ON THE RADIATING AND DYNAMIC PROPERTIES OF THE SOLAR UPPER ATMOSPHERE

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By
David Hamilton Brooks
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Abstract

The spectral variability of the solar upper atmosphere observed from spaceborne satellites has highlighted the need for a reappraisal of the atomic models entering prediction of emission. Solar atmospheric dynamics clearly takes place on timescales shorter than those of ionisation relaxation. Dynamical models of the solar plasma thus require a matching dynamic model at the atomic level to underpin conclusions drawn from the spectral interpretation. The Atomic Data and Analysis Structure (ADAS) (Summers(1994)), used successfully in modelling radiating dynamic plasmas at JET Joint Undertaking, has been extended to astrophysical applications to remove the uncertainty introduced by common oversimplifications. The atomic models are based on generalised collisional-radiative theory. This thesis utilises ADAS in analysis of data from the SOHO satellite while maintaining awareness of the limitations of the analysis methods. Developments are as follows.

Methods to allow flexibility in excited population structure resolution levels, between fusion and astrophysics, have been developed and integrated into the ADAS system.

Methods to calculate experimentally linked derived data including, for example, a metastable resolved density dependent equilibrium ionisation balance, have also been developed. Original results are presented for oxygen, based on a critical review and upgrade of the existing fundamental database and the SOHO instrumentation requirements. This provides an illustration of the atomic modelling analysis path for solar applications.

Extensive investigation of SOHO data and experimental analysis techniques has been undertaken to allow coupling of the data stream to a differential emission measure code in ADAS. Preliminary results from analysis of CDS-NIS data are presented along with a study of the statistical variability of the spectral lines, extending the methods of Lang et al.(1990).

Finally, an outline of the implications for future models of the solar atmosphere is discussed.

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