

On the supersolid state of light

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Abstract

This is a huge breakthrough in physics: For the first time in history, researchers have achieved molding light into a peculiar state. The supersolid state of photons (= light particles) is a truly rare phenomenon.

1. Introduction

This is probably something that one does not think about in everyday life: Does light have different states of matter? Light is not even considered as matter as it has no mass. Of course, changing the state of light is not straightforward, and scientists from Italy, Austria, and the USA [1, 2] have to pull all kinds of tricks to get there.

2. Methods

In our normal lives, we are quite familiar with the state of matter of gas, liquid, and solid. Beyond that, there are more exotic states, such as plasma, superfluid, or supersolid states. [2, 3] The supersolid state combines the constitution of particles in a crystalline structure, yet it retains their frictionless flow. Usually, this state is achieved by cooling atoms to a few Kelvins, close to absolute zero, where they form a so-called Bose-Einstein condensate (BEC), a truly exotic state where the atoms do not behave as individual particles anymore, but rather as one single quantum object, a "super-atom" so to say. This phenomenon has now been realized for photons as well, in the form of an exciton–polariton BEC, by shooting and trapping the light particles in form of a laser onto a semiconductor material (with electron–hole pairs = excitons).

3. Results

The result? An amazing and ultra exotic state of photons, which are usually massless particles. Trapped in the excitons as polaritons, it suddenly behaves like it has mass and can also interact with itself.

Figure 1 depicts Light Yagami from Death Note demonstrating a loose idea of supersolidity.

4. Conclusion

In conclusion, we can say that physicists have found a truly mesmerizing phenomenon which can also benefit humanity in terms of technological advancements.



Figure 1: Light Yagami from Death Note as imagined by ChatGPT in a supersolid state.

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References

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