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Summary of dispersive shell pellet injection experiments on DIII-D

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Dispersive shell pellet (DSP) injection is currently being developed as an alternative disruption mitigation technique to massive gas injection and shattered pellet injection. The main advantage of DSP injection is the core deposition of the payload which is expected to result in higher assimilation fractions and an inside-out thermal quench (TQ). DSPs have been successfully launched into DIII-D Super H-Mode plasmas, resulting in the rapid shutdown of the plasma current. Core payload deposition was most readily achieved using high density carbon (HDC) shells with 3.6 mm outer diameter and 40 μm wall thickness. Both low-Z (boron dust) and high-Z (tungsten grains) payloads have been investigated. Initial experiments have shown that the pellet penetration increased with pellet velocity, however the assimilation fraction remained approximately constant (0.5 –0.9). The assimilation fraction decreased when using larger 5 mm diameter pellets with larger payloads, but this may be due to added perturbation from the increased shell mass and surface area. Both small and large HDC shells have been found to be too perturbative to produce a true inside-out TQ. To remedy this, materials with lower atomic numbers than carbon have been proposed as an alternative coating/shell material. The development of multi-micrometer thick lithium coatings for future DSP experiments on DIII-D is underway.

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Speaker's title

Mr

Speaker's email address

bodnerg@fusion.gat.com

Speaker's Affiliation

General Atomics, San Diego, CA

Member State or IGO

United States of America

Primary author: Dr BODNER, Grant (General Atomics)

Co-authors: SHIRAKI, Daisuke (Oak Ridge National Laboratory); HOLLMANN, Eric M. (University of California San Diego); BOEHM, Kurt (General Atomics); EIDIETIS, Nicholas (General Atomics); VARGAS, Nicolas (General Atomics)

Presenter: Dr BODNER, Grant (General Atomics)

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