DTP-Math-Circle: Session 4—Probability, Inequalities and Quantum Mechanics

Oct 14 2022

5   Double-slit experiment

In the world of electrons and atoms, which obey quantum mechanics, probabilities for different alternatives cannot always simply be added. And inequalities that are provably true in our usual mathematical theory of probability can end up being false. We will now try to give a very rough illustration of such strange behaviour.

By way of warm-up, first consider a situation in which Gabbar has an electron gun with many bullets, and he shoots a large number of bullets towards a pair of vertical slit-like opening in a wall. These openings are close enough to each other that when Gabbar shoots, he is equally likely to hit either of them. Behind this wall is a thick wooden barrier that stops the bullets that strike it. The embedded bullets make a pattern. This pattern gives us an idea of what the probability of an electron hitting any given area of this barrier is.

(a) Initially block the first slit and keep the second open. What would the pattern of embedded bullets look like?

Now block the second slit and keep the first one open. How does the pattern change?

(b) What would one expect to happen if both the slits are open? See

https://www.youtube.com/watch?v=ZqS8Jjkk1HI

to see what actually happens.