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Numerical Investigation on the Thermal Performance of the Rotating Target for CANS

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Compact Accelerator-driven Neutron Sources (CANS) demonstrate significant potential for applications in both scientific and industrial fields. A critical challenge for further expanding CANS's applications is to improve the neutron yield, which requires a highly-efficient thermal dissipation ability for neutron target to bear the high power of incident beam. By employing the rotating target, the bearable thermal load of neutron target can be significantly enhanced. Therefore, a quantitative evaluation of the thermal dissipation capacity of rotating target is in need.

Based on the Compact Pulsed Hadron Source (CPHS) at Tsinghua University, we are developing a neutron target station for Boron Neutron Capture Therapy (BNCT) utilizing the 7Li(p,n)7Be nuclear reaction. Given lithium's low melting point, we conduct systematic simulation studies on the rotating lithium target to improve its thermal dissipation efficiency, which is essential for reducing localized overheating damage and extending operational lifespan. By employing finite element and finite volume methods, we optimize the configuration of target slices and adjust rotational velocities according to various beam intensity distributions, including uniform and Gaussian profiles, at different beam powers. These optimizations ensure an efficient thermal dissipation while meeting stringent engineering criteria. Our results provide robust theoretical and practical foundations for the application of rotating targets in CANS.

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