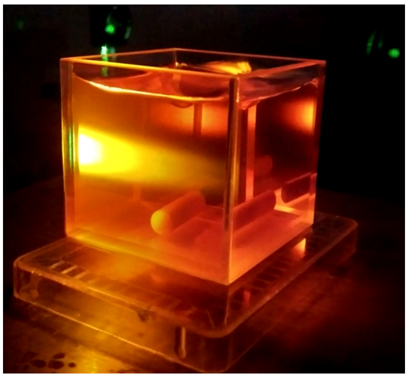
Popular Description

Author: Klara Lozani Gerdhem



An irradiated fluorophore.

What if it was possible to identify elements by simply shining a light on them? This proposed method might make it possible to do just that - by analysing just one photograph. Many of us have probably encountered a pen with "invisible" ink that is only visible if you shine on it with a UV lamp. Besides that these are useful for writing secret messages, they also demonstrate an interesting phenomenon in physics - fluorescence.

Fluorescence begins with an atom or molecule that is irradiated by light. The molecule absorbs the energy and reaches an excited energy state. During the so-called fluorescence lifetime, the molecule drops to a lower excited state without emitting light. Finally, the molecule drops to its original state - the ground state. It then sends out energy in the form of light. Because of this, we can see the ink "glow" when we irradiate it with light.

Not all atoms or molecules have this kind of behaviour when irradiated. In fact, it is only possible to see fluorescence if the molecule is a fluorophore. If the fluorophore is excited by a laser the process is called laser-induced fluorescence or LIF. Suppose that we were to conduct LIF with a laser that emits a great deal of light. If the intensity of this light is high enough, the fluorophore will become saturated. This means that it will emit the same amount of light, regardless of the laser intensity. Therefore the outgoing light will always have a lower intensity. This phenomenon is called saturated laser-induced fluorescence or saturated LIF.

Fluorophores are more or less easy to saturate. Because of this, the relation between the incoming and outgoing intensity will be different. We can see this as a pattern that is unique for each fluorophore. However, it is necessary to take a lot of measurements at different incoming intensities to be able to create such a pattern. This new method combines saturated LIF with something called structured light. Thanks to the properties of the latter the problem is avoided.

We can understand structured light by analysing water waves. Imagine a perfectly symmetric sea with waves of the same size and height. Now imagine that we have a light beam shaped in the same way as the sea. Although in this case, we look at the wave formation from above. The crest will now be part of the beam with the highest intensity, and the trough will be the part with the lowest. Between these extreme points, there is a range of different intensities. By combining saturated LIF and structured light, it is possible to have a whole range of intensities in a single measurement. We can then create the saturation pattern from just one measurement.

In this new method, a camera will take a picture of the irradiated fluorophore. One measurement then corresponds to one image. So, according to this method, it is possible to create a unique saturation curve by just analysing the information from one picture. Therefore this is a very effective method to tell fluorophores apart. As a bonus, we also receive plenty of information about their characteristics.

An effective way of differentiating between fluorophores is highly sought after in optics research. It is possible that this method could help researchers make new fascinating discoveries. So to conclude, this proposed method sums up what physics is all about - finding new ways to understand nature.