Uncertainty propagation in nuclear forensics

Abstract:
Uncertainty propagation formulae are presented for age dating in support of nuclear forensics. The age of radioactive material in this context refers to the time elapsed since a particular radionuclide was chemically separated from its decay product(s). The decay of the parent radionuclide and ingrowth of the daughter nuclide are governed by statistical decay laws. Mathematical equations allow calculation of the age of specific nuclear material through the atom ratio between parent and daughter nuclides, or through the activity ratio provided that the daughter nuclide is also unstable. The derivation of the uncertainty formulae of the age may present some difficulty to the user community and so the exact solutions, some approximations, a graphical representation and their interpretation are presented in this work. Typical nuclides of interest are actinides in the context of non-proliferation commitments. The uncertainty analysis is applied to a set of important parent-daughter pairs and the need for more precise half-life data is examined.

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