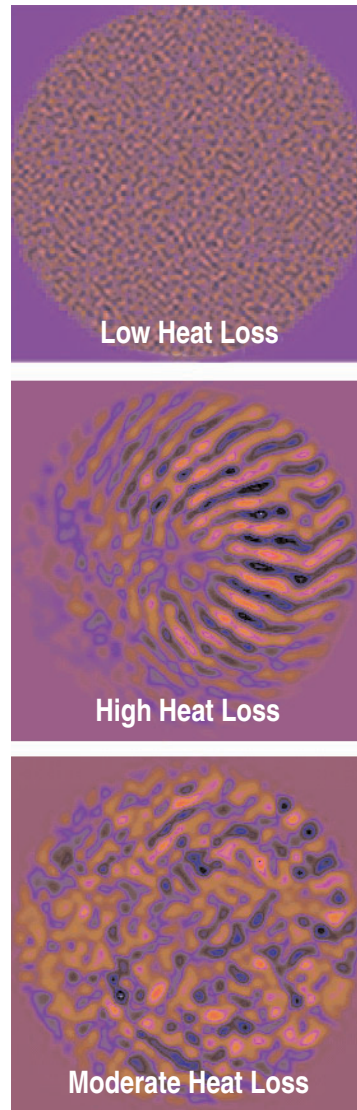


Smaller Turbulent Eddies Reduce Heat Loss From Plasma

Somewhat like a heated house with several open windows, today's fusion energy research devices lose some of their hot ionized gases (plasma) more quickly than the theoretical minimum rate. Most of this loss is due to turbulence within the plasma, which causes movement of the ionized gases across the confining magnetic field. This loss can be overcome by making the size of the containing device large enough; however, it is much more cost effective to reduce the turbulent leakage itself (close some of the windows!). Improved understanding of the turbulence within the plasma can lead to ways to reduce this turbulent leakage.

Recent experiments on the DIII-D tokamak are being compared to massive computer simulations of the turbulence in order to advance this understanding. The size of the turbulent eddies or swirls have been measured and are being compared to the simulations. Small eddies result in smaller amounts of heat lost by the plasma while large eddies result in larger heat losses. These are difficult measurements as the plasma temperature is in the 10 million degree range requiring the use of radar, lasers, and particle beams. The size of the plasma turbulence eddies was found to depend on the total magnetic field in the plasma — similar to the computer predictions and an important piece of information for understanding the turbulence. Furthermore, recently discovered methods that reduce the unwanted heat loss have resulted in smaller turbulence eddies similar to both expectation and the computer simulations. Comparisons of other measured quantities are underway to further test our ability to simulate and understand plasma turbulence.



Three computer simulations of turbulence. The top figure shows a stable case with fine grain noise and low heat loss. The middle figure shows a linearly unstable case with large eddies and high heat loss. The bottom figure shows a saturated state with medium size eddies and moderate heat loss.