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Narrow limiter SOL power channels and their impact on ITER first wall shaping

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Until recently, it was generally accepted that the profile of parallel heat flux density in the SOL of limited tokamak plasmas can be well approximated by a single exponential with decay length λ_q. This popular belief was emphatically shown to be erroneous in 2012, when IR measurements on the inner column of JET limiter discharges revealed the presence of a narrow heat flux channel adjacent to the last closed flux surface, resembling a feature seen elsewhere two decades ago, but never seriously pursued by the edge physics community. This near-SOL decay occurs with λ_q few mm, much shorter than the main SOL λ_q, and can raise the heat flux at the limiter apex a factor 1-4 above the value expected from a single, broad exponential. The JET observations were of great practical consequence, demonstrating that the logarithmically-shaped ITER inner wall (IW), foreseen as a limiter surface for plasma start-up, would be unsuited to handling the power loads produced by such a narrow feature. Alerted by this JET data, the ITER Organization (IO) initiated a multi-machine effort to examine this new physics, with the C-Mod, DIII-D, COMPASS and TCV tokamaks all finding the narrow heat flux channel in dedicated experiments. This talk will describe how these new data are helping to unravel the physics of the narrow feature and how they have provided a strong enough basis for the IO to modify the IW toroidal shape profile. The new IW shape is optimized for a double-exponential profile with $\lambda_q = 4$ and 50 mm, both derived from multi-machine databases for the near and main-SOL features. It has the interesting property of mitigating the impact of the narrow feature, whilst paying no penalty if the latter is not eventually found in ITER. If it were, and without the modification, IWL limiter operation up to several MA, as required by the ITER Heat Load Specifications, would not be possible. The views and opinions expressed herein do not necessarily reflect those of the ITER Organization.