1-Dimensional Random Walk of a Photon in a Star

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The Concept

A photon...

- Begins its walk at $x_0 = 0$ (center of star)
- Takes a N steps in any direction of length ℓ
- After each time interval τ, the photon has equal probability of moving left or right (or, up or down)

The Concept

- The direction of each step is independent of the previous one

$$S_i = \begin{cases} +\ell \text{ (50\% probability)} \\ -\ell \text{ (50\% probability)} \end{cases}$$

The Concept

- After N steps over time τ, the position (and displacement) of the photon is given by:

$$x(N) = \sum_{i=1}^{N} s_i$$

Displacement squared is:

$$x^2(N) = \left(\sum_{i=1}^{N} s_i \right)^2$$

The Concept

- Average distance the photon is moved:

$$\langle x(N) \rangle = 0$$

Probability of finding the photon is always *centered* at $x_0 = 0$

Probability distribution gets wider as N increases

The Concept

- After N steps, the average displacement is:

$$\langle x^2(N) \rangle = l^2 N$$

Calculations should yield for n_{walks} (representative):

$\langle x(N) \rangle$ is on average 0

$\langle x^2(N) \rangle \approx N$