

SUMMARY STATEMENT ON ELMs IN BURNING PLASMA EXPERIMENTS
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- **Type I ELMs raise concerns for BP Experiments**
 - ELMs constitute an important concern for any BP experiment relying on H-Mode for several reasons:
 - (i) Their impact on the divertor lifetime
 - (ii) Their impact on high performance operation (ITB or VH Mode transport barrier)
 - ELMs also have a beneficial effect in:
 - (i) Reducing impurity and ash accumulation
 - (ii) Steady state density control
- **Operational regimes with smaller ELMs or tools to control ELM size are clearly desirable.**
 - In ITER and FIRE the power loads to the divertor plates from the largest conceivable ELMs in steady state are at the respective design limits.
 - Several operational regimes are known in various machines which appear to maximize the benefits and minimize the concerns:
 - (i) Type II and Grassy ELMs
 - (ii) Reduced Type I ELMs
 - (iii) Type III ELMs (with reduced confinement)
 - (iv) Enhanced D-alpha (EDA) and QH-mode regimes
- **An understanding of Type I ELMs is beginning to emerge:**
 - It is becoming clear that intermediate n ideal peeling-ballooning modes play an important role in Type I ELMs onset
 - However, for the alternative regimes, several issues are not yet well understood:
 - (i) What are the crucial physics parameters required to attain these regimes or
 - (ii) How do the regimes scale to BP relevant parameters
- **Several tools for controlling ELM size and type are, however, known:**
 - High triangularity and Double Null (DN) proximity has been demonstrated to reproducibly allow transition to smaller Type II ELMs in DIII-D, JT60-U, and ASDEX-U under limited conditions
 - Shaping parameters (triangularity, squareness, aspect ratio, and proximity to DN) can also change Type I ELM size (possibly through deeper magnetic well)
 - Edge collisionality changes Type I ELM size
 - Edge current density (current ramps, impurity puffing, or other techniques)
 - Pellet injection has potential to control ELM power loss
- **These need to be, and are being, investigated in a systematic research effort**
 - A reliable quantitative estimate of the effectiveness of any of the ELM control tools in the proposed experiments is not yet possible
 - Nevertheless, it is expected that each of the experiments has sufficient flexibility in varying shape or edge conditions to avoid serious divertor problems