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DE-EXCITATION CASCADE CALCULATION FOR HIGHLY EXCITED HOLLOW ATOMS

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Abstract.

Hollow atoms (HAs) are an intricate type of particles, mainly having electrons in highly excited n-shells and no or only few electrons in core shells. They are formed upon highly charged ion impact on a conductive surface. Some Ångströms above the surface, electrons are resonantly captured by the projectile into states roughly equal to the incident charge state $n \sim q_{\mathrm{in}}$, see Burgdörfer et al. 1991. Upon creation, the hollow atom deexcites (in free vacuum) via autoionising and radiative pathways, as sketched in Fig. 1 a). In this contribution, we discuss the lifetime of the hollow atom and assess how an experimental observation of an HA can be feasible. To do so, we apply a Monte-Carlo based code describing the formation and deexcitation of HAs through coupled rate equations. Input transition rates are obtained from the atomic structure code package FAC (Gu 2018). Our results show that, given suitable experimental conditions (projectile and target species, incidence angle and kinetic energy), it is possible to produce HAs with lifetimes of several tens of ps (see Fig. 1 b).

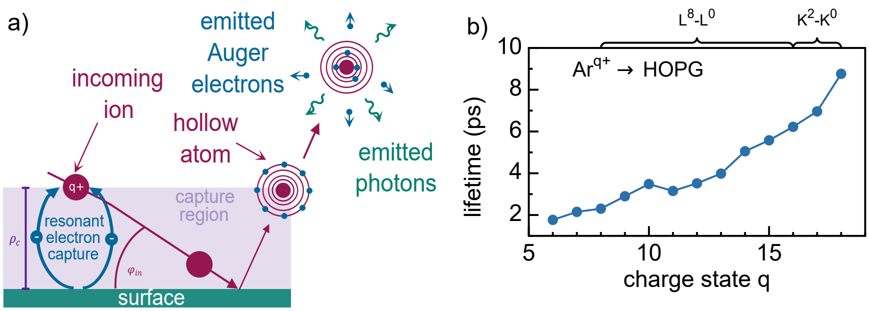

Figure 1: a) Schematics of the formation and subsequent deexcitation of a hollow atom. Electrons are captured by the surface into high-n states, before decaying via radiative and autoionising pathways. b) Hollow atom lifetimes formed by scattering of Ar^{q+} on a HOPG surface. Adapted from Werl et al. 2024.

References

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