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# Plasma Core Fuelling by Cryogenic Pellet Injection in the TJ-II Stellarator

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Core plasma fuelling is a critical issue on the pathway to developing steady-state scenarios in 3-dimensional magnetically confined plasma devices. Indeed, neoclassical theory predicts that on-axis electron cyclotron resonance heating (ECRH) requires a particle source situated at the same radial position as ECRH with an analogous deposition profile shape in order to mitigate potential core particle depletion [1]. A prime candidate for core fuelling is cryogenic pellet injection [2]. However, a detailed understanding of pellet ablation mechanisms, and subsequent particle transport, remains outstanding and is of paramount interest for stellarators.

A pellet injector (PI) is operating on the TJ-II stellarator [3]. It is a 4-pellet system, developed in conjunction with the Fusion Energy Division at Oak Ridge National Laboratory, Tennessee [4] with in-situ pellet formation, fast propellant valves for pellet acceleration (800 to 1200 m/s), plus in-line diagnostics and optical access to the pellet path through the plasma (diodes and a fast frame camera collect the luminescence light emitted by the neutral, or partially ionized, cloud that surrounds an ablating pellet).

On TJ-II, hydrogen pellets are injected into plasmas created using a range of magnetic configurations and heated by ECRH, neutral beam injection heating or by both. Studies are made of pellet ablation and penetration, neutral cloud evolution, particle transport and confinement, as well as fuelling efficiency. The findings can provide input for the W7-X pellet injection program, this being of critical importance for neoclassical transport optimization in W7-X and the attainment of long-pulse high-power discharges with pure microwave heating.

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