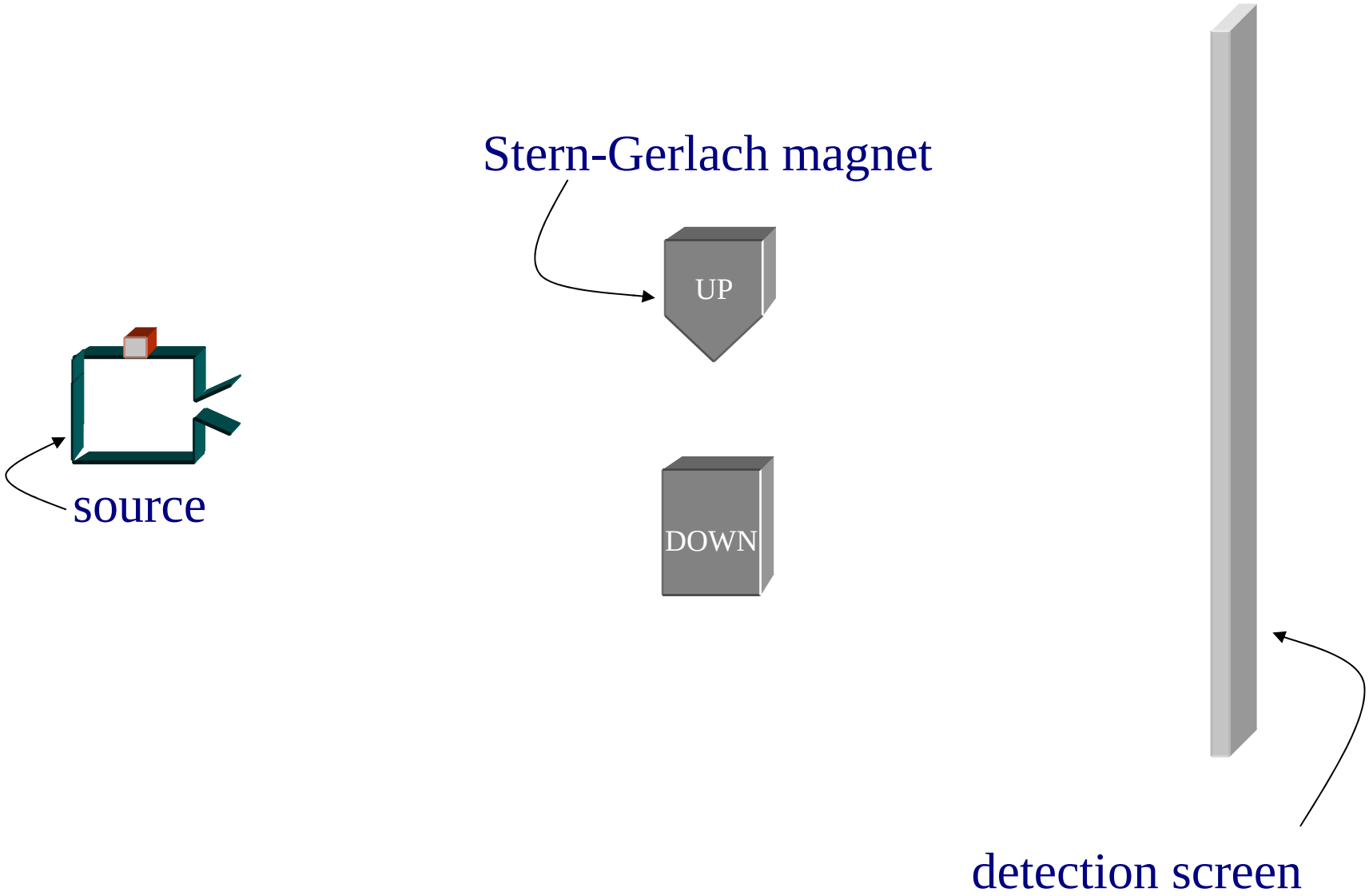
Philosophy of QM 24.111

Second lecture,

7 Feb. 2005

THE BASIC EXPERIMENT:



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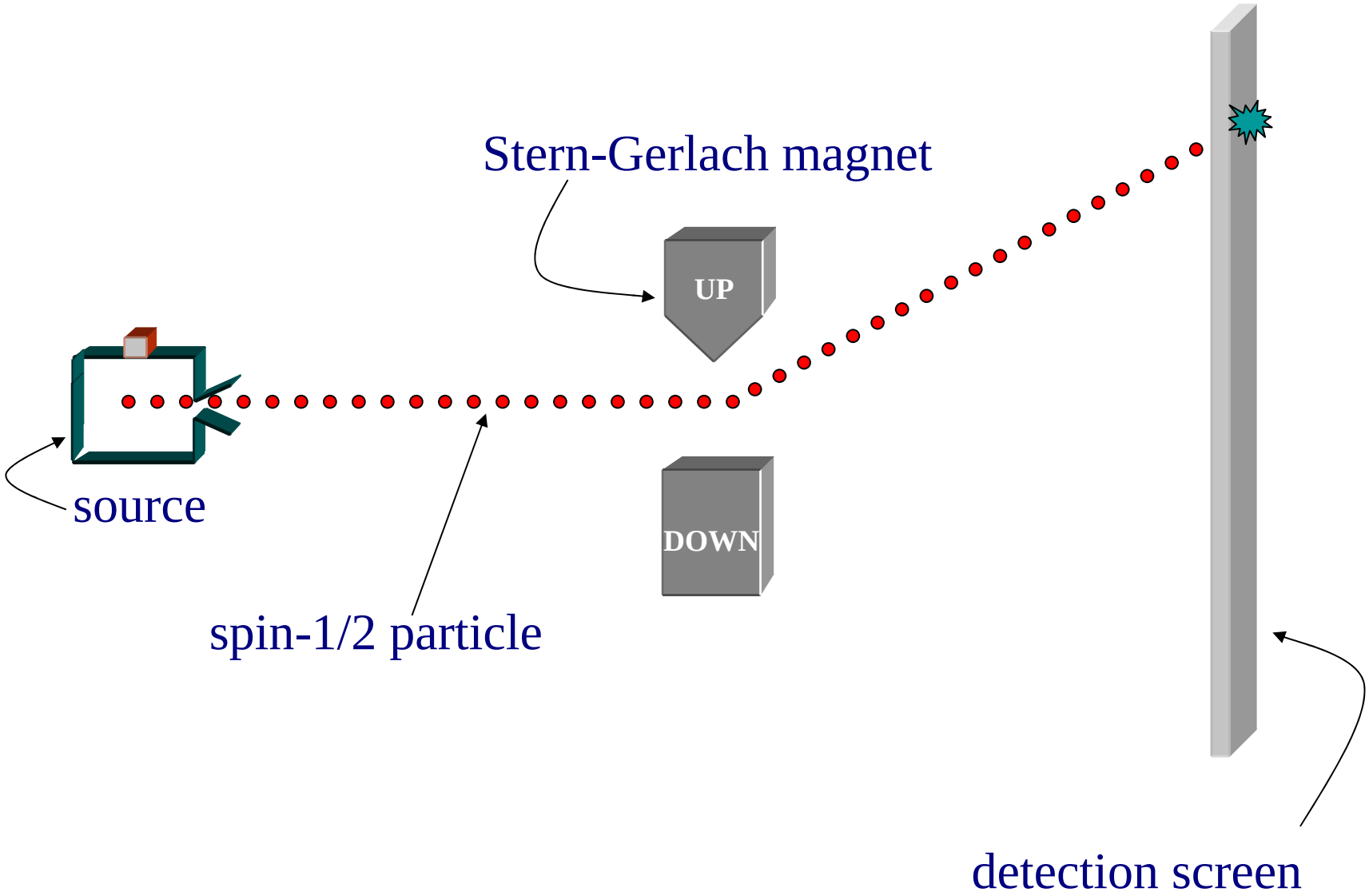

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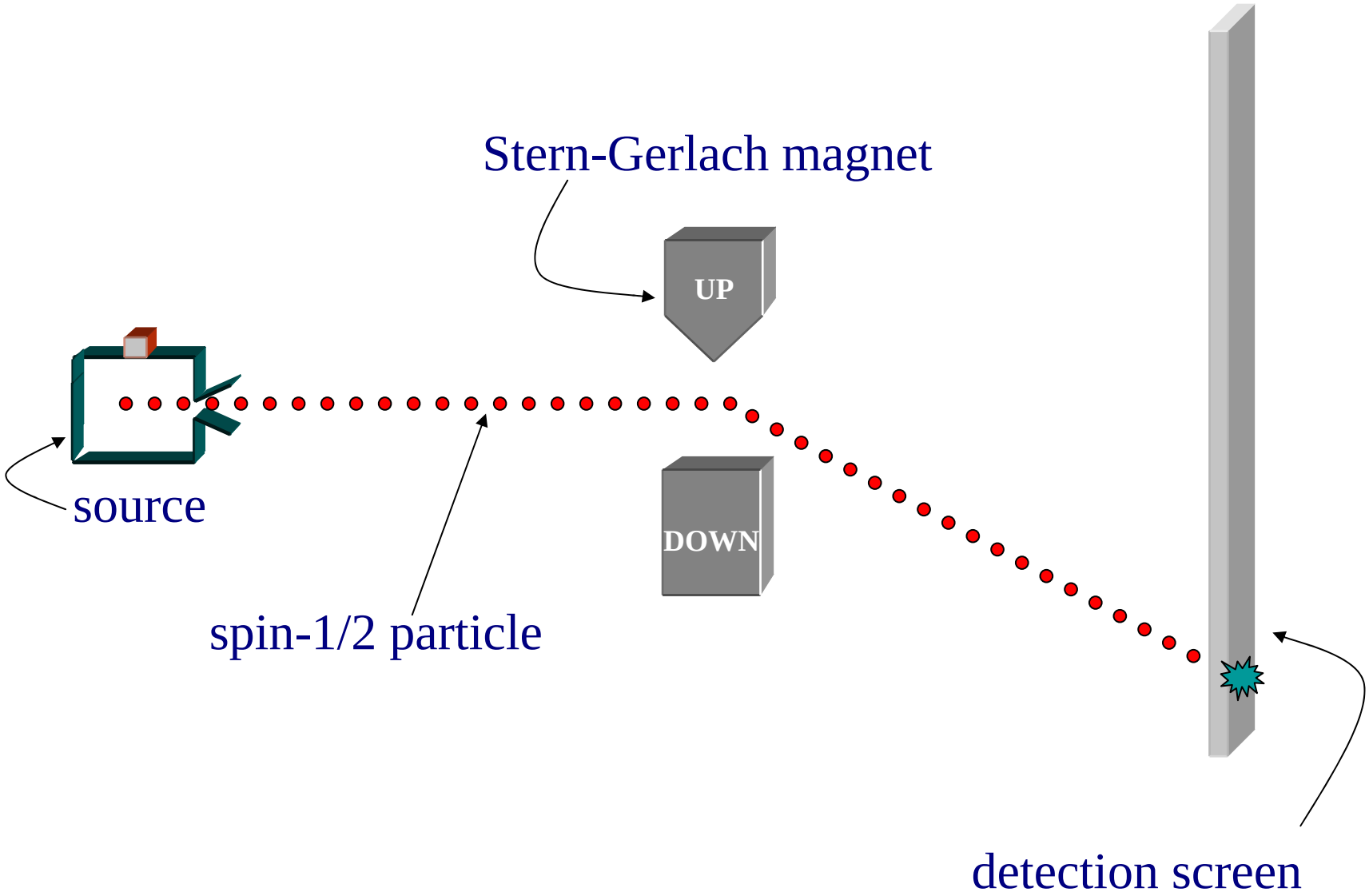
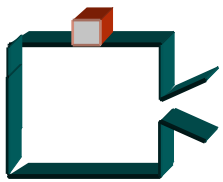
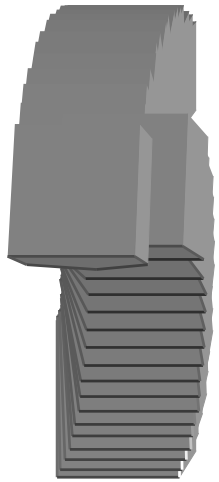
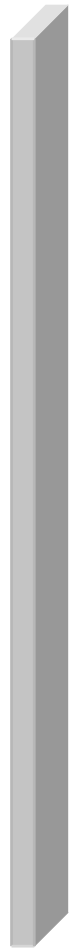
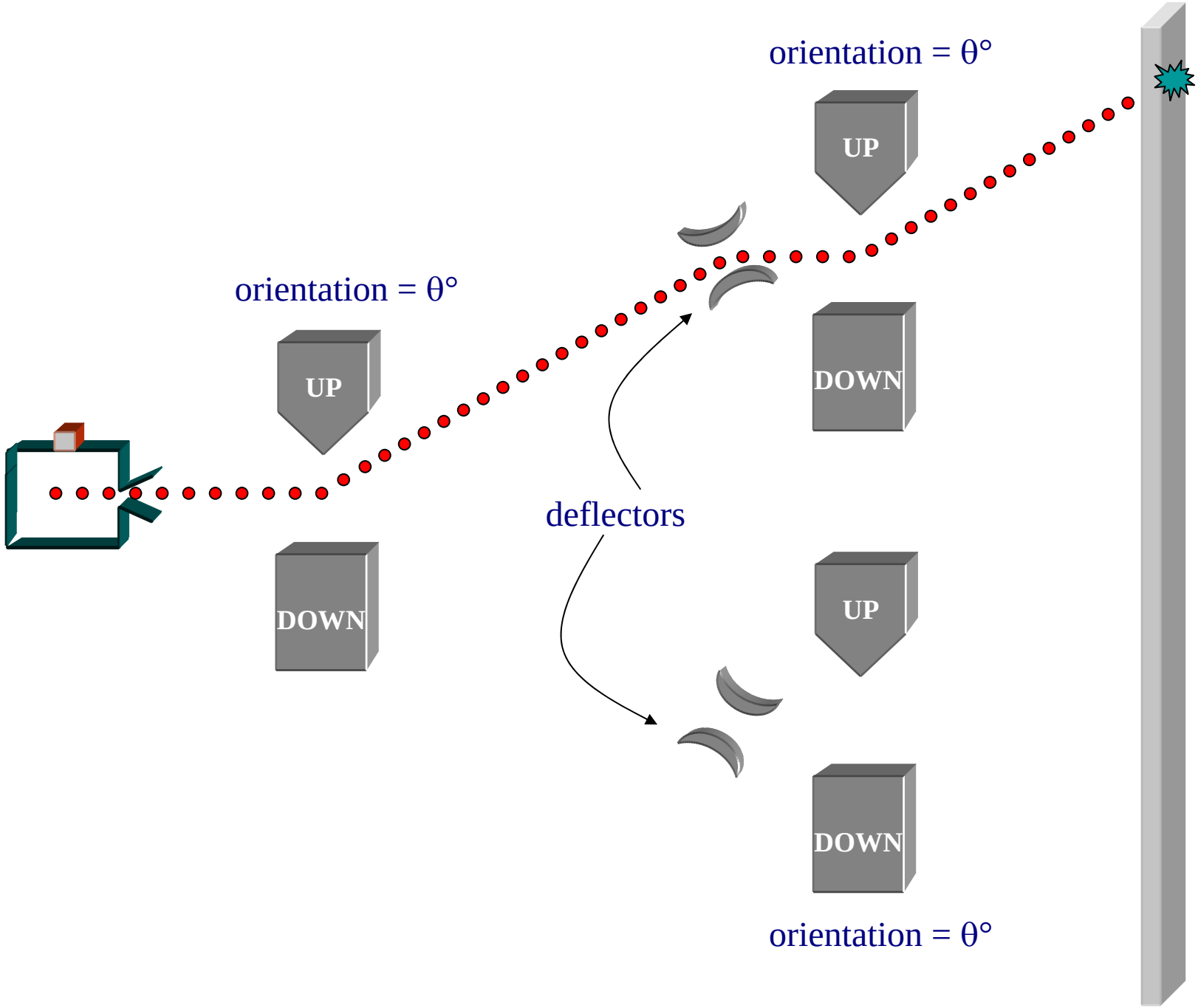


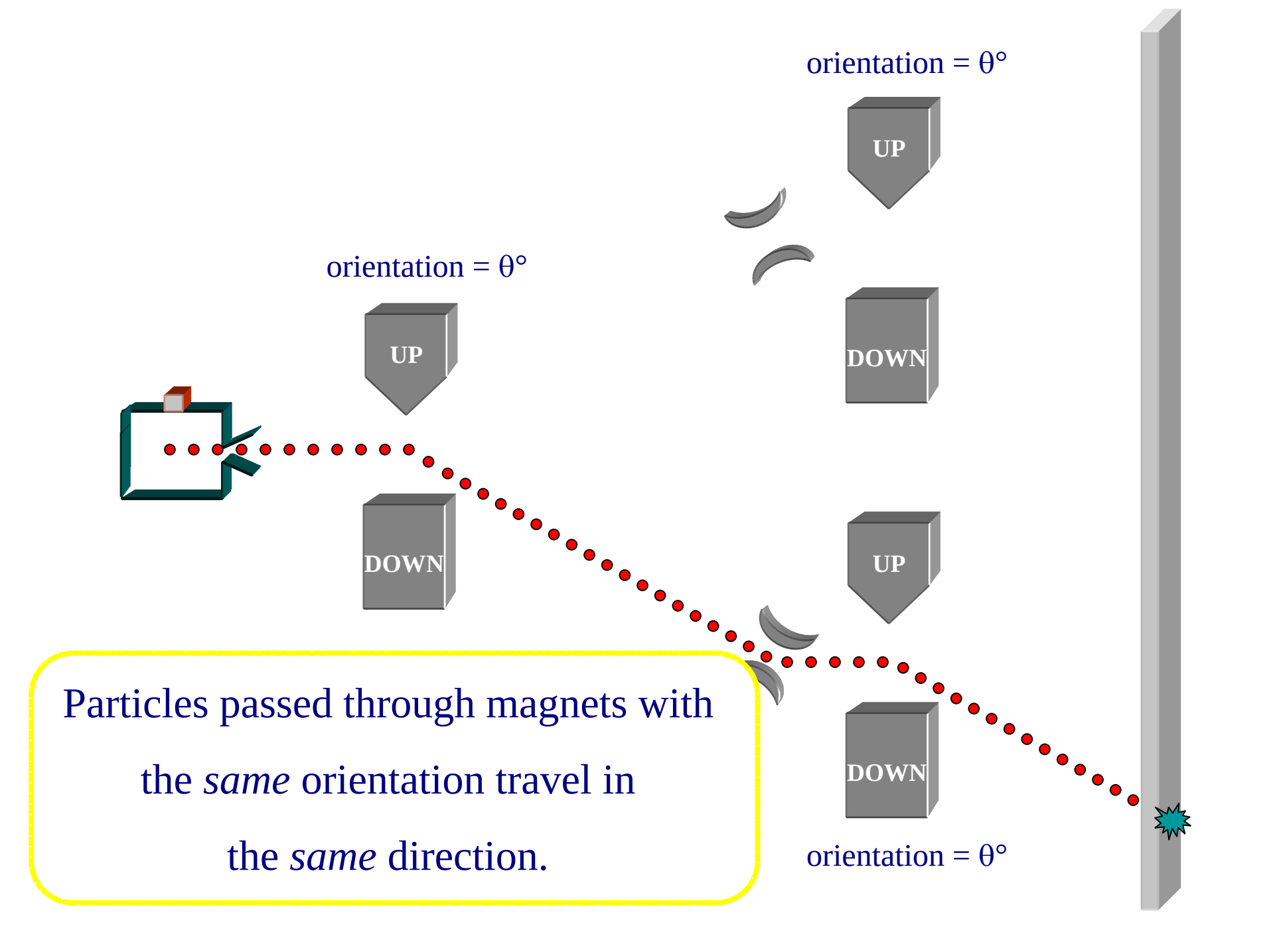






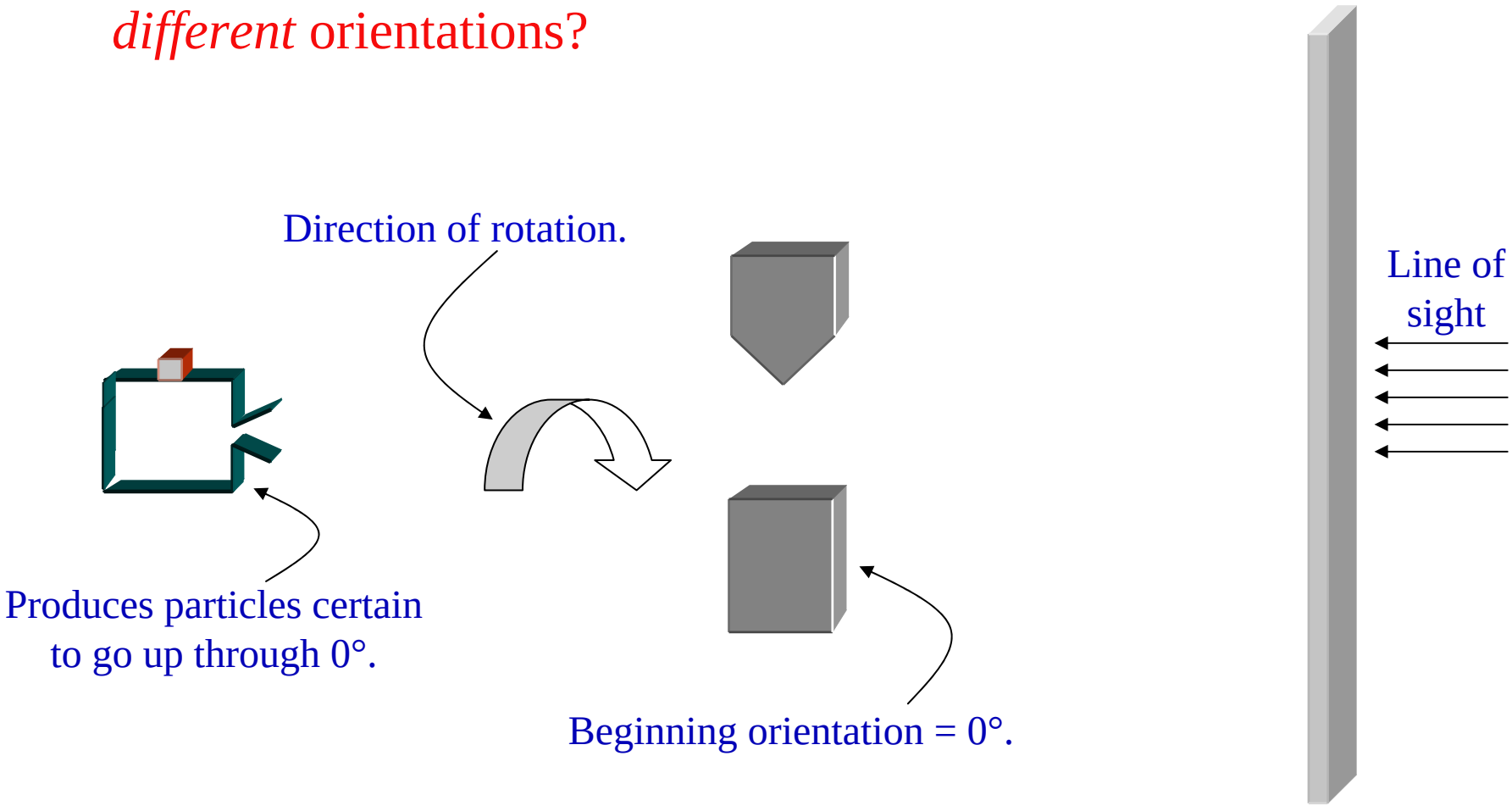
We can change the magnet orientation
to any angle from 0° to 360°; the outcomes are still
“up” and “down”.


orientation = θ°
UP
orientation = θ°
UP
DOWN
deflectors
DOWN
UP
DOWN
orientation = θ°



Particles passed through magnets with the *same* orientation travel in the *same* direction.

So, for any orientation magnet we choose, we can design a source that will produce particles *certain* to go up through a magnet with that orientation. What happens when we send such particles through magnets with *different* orientations?



WHAT WE SEE:

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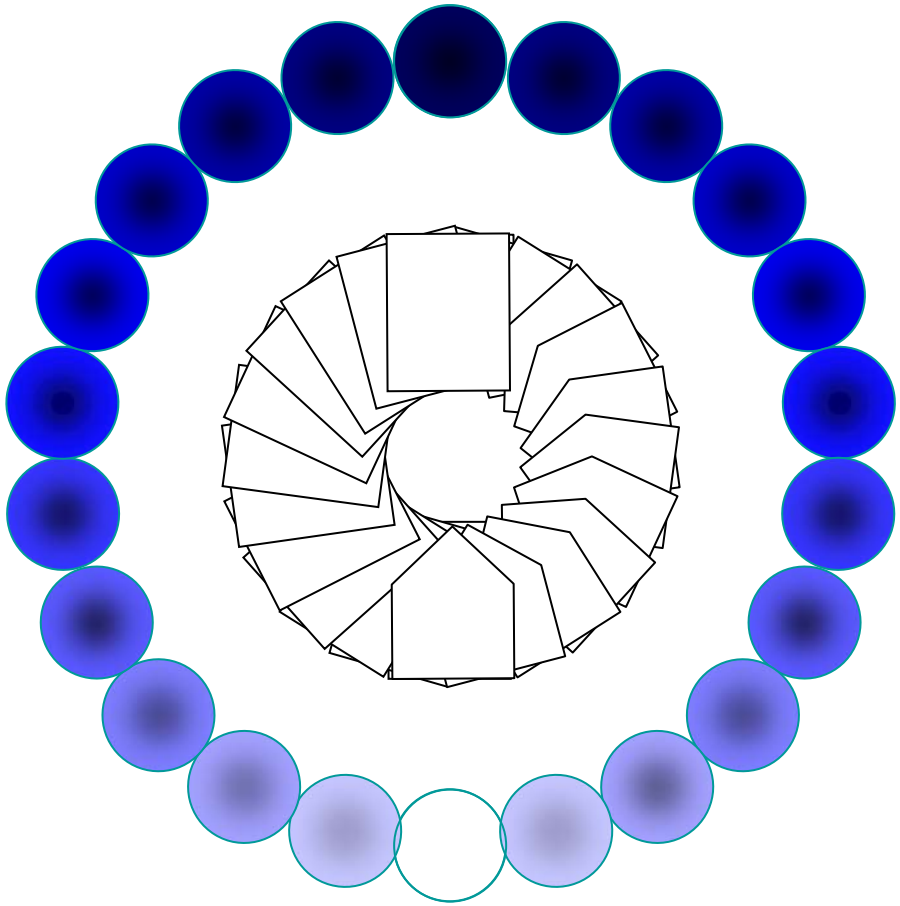


WHAT WE SEE CONFORMS TO THE FOLLOWING LAW:

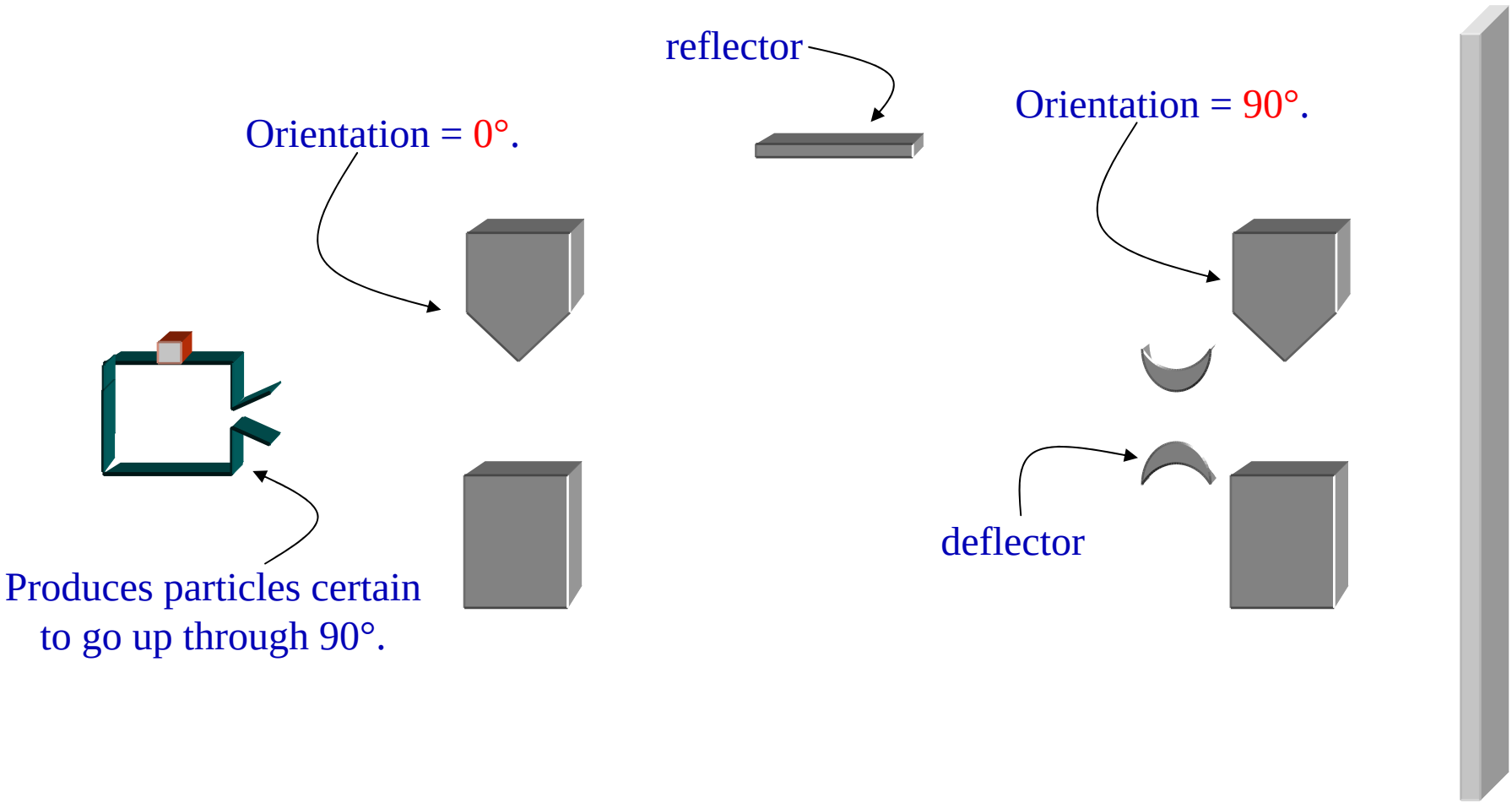
If a particle is certain to go up through a magnet with orientation θ_1, then its probability for going up through a magnet with orientation θ_2 is

$$COS^2\left(\frac{\theta_1 - \theta_2}{2}\right)$$

(Quantum mechanics, incidentally, predicts this "cos-squared law" exactly.)

Note that both of our "laws" hold with 'up' replaced by 'down'.

THE TWO-PATH EXPERIMENT:



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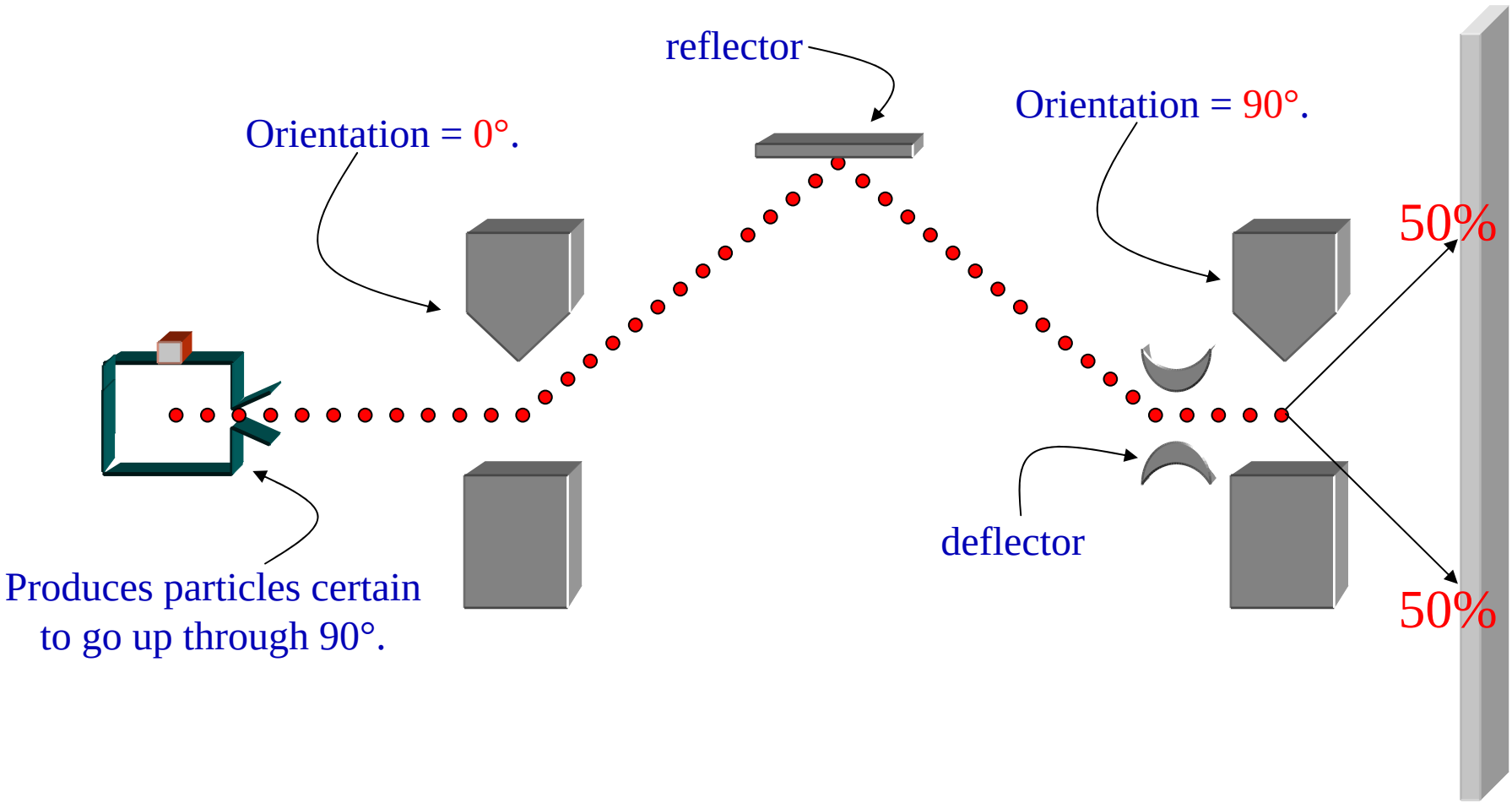

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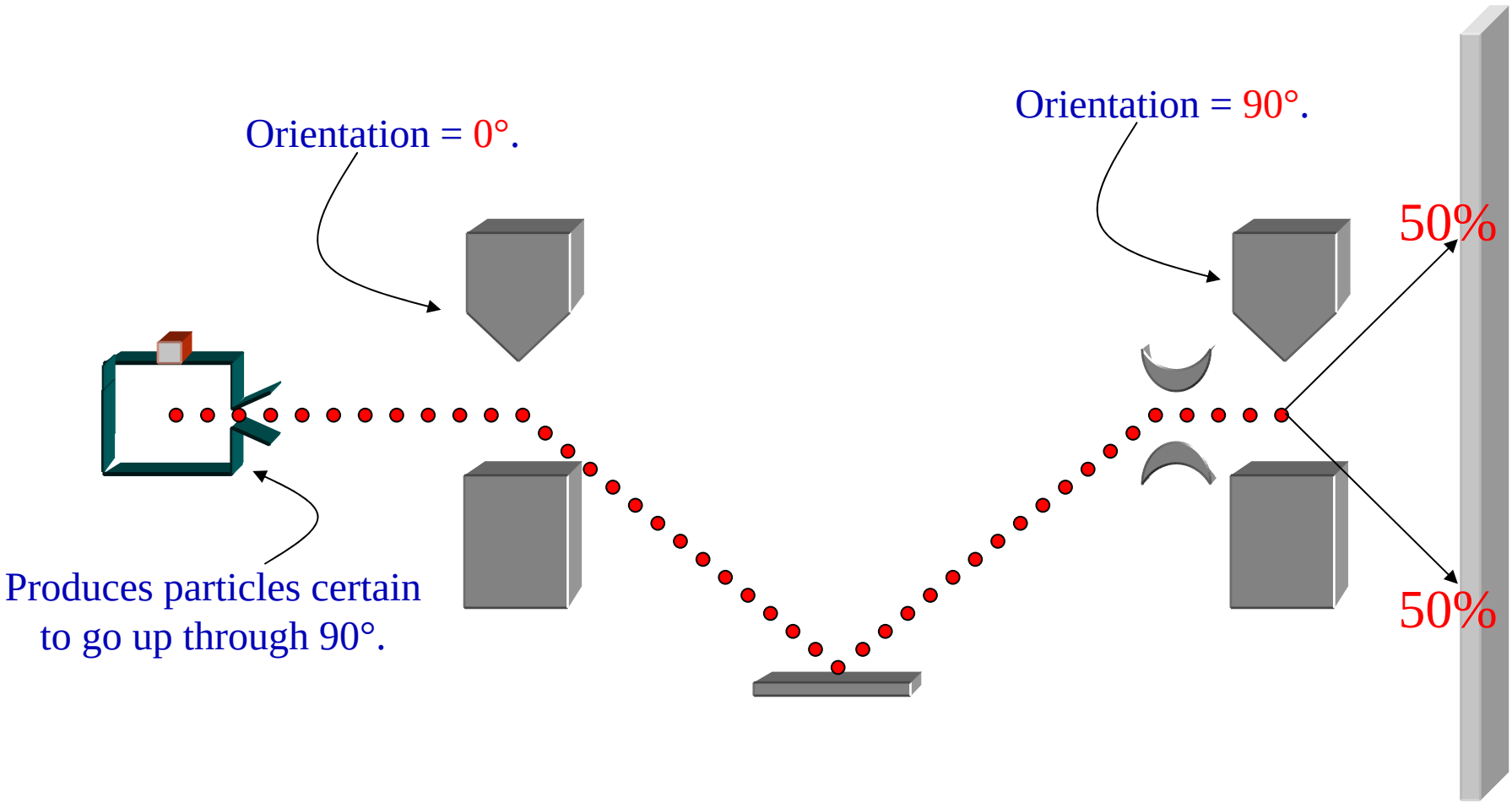
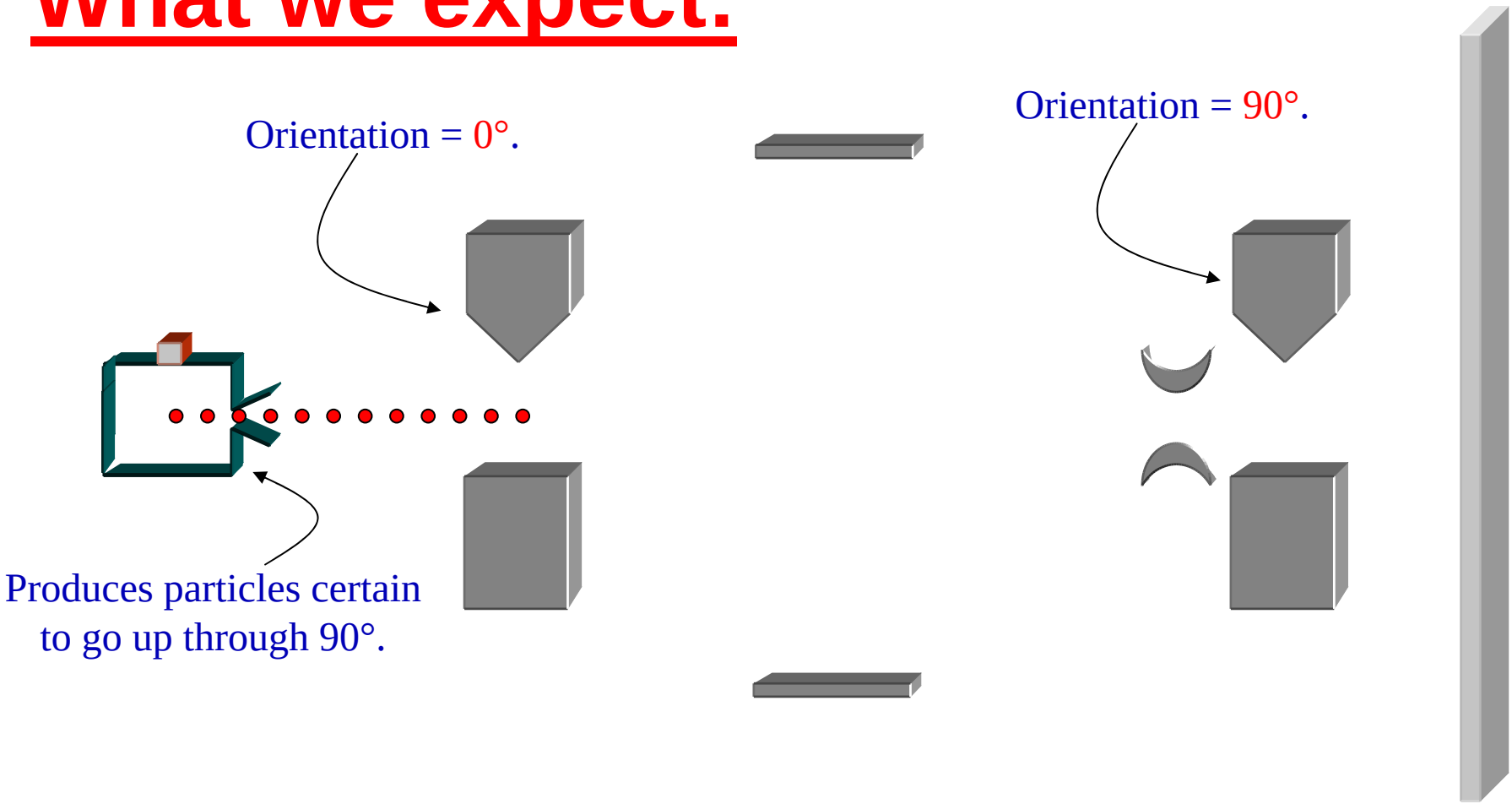


THE TWO-PATH EXPERIMENT—
What we expect:



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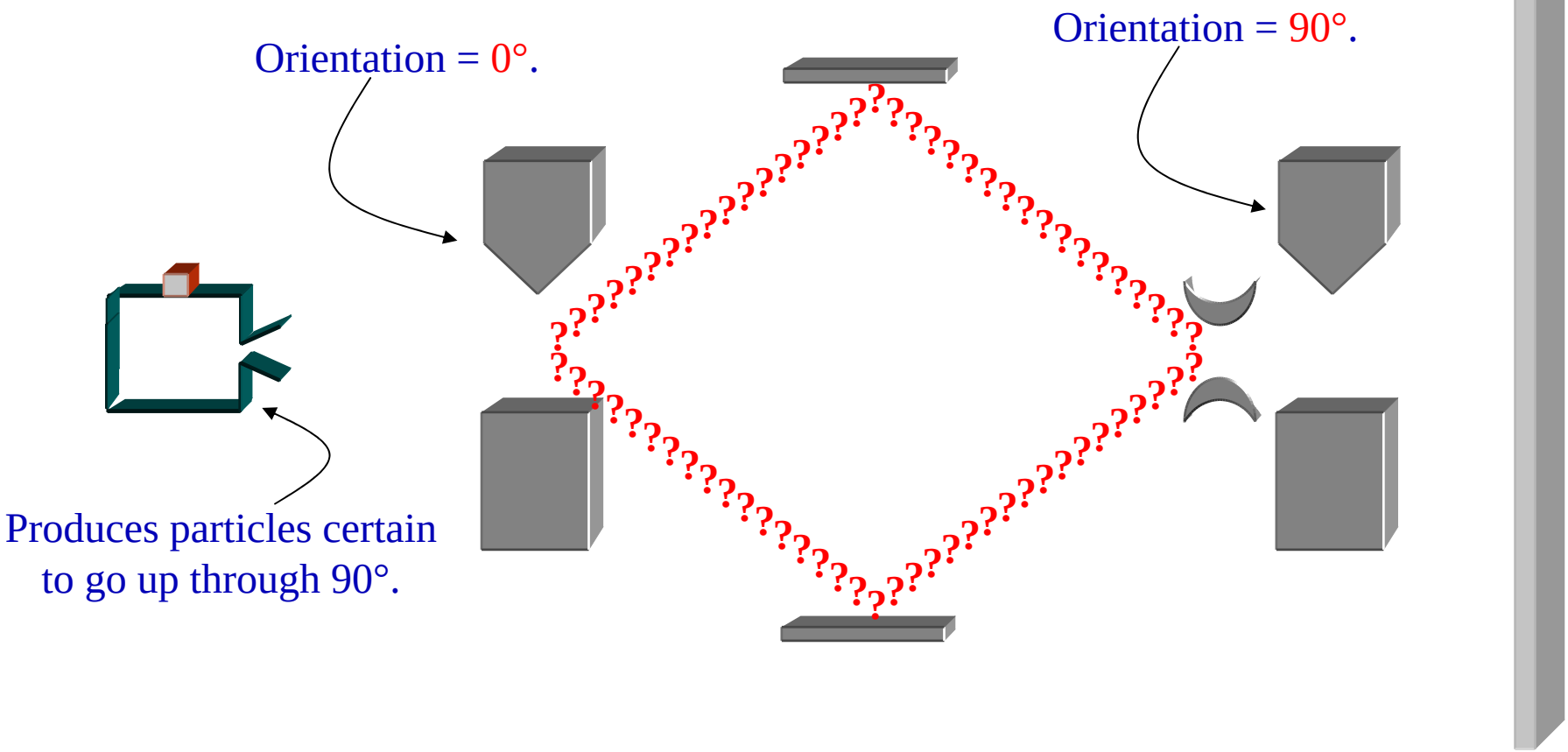

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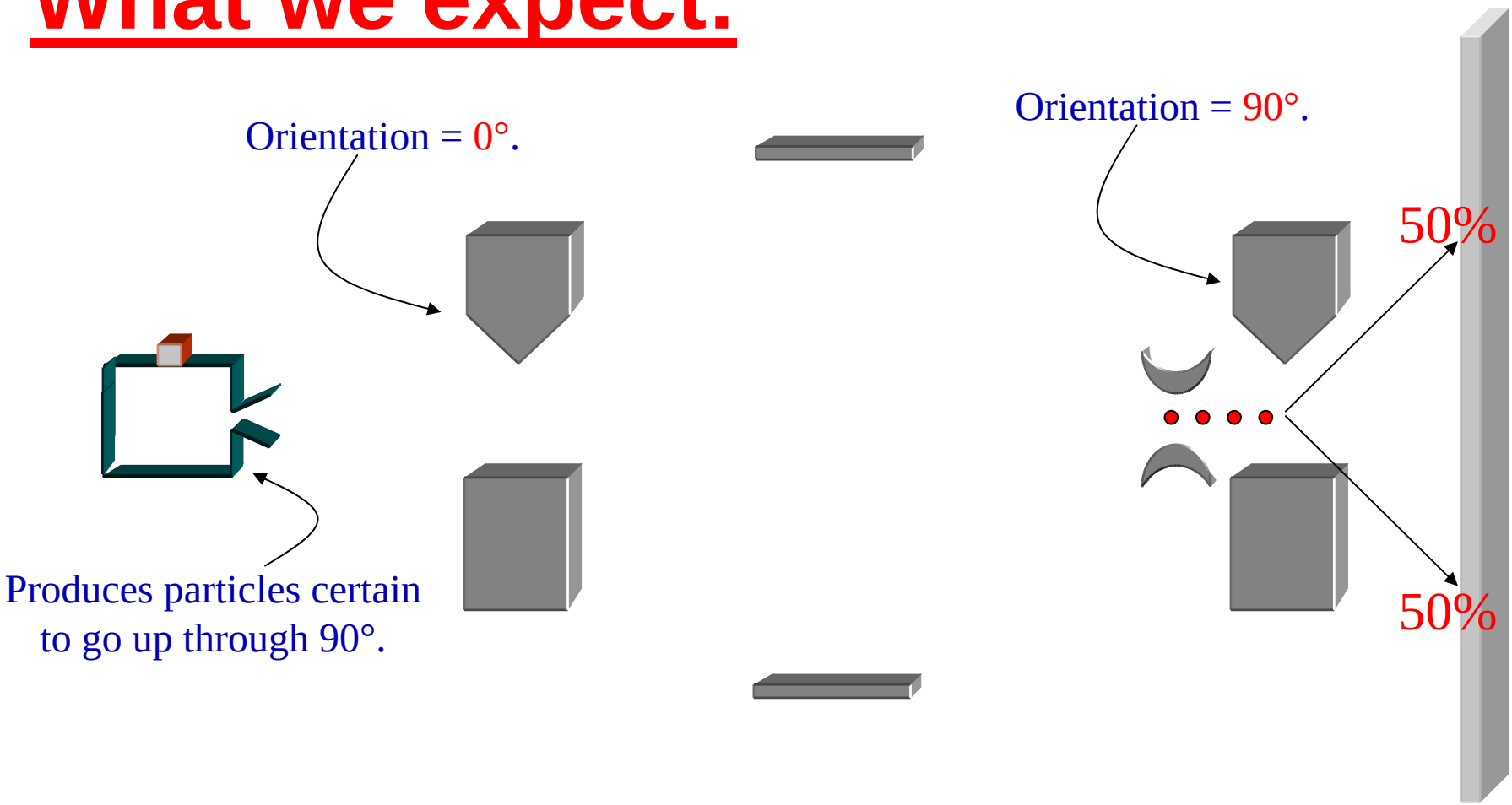
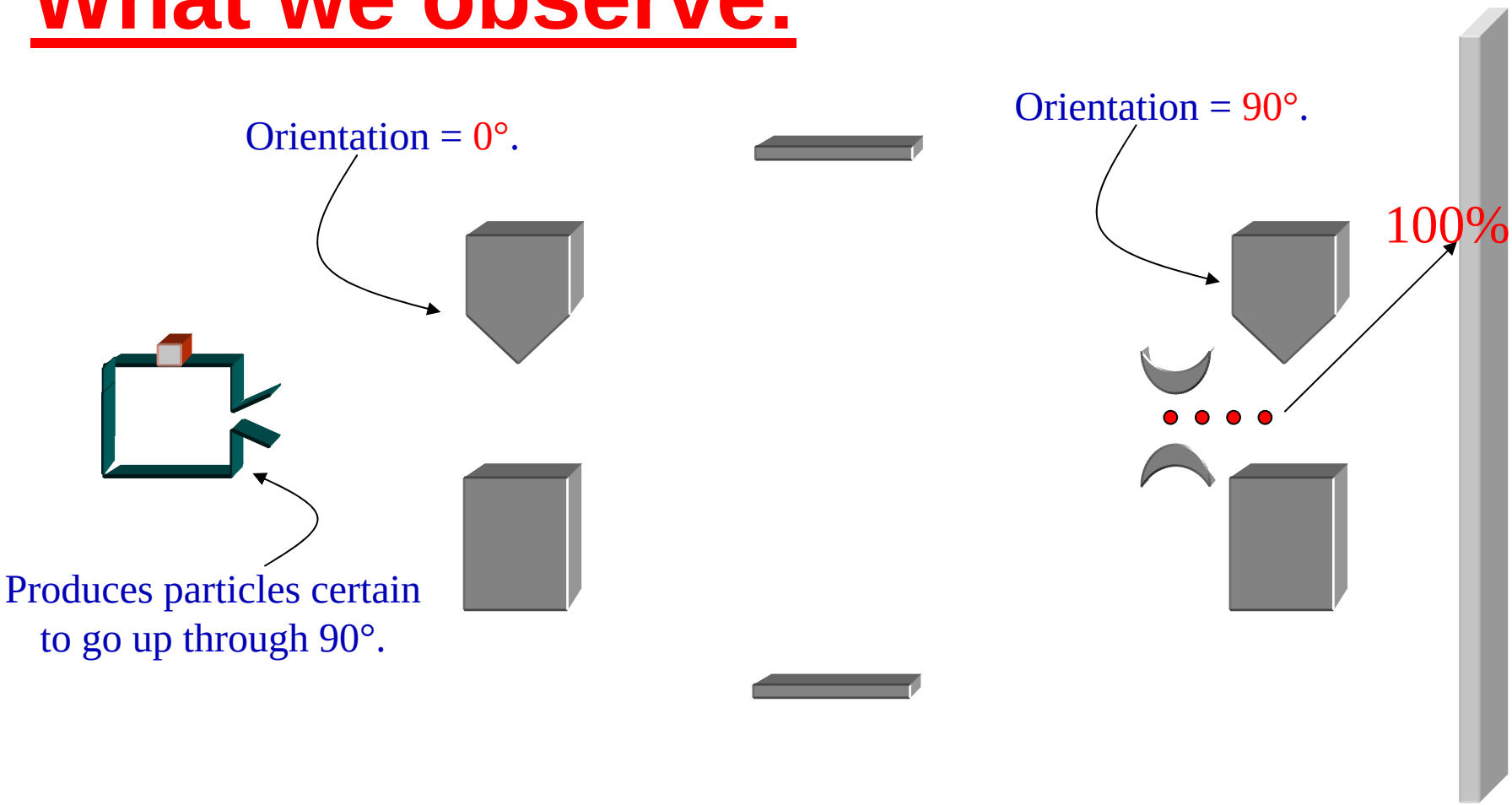
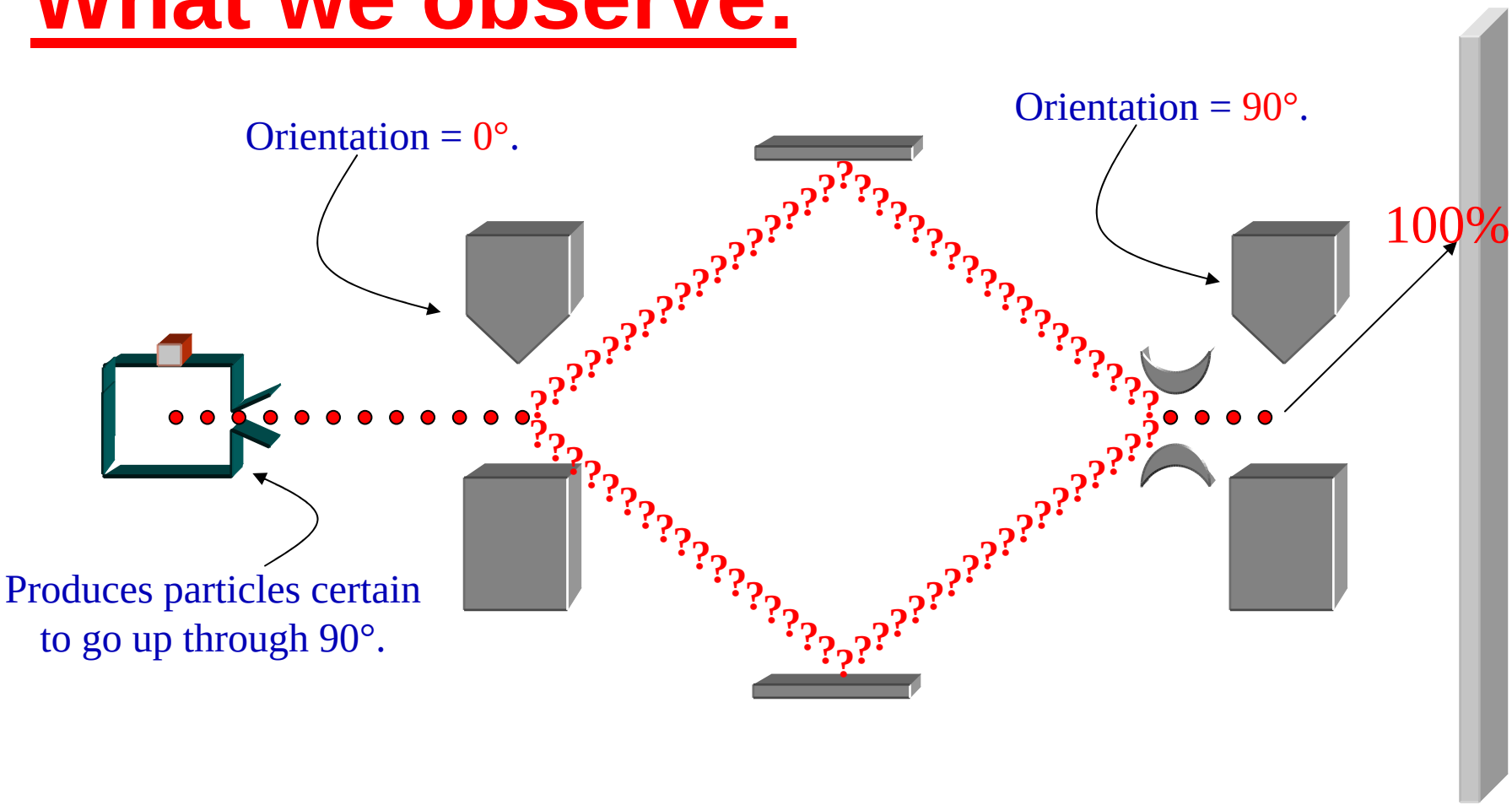


THE TWO-PATH EXPERIMENT—
What we observe: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