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Muon Cascade Calculations

Muonic X-ray Emission Spectroscopy is a non-destructive method of elemental analysis, which has recently been adopted several fields, such as cultural heritage. It is desirable to have a robust way of computationally modelling these experiments, to allow for simpler and more systematic identification of elemental X-ray intensities, particularly in samples consisting of multiple elements. Currently, muonic x-ray energies can be computed accurately using MuDirac [1], but the intensities are not correct. In order to do this, muonic cascade calculations are performed, which is typically done using the Akylas-Vogel [2] cascade code.

There are several important features of a muonic cascade calculation: the initial angular momentum distribution of the muon at capture, radiative transitions, Auger electron emission, and electron refilling. All of these must be treated correctly to obtain correct intensities. The Akylas-Vogel cascade code treats these mechanics using techniques appropriate at the time of writing, at the expense of having several input degrees of freedom.

This talk will discuss muon cascade calculations in their current form, and how modern computational and theoretical techniques can be applied to the problem. This will include how the theory can be incorporated into a relativistic framework, in particular for radiative and Auger transitions.

[1] S. Sturniolo, A. Hillier,X-Ray Spectrometry 50, 180 (2021)
[2] V. R. Akylas, P. Vogel,Comp. Phys. Comms 15, 291 (1978)

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