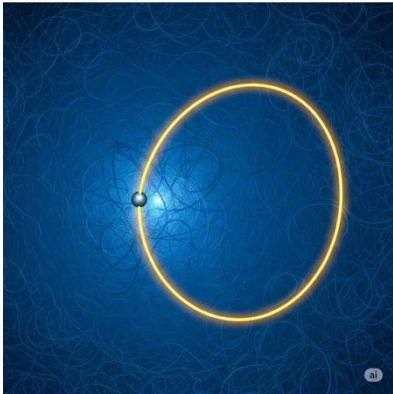


A Study in Scar

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Scarred state (from Gemini)



Detective (from <https://www.irasutoya.com>)

“It is my business to know what other people do not know.”

— Sherlock Holmes, from *The Adventure of the Blue Carbuncle*

Hello, it's you from 2025. I am writing this letter to tell you how I'm doing and to give some advice to my past self.

After graduating from college, I became a graduate student studying physics. My research is about how and why things made of many particles behave the way they do.

You might know that things are made of small particles. In this sense, those things are called many-body systems. Each particle in a many-body system follows a rule called quantum mechanics. In the law of quantum mechanics, if a motion can happen, the backward motion is also possible. However, consider this example. If you put cold water and hot water in the same container, they will get mixed up and eventually

become stable, which is called "equilibration." It cannot happen backwards, right?

Although water is made of many atoms and their behavior should be reversible, water as a whole behaves irreversibly. So there seems to be a contradiction.

This apparent paradox is an essential problem that connects microscopic and macroscopic physics, and this is why I am studying this problem. However, it is not yet completely solved why irreversible phenomena of macroscopic objects arise from microscopic laws. Scientists have developed a good theory that explains that most states in quantum mechanics behave irreversibly. Nevertheless, there are some exceptions called "scarred states." While most states evolve toward equilibration, scarred states are special states that do not. If you start with scarred states, the motion will be periodic (see the figure at the top left). I am now studying these scars and their relationship with the equilibration of many-body systems.

The research on irreversible motions of many-body systems is very interesting because it is strongly related to our daily lives. For example, it allows us to investigate how fast hot and cold water get mixed up. Moreover, it gives us information about the stable state, such as the temperature of the mixed water.

The study of scars, in particular, is also applicable to our lives. Some examples of scars have already been confirmed by experiments. By studying scars, I am trying to find new, special dynamics that can happen in many-body systems. If I succeed, I can cause special motions of things in our real lives. For instance, we might be able to make hot and cold water out of average-temperature water with little energy. My research can also be applied to make new types of codes and to control things effectively.

That is all about me and my research, so let's talk about you in 2015. I remember that you were especially into soccer back then. The physical strength I have now is mostly thanks to playing soccer, so you should continue to work on it. And if you are watching the Premier League, put all the money you and your family have to bet on Leicester City. I know you don't believe me, but trust me. You will be 4,000 times richer.

I believe the second best thing you were interested in then is detective novels (or possibly Duel Masters). I remember that I used to read Sherlock Holmes and Hercule Poirot a lot. If you haven't read *The Murder of Roger Ackroyd*, read it right away because someone will spoil it for you.

Come to think of it, detective novels and the physics research have a lot of things in common. Detectives think how and why a crime happened, while physicists investigate how and why a specific phenomenon happens. The former collect evidence to identify the criminal, while the latter performs experiments to test his/her hypothesis. Moreover, the most important weapon of both detectives and scientists is logical thinking.

Therefore, it might not be an exaggeration to say that reading detective novels helps me to be a better physicist. So, I advise you to read them, but more carefully. I used to read the detective novels too fast, not caring about the clues written in the books. Although it is fun, what you acquire through reading them is small. So, you should pay close attention to all the clues in the novels and carefully think about who the criminal is. Even if you cannot spot the criminal, I assure you that the experience of having thought logically for a long time will not be a waste of time.

Based on ten more years of reading detective novels, I recommend reading mystery novels by Ellery Queen. They provide us with all the clues necessary to deduce who the criminal is, so they are called ``fair'' detective novels. Also, the stories themselves are very attractive, so you will not regret reading them. As a Japanese writer, I recommend Souji Shimada. His novels are also ``fair,'' so I think that he is a Japanese counterpart of Ellery Queen. On the other hand, tricks used in Shimada's novels are more unexpected, so you will be astonished to figure out the tricks.

I believe what I used to do ten years ago is basically not wrong. By keeping up the good work, you will be a researcher as good as (or maybe better than) me. Just read detective novels carefully and bet on Leicester.

Declaration:

ChatGPT and Gemini are used to correct grammar mistakes.