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4.12 Passive Detection of High Energy Particle Loss using Rippled Tiles

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A novel detection approach for energetic particle loss has been developed and implemented on DIII-D. Incident energetic ion flux has been observed to produce a measurable temperature change on the DIII-D outer wall during neutral beam injection. A challenge with detecting energetic particle losses is to distinguish their heat signature from SOL heat flux profiles. The new detection technique relies on modified tile geometries composed of short barricades to prevent small gyroradius particles from impacting the downstream wall surface. The regions deprived of energetic particle impacts should exhibit specific heat patterns that can be identified using IR imaging. The geometry of the tiles set the energetic particle energy and pitch angle sensitivity, both of which can be modeled to inform the tile design. Four rippled tiles are in use on DIII-D, with two near the midplane and two approximately 45o below the midplane. Simulations of prompt loss from counter-current neutral beam injection indicates unique heat patterns for each tile. Heating patterns are measured using a wide-angle, high-speed IR camera and the resulting images indicate that ripple tile shapes affect downstream ion impacts. This passive detection technique is potentially applicable to ITER-class fusion devices.

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