the centred position ($z = 0$), both divertors are active yielding a double-null (DN) configuration with two X-points; for $z > 0$ only the upper divertor is active, yielding an upper single null (SN) configuration with one X-point *(vice versa* with $z < 0$). Figure 4 shows that at high beam power, the H-mode is obtained irrespective of the details of the configuration. In the upper SN-position ($z = 4$), the power limit of the H-mode is 1.2 MW; in the symmetric position, the effects of the ion grad-B drift just cancel, and the H-mode power limit is 1.8 MW. In the lower SN-position, the ion grad-B drift is away from the X-point, giving rise to unfavourable edge conditions, and an H-mode threshold close to 3 MW. When the toroidal field is turned around, the ion grad-B drift is downward. The H-mode now develops in the opposite sense to the previous case. In summary, with the ion grad-B drift toward the X-point, the single null position is superior to the double. This advantage is also seen in the length of the preceding L-phase which is typically shorter by a factor of two in the SN as compared with the DN configuration.

How do high electron and ion temperatures at the plasma edge give rise to improved confinement? This question has been studied by the technique described above, namely the transmission of heat pulses through the separatrix. Experimentally, a situation has been realised with a heating power below the power threshold but with large saw-tooth relaxations. Figure 5 shows how these repetitive thermal waves modulate the soft X-ray (SX) radiation along a chord just inside the separatrix and one just outside (The SX-signal depends primarily on electron temperature and density). A thermal pulse in the L-phase transiently enhances the SX-radiation. The behaviour is different in the case of a large saw tooth which triggers an H-transition. Inside the separatrix, the thermal wave stagnates, leading to a temperature and density increase and in the scrape-off layer the SX-signal totally disappears: A transport barrier develops close to or at the separatrix which impedes the perpendicular particle and energy outflux [6]. The energy flux onto the divertor target plates is suddenly reduced to a low value comparable to the one during the preceding Ohmic phase, in spite of the fact that the power input into the discharge is 10 times as large as the Ohmic input. Therefore the plasma parameters in the divertor chamber drop to the Ohmic values. Steep pressure gradients develop at the plasma periphery causing pedestals in the T_e profile. The steep edge gradient gives rise to a new instability dubbed «edge localized mode» which has never been observed before. These instabilities transiently destroy the edge barrier, giving rise to large power and particle outfluxes, degrading the good H-mode confinement somewhat but ultimately providing quasi-steady state conditions.

The actual reasons for the edge transport barrier are not yet known. A judgment of this deficiency, however, has to consider that 20 years of tokamak research have not yet unravelled the mysteries of electron heat transport. It could be that the peculiarities of the divertor magnetic field topology at the X-point (rapid spatial variation of field line length and inclination) stabilizes plasma turbulence. The study of the H-mode might contribute to the understanding of tokamak transport.

In a technical sense, the divertor concept provides the expected solution to impurity control and offers with the thermal insulation layer at the edge a solution to confinement control. The electron heat diffusivity in the thermal barrier is about a factor of 50 lower than the usual value. Now we come back to the starting point of this article. The comparison with the Styrofoam layer may have been instructive but somewhat misleading. Even at degraded confinement, the perpendicular heat conductivity in a magnetically confined plasma is superior to that of Styrofoam.

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H.R. Dalafi
International Centre for Theoretical Physics
P. O. Box 586, I-34100 Trieste