Abstract Submitted
for the GEC06 Meeting of
The American Physical Society

How many particles must a two-dimensional dusty plasma have to appear infinite? T.E. SHERIDAN, Ohio Northern University — A complex (dusty) plasma disk (CPD) is a two-dimensional system of n particles interacting through a shielded Coulomb potential with Debye length λ and confined in an isotropic parabolic well. The emergence of macroscopic behavior in a CPD is studied by considering the dependence of the breathing frequency $\omega_{\rm br}$ on n, λ, the disk radius R_0, and the nearest neighbor distance a. An approximate analytical expression for $\omega_{\rm br}$ is derived for $R_0 \gg \lambda$ with a/λ finite. In the plasma regime $a < \lambda$, so that each particle interacts with many other particles, $\omega_{\rm br}^2 \approx 4$ independent of n. In the "condensed-matter" regime $a > \lambda$, nearest-neighbor interactions dominate and $\omega_{\rm br}^2 \sim a/\lambda$. Exact solutions for $n = 100$ to 3200 particles approach the unbounded-plasma limit as n increases. Solutions with $n = 3200$ and a/λ between 0.25 and 0.5 are found to provide the best approximation to an infinite plasma.

Terrence Sheridan
Ohio Northern University

Date submitted: 15 Jun 2006 Electronic form version 1.4