Abstract Submitted
for the MAR09 Meeting of
The American Physical Society

Hole doping-induced evolution of self-organized bulk vortex structure in the high temperature $YBa_2Cu_3O_{7-\delta}$ superconductor AHMAD MANSOUR, RONGCHAO MA, MEHMET EGILMEZ, MOHAMED SABER, ISAAC FAN, KIM CHOW, JAN JUNG, University of Alberta — We present systematic studies of the persistent current relaxation of 24 different oxygen contents of $YBa_2Cu_3O_{7-\delta}$ (YBCO) as a function of oxygen defect concentration δ. These studies allowed us to map out the (δ,μ) phase diagram of the vortex matter, where the exponent μ of the vortex structure was obtained using the scaling properties of the energy barrier against vortex motion. The reduction of the hole-doping level (an increase of δ) of the material leads to a transformation of the vortex lattice into a glass and subsequently into a liquid phase. These vortex phases self-organize and produce relaxation plateaus in regions between step-like changes in the dependence of relaxation kinetics on hole doping, revealing the existence of a previously unknown correlation between the vortex structure and the hole-doping level in a cuprate superconductor, such as YBCO.

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Date submitted: 20 Nov 2008 Electronic form version 1.4