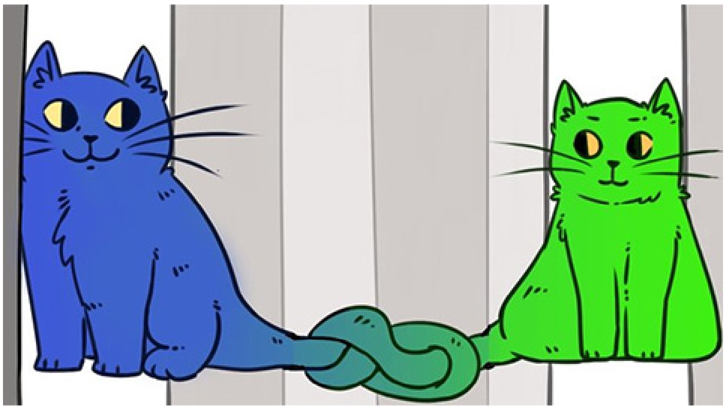
Physicists have learned to change the wavelength of Tamm plasmons

Scientists from Siberian Federal University (SibFU) and the L. V. Kirensky Institute of Physics (SB RAS) conducted theoretical studies of hybrid Tamm plasmons. Using numerical calculations, they were able to predict the structure in which it is possible to control the wavelength of these quasiparticles by means of an external electric field or heating. The study is presented in the Journal of the Optical Society of America B.



School Physics teaches that the basis of an ordinary mirror is a thin aluminum or silver foil. Glass, which is in fact a large transparent piece of ordinary silica sand, just does not allow the foil to bend and rust. However, glass also reflects light, so a dozen layers of ordinary glass and flint glass (a special high-reflective glass) is more expensive and high-quality analogue of a metal mirror. Such a structure is also called a one-dimensional photonic crystal. It means that the refractive index changes periodically in one direction, in this case perpendicular to the layers.

What happens if such a multilayered mirror is covered with silver? It looks like mille-feuille or Napoleon cake, where instead of doughs — glass and flint glass, instead of top-cream, silver, and the thickness of this cake is slightly larger than a micron. In such a device, light can be locked between two mirrors — metal and multilayer. The energy of light accumulates on the boundary between the metallic and multilayer mirrors and begins to leak through the multilayer mirror. So a double mirror can pass, and not reflect light.

In such a situation, a special quasiparticle of light is formed between the mirrors — not a photon, but a Tamm plasmon.

> *«The emergence of such a quasiparticle is possible only when the metal is coated with a multilayer mirror. In this case, it is possible to obtain a light trapped between mirrors, and one of the reflecting surfaces must be metallic. Unlike the ordinary plasmon which is a traveling wave Tamm plasmon represents a standing wave, and it does not lead to energy transfer»*, — explains **Pavel Pankin** of Siberian Federal University, one of the authors of the paper.

For most practical applications, it is very important to control the wavelength of a Tamm Plasmon and its color. For example, it allows making a laser with a tunable frequency of radiation, rather than with a fixed frequency. For this purpose, Russian physicists proposed to connect the plasmon with a microcavity. This was achieved by including a layer of a liquid crystal in a multilayer mirror in the model. As a result, light began to accumulate not only on the border of two mirrors, but also in this layer, — so the hybrid structure was achieved. Earlier, in order to change the color of a Tamm plasmon, scientists had to make a new structure. Now it is enough to heat or electrify the liquid crystal, and that connection causes changing the color of Tamm plasmon.

The Tamm plasmon allows creating lasers, optical filters, single photon sources, thermal emitters and absorbers of a new type. The authors hope that their work will expand the range of possible applications.

Image: Cats-quasiparticles (color transferred position of cats in the electromagnetic spectrum)

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