Aging memory and glassiness of a driven vortex system.

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Many systems in nature cannot equilibrate with the environment giving rise to novel and surprising behaviour including memory, aging and nonlinear-dynamics. Glasses[1-11], interfaces[12] and fractures are some examples[13]. Unlike their equilibrated counterparts, the dynamics of out-of-equilibrium systems is generally too complex to be captured by simple macroscopic laws[1]. Here we investigate a system that straddles the boundary between glass and crystal, a Bragg glass[14,15], formed by vortices in a superconductor. We find that the response to an applied force evolves according to a stretched exponential, with the exponent reflecting the deviation from equilibrium. After removing the force, the system ages with time and its subsequent response scales linearly with its "age" (simple aging), *i.e.* older systems are slower than younger ones. We show that simple aging can occur naturally in the presence of sufficient quenched disorder and that the hierarchical distribution of time scales arising when chunks of loose vortices cannot move before trapped ones become dislodged, leads to stretched exponential response.