in Brazil.

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