Density and radiation operational limits to H-mode sustainment

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Recent progress in the experimental characterization and physical understanding of the H-mode density limit (HDL) will be reviewed. The HDL is the maximum plasma density accessible before the back transition from the high confinement mode (H-mode) to the low confinement mode (L-mode). Therefore, the HDL is connected to the H→L back transition. The HDL achieves Greenwald fractions of the order of unity. If uncontrolled, this is often associated with a disruptive radiative collapse. A fusion-relevant regime of high confinement at high power and high density is likely to confront the HDL, making it a key issue for magnetic fusion. Despite its importance, the HDL is not nearly as thoroughly studied or understood as its L-mode counterpart. Key questions are: How does the H→L back transition differ at low and high densities? Is the HDL a soft limit, which only limits the achievable density, or is it a hard limit, so that the discharge is terminated by a disruption? Does the HDL exhibit a power dependence that makes it possible to achieve much higher densities at higher power? Is the HDL more than its parts (H→L back transition and subsequent disruption)? There are different experimental observations and also different theoretical explanations for these questions, which will be presented in this contribution.