About Thought Experiment

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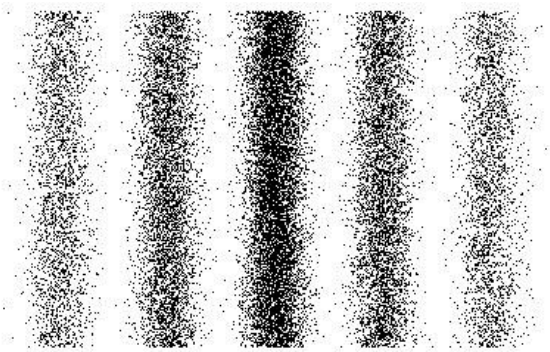
In physics, whenever we cannot do an experiment for physical, technological, financial or ethical reasons, we use "thought experiment". In this letter we will prove that sometimes a thought experiment may lead us to the wrong results and we will prove that to achieve the correct results, an experiment must be done in the real world.

There are several thought experiments in physics; Schrodinger's cat experiment [1], EPR paradox [2] and Einstein's light box [3][4][5] are some of the most famous of them. It is clear, all experiments are initially a thought experiment. Some of them remain a thought experiment due to the human inability to perform them in the real world (because of physical, technological, financial or ethical reasons), and some of them become real physical experiments. But there is a very important point about thought experiments that seems to have been ignored so far. Sometimes a thought experiment may lead us to a wrong result. A thought experiment is an experiment designed in the mind of a researcher, using the amount of knowledge of the time, and since human knowledge has never been complete, a thought experiment can sometimes lead us to wrong conclusions. Let me illustrate this with two examples. In the Photoelectric effect, which was studied by Philip Lenard in the 1990s, there is a threshold frequency that scientists at the time could not have predicted existence of it based on electromagnetic theory [6]. The existence of a threshold frequency for a given metal, a frequency below which no photoemission occurs, however great the light intensity, is completely inexplicable in electromagnetical terms. From the electromagnetical point of view the primary circumstance that determines whether or not photoemission will occur is the energy reaching the surface per unit time (or the intensity), but not the frequency [6]. If a person in the 1990s (before the discovery of the quantum aspect of light) wanted to predict the result of photoelectric experiment based on electromagnetic theory, could he have predicted the existence of a threshold frequency??? The existence of threshold frequency was discovered by performing the experiment in the real world, not by thought investigation. The photoelectric effect shows well that thought experiment can lead us to wrong conclusions.

Another example is the two-slit experiment for sub-atomic particles. If you do the double slit experiment for macroscopic particles (such as sand particles or salt grains), the image of diffraction will be random [7]. If we do this experiment with subatomic particles like electrons, we expect to achieve the same result, but performing the experiment leads us to an interference pattern, dark and light bands, (Figure 1) [7] which is contrary to prediction. Therefore, in this case, too, the prediction of a thought experiment is untrue.



Source: https://brilliantlightpower.com/double-slit/

Fig. 1

Numerous other examples can be mentioned that show that the results of thought experiments are not reliable. As another example, most of us know the famous phenomenon of chain fountain (Figure 2). In this experiment, we expected the chain to fall from the glass edge, but the result of the experiment is different from our prediction, and the chain falls with a distance from the edge of the glass (Fig. 2).

Source: Wikipedia

Fig. 2. chain fountain phenomenon

Finally, based on all of these discussions, the conclusion of this letter is that an experiment **must** be performed in the real world so that we can use its results. A thought experiment is completely unreliable and arguing about its possible results is completely meaningless; Because doing experiments in the real world can yield results we never even imagined.

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