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Evaluating the feasibility of TPS high heat load components for high-current operation using TMSI

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The Taiwan Photon Source (TPS) currently operates at 500 mA beam current, with future evaluations targeting 800 mA to assess the feasibility of high-intensity operation. This imposes significant thermal and mechanical challenges on high heat load (HHL) components, such as pre-masks, fixed masks, slits, and absorbers, in the storage ring and front end. To systematically evaluate the severity of existing designs, we developed the Thermal-Mechanical Severity Index (TMSI), which quantifies combined thermal and mechanical stresses, enabling targeted comparisons within component categories. Finite Element Analysis (FEA) simulations using ANSYS were conducted to provide detailed thermal and thermo-mechanical results, supporting the validation of the TMSI framework. TMSI streamlines component assessment, reduces the need for exhaustive case studies, and facilitates prioritization of redesigns to ensure the reliability and longevity of HHL components. This methodology represents a practical and efficient approach to advancing TPS design and operation for next-generation synchrotron performance.

Footnotes

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Author: SHENG, I-Ching (National Synchrotron Radiation Research Center)

Co-author: HSIAO, Yuan-Ming (National Synchrotron Radiation Research Center)

Presenter: SHENG, I-Ching (National Synchrotron Radiation Research Center)

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