Abstract Submitted
for the DPP05 Meeting of
The American Physical Society

Self-Similar Evolution of Dense Plasmas into Nano-Clusters
YONG W. KIM, HEDOK LEE, Department of Physics, Lehigh University — A dense laser-produced plasma (LPP) plume of aluminum atoms terminates in atomic clusters of nanometer dimensions. Their formation and growth process has been investigated by first determining the structure and its subsequent evolution of the LPP plume. To this end, a new robust method has been developed for reconstruction of the 3-D structure of a LPP plume as a function of time.[Kim, Lee, *Rev. Sci. Instr.* **75**, 3953 (2004)] From the reconstructed structure, we follow the paths of plasma cooling to super-saturation below the gas-liquid critical point of aluminum. More than 100,000 cells of the plasma plume have been followed in time. Nano-cluster formation by atom-atom and atom-cluster collisions in each cell is then computed. The resulting clusters grow larger in size and broader in distribution over time but in a manner that is strikingly self-similar. This self-similarity is utilized to transform the clustering computation in each of the 100,000 cells into the scaling of the maximal population and size with the initial cellular atom density at large times. The computed cluster size distribution is in excellent agreement with the histogram of nano-clusters sampled from laboratory LPP experiments.

Yong W. Kim
Department of Physics, Lehigh University

Date submitted: 22 Jul 2005 Electronic form version 1.4