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Novel deuteron accelerator for nuclear waste transmutation

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Accelerator-driven systems (ADSs) can accelerate high intensity ions to generate high flux of neutrons to transmute the long-lived species in used nuclear fuel (UNF) from nuclear reactors. A typical specification would be for a 1-2 GeV proton beam, comprising multi-MW-level power load on a spallation target. An alternative approach could be to produce the neutrons via breakup of 40-MeV deuterons on a low-Z target. For this purpose, an innovative deuteron cyclotron auto-resonance accelerator dCARA is described here. It is predicted to produce a 40-MeV, 125 mA CW deuteron beam, with notable features including continuous acceleration without bunching for good beam stability, high efficiency, wide beam aperture, and an exceptionally short length of 1.6 meters. It is estimated that 5-10 smaller ADS dCARA-based modules could provide the same level of transmutation as one ADS employing a GeV-level 25-MW linac. Other applications of dCARA include medical isotope production system, or fusion prototypic neutron source for testing inner-wall materials for a future fusion power reactor.

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