Many Electron Effects in the Decay of Inner-Shell Resonances

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Inner-shell resonances decay predominantly via resonant Auger decay. The study of resonant Auger decay was a prominent subject of synchrotron radiation-based atomic and molecular physics, since it is possible to employ resonant Auger Raman spectroscopy to achieve subnatural linewidths resolution [1]. Thus, high-resolution spectroscopy was the major activity in the field of decay processes of core-excited species over the last decade (see e.g. [2, 3]). In this context, the study of many-electron effects was limited to the contribution of non-diagram lines to the Auger spectrum. But the most prominent many-electron effect, the simultaneous emission of more than one electron in the decay of a resonance was barely touched both experimentally and theoretically, although these processes were extensively studied in direct photoionization (see e.g. [4, 5]).
We report on the first direct evidence of such processes in the decay of the Ar 2p resonances as well as in the regular Auger following Ar 2p photoionization. We find that the resonant Auger decay shows little evidence for simultaneous double Auger; most doubly charged ions are produced via two-step processes. However, continuously distributed electron intensity shows up above the triple ionization threshold pointing to an unexpectedly strong occurrence of triple Auger emission. This interpretation is supported by the quenching of this process into double Auger above the Ar 2p threshold due to relaxation. The corresponding double Auger intensity distribution is clearly exhibited in the regular Ar LMM Auger spectrum taken at $h\nu = 270$ eV.

References

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