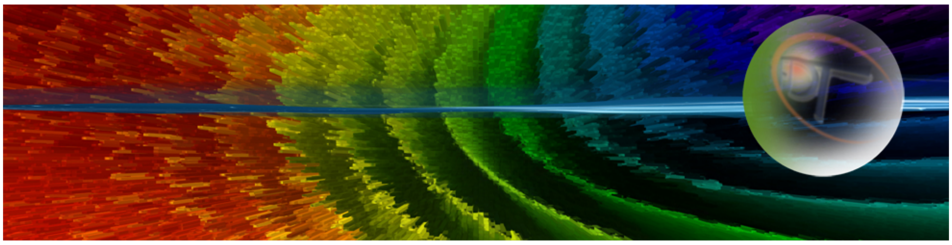

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Diagnosing transient plasma status: from solar atmosphere to tokamak divertor

The emission of the solar upper atmosphere reflects time-dependent and non-equilibrium effects due to plasma dynamics (e.g. flares, solar transition region). Simplified models which imply zero density approach (coronal picture) and ionisation equilibrium are often adopted in the analysis of the observed spectra.
However, in dynamic plasmas, the ionisation states are not relaxed to local thermal conditions. Additionally, at chromosphere/transition region boundary, the higher densities modify the atomic populations through redistribution and the recombination and ionisation rate coefficients are affected by step-wise processes.
The present work addresses such issues using the Generalised Collisional-Radiative (GCR) theory, as implemented in the Atomic Data and Analysis Structure (ADAS), together with the most accurate atomic data available.
This approach has enabled the extension of diagnostic techniques, such as line ratios and emission measure, to the investigation of low temperature/high density layers of the solar atmosphere, with validation by recent observations, leading to a fresh methodology for the detection and assessment of non-equilibrium processes in the solar upper atmosphere.
These techniques are introduced for the analysis of a flare observed using the Ultraviolet Spectrometer and Polarimeter (UVSP), on-board the Solar Maximum Mission (SMM), and for their diagnostic potential in support of the Interface Region Imaging Spectrograph (IRIS) and the Spectral Imaging of the Coronal Environment (SPICE), on-board the forthcoming space borne satellite Solar Orbiter.
It also strongly exploits the interdisciplinary links between astrophysical and laboratory (such as tokamak devices) plasmas, sharing the development of the common modelling for the time-dependent ionisation study, which is applied to the interpretation of the data from B2-SOLPS simulations in the context of MAST Super-X divertor upgrade. The derived atomic data allow equivalent prediction in non-stationary transport regimes and transients of both the solar atmosphere and tokamak divertors, except that the tokamak evolution is about one thousand times faster.

Primary author: Dr GIUNTA, Alessandra (STFC RAL Space)

Presenter: Dr GIUNTA, Alessandra (STFC RAL Space)