

Observer Effect

First, let's consider the problem of finding the particle. We can do it in at most $n - 1$ queries:

1. Fix a position p and ask if the particle is there $n - 1$ times;
2. If not found, then it will be at position p after those queries.

However, this does not help us solve the original problem, since in the worst case there would be a single query left, and that query alone cannot be used to determine the particle's direction.

Therefore, let's save one more query and see what we can do with it. Suppose that we make $n - 2$ queries at position 1. There would be four cases in which the particle is not found:

Direction	Starting position	Final position
forwards	2	n
forwards	3	1
backwards	$n - 1$	1
backwards	n	2

Suppose we now query for position n . If this fails, and the particle were moving forwards, then it was at position 1 and would be at 2 after the query. So we query for position 2 and, if this succeeds, we can conclude that it is indeed moving forwards.

If the particle were moving backwards, none of the above queries would find it: in the second-to-last query, it would move from 1 to n or from 2 to 1, neither of which is the position asked by the last query.