# Assembling atomic data for diagnosing and modelling fusion plasmas

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Modern spectroscopy techniques for diagnosing magnetically confined fusion plasmas, and the linked topic of modelling the impurity transport, demand high quality atomic data. The fundamental atomic quantities, such as energy levels and excitation rates, are not sufficient in themselves to describe the behaviour of radiation in finite-density plasmas. Effective coefficients, derived from a collisional-radiative population model, are the appropriate quantities to use [1].

The wide variety of elements present in fusion and astrophysical plasmas means that coverage across the periodic table is also a requirement for the provision of atomic data. Impurity transport modelling and radiated power evaluation requires atomic data for all ionisation stages of an element, rather than iso-electronic collections which are more convenient for large scale computation. With increasing Z, and noting that tungsten (Z=74) is a plasma facing component in current and future machines, the complexity of the emission increases. Therefore methods of handling different resolutions of atomic data, considering spectral features rather than individual lines and incorporating fundamental data with very different uncertainty measures into a coherent model for an element are the current challenges.

Precision spectroscopy will highlight physical processes such as charge exchange from thermal and high energy neutral beams, non-Maxwellian electron distributions, effects on excited populations due to optically thick plasmas and the influence of ion impact as a significant re-distributing mechanism.

ADAS, the Atomic Data and Analysis System [2], is a systematic approach to data provision for fusion studies. There is a database of fundamental and derived data, a set of interconnected codes for generating and processing the data and code libraries for extracting and using the data.

This talk will describe the atomic models within ADAS, the organization of the data and its use. Examples from analysing emission from present day tokamaks, soft X-ray emission predictions for ITER diagnostic design and estimations of radiated power for DEMO will illustrate the breadth of the atomic data need. Methods for assessing the quality of the data, and incorporating this uncertainty into the models, are explored.

**References**

[1] H P Summers et al, Plasma Physics Controlled Fusion, **48** (2006) 263-293

[2] http://www.adas.ac.uk/ and http://open.adas.ac.uk/