

Entry to and exit from ELM suppressed H-mode in detached conditions

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While detachment is in present-day machines routinely achieved under different conditions during the flat-top of a discharge by either density ramps or extrinsic impurity seeding, it has not yet been shown to be accessed and controlled throughout the full duration of a discharge. For future machines, it is essential to be in detachment already during the power ramp up, the L-H transition and also ramp down, in order to assure that the heat load limit of the target materials are not exceeded.

During these transient conditions, the heat flux to the target is continuously changing, e.g due to changes of the exhaust power, changes of the power flux width or due to movements of the strikeline. This makes the control of detachment and the guaranteed safe divertor operation challenging.

At ASDEX Upgrade, detachment can be controlled either by proxies of the electron temperature at the target (partial detachment) or by the location of a so-called X-point radiator XPR (full detachment). For the latter, it was shown that power transients can be well buffered. In combination with well-adjusted pre-seeding, allowing to detect the XPR in L-mode, it is possible to achieve detachment before the L-H transition. With the activated XPR controller, the height of XPR relative to the X-point is regulated, and, thus, detachment maintained during the increase of the injected power, the resulting L-H transition and also throughout the flat-top phase of the discharge. The controller also assures to maintain detachment at a safe level during the power and current ramp down. In this contribution we will present the recent demonstration of these capabilities within one discharge at ASDEX Upgrade and discuss the reproducibility of detached L-H transitions in different scenarios.

The experiments show for the first time that an H-mode can be accessed while avoiding too high heat loads on the target beforehand. Further input from the community is required to expand this proof of principle to meet all requirements for the current ramp-up and -down in a future reactor.

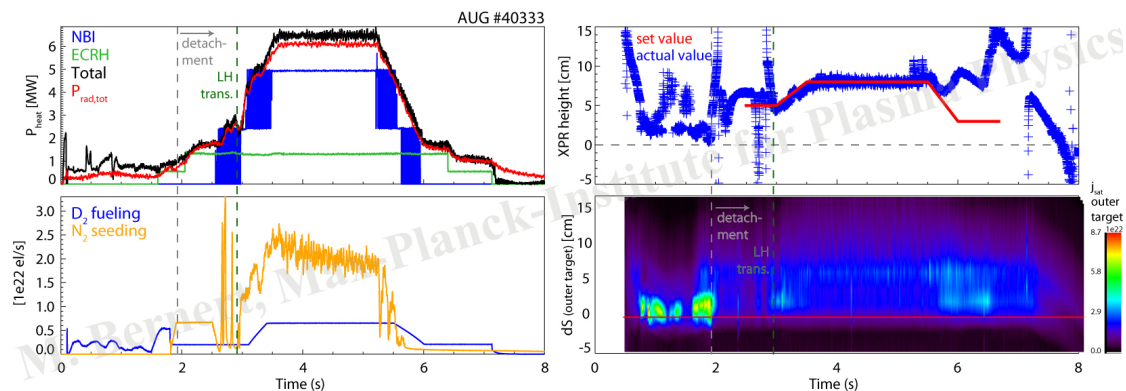


Figure 1: Overview of ASDEX Upgrade discharge 40333 with detached LH- and HL transitions.

Speaker's Affiliation

Max-Planck-Institut für Plasmaphysik, Garching, Germany

Member State or IGO

Germany

Primary author: Dr BERNERT, Matthias (Max-Planck-Institut für Plasmaphysik)

Co-authors: WIESEN, Sven (Forschungszentrum Jülich); BIRKENMEIER, Gregor (Max Planck Institute for Plasma Physics, Garching, Germany); DUNNE, Mike (IPP-Garching); BOSMAN, Thomas (DIFFER); LUNT, Tilmann (Max-Planck-Institut für Plasmaphysik); GLEITER, Tabea (Max-Planck-Institut für Plasmaphysik); SIEGLIN, Bernhard (Max-Planck-Institut für Plasma Physics)

Presenter: Dr BERNERT, Matthias (Max-Planck-Institut für Plasmaphysik)

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