Pellet ELM Pacing Developments – DIII-D
December Experiment Highlights

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VLT Conference Call
21-Dec-2011
Projected erosion of divertor materials by type I ELMs is a serious issue for ITER. ELM Pacing has been shown to reduce the ELM size.

In support of ITER, the pellet injector gun design has been modified to produce small pellets at slow speeds.

The new injector gun design has been successfully tested in the lab and at DIII-D, where a new LFS injection line was installed that mimics the ITER plan for pellet ELM pacing.

New data from this trajectory confirms ELMs are triggered before the pellet reaches the top of the Te pedestal.

Pellets injected at 60 Hz into plasma. Pacing observed at 5 - 10x the natural ELM frequency.
• New ITER like LFS injection line installed and tested on DIII-D. 1.3mm pellets injected appear to trigger ELMs.
Demonstration of ELM Pacing by 60 Hz Pellets

Pellet Shot

- ELM Pacing demonstrated at ~10x the natural ELM rate.
- ITER Shape with ITER \( \beta_N \approx 1.8 \)
- 60 Hz 1.3mm pellets injected from LFS midplane and divertor at 150-200 m/s.
- Much smaller ELMs observed from the pellets. Large stored energy drops with natural ELMs.
- Only modest fueling and reduction in H-factor observed.

Non- Pellet Shot

Plasma Density

Energy Confinement H-factor

Stored Energy

Preliminary – not for Distribution
Reduction of Impurity Emission Intensity Observed with Pellet ELM Pacing

- ELM Pacing demonstrated at ~10x the natural ELM rate.
- ITER Shape with ITER $\beta_N \sim 1.8$
- 60 Hz 1.3mm pellets injected from LFS midplane and divertor at 150-200 m/s.
- Much smaller ELMs observed from the pellets.
- Reduced high-Z and lower Z impurity signal intensity in the plasma core during the ELM pacing phase.

Pellet Shot

Non-Pellet Shot

Ni 26 intensity - plasma center

O 8 intensity - plasma edge

Divertor Dα - inner strike point

Preliminary – not for Distribution
Fast Camera Images of Pellets that Trigger ELMs

R-2 Pellet

LFSmid Pellet
Future Plans for DIII-D Pellet ELM Pacing

• What are the minimum pellet size and speed requirements to reliably trigger ELMs?

• DIII-D is investigating this in concert with JET and ASDEX-U (ITPA PEP24).

• In 2012 we plan to test 1.3x1.0mm pellets (~20% reduction in size).

• Also will investigate inner wall fueling combined with LFS ELM pacing pellets.

DIII-D Pellet Parameters

ELM triggered
No ELM triggered

New 1.3mm slow pellet tested from LFS