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The role of chemi-ionization in fluorescent lamp discharge

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Chemi-ionization processes resulting from the interaction of two excited Hg atoms have been widely used in numerical models of fluorescent lamp discharges. In particular, the Penning process Hg(6p $^3P_2$) + Hg(6p $^3P_2$) $\rightarrow$ Hg^+ + Hg(6p $^1S_0$) has been invoked as an important contribution to ionization and to the maintenance electric filed. There is no experimental measurement of the cross section for this process and experiments to measure cross sections of other chemi-ionization rections have been shown to be unreliable [1]. Numerical calculations of cross sections for these processes [2] indicate that they are much smaller than those previously assumed. We present a series of computations showing the influence of the calculated cross sections on the ionization balance over a range of discharge parameters. For discharge parameters appropriate to fluorescent lamps under standard operating conditions, it is necessary to invoke alternative ionization mechanisms, such as ladder like ionization via higher Rhydberg states, in order to reproduce the experimental results.

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[2] J.S. Cohen, R. L. Martin, and L. A. Collins, 2002, Phys. Rev. A 66, 012717.