Atomic Cluster Expansion

The expansion of the nanoplasma is driven by two pressures, the Coulomb pressure arising from repulsion between ions following a charge build-up *Qe* on the cluster of radius *r*:

See formula (5) [TD69.pdf, page 313]

and the hydrodynamic pressure from the hot electrons (one can think of the hot electrons expand outwards, dragging the ions with them):

See formula (6) [TD69.pdf, page 313]

where *k* is the Boltzmann constant and T_e the electron temperature. The Q/r^4 scaling of P_{Coul} shows that it will be important for small clusters or for low *Z* clusters where the electrons are not confined and *Q* can become large. The hydrodynamic pressure scales as r^{-3} (since n_e ~ volume^{-1}), so is therefore more important for larger clusters. The internal pressure driving the cluster apart can be huge. For realistic nanoplasma conditions ($n_e = 10^{23}$ cm^{-3}, kT_e = 1 keV), the hydrodynamic pressure, P_H â‰ˆ 100 Mbar. It is hardly surprising that the end result is an explosion of the nanoplasma that gives rise to a shrapnel of high energy ions and electrons. The cluster expansion rate is calculated in the model by equating the rate of change of the cluster kinetic energy (proportional to the total pressure $P_{Coul} + P_H$) with the rate at which work is done by the plasma in its expansion [41]. At any stage in the interaction the model allows the relative significance of the Coulomb and hydrodynamic pressures to be compared. Simulations shows that 'P_H *dominates over* P_{Coul} *for Ar, Kr and Xe clusters greater than* r'' > 2 nm. [TD69.pdf page 313-314]

See Also

3.14 - Vortex Theory of Atomic Motions 5.8.5 - The complete Contraction Expansion Cycle is as follows 9.27 - Expansion and Contraction 13.04 - Atomic Subdivision 16.15 - Negative Electricity is Expansion atomic Atomic Cluster Heating Atomic Cluster Ionization Atomic Cluster X-Ray Emission Atomic Clusters Atomic Force atomic mass atomic number atomic theory atomic triplet atomic weight diatomic Egyptian fraction expansion expansion Figure 13.06 - Atomic Subdivision Figure 14.10 - Proportionate Tonal Relations dictate Contraction or Expansion Figure 3.28 - Compression and Expansion Forces in Gyroscopic Motions Figure 9.10 - Phases of a Wave as series of Expansions and Contractions Figure 9.5 - Phases of a Wave as series of Expansions and Contractions Force-Atomic Formation of Atomic Clusters Hydrodynamic Equations - Vortex Motions Hydrodynamic Expansion InterAtomic Laser Cluster Interactions Law of Atomic Dissociation Law of Atomic Pitch Law of Oscillating Atomic Substances Law of Pitch of Atomic Oscillation Law of Variation of Atomic Oscillation by Electricity Law of Variation of Atomic Oscillation by Sono-thermism Law of Variation of Atomic Oscillation by Temperature Law of Variation of Atomic Pitch by Electricity and Magnetism Law of Variation of Atomic Pitch by Rad-energy Law of Variation of Atomic Pitch by Temperature Law of Variation of Pitch of Atomic Oscillation by Pressure Models of Laser Cluster Interactions monatomic Nanoplasma subatomic