

Penning Lattice: Dissociation and the development of spatial correlation in a molecular ultracold plasma

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Abstract

We describe a new, highly robust method by which to correlate the distribution of ion positions in an ultracold plasma. This correlation occurs naturally over a range of density and initial principal quantum number in the evolution of a molecular Rydberg gas to plasma. It arises as a result of the selectivity of Penning ionization for near neighbours and the dissociation of deactivated Penning partners. We show model calculations supported by experimental results suggesting that the Penning lattice formed in this way leads to a state of ion correlation that can significantly affect the properties of the plasma.