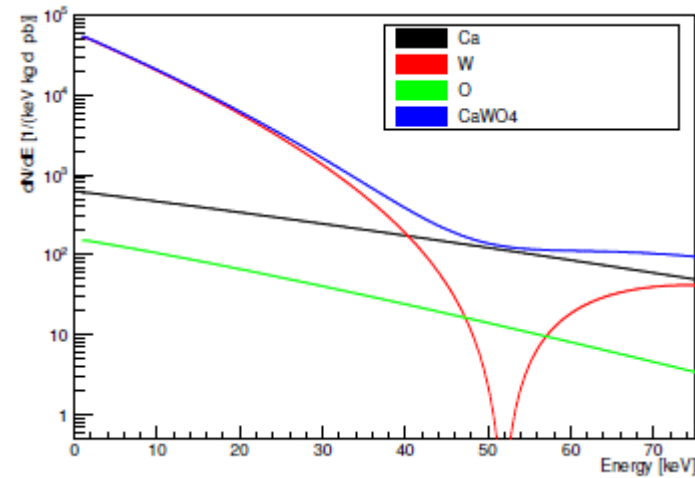
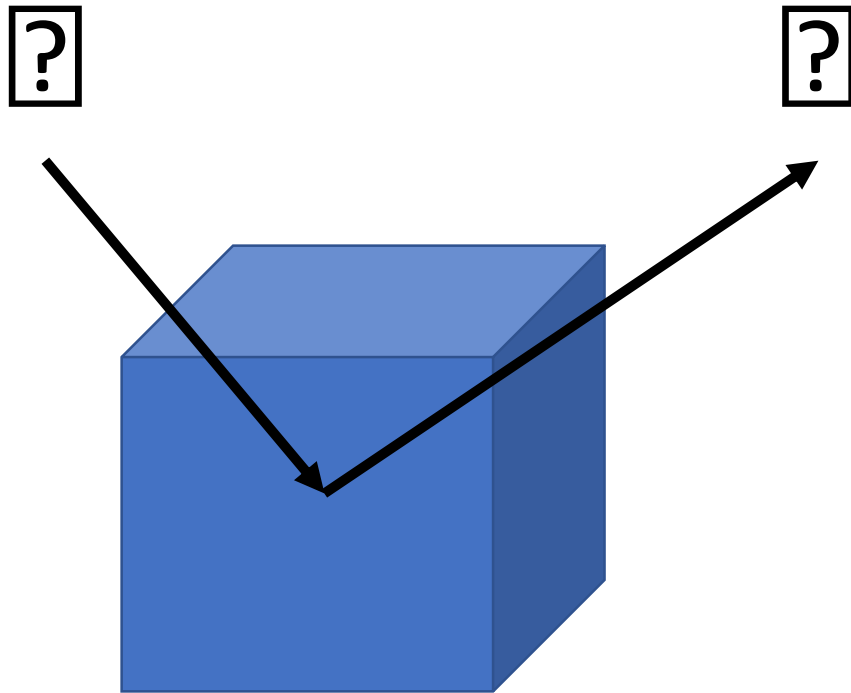


# Likelihoods for direct dark matter searches

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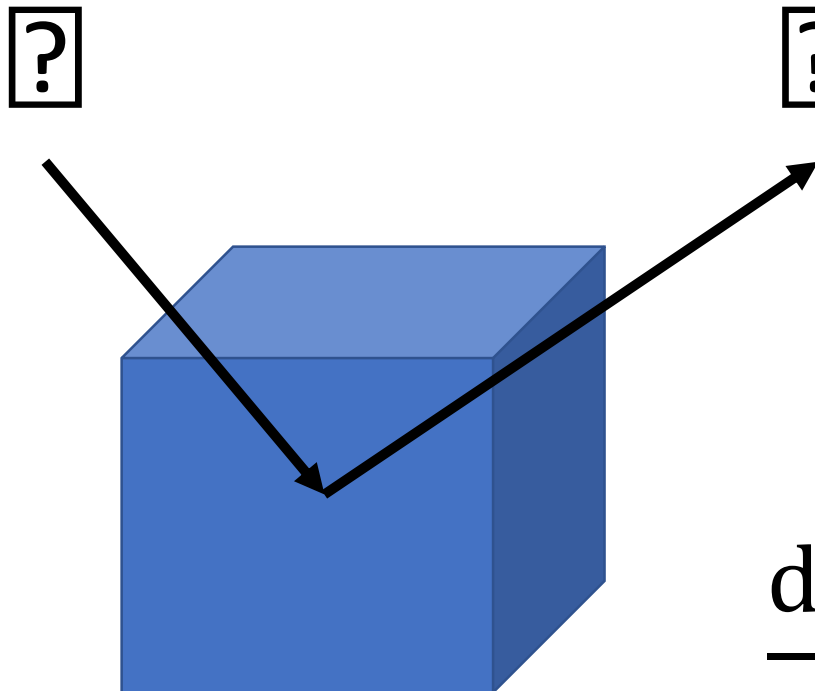
# The experimental signature



$$\frac{dR_{DM}}{dE_R}$$

$$= N_T \frac{\rho_0}{m_{\boxed{?}}} \int_{v > v_{min}}^{v_{esc}} \frac{d\sigma}{dE_R} v f(v) d^3v$$

# The experimental signature



The diagram shows a blue 3D rectangular box representing a detector. Two black question marks in square boxes are positioned above the box. Two black arrows originate from these question marks and point towards the center of the box. To the right of the box is a mathematical equation for the differential dark matter event rate, with various terms and limits annotated with colored arrows pointing to labels: 'Detector' (green), 'Particle/nuclear physics' (blue), and 'Astrophysics' (orange).

$$\frac{dR_{DM}}{dE_R} = N_T \frac{\rho_0}{m_{\square}} \int_{v > v_{min}}^{v_{esc}} \frac{d\sigma}{dE_R} v f(v) d^3v$$

Labels and arrows in the equation:

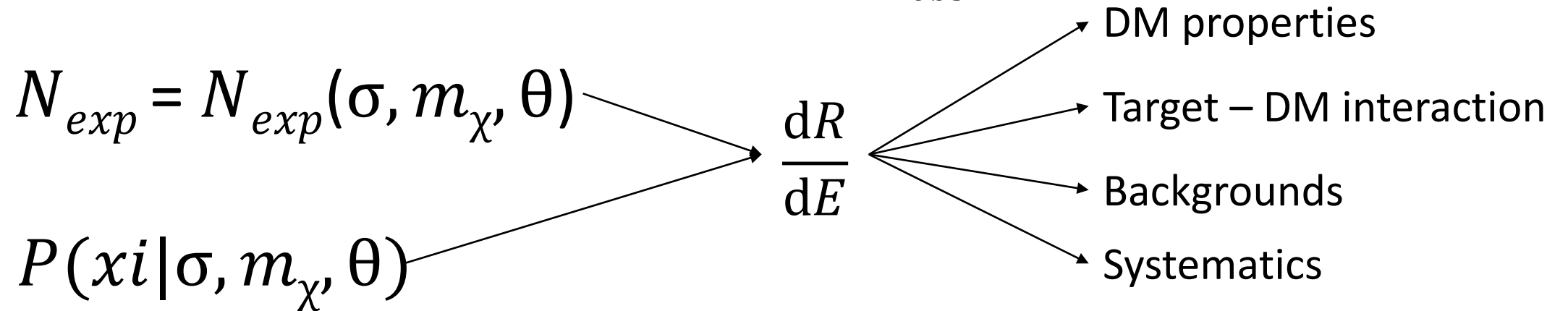
- $N_T$ : Green arrow from 'Detector'
- $\rho_0$ : Orange arrow from 'Astrophysics'
- $m_{\square}$ : Blue arrow from 'Particle/nuclear physics'
- $v_{esc}$ : Orange arrow from 'Astrophysics'
- $v_{min}$ : Green arrow from 'Detector'
- $\frac{d\sigma}{dE_R}$ : Blue arrow from 'Particle/nuclear physics'
- $v f(v)$ : Orange arrow from 'Astrophysics'

Not always elastic nuclear recoils

Likelihood for direct search detectors.

Direct searches are usually low-background experiments, therefore Extended Maximum Likelihood is often used

$$\mathcal{L}(\sigma, m_\chi, \theta | x) = \frac{e^{-N_{exp}} N_{exp}^{N_{obs}}}{N_{obs}!} \prod_{N_{obs}} P(x_i | \sigma, m_\chi, \theta)$$



$x_i$  —————> Phonon, light, charge...