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Neutron Capture Enhanced Particle Therapy (NCEPT): A new frontier in cancer treatment

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Neutron capture enhanced particle therapy (NCEPT) is a radical new paradigm in radiotherapy being developed by an international team led by researchers at the Australian Nuclear Science and Technology Organisation (ANSTO).

NCEPT combines the precision of particle therapy with the cancer-specific targeting capability of neutron capture therapy (NCT). NCEPT captures internally generated slow (thermal) neutrons, produced at and around the target volume to (Figure 1):

1. Enhance the dose to target
2. Reduce the dose to normal tissue
3. Simultaneously target out-of-field satellite lesions

Figure 1: Conformal delivery of planned radiation dose to the target volume with particle beam (red); the resulting thermal neutron field (white) is utilised to (1) Enhance the dose at target and (2) deliver a comparable dose to satellite lesions via targeted delivery of a neutron capture agent.

NCEPT leverages low toxicity ^{10}B and ^{157}Gd -enriched neutron capture agents which concentrate in cancer cells, already approved or under development for other medical applications.

Simulations and experiments on cancer cells have yielded extremely compelling results, indicating that NCEPT achieves equivalent cancer cell control with between $\frac{1}{3}$ and $\frac{1}{5}$ of the radiation dose compared to helium and carbon ion therapy alone.

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