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**Observation of Temperature Chaos in Mesoscopic Spin Glasses**[1]

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Temperature Chaos (TC) results from a change in temperature for spin glasses (SG), polymers, and other glassy materials. When the temperature is changed, TC means that the new state has no memory of the preparation of the initial state. TC was predicted long ago [PRL **48**, 767 (1982)]. However, "An experimental measurement of TC is still missing" [EPL **103**, 67003 (2013)]. One reason for this is the question of length scale. In the thermodynamic limit, even an infinitesimal temperature change, $\Delta T$, will create a chaotic condition. However, by working at the mesoscale, one can establish a length scale sufficiently small to exhibit reversible behavior before crossing over to chaotic behavior as the temperature change increases. Observation of TC is possible because, on reasonable laboratory time scales, the SG correlation length can grow to the size of the thickness of the film, $L$. The lower critical dimension for a SG is $\sim 2.5$, so that the thin film SG crosses over to a glass temperature $T_g = 0$. However, there remains quasi-equilibrium SG states with length scales $< L$. After crossover, a small $\Delta T$ will generate a TC coherence length which, if greater than $L$, will leave the system in a reversible state. However, when $\Delta T$ is sufficiently large, such that the TC coherence length is less than $L$, and chaos will ensue. I will discuss our recent results of temperature cycling on 15.5 nm SG films of amorphous Ge:Mn. By use of end of aging and temperature cycling, both the reversible region and the chaotic region are observed. Remarkably, the transition from a reversible to chaotic behavior is abrupt, and not smooth as a function of $\Delta T$. This is in contrast to previous work using polycrystalline materials where the distribution of length scales smoothed out the transition to chaos. Using the calculated TC critical exponent, the range of $\Delta T$ for reversible behavior is calculated and is in very good agreement with the measured range.

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