

## Primary Activity Standards and Nuclear Data for Targeted Alpha Therapy

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Targeted alpha therapy is a rapidly evolving discipline, referring to an emerging class of revolutionary cancer agents delivering alpha-particle-emitting radiopharmaceuticals selectively to cancerous lesions via attachment to appropriate ligands and carriers.

Clinically effective alpha particle-emitting radionuclides for cancer therapy exhibit short half-lives, (limiting long-term radiation exposure to patients) and exhibit a high level of radiobiological effectiveness (due to the high-energy and short-range of the alpha radiation) thus limiting damage to non-cancerous surrounding tissue.

The calculation of the absorbed dose delivered to malignant and surrounding normal tissue is a key parameter in optimising the effectiveness of these treatment modalities, requiring accurate assessment of the activity administered to patients (via demonstrable traceability of clinical Dose Calibrator assay to primary activity standards) as well improvements in the knowledge of radioactive decay scheme parameters/nuclear data for the radionuclides employed.

This report reviews the current status of measurement and standardisation needs for Targeted Alpha Therapy, and details recent work performed at the United Kingdom's National Physical Laboratory (and worldwide), to address these key measurement issues for the Targeted Alpha Therapy radiopharmaceuticals  $^{223}\text{Ra}$ ,  $^{227}\text{Th}$  and  $^{224}\text{Ra}$  each of which may be considered as the parent of a radioactive decay-chain. The nuances of radioactive decay (and associated progeny ingrowth) for each radionuclide on activity measurements (for primary and secondary standardisations, as well as clinical use) are detailed.

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