Stern-Gerlach experiment

a)

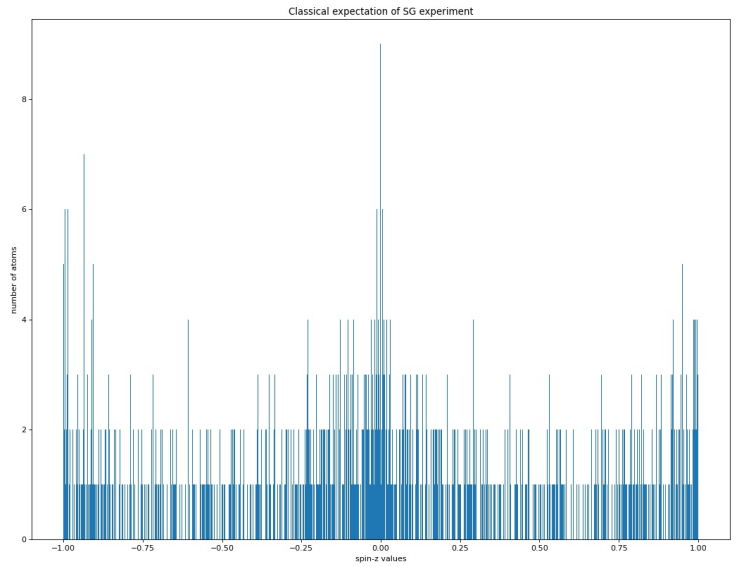
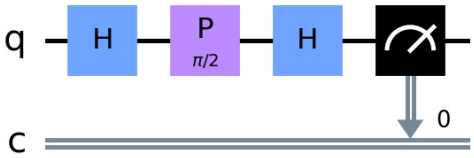


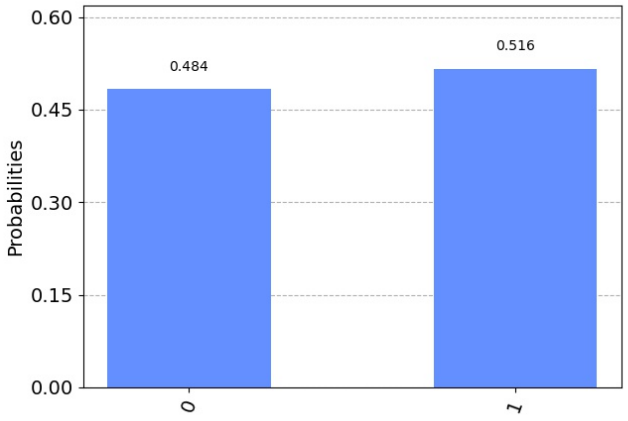
Figure 1: Classical expectation of Stern-Gerlach experiment

In the experimental outcome, we observe two distinct locations where silver ions ended up in. However, as in the Figure 6, classical expectation was that ions would have random directions and resulting a wave pattern in such middle is mostly populated. However, electrons don't tend to have random directions after going through a magnetic field, instead they are quantized in spin-up and spin-down states, resulting the split of ions in the screen based on their spin orientation.

b)



(a) Stern-Gerlach experiment q.circuit implementation



(b) simulation of the quantum circuit

Notice that applying Hadamard, and then phase and then Hadamard again creates an analogue of non-uniform magnetic field as in the original experiment. In the histogram, we can see that outcomes are two distinct states with very close probablity of $\frac{1}{2}$

Bonus

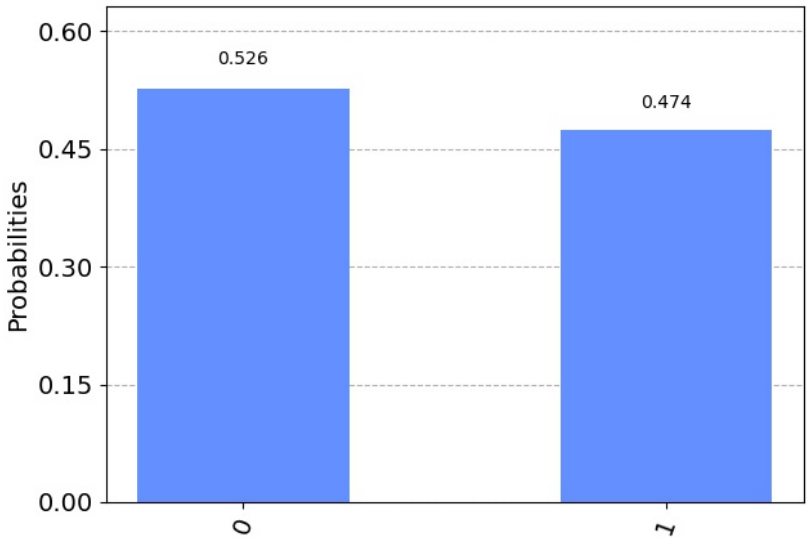


Figure 3: using real qubits

As we can see, using real qubits in the Stern-Gerlach experiment gave even worse results compared to simulated one, because we haven't introduced any noise channel in simulated one OR any quantum error correction scheme in real qubits. So, this result is not surprise considering the errors of real devices.