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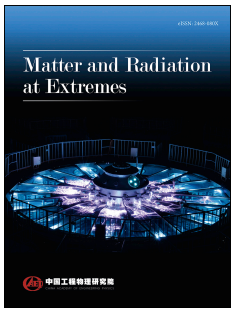

Dipole and generalized oscillator strength derived electronic properties of an endohedral hydrogen atom embedded in a Debye-Hückel plasma

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PII: S2468-080X(18)30003-7

DOI: 10.1016/j.mre.2018.05.001

Reference: MRE 90

To appear in: *Matter and Radiation at Extremes*

Received Date: 9 January 2018

Revised Date: 12 April 2018

Accepted Date: 16 May 2018

Please cite this article as: C. Martínez-Flores, R. Cabrera-Trujillo, Dipole and generalized oscillator strength derived electronic properties of an endohedral hydrogen atom embedded in a Debye-Hückel plasma, *Matter and Radiation at Extremes* (2018), doi: 10.1016/j.mre.2018.05.001.

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Dipole and generalized oscillator strength derived electronic properties of an endohedral hydrogen atom embedded in a Debye-Hückel plasma

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Abstract

We report electronic properties of a hydrogen atom encaged by an endohedral cavity under the influence of a weak plasma interaction. We implement a finite-difference approach to solve the Schrödinger equation for a hydrogen atom embedded in an endohedral cavity modeled by the Woods-Saxon potential with well depth V_0, inner radius R_0, thickness Δ, and smooth parameter γ. The plasma interaction is described by a Debye-Hückel screening potential that characterizes the plasma in terms of a Debye screening length $\lambda_{\rm D}$. The electronic properties of the endohedral hydrogen atom are reported for selected endohedral cavity well depths, V_0, and screening lengths, $\lambda_{\rm D}$, that emulate different confinement and plasma conditions. We find that for low screening lengths, the endohedral cavity potential dominates over the plasma interaction by confining the electron within the cavity. For large screening lengths, a competition between both interactions is observed. We assess and report the photo-ionization cross section, dipole polarizability, mean excitation energy, and electronic stopping cross section as function of $\lambda_{\rm D}$ and V_0. We find a decrease of the Generalized Oscillator Strength (GOS) when the final excitation is to an s state as the plasma screening length decreases. For a final excitation into a p state, we find an increase in the GOS as the endohedral cavity well-depth increases. For the case of the electronic stopping cross section, we find that the plasma screening and endohedral cavity effects are larger in the low-to-intermediate projectile energies for all potential well depths considered. Our results agree well to available theoretical and experimental data and are a first step towards the understanding of dipole and generalized oscillator strength dependent properties of an atom in extreme conditions encaged by an endohedral cavity immersing in a plasma medium.

Keywords: Oscillator strengths, Debye-Hückel plasma, cavities, endohedral, energy loss, stopping power
PACS: , 32.70.Cs,, 62.50.-p,, 37.30.+i,, 52.20.-j

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