EVOLUTION OF IONIC CORRELATIONS IN AN EXPANDING ULTRACOLD PLASMA

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The very low initial temperatures of ions and electrons in ultracold quasineutral plasmas suggest that these plasmas are created deep within the strongly coupled regime, with Coulomb coupling parameters greatly exceeding unity. The fact that they are produced from an ensemble of uncorrelated neutral atoms implies an initial state far away from thermodynamical equilibrium.

On the one hand, this leads to disorder-induced heating of the ions[1] driving the plasma to the edge of the strongly coupled regime. On the other hand, the ionic coupling is still large enough that interesting effects can be observed in the relaxation behavior of the plasma, which are not found for weakly coupled plasmas. Furthermore, the expansion of the plasma leads to a crossover of relaxation timescales, giving rise to an unusual behavior which is specific to systems with continuously evolving quasiequilibria, but which may be much more general than cold plasmas.

Based on a recently developed Hybrid Molecular Dynamics approach[2] we discuss the expansion dynamics of ultracold neutral plasmas with special emphasis on the strongly coupled ion dynamics. We demonstrate that the present method yields an accurate description of recent measurements[3] and discuss the consequences of the strong ion coupling for the system evolution[4].

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