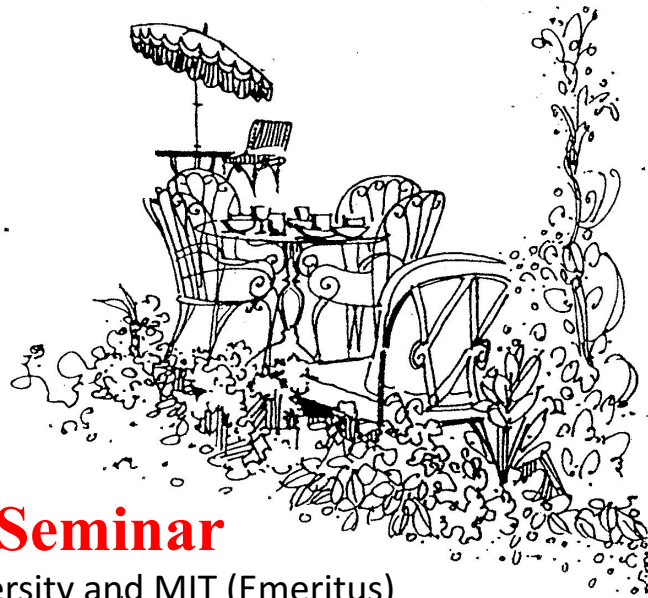# Chez Pierre

Presents ...
Monday, April 3, 2017
12:00pm Noon
MIT Room 4-331

Chez Pierre Seminar

Nihat Berker - Kadir Has University and MIT (Emeritus)

"Chiral Spin-Glass Phases, Fibrous Microreentrances, Nano-Controlled Frustration, Multiple Chaos, and Holywood Goes to Statistical Mechanics"

A spin-glass phase is obtained, for the first time, from competing chirality (helicity) interactions.[1] The global phase diagram of this frozen-disordered chiral 3-state Potts system in d=3 is calculated by renormalization-group theory, in temperature, chirality concentration p, and chirality-breaking concentration c, with distinct determination of phase chaos and phase-boundary chaos. The system has ferromagnetic, left-chiral, right-chiral, chiral spin-glass, and disordered phases. The phase boundaries to the ferromagnetic, left- and right-chiral phases show, differently, an unusual, fibrous patchwork (microreentrances) of all four (ferromagnetic, left-chiral, right-chiral, chiral spin-glass) ordered phases, especially in the multicritical region. The chaotic behavior of the interactions under scale change are determined in the chiral spin-glass phase and on the boundary between the chiral spin-glass and disordered phases, showing Lyapunov exponents in magnitudes unexpectedly reversed from ferromagnetic-antiferromagnetic spin-glass systems. The latter, in which local odd-clock degrees of freedom inject further entropy, are also studied by renormalization-group theory in various integer and fractional spatial dimensions.[2] We show that with random rearrangements of ferromagnetic and antiferromagnetic interactions, frustration can be tuned. Thus, the spin-glass phase never before seen in d=2 dimensions has been obtained and, in the opposite direction, the spin-glass phase always seen in three dimensions has been removed. In the spin-glass phase in even-q-state clock spin models, we show the equivalence of the chaotic distribution of interactions at a given position appearing under consecutive scale changes and the chaotic distribution of interactions in all positions of the system at a given scale. A universality is found across the different q values. In odd-q-state clock spin models, differently, asymmetric phase diagrams, as in quantum spin-glass systems, and many phases in which every point is a critical point are found. 23 sequenced hierarchical models have been solved and the lower-critical dimension where the spin-glass phase disappears has been precisely determined with the non-simple non-integer value of 2.5210 [3], which also appears to be obeyed by chiral spin-glass ordering. In very recent work [4], ferromagnetic/antiferromagnetic right/left chiral clock spin-glass systems have been studied, showing rather rich phase diagram sequences, one example of which is shown below. In this connection, several obtained phase-diagram-morphing video movies will be shown.

[1] T. Çağlar and A.N. Berker, Phys. Rev. E **94**, 032121 (2016).
[2] E. Ilker and A.N. Berker, Phys. Rev. E **87**, 032124 (2013); **89**, 042139 (2014); **90**, 062112 (2014).
[3] M. Demirtaş, A. Tuncer, and A.N. Berker, Phys. Rev. E **92**, 022136 (2015).
[4] T. Çağlar and A.N. Berker, arXiv:1612.03330 [cond-mat.dis-nn] (2016).