What do we see if we look at the molecule or an atom in an optical microscope?

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For all people, and even more so schoolchildren, are well known for pictures such as the above. However, do we see something like this if we look at the molecule or an atom even through the coolest optical microscope?

We know that there are optical devices such as microscopes. These devices allow you to consider very small objects. They can consider cells of living organisms and even their internal structure, as well as much more from what is not visible to the usual eye. But is it possible to step further, and see molecules from which cells consist?

Strictly speaking, all microscopes have a certain limit to which they can increase the picture, or in other words, how small the object in them can be considered. And immediately honestly admit that there is no such an optical microscope, in which it would be possible to consider the object as small as one molecule or an atom. This is hampered by some fundamental optics laws.

However, suppose still that we managed to get a microscope with such a gorgeous resolution that it would be ready for us to show the same small object as one molecule or an atom. And here we have brought this microscope to one single atom or molecule, what will we see?

The answer is very simple: actually nothing. The fact is that the light consists of photons. And to see any object in a microscope or even just with the eye, and to consider its structure, we need many photons to be reflected simultaneously from different parts of this object and in abundance have come into the ocular of the optical device or to our eye. Of course, the situation is also possible that the object itself is glowing. emits photons. The meaning remains the same, many photons from different parts of the object should simultaneously enter the optical instrument.

But molecules or atoms interact with photons in a different way. They do not reflect them. Molecules and atoms can only absorb or emit photons. And most often, the photons are generally flying past molecules and atoms without interacting. At the same time, an atom or molecule is usually emitted only one photon, which is then flies in an unpredictable direction. In addition, in order for the molecule or atom to radiate a photon, it is necessary for (or he) to be absorbed by another photon.

Thus, our experiment to observe the molecule in the microscope would look like this: we light at an atom or molecule light, but most photons fly past an atom or molecule. Then at some point, one of the photons is still absorbed, and after some time the atom or molecule emit a similar photon in an unpredictable direction (often by the way, he flies into the same direction, where the previously absorbed photon flew from).

Thus, this single photon emitted by a molecule or atom, we are unlikely to be able to distinguish from the backlight, which is shining on the object under study, i.e. Billions of other of the same photons flying nearby. And if the molecule is not to highlight, then the photon empty it is possible to wait for a very long time.

But even if we can separate the photon, flying out of the molecule, from the photons of the backlight, then nevertheless, the best, which we can expect from a molecule or an atom to which we look into the optical microscope, is that in some unpredictable moment, She (or he) still radiates one photon in the side of the microscope. A person's eye is not enough single photon to see at least something. But the microscope is likely to make such that it can point and strengthen the signal obtained by entering one single photon.

In any case, the best that we obtain when observing the molecule or atom in the coolest optical microscope is the fadingly small and rare light flashes, which are based on an escaping moment that occur in unpredictable moments. These outbreaks will not visually reflect the structure of the molecule or atom (although their spectrum will contain some information about it), and we will not see the pictures similar to what is given above. Generally speaking, the picture above is only a bad visualization of the internal structure of the atom, which was investigated using other methods, but not with the help of an optical microscope.