PHYSICAL REVIEW B VOLUME 26, NUMBER 1 1 JULY 1982

# Exact criticality condition for randomly layered Ising models with competing interactions on a square lattice

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(Received 1 October 1981)

Ising models, with quenched bond disorder along one direction on a square lattice, are studied by the transfer-matrix method. The exact criticality condition is rederived, and extended to an arbitrary variation, in magnitude and/or sign, of the interactions from layer to layer. With competing interactions, a phase diagram is obtained, with a zero-temperature spin-glass point. We consider $2n$ different nearest-neighbor coupli
and repeated periodically along one direction. The phase boundaries, including
temperature bicritical points, the order parameters, and the ground-state degene
illustrated by a detailed discussion for $n=2$. Closed-form free energies are giv
$n=2$ and 3. The unique criticality condition is derived for any $n$, the limit $n$ –
sponding to quenched disorder. Our extended result is made possible by a simi
transformation in the free-fermion representation. A conjecture emerges for th
ty condition of randomly layered ferromagnetic $q$-state Potts models.

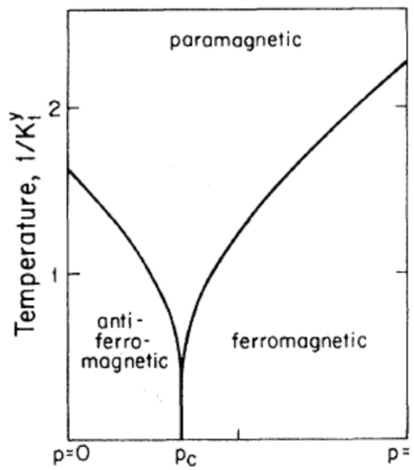
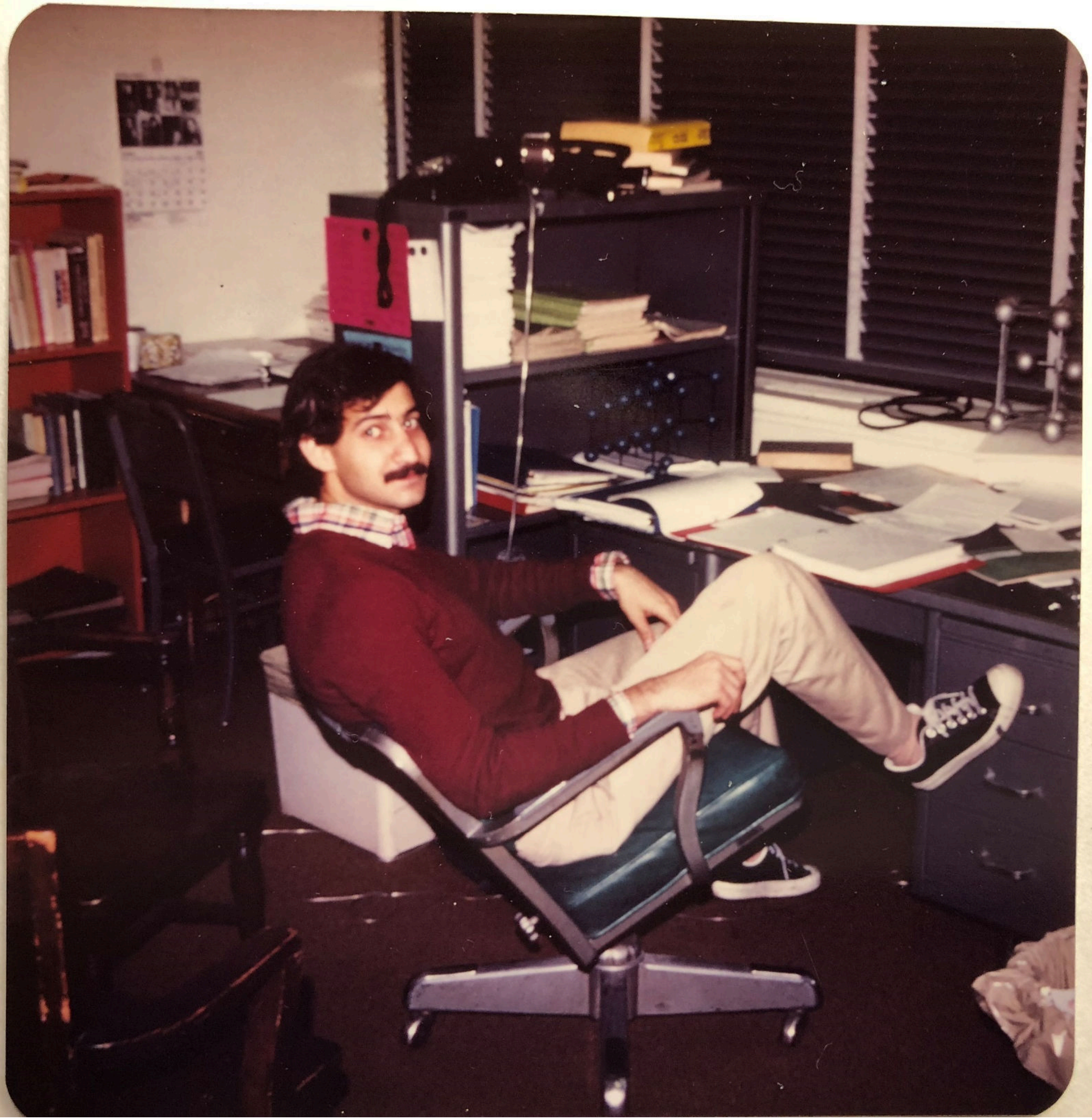



FIG. 2. Phase diagram as a function of the probability $p$, for a random mixture of competing bonds $K^x = K_1^y > 0$ and $K_2^y = -K_1^y/2$. The zero-temperature spin-glass point occurs at $p_c = (1 - K_1^y/K_2^y)^{-1}$.



October 1981

October 1981

October 1983

VOLUME 48, NUMBER 22 PHYSICAL REVIEW LETTERS 31 MAY 1982

# Commensurate-Incommensurate Phase Diagrams for Overlayers from a Helical Potts Model

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(Received 22 March 1982)

Oversaturated layers such as krypton on graphite are represented by a triplet helical Potts model, incorporating domain walls and antiwalls, and their crossings and annihilations (dislocations). Renormalization-group treatment yields a disordered phase between commensurate and incommensurate phases, down to zero temperature. Coadsorption produces a first-order transition directly between the commensurate and incommensurate phases, in analogy to temper embrittlement.

PACS numbers: 68.45.-v, 64.60.-i, 82.65.Dp, 05.70.Fh

PHYSICAL REVIEW B VOLUME 31, NUMBER 7 1 APRIL 1985

# Reentrant melting of krypton adsorbed on graphite and the helical Potts-lattice-gas model

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(Received 1 October 1984)

A model is constructed which explicitly includes the microscopic phenomena occurring in krypton adsorbed on basal graphite from submonolayer to dense-layer regimes. Second-layer adsorption is also included. The experimentally observed reentrant phase diagram, in the pressure and temperature variables, is reproduced. The problem requires different renormalization-group transformations at different length scales. Sublattice occupation and vacancy fluctuations are accounted for, starting from the length scale of the separation of adsorption sites. Dense domain-wall fluctuations, as well as their crossings and dislocations, are accounted for starting from the length scale of

# Domain Walls and the Melting of Commensurate Surface Phases

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(Received 22 July 1982)

Commensurate adsorbed surface phases, particularly $p\times 1$ rectangular and $\sqrt{3}\times\sqrt{3}$ hexagonal phases, exhibit two (or more) classes of domain wall, reflecting a lower than ideal symmetry; these compete statistically and undergo wetting transitions. Scaling arguments and model calculations indicate that new types of continuous melting transitions, possibly already seen in Kr on graphite, can thereby arise.

Potts-like behavior should be maintained along the critical line, at least for a range of $\zeta$ near $\zeta_0$. Nevertheless, as in Fig. 2(b), a tricritical point, $T_3$, and first-order segment may appear and, possibly, also a new multicritical point, $M$, and a *subsequent* chiral transition region.[8] We believe that phase diagrams like Fig. 2 can be realized in physical systems. To distinguish the possibilities we present, first, a scaling argument, applicable to the disordered, melted phase, which suggests that chiral melting may already have been seen in Kr on graphite[3]; second, we discuss calculations for a *uniaxial chiral Potts* or *asymmetric* $p=3$ *clock model*,[5,9] which indicate an isolated Potts multicritical point and a new chiral transition.

the commensurate phase, and $\nu$. At a continuous commensurate-incommensurate transition $\overline{q}$ and $\overline{\beta}$ are well defined in the incommensurate, floating solid[4,11] although $\kappa_x$ and $\nu$ are not; but scaling implies $\overline{\beta}=\nu'$, generally.

The symmetric $p$-state coupling quoted above is generalized in the uniaxial chiral (or asymmetric) clock models[5,9] to $-J\cos[2\pi(n_i-n_j+\vec{\Delta}\cdot\hat{R}_{ij})/p]$, where $\hat{R}_{ij}$ is a nearest-neighbor vector. Then for a small chiral field, $\vec{\Delta}=\hat{x}\Delta$, like pairs, 00, 11, ..., are still preferred to unlike pairs *but*, along the $x$ axis, the + pairs, 01, 12, ..., are favored over the − pairs, 10, 21, ..., when $\Delta>0$; likewise, as has been confirmed by low-temperature expansions, there are two distinct wall tensions, which satisfy $\Sigma_+<\Sigma_-$ for $\Delta>0$. On a square lattice

PHYSICAL REVIEW B VOLUME 24, NUMBER 1 1 JULY 1981

# Incommensurate and commensurate phases in asymmetric clock models

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(Received 15 December 1980)

When the ordinary nearest-neighbor $p$-state clock model (discrete $xy$ model) is generalized to include asymmetric interactions, an incommensurate phase appears for integer $p \geqslant 3$ in addition to the usual liquid and commensurate phases. Aside from being theoretically interesting, it is of practical importance in studies of the commensurate-incommensurate transition where the existence of a discrete nearest-neighbor model with this property gives a computational advantage over further-neighbor and continuum models. For $p = 3$, the incommensurate phase always has a high degree of discommensuration and a Lifshitz point will occur where the incommensurate, liquid, and commensurate phases coincide. For $p = 2$ no incommensurate phase occurs. The system is analyzed at low temperature using a transfer matrix technique recently used by J. Villain and P. Bak to analyze a similar model with further-neighbor interactions.

PHYSICAL REVIEW E **95**, 042125 (2017)

# Devil's staircase continuum in the chiral clock spin glass with competing ferromagnetic-antiferromagnetic and left-right chiral interactions

Tolga Çağlar[1] and A. Nihat Berker[1,2,3]

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The chiral clock spin-glass model with $q = 5$ states, with both competing ferromagnetic-antiferromagnetic and left-right chiral frustrations, is studied in $d = 3$ spatial dimensions by renormalization-group theory. The global phase diagram is calculated in temperature, antiferromagnetic bond concentration $p$, random chirality strength, and right-chirality concentration $c$. The system has a ferromagnetic phase, a multitude of different chiral phases, a chiral spin-glass phase, and a critical (algebraically) ordered phase. The ferromagnetic and chiral phases accumulate at the disordered phase boundary and form a spectrum of devil's staircases, where different ordered phases characteristically intercede at all scales of phase-diagram space. Shallow and deep reentrances of the disordered phase, bordered by fragments of regular and temperature-inverted devil's staircases, are seen. The extremely rich phase diagrams are presented as continuously and qualitatively changing videos.

DOI: 10.1103/PhysRevE.95.042125

# Maximally random discrete-spin systems with symmetric and asymmetric interactions and maximally degenerate ordering

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Discrete-spin systems with maximally random nearest-neighbor interactions that can be symmetric or asymmetric, ferromagnetic or antiferromagnetic, including off-diagonal disorder, are studied, for the number of states $q = 3,4$ in $d$ dimensions. We use renormalization-group theory that is exact for hierarchical lattices and approximate (Migdal-Kadanoff) for hypercubic lattices. For all $d > 1$ and all noninfinite temperatures, the system eventually renormalizes to a random single state, thus signaling $q \times q$ degenerate ordering. Note that this is the maximally degenerate ordering. For high-temperature initial conditions, the system crosses over to this highly degenerate ordering only after spending many renormalization-group iterations near the disordered (infinite-temperature) fixed point. Thus, a temperature range of short-range disorder in the presence of long-range order is identified, as previously seen in underfrustrated Ising spin-glass systems. The entropy is calculated for all temperatures, behaves similarly for ferromagnetic and antiferromagnetic interactions, and shows a derivative maximum at the short-range disordering temperature. With a sharp immediate contrast of infinitesimally higher dimension $1 + \epsilon$, the system is as expected disordered at all temperatures for $d = 1$.

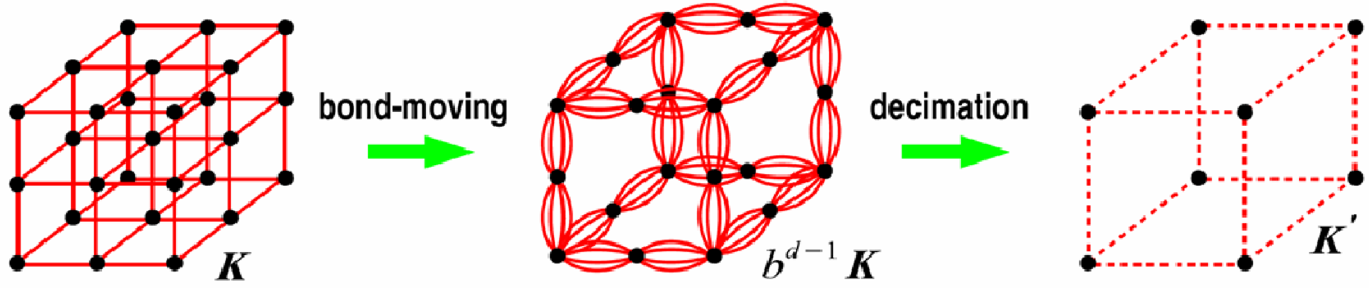
DOI: 10.1103/PhysRevE.97.052102

$$-\beta\mathcal{H} = -\sum_{\langle ij \rangle} \beta\mathcal{H}_{ij},$$

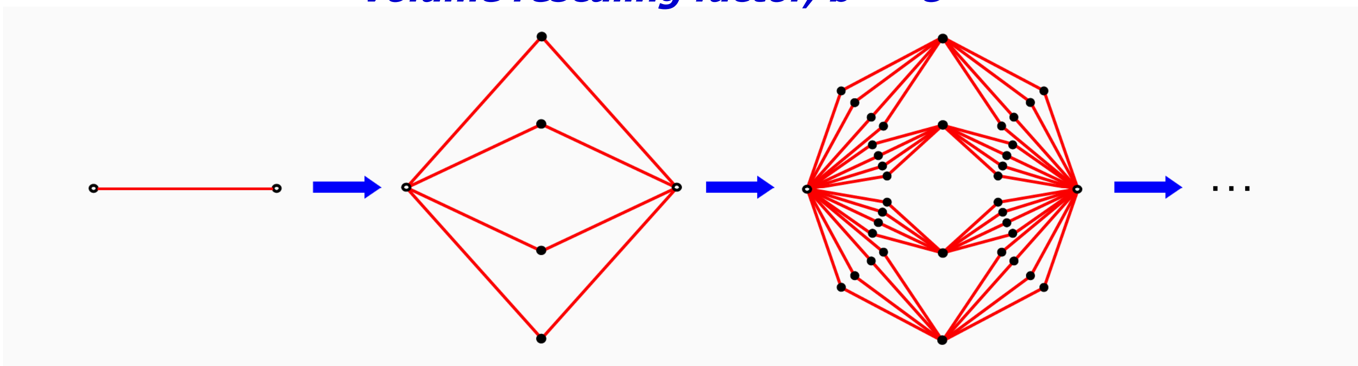
$$\begin{aligned}
\mathbf{T}_{ij} &\equiv e^{-\beta\mathcal{H}_{ij}} \\
&= \begin{pmatrix} 1 & e^J & 1 \\ 1 & 1 & e^J \\ e^J & 1 & 1 \end{pmatrix}, \begin{pmatrix} 1 & 1 & e^J \\ e^J & 1 & 1 \\ 1 & e^J & 1 \end{pmatrix}, \begin{pmatrix} e^J & 1 & 1 \\ 1 & 1 & e^J \\ 1 & e^J & 1 \end{pmatrix}, \\
&\quad \begin{pmatrix} 1 & 1 & e^J \\ 1 & e^J & 1 \\ e^J & 1 & 1 \end{pmatrix}, \begin{pmatrix} 1 & e^J & 1 \\ e^J & 1 & 1 \\ 1 & 1 & e^J \end{pmatrix}, \text{ or } \begin{pmatrix} e^J & 1 & 1 \\ 1 & e^J & 1 \\ 1 & 1 & e^J \end{pmatrix},
\end{aligned}$$

**Migdal-Kadanoff procedure** for *d* dimensional hypercubic lattice, with length rescaling factor *b*:

<u>Example with $d = 3$, $b = 2$</u>




**Equivalent exact model**
**Construction of a Hierarchical Lattice (d=3)**
***Length rescaling factor, b = 2***
***Volume rescaling factor, $b^d$ = 8***



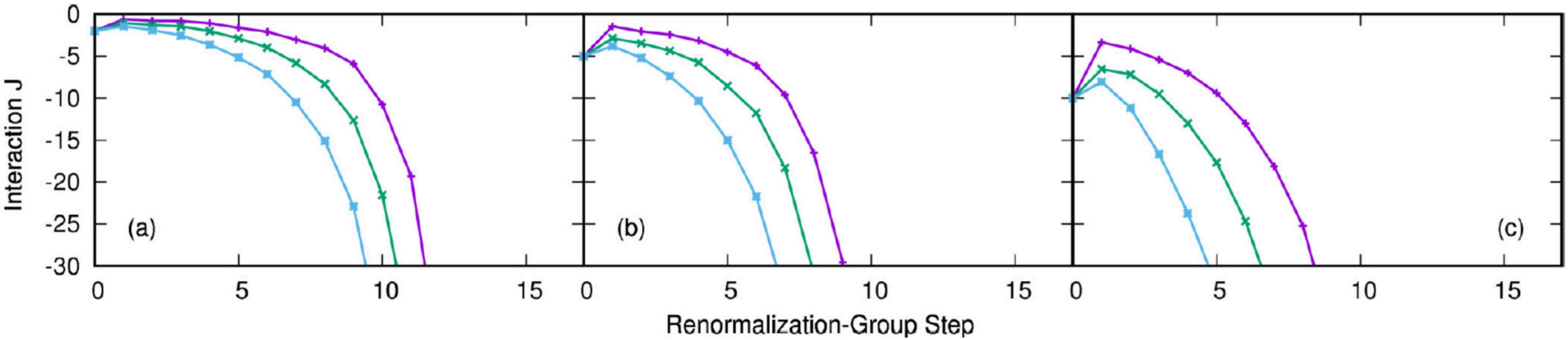



FIG. 1. Renormalization-group trajectories for the system with $q = 3$ states in $d = 3$ dimensions, starting at three different temperatures $T = J^{-1}$ from Eqs. (2) and (3), namely starting with (a) $J = 0.02$, (b) $J = 0.20$, (c) $J = 0.50$. Shown are the second ($J_2$) and third ($J_3$) largest values and the matrix average of the eight nonleading energies $< J_{2-9} >$ of the transfer matrix [Eq. (4)], averaged over the quenched random distribution. The leading energy is $J_1 = 0$ by subtractive choice. The different starting values can be seen on the left axis of each panel

The renormalization-group solution gives the complete equilibrium thermodynamics for the systems studied. The dimensionless free energy per bond $f = F/kN$ is obtained by summing the additive constants generated at each renormalization-group step,

$$f = \frac{1}{N} \ln \sum_{\{s_i\}} e^{-\beta \mathcal{H}} = \sum_{n=1} \frac{G^{(n)}}{b^{dn}}, \qquad (5)$$

where $N$ is the number of bonds in the initial unrenormalized system, the first sum is over all states of the system, the second sum is over all renormalization-group steps $n$, $G^{(n)}$ is the additive constant generated at the $n$th renormalization-group transformation averaged over the quenched random distribution, and the sum quickly converges numerically.

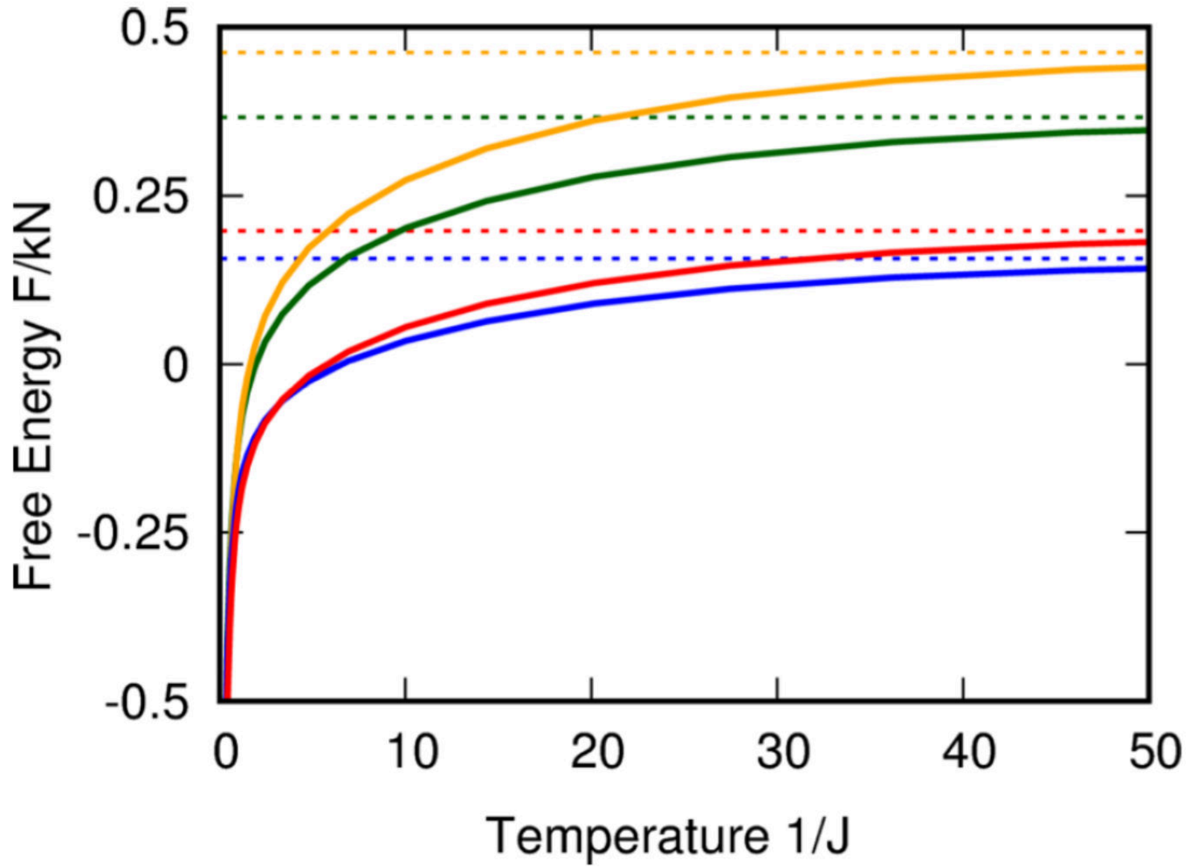



FIG. 2. Calculated free energy per bond as a function of temperature $T = J^{-1}$. The curves are, from top to bottom, for $(q = 4, d = 2)$, $(q = 3, d = 2)$, $(q = 4, d = 3)$, and $(q = 3, d = 3)$. The expected $T = \infty$ values of $f = F/kN = \ln q/(b^d - 1)$ are given by the dashed lines and match the calculations.

From the dimensionless free energy per bond $f$, the entropy per bond $S/kN$ is calculated as

$$\frac{S}{kN} = f - J\frac{\partial f}{\partial J}, \tag{6}$$

and the specific heat $C/kN$ is calculated as

$$\frac{C}{kN} = T\frac{\partial(S/kN)}{\partial T} = -J\frac{\partial(S/kN)}{\partial J}\,. \tag{7}$$

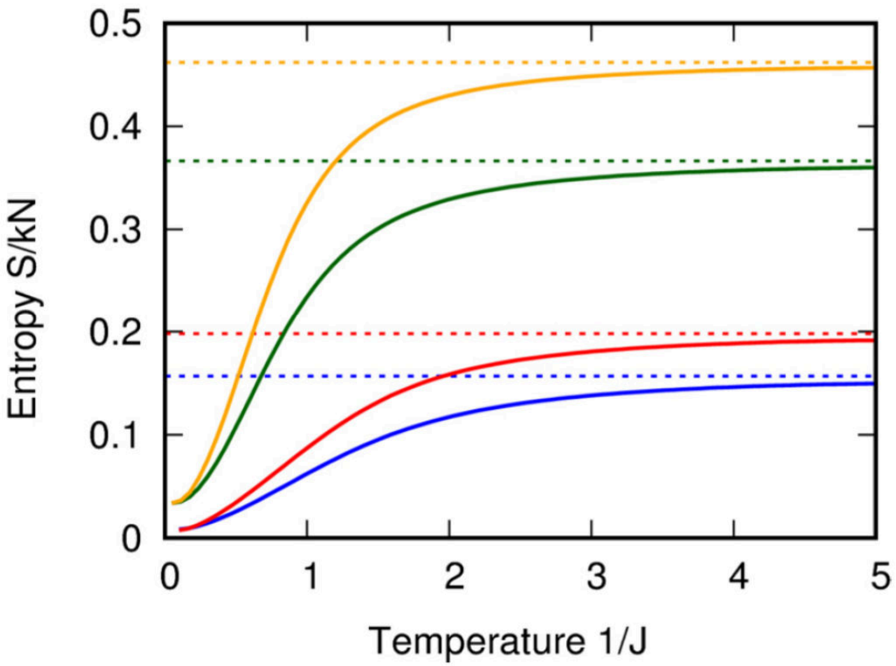



FIG. 3. Calculated entropy per bond as a function of temperature $T = J^{-1}$, for $q = 3,4$ states in $d = 3,4$ dimensions. The curves are, from top to bottom, for $(q = 4, d = 2)$, $(q = 3, d = 2)$, $(q = 4, d = 3)$, and $(q = 3, d = 3)$. The expected $T = \infty$ values of $S/kN = \ln q/(b^d - 1)$ are given by the dashed lines and match the calculations.

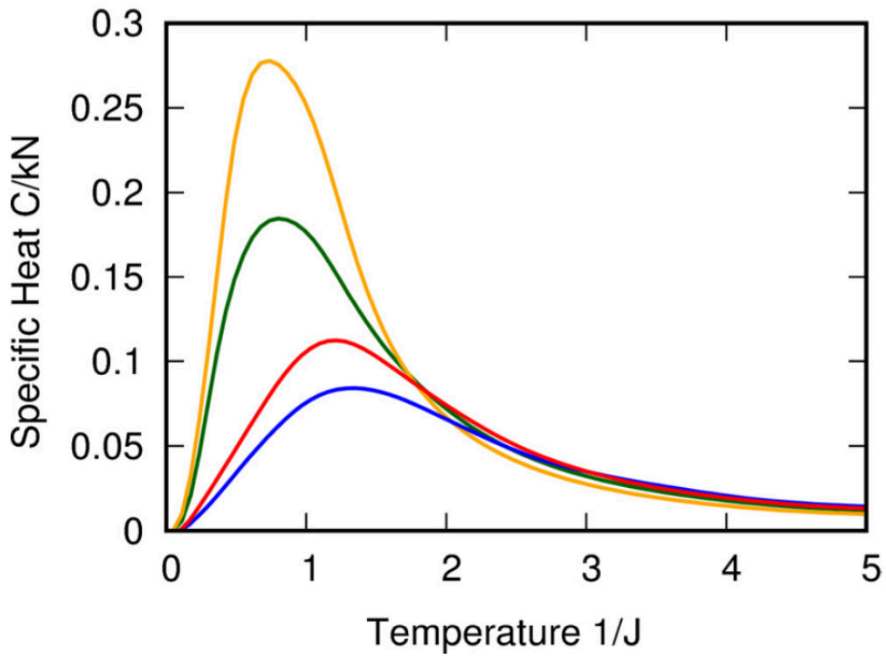



FIG. 4. Calculated specific heat as a function of temperature $T = J^{-1}$, for $q = 3,4$ states in $d = 3,4$ dimensions. The curves are, from top to bottom, for $(q = 4, d = 2)$, $(q = 3, d = 2)$, $(q = 4, d = 3)$, $(q = 3, d = 3)$. A specific heat maximum occurs at short-range disordering.

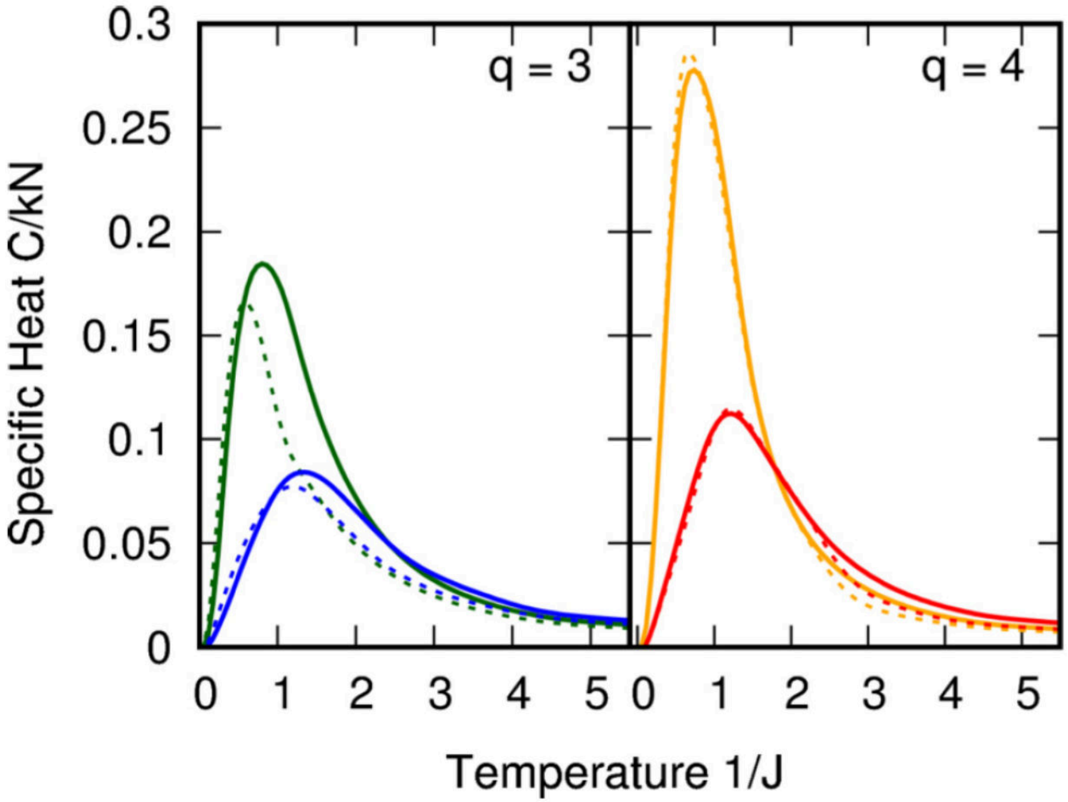



FIG. 5. Calculated specific heat as a function of temperature $T = |J|^{-1}$ for ferromagnetic ($J > 0$), full curves, and antiferromagnetic ($J < 0$), dashed curves, systems, for $q = 3{,}4$ states in $d = 3{,}4$ dimensions. The curves are, from top to bottom in each panel, for $d = 2$ and $d = 3$. The quantitatively same short-range disordering behavior is seen for both ferromagnetic and antiferromagnetic systems.

PHYSICAL REVIEW E **98**, 042125 (2018)

# Lower lower-critical spin-glass dimension from quenched mixed-spatial-dimensional spin glasses

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(Received 16 August 2018; published 15 October 2018)

By quenched-randomly mixing local units of different spatial dimensionalities, we have studied Ising spin-glass systems on hierarchical lattices continuously in dimensionalities $1 \leqslant d \leqslant 3$. The global phase diagram in temperature, antiferromagnetic bond concentration, and spatial dimensionality is calculated. We find that, as dimension is lowered, the spin-glass phase disappears to zero temperature at the lower-critical dimension $d_c = 2.431$. Our system being a physically realizable system, this sets an upper limit to the lower-critical dimension in general for the Ising spin-glass phase. As dimension is lowered towards $d_c$, the spin-glass critical temperature continuously goes to zero, but the spin-glass chaos fully subsists to the brink of the disappearance of the spin-glass phase. The Lyapunov exponent, measuring the strength of chaos, is thus largely unaffected by the approach to $d_c$ and shows a discontinuity to zero at $d_c$.

DOI: 10.1103/PhysRevE.98.042125

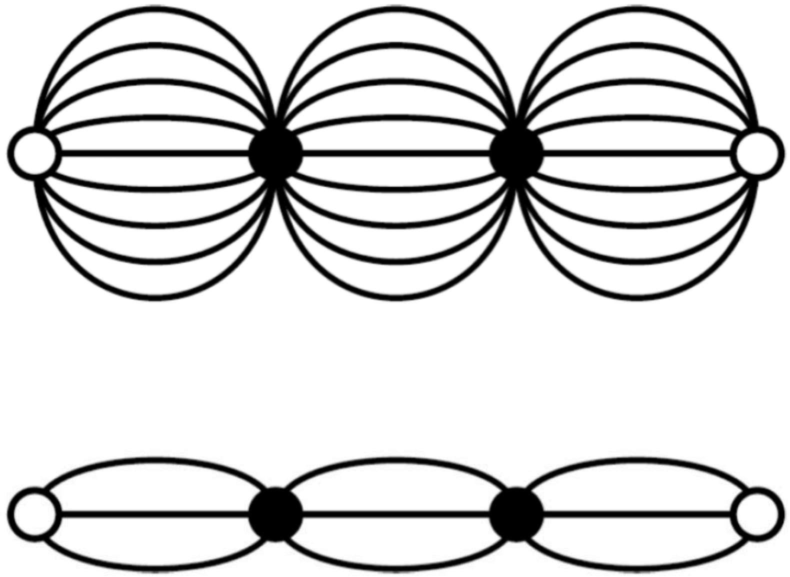


FIG. 1. Local graphs with $d = 2$ (bottom) and $d = 3$ (top) connectivity. The cross-dimensional hierarchical lattice is obtained by repeatedly imbedding the graphs in place of bonds, randomly with probability $1 - q$ and $q$ for the $d = 2$ and $d = 3$ units, respectively.

# New Order in the presence of Frozen Disorder

## Spin-Glass Systems

"Ordinary" Magnets

$$\mathcal{H} = -J \sum_{\langle ij \rangle} s_i s_j \,, \qquad s_i = \pm 1$$

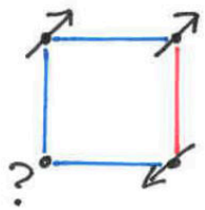
$J > 0$ Ferromagnetic alignment $\uparrow\uparrow\uparrow\uparrow$

$J < 0$ Antiferromagnetic alignment $\uparrow\downarrow\uparrow\downarrow$

Spin Glasses

$$\mathcal{H} = -\sum_{\langle ij \rangle} J_{ij} s_i s_j$$

$J_{ij} = +|J|$ or $-|J|$ , frozen randomly




Frustration

New frustration:
From competing L/R
CHIRALITY
(HELICITY).
Chiral Spin-Glass
Phase
and 3 other
new SG phases

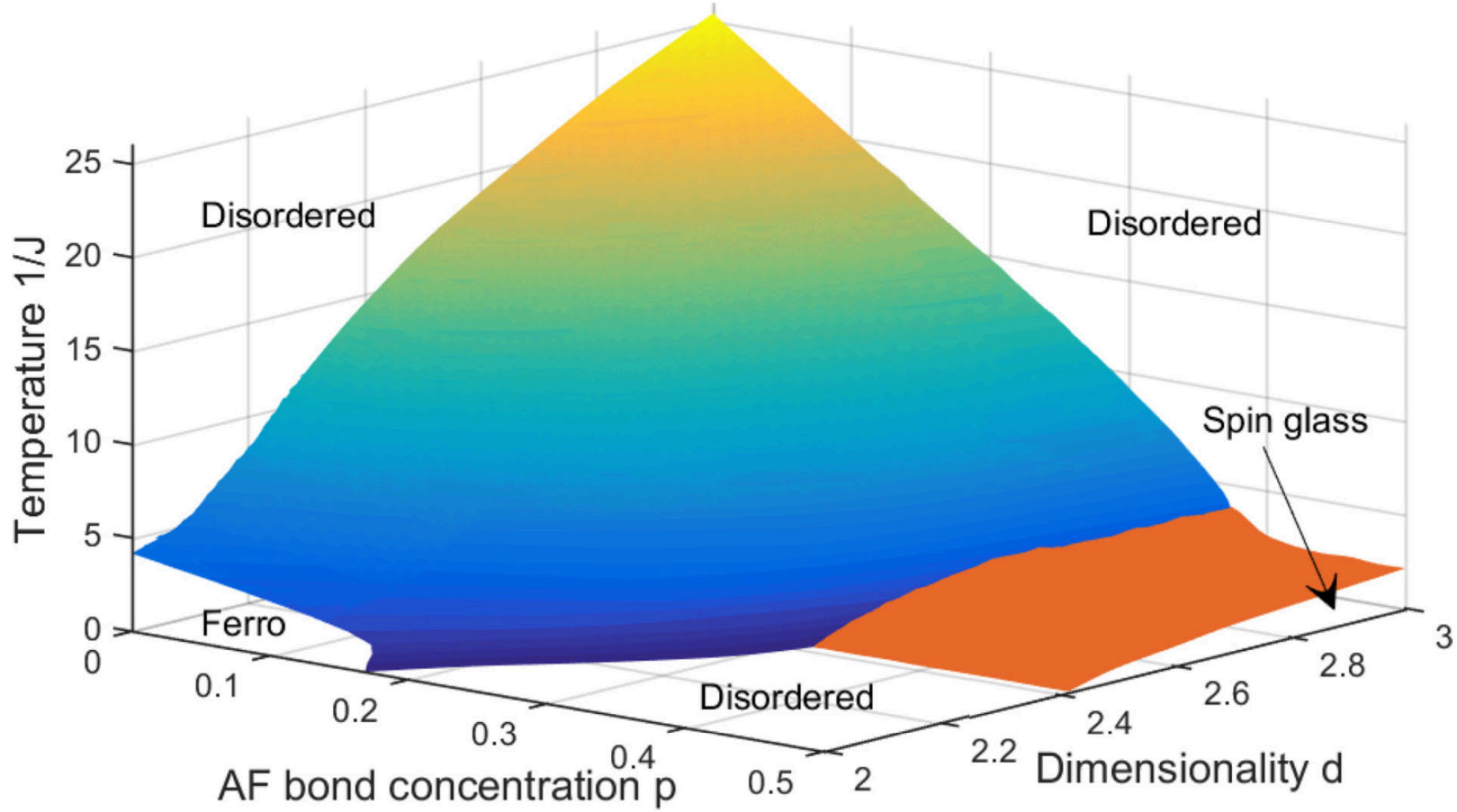



FIG. 2. Calculated exact global phase diagram of the Ising spin glass on the cross-dimensional hierarchical lattice, in temperature $1/J$, antiferromagnetic bond concentration $p$, and spatial dimension $d$. The global phase diagram is symmetric about $p = 0.5$; the mirror image portion of $0.5 < p < 1$ is not shown. The spin-glass phase is thus clearly seen, taking off from zero temperature at $d_c = 2.431$.

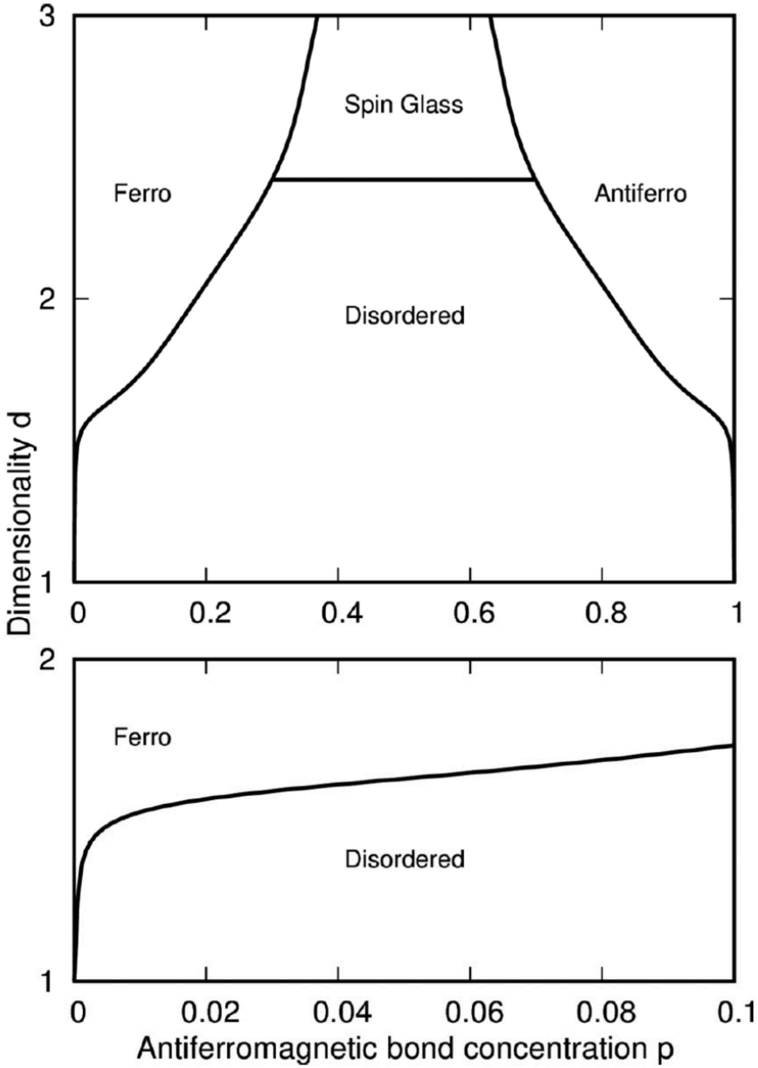



FIG. 4. Zero-temperature phase diagram of the Ising spin-glass system on the cross-dimensional hierarchical lattice, in antiferromagnetic bond concentration $p$ and and spatial dimension $d$. The lower-critical dimension of $d_c = 2.431$ is clearly visible.

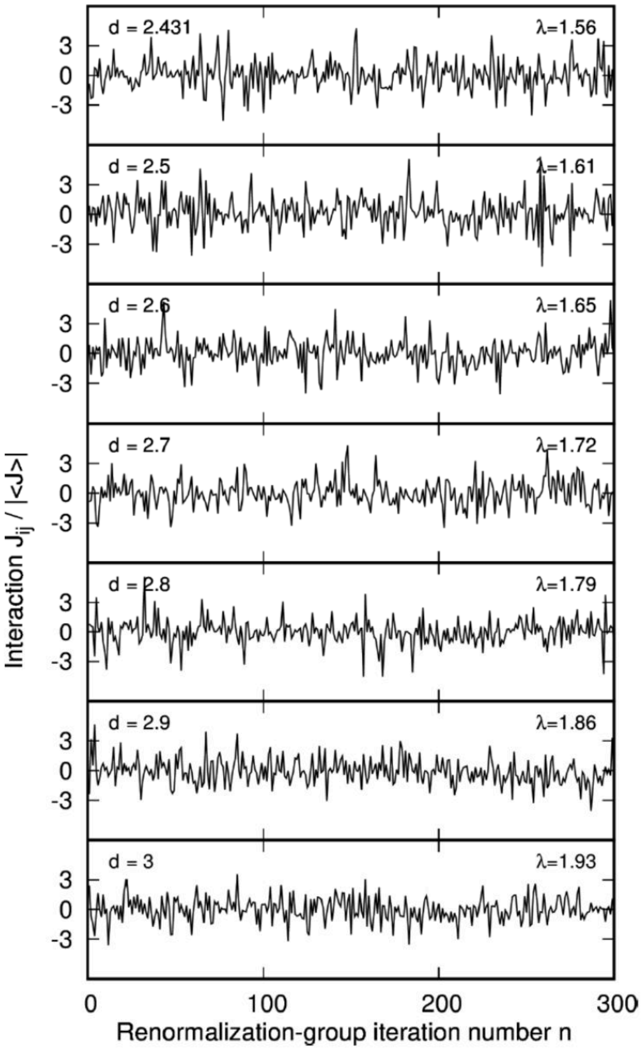



FIG. 5. Chaotic renormalization-group trajectory of the interaction $J_{ij}$ at a given location $\langle ij \rangle$, for various spatial dimensions between the lower-critical dimension $d_c = 2.431$ and $d = 3$. Note that strong chaotic behavior, as reflected by the shown calculated Lyapunov exponents $\lambda$, nevertheless continues as the spin-glass phase disappears at the lower-critical dimension $d_c$, as seen in Fig. 6.

$$\lambda = \lim_{n \to \infty} \frac{1}{n} \sum_{k=0}^{n-1} \ln \left| \frac{dx_{k+1}}{dx_k} \right|$$

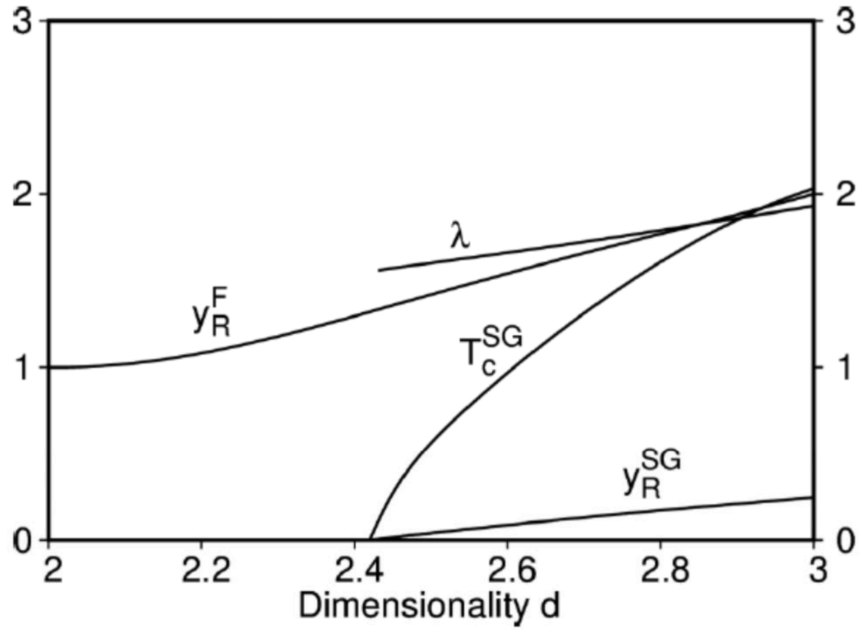
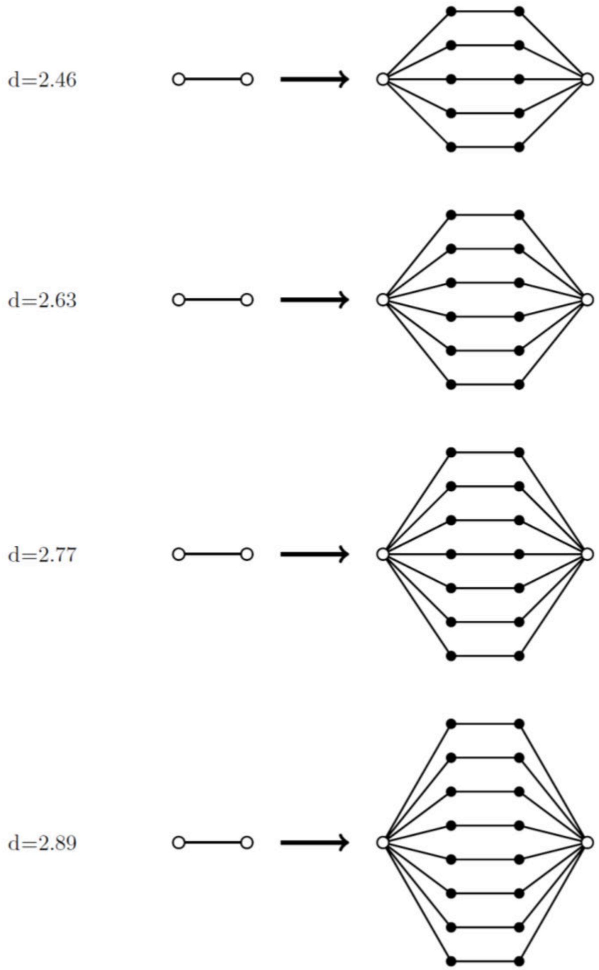
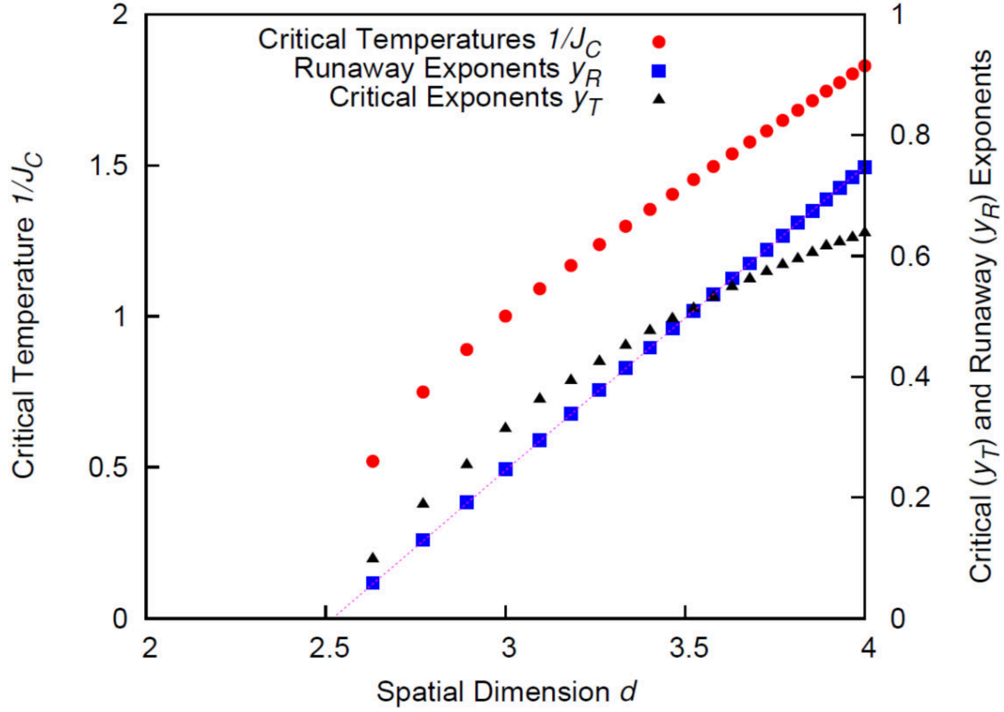



FIG. 6. Spin-glass critical temperature $T_C^{SG}$ at $p = 0.5$, spin-glass chaos Lyapunov exponent $\lambda$, spin-glass-phase runaway exponent $y_R^{SG}$, and ferromagnetic-phase runaway exponent $y_R^F$, as a function of dimension $d$. Note that the ferromagnetic-phase runaway exponent $y_R^F$ correctly tracks $d - 1$.



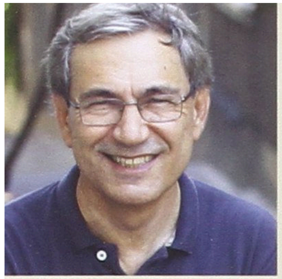

$$y_R = -1.30908 + 0.528513d - 0.00354805d^2$$

$$R^2 = 0.999999$$

**Lower-critical dimension $d_L$ = 2.520** **=63/25**

Mehmet Demirtaş, et al. (2015)

( Linear fit: $R^2 = 0.999992$ $d_L$ = 2.516 )



Fotoğraf: Hakan Ezilmez (YKKSY Arşivi)

## İlk aşk deneyimi bütün bir hayatı belirler mi? Yoksa kaderimizi çizen yalnızca tarihin ve efsanelerin gücü müdür?

Orhan Pamuk, *Kırmızı Saçlı Kadın*'da bizi otuz yıl önce İstanbul yakınlarındaki bir kasabada liseli bir gencin yaşadığı sarsıcı bir aşk hikâyesiyle, büyük bir insani suçun peşinden sürüklüyor.

1980'lerin ortasında geleneksel usulle kuyu kazan Mahmut Usta ile çırağı "küçük bey" Cem zor bir arazide su ararlarken, kasabanın hemen dışındaki sarı çadırda esrarengiz bir tiyatrocu kadın her gece eski masal ve hikâyeleri yeniden anlatmaktadır.

Roman, bir yandan genç kahramanın aşk, kıskançlık, sorumluluk ve özgürlük duygularıyla derinden tanışmasını hikâye ederken, diğer yandan medeniyetler üzerinden babalar ve oğullar; "otoriterlik" ve birey olma konularını tartışıyor.

Gustave Moreau, *Oidipus ve Sphinks*

*Kırmızı Saçlı Kadın*'da okur, Batı'nın ve Doğu'nun iki temel efsanesi Sophokles'in *Kral Oidipus*'u (babayı öldürmek) ile Firdevsî'nin "Rüstem ve Sührab"ıyla (oğulu öldürmek) yeniden karşılaşacak ve kendine sıradan hayatlarımızın eski metinlerden ne kadar etkilendiği sorusunu soracak.

İran halk resmi, Rüstem ve Sührab

Pamuk, en iyi kitaplarını Nobel'den sonra yazan eşsiz bir yazar.

Nobel Ödülü

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12 TL
9 789750 835605

ve birey olma konularını tartışıyor.

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ISBN 978-975-08-3560-5

Üstte ve sağda: Galata'daki Rasathâne, *Şehinşâhnâme* [İÜK, F1404].




# Taqi ad-Din Muhammad ibn Ma'ruf

Ottoman author

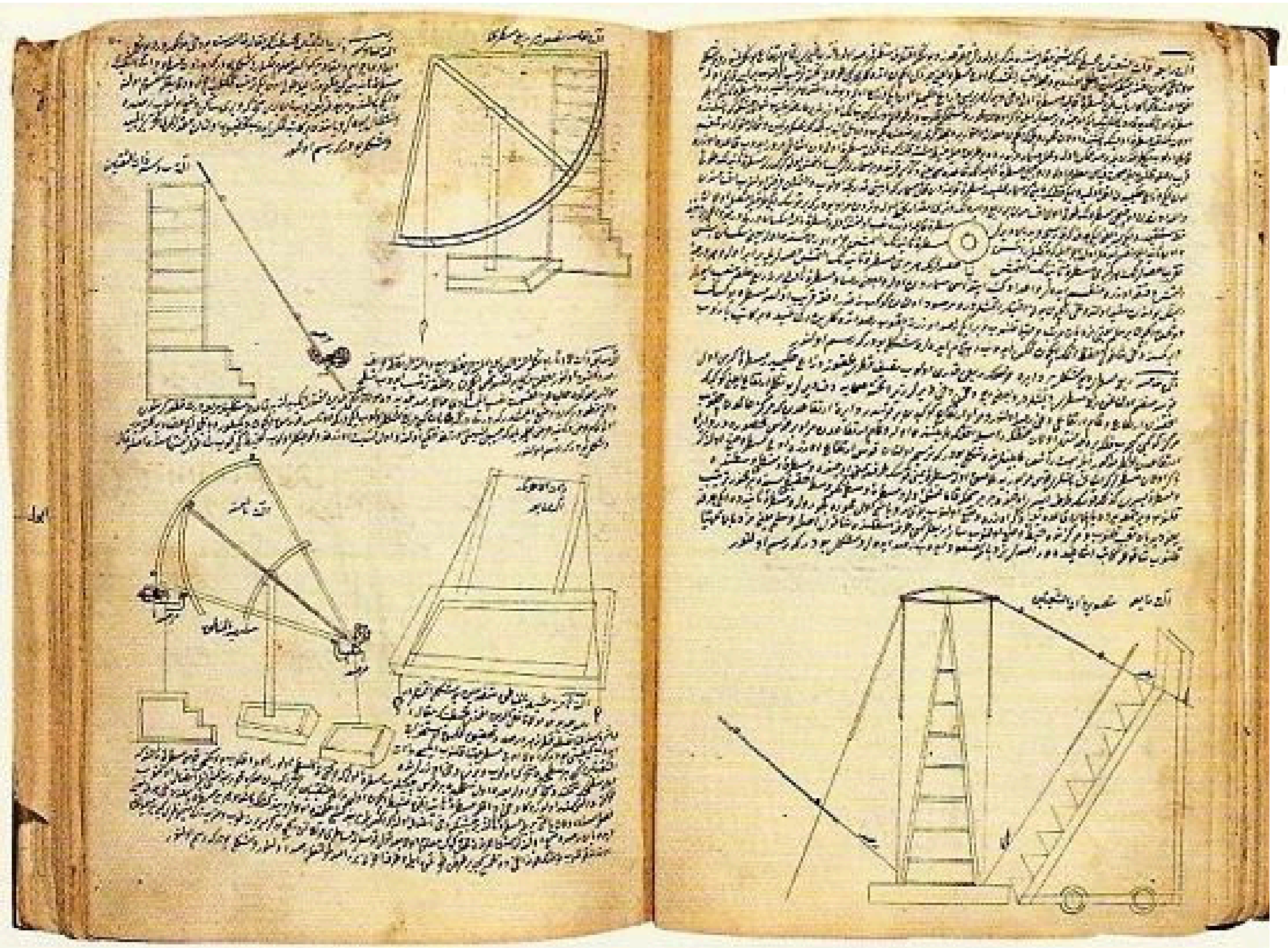
Taqi al-Din Muhammad ibn Ma'ruf ash-Shami al-Asadi was an Ottoman polymath active in Constantinople. Wikipedia

**Born:** June 14, 1526, Damascus, Syria

**Died:** 1585, Constantinople

**Parents:** Mehmed Maruf Efendi

**Known for:** Constantinople Observatory of Taqi ad-Din

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**Known for:** Constantinople Observatory of Taqi ad-Din

Üstte ve sağda: Galata'daki Rasathâne, *Şehinşâhnâme* [İÜK, F1404].



*"989/ 1581 tarihli Arşiv belgesine göre Şehinşahnameyi hazırlayan sanatçı sayısı yirmi iki kişidir. Bu yirmi iki kişi ise şunlardır:*

***Nakkaşlar**: üstad Osman, Ali, Hasan, Mehmed ve diğer Mehmed, Fazlullah Osman, Şah Mehmed, Musa müzehhib*

***Mücellidler**: Mustafa ser, Abdî, İsmail Abdullah çırak*

***Katipler:** Alaaddin Mansur Şirazi, Seyyid Kasım, Katip Haydar, Şemseddin Mehmed, Cafer Abdullah ebna-yı sipahiyandan ehl-i hıref katibi, çırak Mustafa Ferhad*

*Eserin ketebesinde Alaaddin Hüseyin Şirâzî tarafından temize çekildiği kayıtlıdır. Halbuki 5 Receb 989/5 Ağustos 1581 tarihli belgeye göre, ondan önce bu işi yapan katip İlyas'tır."*[3]

*"Şehname-guy Mevlanâ Lokman Sultan Selîm-i Sanî zaman-ı şeriflerinde vaki olan hususu yazup temam etmeğin zeametine 10 000 akçe terakkî buyuruldı. Ve Şehnâmeyi tasvir eden Nakkaş üstad Osman ile Ali'ye mahlulden ikişer akçe terakkî buyuruldı."* **[4]**

Seyyid Lokman'ın yazdığı ve Nakkaş Osman ile ekibin süslediği Şehinşahname'nin ikinci cildi ise Sultan 3.Murad'ın saltanatının 1581-1588 yılları arasındaki olayları kapsar. Şehinşahnâme'nin ikinci cildi(Topkapı Sarayı Müzesi Ktp. B. 200) de kayıtlıdır. II. cildi Safer 1001 / Kasım 1592 sonunda tamamlanan Şehinşahnâme, Mirza Ali b. Hacim Kulu tarafından temize çekilmiştir.[5]

Üstte ve sağda: Galata'daki Rasathâne, *Şehinşâhnâme* [İÜK, F1404].



*"989/ 1581 tarihli*
*kişi ise şunlardır:*

***Nakkaşlar**: üstad*
*müzehhib*

***Mücellidler**: Must*

***Katipler:** Alaaddir*
*sipahiyandan ehl-i*

*Eserin ketebesinde*
*Ağustos 1581 tarih*

*"Şehname-guy Me*
*etmeğin zeametin*
*mahlulden ikişer a*
Seyyid Lokman'ın
3.Murad'ın saltana
Sarayı Müzesi Ktp.
Şehinşahnâme, Mi