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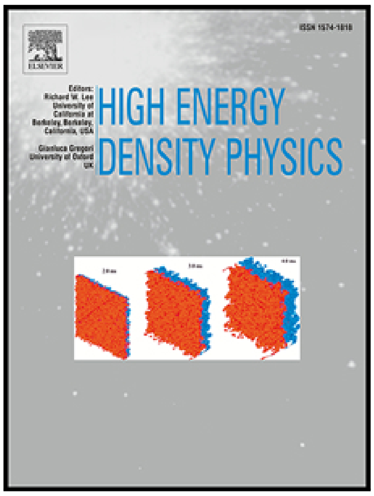

A note on the contribution of multi-photon processes to radiative opacity

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A note on the contribution of multi-photon processes to radiative opacity

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Abstract

Recently, Bailey *et al.* performed iron opacity measurements on the Z machine at Sandia National Laboratory in conditions close to the ones of the base of the convective zone of the Sun. Such experiments have raised questions about the physical models commonly used in opacity codes. To understand the discrepancy between experiment and theory, More *et al.* investigated the role of two-photon processes. In the present work we show, by a simple estimate and using hydrogenic formulas, that due to the intensity of the backlight radiation seen by the sample, such processes are likely to play an important role only for highly excited states.

Key words: high-energy-density matter, atomic physics

Two-photon absorption opacity was calculated by More and Rose in 1991 [1] using a semi-classical method. Recently, More *et al.* presented a tentative study of such processes [2] in order to quantify their contribution to the opacity in the conditions of the recent opacity measurement on the Z machine by Bailey *et al.* at T=182 eV and n_e=3.1×10^{22} cm^{-3}, conditions close to the ones of the frontier between the radiative and convective zones of the Sun [3]. In the latter experiment, the inferred opacity was found to be 30 to 400 % higher than all the calculations, which represents a puzzling enigma for theorists. The preliminary numerical calculations published in Ref. [2] give substantial cross-sections comparable to the extra opacity observed in experiments on the Sandia Z-machine, but without yielding agreement with the experimental data.

We also believe that multi-photon absorption deserves scrutiny. In the present note, we show that the radiation from the backlighter source, due to its brightness temperature, ensures that electric-dipole two-photon processes are of the same order of magnitude as one-photon ones for highly excited states, which

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