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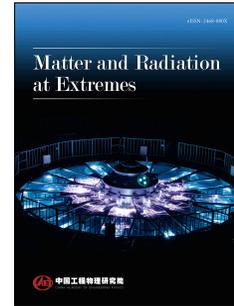
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Energy loss of an energetic Ga ion in hot Au plasmas

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Abstract: Self-consistent calculations of energy loss for a Ga ion moving in hot Au plasmas are made under the assumption of wide ranges of the projectile energy and the plasma temperature with all important mechanisms considered in detail. The relevant results are found to be quite different from those of an α particle or a proton. One important reason for this is the rapid increasing of the charge state of a Ga ion at plasma temperature. This reason also leads to the inelastic stopping which does not always decrease with the increase of plasma temperature, unlike the case of an α particle. The nuclear stopping becomes very important at high enough plasma temperature due to the heavy reduced mass of a Ga and an Au ion and the above-mentioned reason. The well-known binary collision mode [Phys. Rev. 126 (1962) 1] and its revised one [Phys. Rev. A 29 (1984) 2145] are not working or unsatisfactory in this case.

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Keywords: Energy loss, Hot Au plasma, Ga ion

1 Introduction

With the development of fusion science, especially the ion-driven inertial confinement fusion [1] and fast ignition [2], the stopping power in plasmas has become a hot topic [3]. The stopping data of various ion beams in the plasmas of different materials is necessary for the fusion research. Besides DT, some other materials such as C, Be and Au are often used in the design of fusion targets [4, 5] or fusion devices of fast ignition driven by ions [2, 6]. During the implosion process, these materials will mix with DT fuel inevitably, which will affect the heating of DT ions. In recent years, the fuel with heavy elements Pu and U is under consideration in the controlled fusion experiments [7]. Usually the heavy element materials such as Au, U and Pu are hard to be fully ionized even at very high temperature. In inertial confinement fusion driven by energetic ion beams, various species of ions from low to high Z elements are possible candidates of the driven beam [2, 6]. So far, there were some experiments about the energy loss of lots of particles from light to heavy ions [8] in plasmas. In recent year such experiments for highly-charged Ar ions [9] and fully-ionized He ions [10] were made in GSI and IMP in Lanzhou, respectively.

Generally speaking, there are three main mechanisms for the slowing down of heavy particles in fully-ionized plasmas. The first one is the close collision [11] between the

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