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### Plasma Density in DIII-D<sup>1</sup>

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Plasma density is crucial in achieving peak performance in confined fusion plasmas. It has been indicated the existence<sup>2</sup> of an operational density limit (Greenwald limit) which is independent of heating power. Several theories have reproduced the observed dependence in the data has presented an enigma. This limit is a major concern for ITER because the nominal operating density for ITER is close to the Greenwald limit. To understand the physical processes which limit operating density, experiments on DIII-D have shown that ELM formation, high core recycling and neutral pressure, resistive wall heating, and edge/scrape-off layer conduction affect plasma properties, i.e. edge/scrape-off layer conduction, edge temperature, density profile, and core radiation, which in turn restrict the maximum density. For pellet fueling, core neutral pressure is reduced and X-point radiation is reduced. The largest-sized pellets does cause transient formation of divertor filaments. These filaments are rapidly extinguished in pumped discharges in the time scale of the density relaxation time after pellets is largely independent of pellet size. The presence of Mirnov oscillations indicates the de-stabilization and growth of the mode. Large density perturbations caused by pellets cause large density perturbations, and these modes are examined by examining the mechanisms for de-stabilization of the mode, and the effect of pellet size. Discharges with a gradual density increase are often free of ELMs. In high density regimes in which off-axis beam deposition can lead to ELMs, the highest achieved  $\bar{n}_e$  was  $1.5 \times n_{\max}^{\text{GW}}$  with  $\tau_E/\tau_E^{\text{JET-DIII-D}} \geq 0.9$ . Implications of these results for ITER will be discussed.

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