

# The poisoning of Andrei Litvinenko

Note Title

4/1/2008

Litvinenko was a former Russian security agent who was apparently poisoned with Po-210, probably administered via a cup of tea, in London in late October of 2006. You can look him up on Wikipedia for details (remember this is an ongoing international incident, so take your wikipedia with a grain of salt.)

Various values have been given for the dosage he was given, varying from 5 to over 100 times the "lethal dose". I'll presume this is the LD50, which is the dose that will kill 50% of those receiving it. Wikipedia gives this as 50 ng/kg. Assume he had a mass of 80 kg, this would mean the lethal dose was 4 micrograms. Let's make a (very rough) estimate of the dosage in rads and rems:

$$\text{For Po-210, } T_{1/2} = 138 \text{ days, } = 1.19 \times 10^7 \text{ s}$$

$$\text{decay constant: } \lambda = \frac{\ln(2)}{T_{1/2}} = 5.82 \times 10^{-8} \text{ s}^{-1}$$

atoms available in 4  $\mu\text{g}$ :

$$\frac{(4 \times 10^{-6} \text{ g})}{210 \text{ g mol}^{-1}} (6.022 \times 10^{23} \text{ atoms mol}^{-1}) = 1.145 \times 10^{16} \text{ atoms} \\ = N$$

$$\text{activity } A = \lambda N = 6.67 \times 10^8 \text{ s}^{-1}$$

$^{210}\text{Po}$  emits almost all  $\alpha$ 's at 5.3 MeV

$$\text{Power} = A \cdot E_{\text{decay}} = (6.67 \times 10^8 \text{ s}^{-1}) (5.3 \times 10^6 \text{ eV}) (1.6 \times 10^{-19} \frac{\text{J}}{\text{eV}}) \\ = 5.65 \times 10^{-4} \text{ J/s (watts)}$$

This is for the whole body. For 80 kg, this is

$$\frac{D}{s} = 7.07 \times 10^{-6} \frac{\text{J}}{\text{kg} \cdot \text{s}} = 7.07 \times 10^{-4} \frac{\text{rad}}{\text{s}} \\ = 61 \text{ rad/day}$$

Since the RBE of  $\alpha$ 's is about 10-20 this means

$$\frac{D_{\text{rem}}}{\text{day}} = 600 - 1200 \text{ rem/day, which looks quite deadly.}$$

Much more sophisticated models would actually be used in medical treatment.

