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Universal critical phenomena of the cloud → crystal phase transition in the Paul trap: Powerlaws DANIEL WEISS, YUNSEONG NAM, REINHOLD BLMEL, Wesleyan University — N charged particles, simultaneously stored in a radio-frequency (rf) Paul trap, exhibit deterministic heating. Depending on the damping (γ) imparted to the system, these particles can exist in multiple phases, the most commonly found being the cloud and crystal phases. With a small γ, the particles exhibit gas-like behavior, where the heating and cooling equilibrate and a stable cloud results. For larger γ, the damping overcomes the heating and the particles are forced into the crystalline state. We explore the cloud → crystal transition as a critical phenomenon. We find that the transition occurs at a critical value γ_c of the damping constant γ. We find that as a function of N, γ_c scales approximately like an iterated log law. We also present a universal power law, $\bar{\tau}_m \sim (\gamma - \gamma_c)^{-\beta}$, $\gamma > \gamma_c$, $\beta > 0$, independent of both N and the Paul trap parameter a, depending only on the Paul trap parameter q, that describes the number of cycles necessary for the system to crystallize as a function of $\gamma - \gamma_c$.

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