Fusion energy has the potential to be a high-energy-density, baseline, CO₂ neutral energy source for future generations. To realise this concept, the reactor fuel must be heated up to 150 million degrees Celsius, forming a plasma hotter than the centre of the sun. Under these conditions, the reactor walls are subjected to tremendous heat and particle bombardment. The presence of heavy elements originating from the reactor walls can cool the plasma significantly and thus reduce fusion performance. In a commercial future reactor, this scenario must be avoided.

In this thesis, the transport of the heavy element tungsten inside the experimental fusion device ASDEX Upgrade is simulated using state-of-the-art computer codes. The levels of plasma turbulent and collisional transport measured in experimental reactors are described accurately throughout the bulk of the plasma volume (see Figure 1). In the very centre of the plasma, the direct impact of certain periodic plasma instabilities is shown to be crucial for avoiding the accumulation of heavy elements (see Figure 2).

The success of the computer codes used throughout this work increases the confidence in the underlying models. This encourages application of these codes for the design of transport optimised fusion reactors towards the realisation of fusion energy.