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The influence of magnetic geometry on the external transport barrier

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Advanced experimental fusion scenarios on magnetically confined devices exploit the plasma's unique self-organisation behaviour, with the formation of external transport barrier (ETB) following the application of sufficient heating power [1]. Decades after their first observation, the physics principles of what triggers the ETB formation and relaxation are still debated [2]. The spatio-temporal dynamics of ETB establishment and disappearance has been recently investigated using high resolution pedestal and scrape-off layer diagnostics, over a range of magnetic configurations [3]. The power threshold for H-mode access and exit is found to be sensitive to both the number of divertor magnetic null points and their relative location. These results demonstrate that magnetic topology could provide an additional control parameter to lower power requirements for H-mode access and sustainment on next-step fusion devices.

These studies have been extended with the development and application of a time-dependent statistical analysis framework to understand the correlation and regulation between key pedestal and SOL fluctuation measurements over the formation and collapse of the ETB [4]. Information geometry metrics for the plasma relative density fluctuations, perpendicular velocity and magnetic signals are shown to provide important markers for the H-mode transitions and are used to track self-regulation between these key variables over time [3].

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