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Isotope-mixing at JET: experiments and modelling

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Accurate modelling of particle transport is crucial to interpret and predict tokamak experiments. Multiple-isotope experiments at JET have allowed a detailed investigation of ion particle transport, providing a valuable test of the underlying theory. These experiments varied the core isotope sources by scanning the relative contribution of peripheral gas injection (edge source) and neutral beam injection (core source). The isotope density peaking followed the electron density peaking, and was found to be insensitive to the core isotope source [1]. This is consistent with ion particle transport coefficients being significantly larger than electron particle transport coefficients.

This interpretation is supported by recent analytical, nonlinear and quasilinear analysis in the Ion Temperature Gradient (ITG) dominated regime [2]. We show that the experimental observations of the mixed-isotope experiments are well reproduced by first-principle-based flux-driven transport modelling using the quasilinear turbulent transport model QuaLiKiz [3] within the JINTRAC integrated modelling suite [4]. This encompasses the successful reproduction of ion and electron temperature profiles, electron density profiles, and the insensitivity of isotope profiles to core sources. This result has implications for multi-isotope core fuelling and burn control, where in the ITG regime we predict both fast isotope mixing and peaked isotope profiles.

References

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