# Modelling the Number of Radioactive Particles on a Surface

Group 2

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## Count Rate Integral

We assume:

- $L$ is the activity (or emission rate) of the source.
- The source occupies a volume parameterized by $(x_1, y_1, z_1)$ in the bounds $x_1 \in [X_{1,\min}, X_{1,\max}]$, $y_1 \in [Y_{1,\min}, Y_{1,\max}]$, $z_1 \in [Z_{1,\min}, Z_{1,\max}]$.
- The detector is centered at $x = x_2$ on the $x$-axis and spans $(y_2, z_2)$ in $y_2 \in [Y_{2,\min}, Y_{2,\max}]$, $z_2 \in [Z_{2,\min}, Z_{2,\max}]$.
- The integrand below is an example for a simple $1/r^2$ geometry factor (plus angular dependence). You may need to adjust powers of $r$ depending on your precise setup (solid angle, flux, etc.).

A typical form for the count rate $C$ (number of detections per unit time) can be written as a 5-dimensional integral:

$$C = \frac{L}{4\pi} \iiint_{\substack{x_1 \in [X_{1,\min}, X_{1,\max}] \\ y_1 \in [Y_{1,\min}, Y_{1,\max}] \\ z_1 \in [Z_{1,\min}, Z_{1,\max}]}} \iint_{\substack{y_2 \in [Y_{2,\min}, Y_{2,\max}] \\ z_2 \in [Z_{2,\min}, Z_{2,\max}]}} \frac{x_2 + x_1}{\left((x_2 + x_1)^2 + (y_2 + y_1)^2 + (z_2 + z_1)^2\right)^2} \, dy_2 \, dz_2 \, dx_1 \, dy_1 \, dz_1.$$

Here:

$$r^2 = (x_2 + x_1)^2 + (y_2 + y_1)^2 + (z_2 + z_1)^2,$$

and we have written one possible form of the integrand that places the detector plane at $x = x_2$ (i.e. we shift $x_1$ by $x_2$).

Adjust exponents (e.g. $1/r^2$ or $1/r^3$) to match your particular physical model (flux, solid angle subtended, etc.).