Ionisation equilibrium in dense carbon and beryllium plasmas

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Ionisation is central in defining many radiative and transport quantities in dense plasmas. For plasmas with pressures in the Mega- and Gigabar range, models tend to deviate significantly even for light elements which puts large uncertainties on any calculation relying on inputs for the ion charge state. Moreover, the few experimental results available deviate also significantly from often-used models for the ionisation degree. This situation gets even more complicated as the charge state is not well a defined quantity in dense media and one has to be careful when comparing models and experimental results.

This contribution will review the recent experimental results and compare them with predictions from a variety of theoretical approaches. The focus will be on light elements, that is carbon and beryllium, where the degree of K-shell ionisation is the most relevant question. These elements have been probed at the extreme pressures using the National Ignition Facility [1, 2] and large deviations from standard descriptions [3] have been found while the data agree with results from DFT-MD simulations [4]. Both experiments and *ab initio* simulations show also a different trend with increasing density and pressure than the standard models. This deviation can't be explained by a different model for the ionisation potential depression. Details of this comparison as well as details of the extraction of the mean ion charge states from the X-ray scattering data and possible sources of uncertainties will be discussed. One possible source for the different trends in charge state distributions at high pressures can be the distribution of local environments for the ions with allows for an additional spread of the charge states of ions. The significance of these results for astrophysics and inertial confinement fusion will be briefly highlighted at the end.

References

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