Battling ELM's in ITER

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The Edge Localized Mode, or ELM, is one of the major instabilities that ITER must overcome if the goal of a steady-state, Q>10 tokamak is to be achieved. The ELM is a disruptive instability occurring in the edge region of a tokamak plasma due to a quasi-periodic relaxation of a transport barrier that was previously formed during an L->H transition. It is expected that ELMS will play the main role in the erosion of the plasma-facing components in ITER [3].

The ELM instability is capable of releasing ~10% of stored plasma energy to the plasma-facing components and the divertor. In a burning-plasma sized device, the heat fluxes due to the ELM filaments would result in unacceptable erosion of these surfaces. ELM erosion of the W divertors in ITER would additionally result in high-Z impurity pollution of the plasma; unacceptable due to the high radiative losses.

Research is underway as to how to prevent formation of edge localized modes. The principal theory behind controlling ELM's is not to remove them entirely, but to make them more frequent with smaller amplitude. In fact, frequent, low-amplitude ELMS can have beneficial impacts on a tokamak plasma by removing impurities and allowing higher plasma-density operation [6]. One way to mitigate ELMS is to injecting static magnetic noisy energy into the containment field with the use of external coils: this has been investigated in the DIIID tokamak. Another potential method investigated by ASDEX-Upgrade is to use pellet injection to increase the frequency and thereby decrease the severity of ELM bursts.

[1]: The Impact of Large ELMs on JET: http://www.iop.org/Jet/fulltext/EFDC080224.pdf

[2]: ITER - ELMs and how to control them: http://www.youtube.com/watch?v=P9NuDdH3ZGg

[3]: Effects of ELMs on ITER divertor armor materials: Journal of Nuclear Materials

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[4]: http://www.iter.org/newsline/16/993

[5]: "Edge Pedestal Physics and its implications for iter" Kamada.

[6]:https://fusion.gat.com/conferences/snowmass/working/mfe/physics/p4/Snyder_Pedestal.07.19.02.pdf