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Plasma chamber particle balance and physics of fuel behaviour

Tuesday 11 October 2022 10:00 (35 minutes)

Efficient plasma fuelling, impurity exhaust and power load control are essential for the successful operation of fusion reactors and have a direct impact on the fuel cycle and the achievable tritium burn-up fraction.
The physics of plasma fuelling in fusion devices and the processes determining the balance of particles in the reactor chamber are described, with emphasis on the core and edge plasma conditions required to provide the impurity exhaust and power load control necessary to sustain high Q operation. These processes include the ionization and transport of neutrals into the edge plasma (produced by recycling of ions lost from the plasma and from gas injection) as well as of pellets injected to fuel the confined plasma. The impact of fusion reactor edge plasma conditions on the effectiveness of these fuelling schemes will be described, together with the open R&D issues in this area.
Once fuel neutrals (either from recycling/gas injection or pellet injection) are ionized in the confined plasma, they have to reach the core plasma region where fusion reactions take place. This is dominated by turbulent transport. The impact of the expected reactor scale plasma density and temperature profiles and the impurity level and mix composition on fuel transport will be discussed, together with open R&D issues.
Based on the understanding of the fuelling and plasma transport physics processes highlighted here, approaches to optimize tritium recirculation and burn-up will be discussed.

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