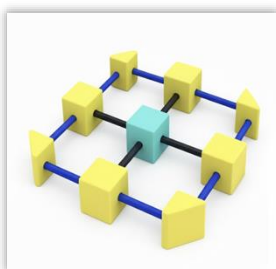
Quantum magnetism on six-fold lattices: from valence bond to simplex states

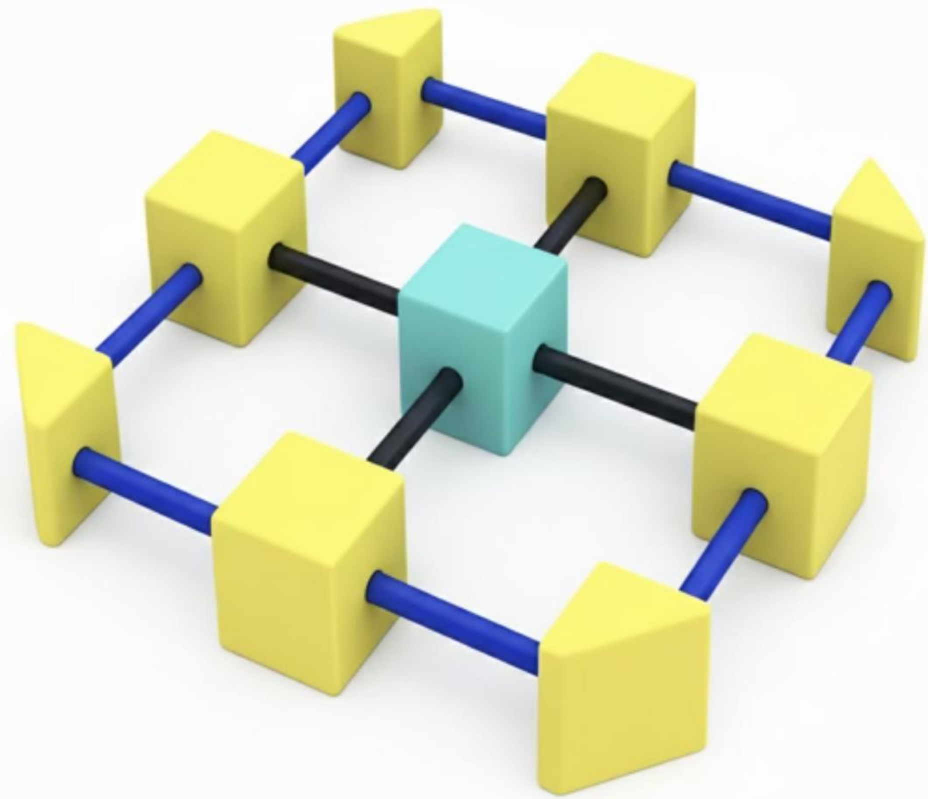
Pratyay Ghosh

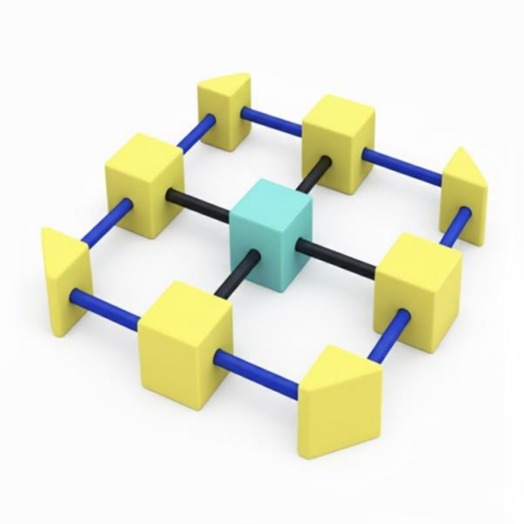
EPFL

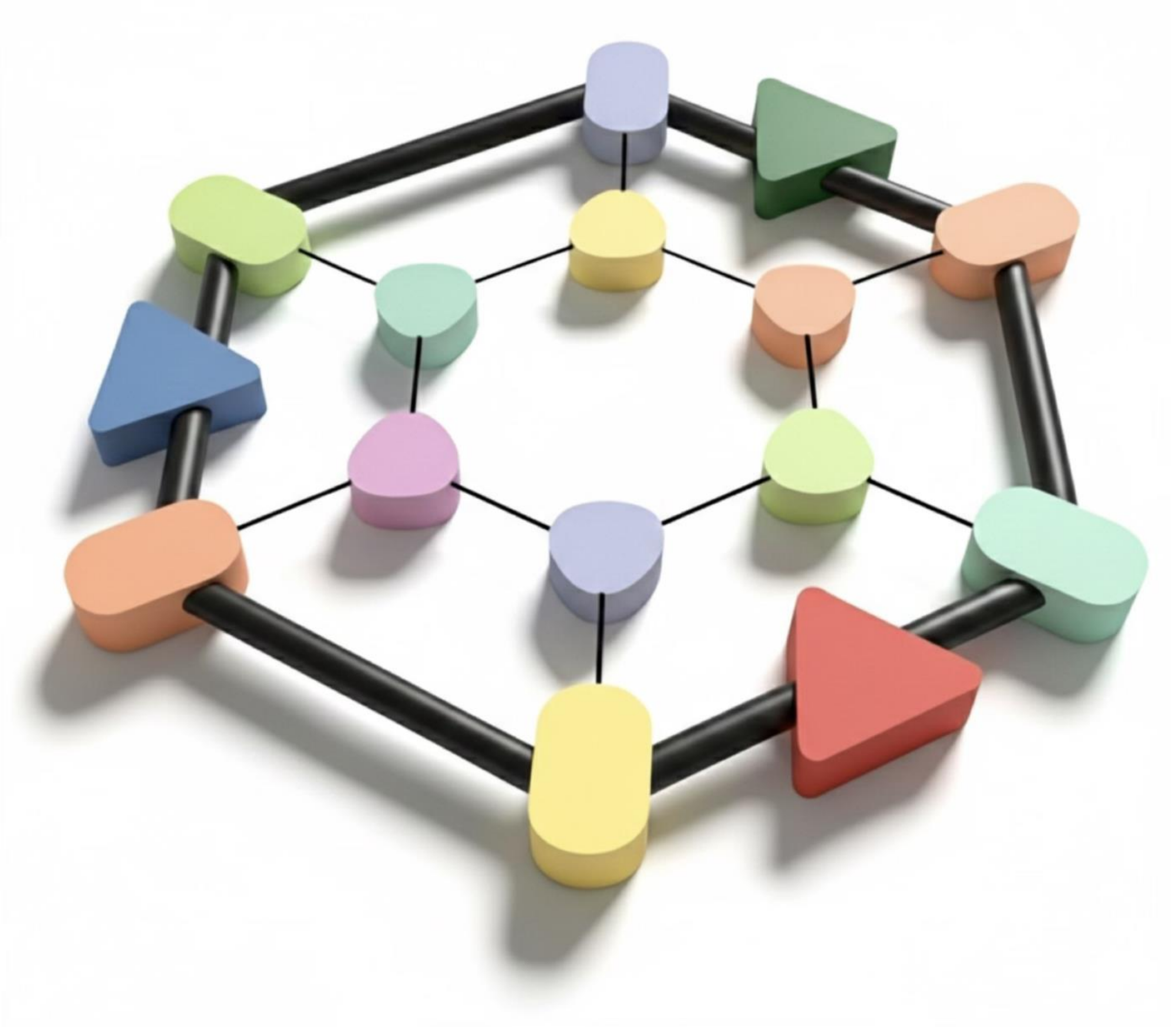


Entangled and topology in interacting quantum matter

2026, Feb 15 - Feb 28







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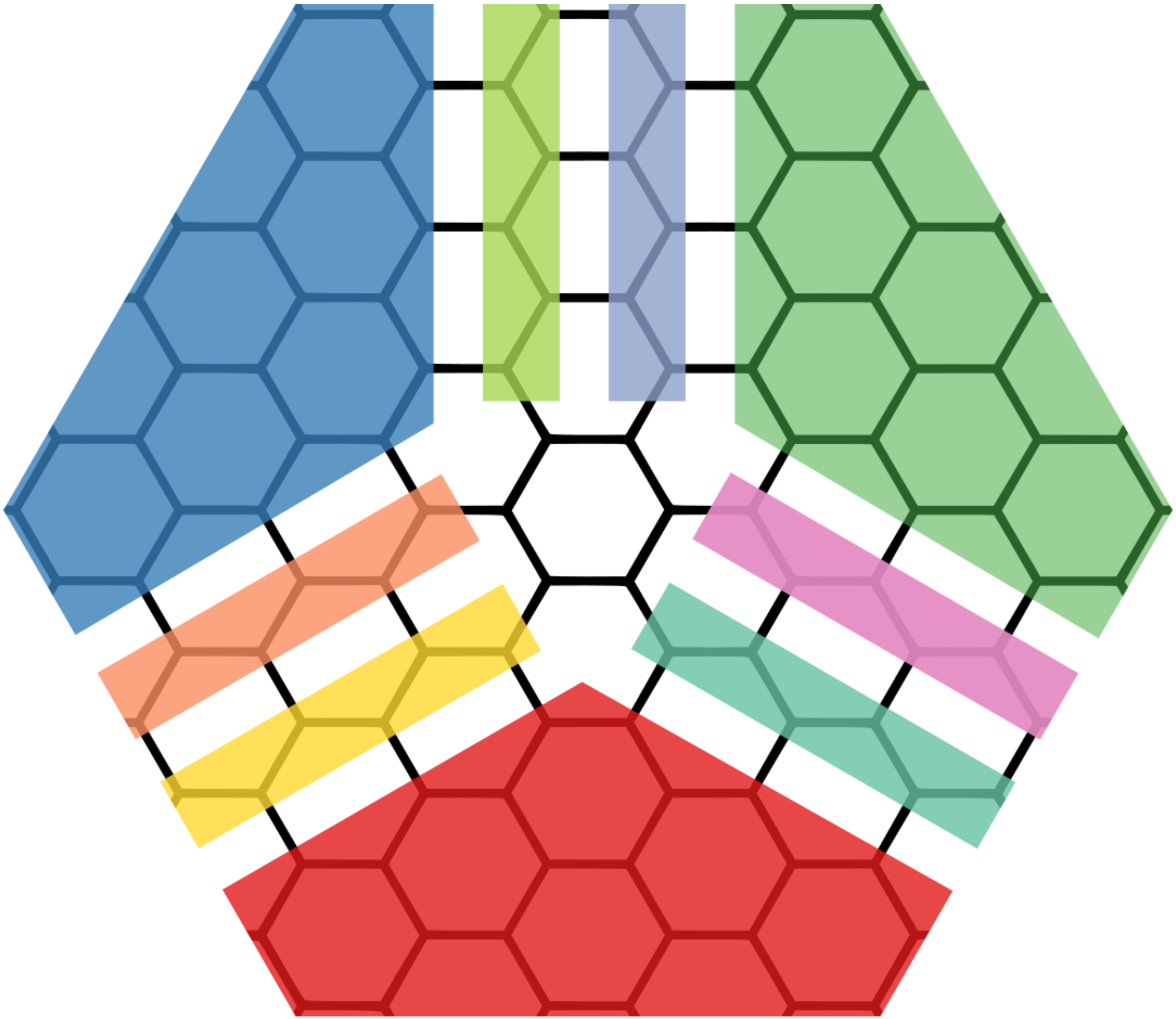


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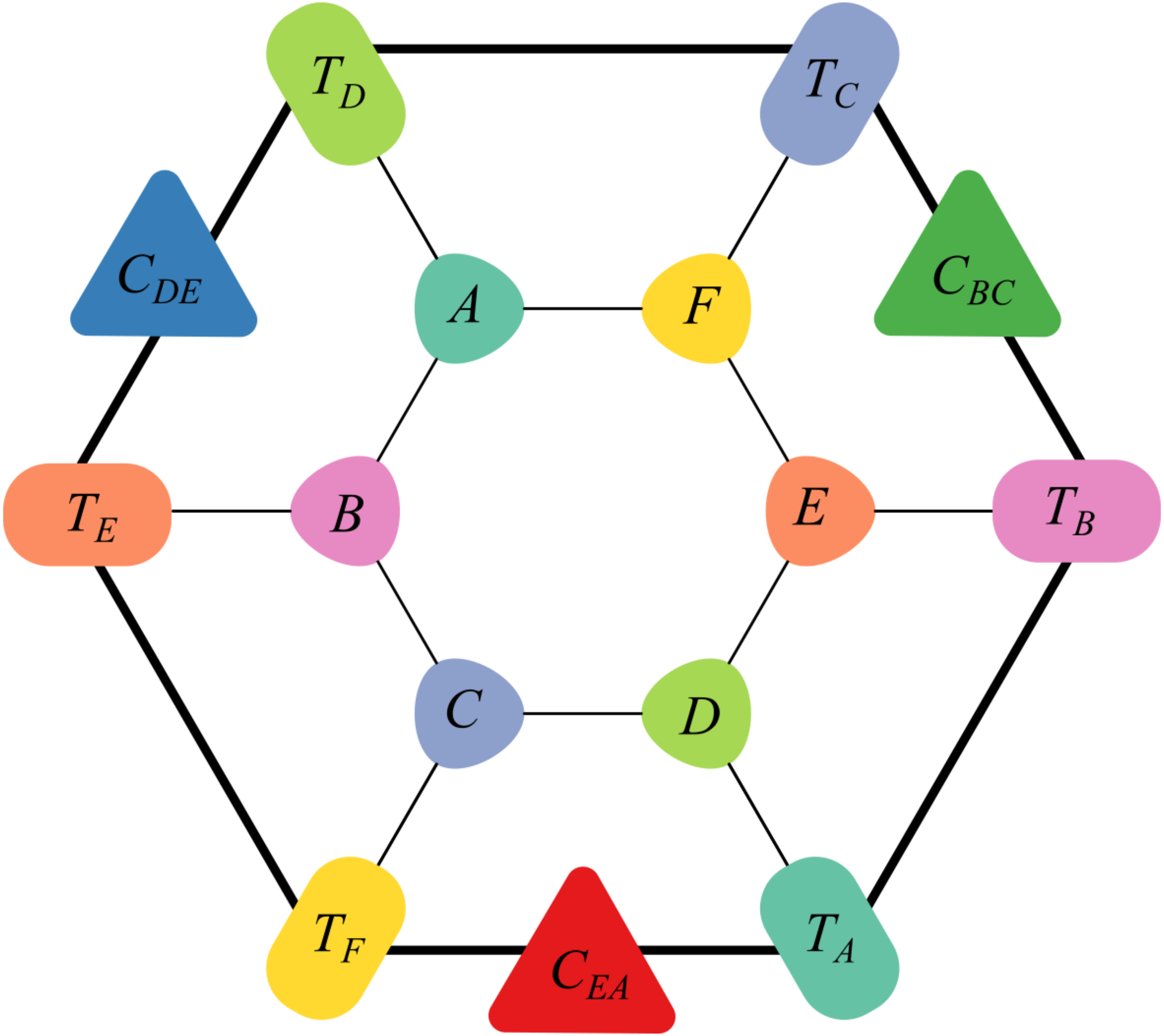

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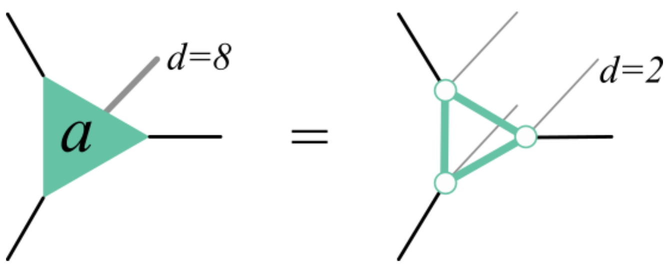
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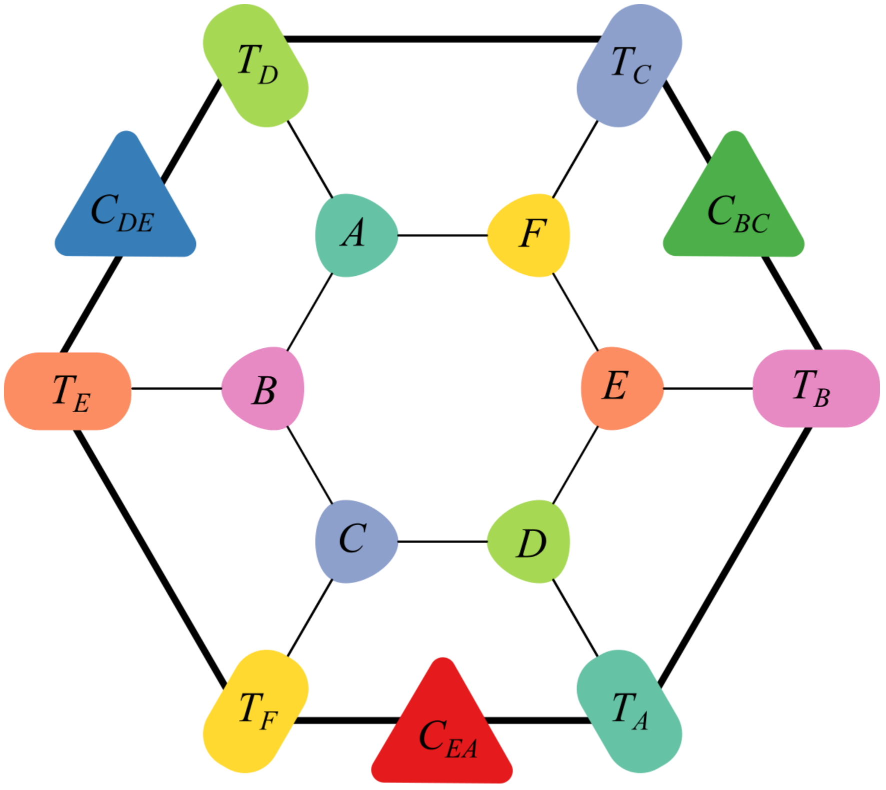
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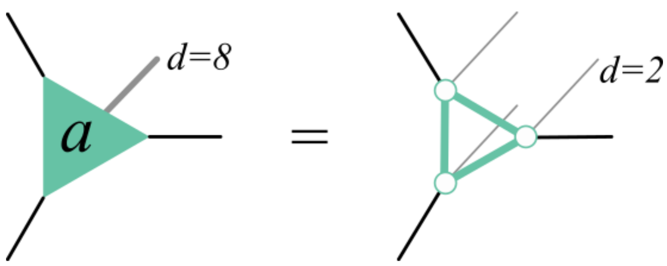

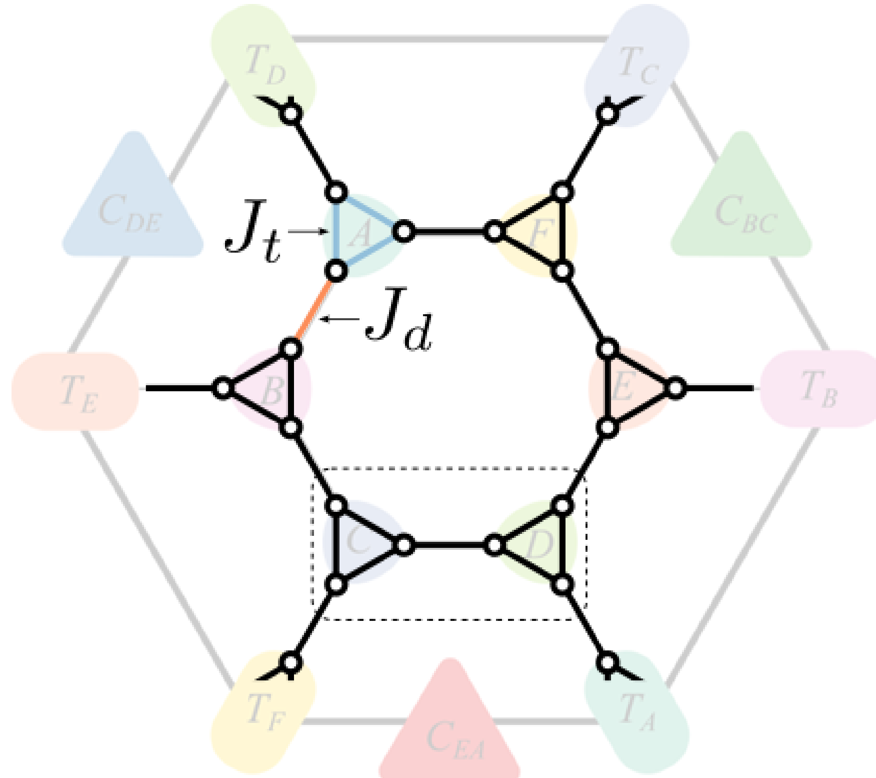

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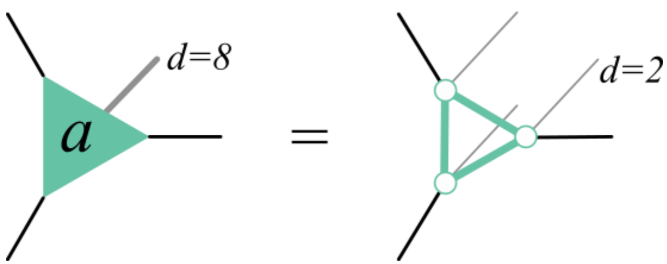

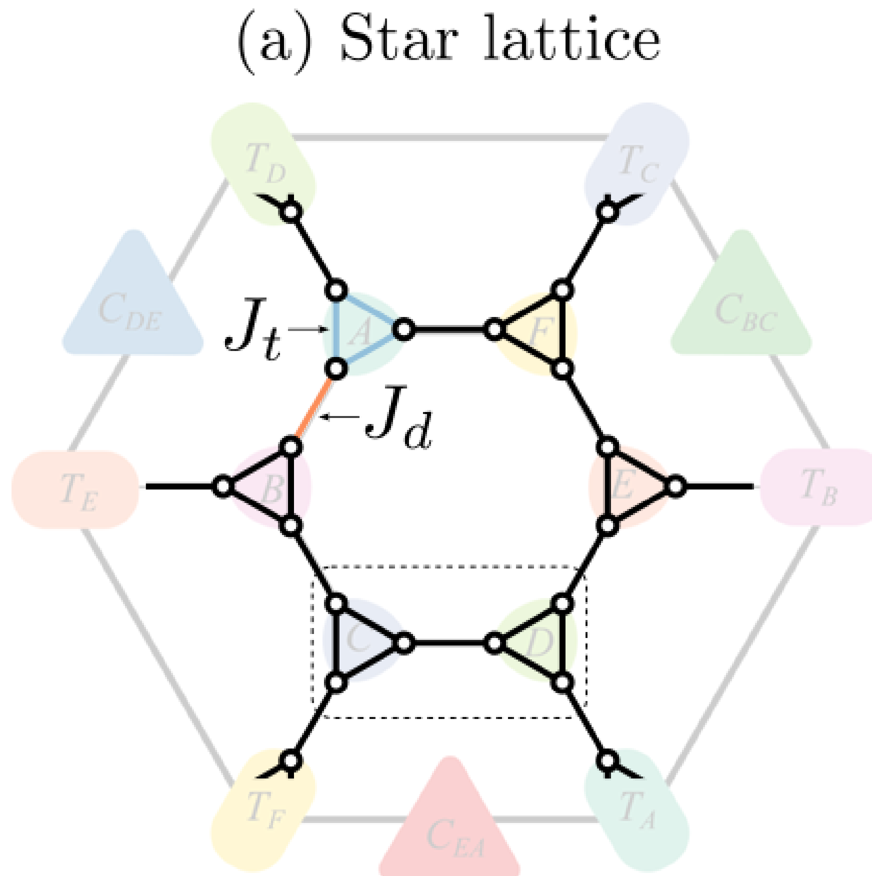

G. Misguich and P. Sindzingre, Detecting spontaneous symmetry breaking in finite-size spectra of frustrated quantum antiferromagnets, J. Phys. Condens. Matter **19**, 145202 (2007).

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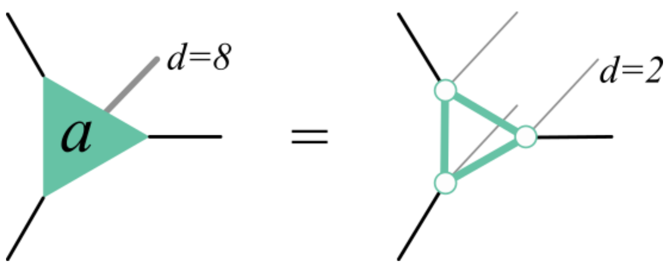

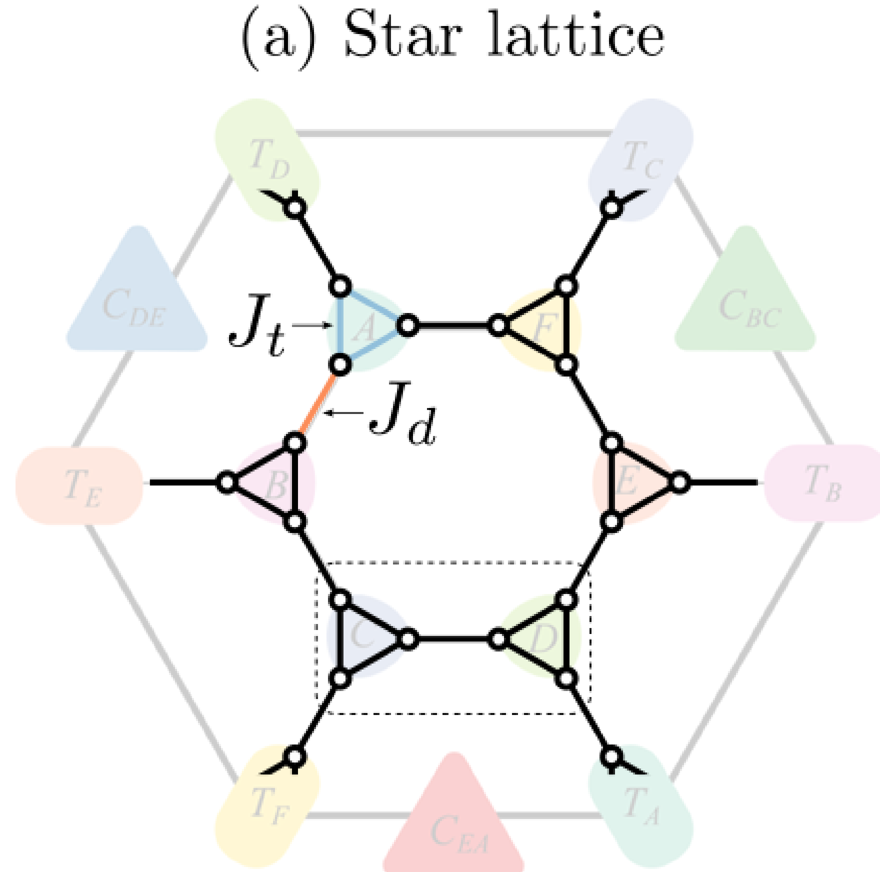

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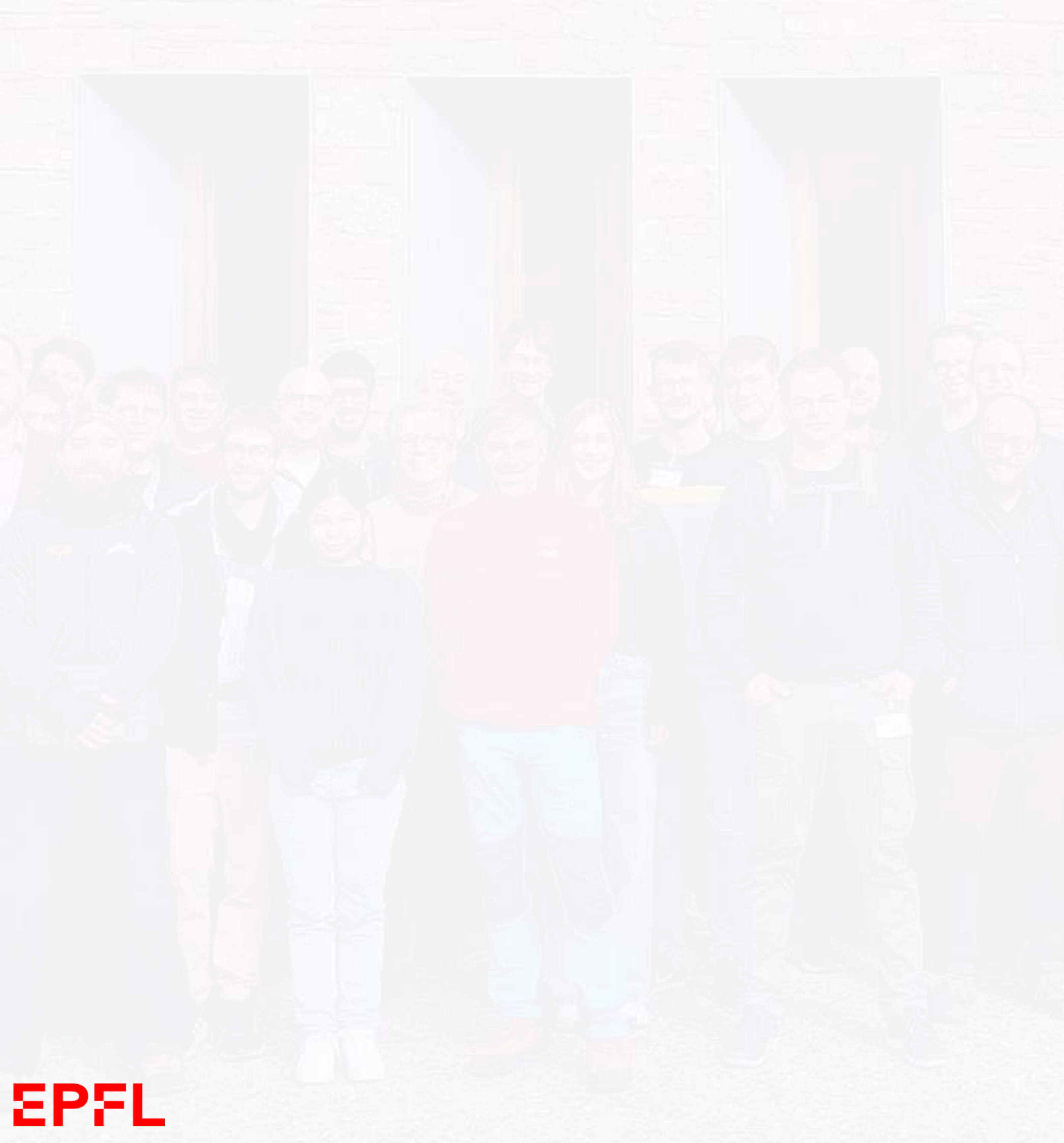
$Fe_3(\mu_3\text{-}O)(\mu\text{-}OAc)_6\ (H_2O)_3][Fe_3(\mu_3\text{-}O)(\mu\text{-}OAc)_{7.5}]_2\cdot 7H_2O$

$[(CH_3)_2(NH2)]_3Cu_3(OH)(SO_4)_4\cdot 0.24H_2O$


Entanglement in Strongly Correlated Systems
2025, Feb 23 - Mar 8



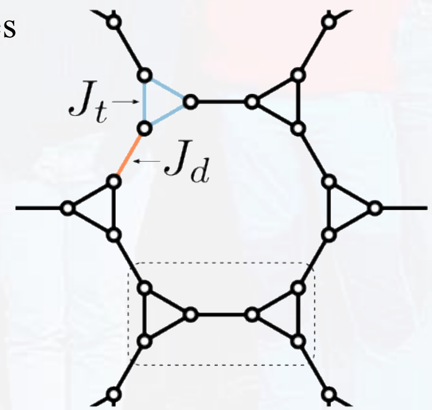
Frederic Mila

Frederic Mila

Samuel Nyckees

Frederic Mila

Samuel Nyckees



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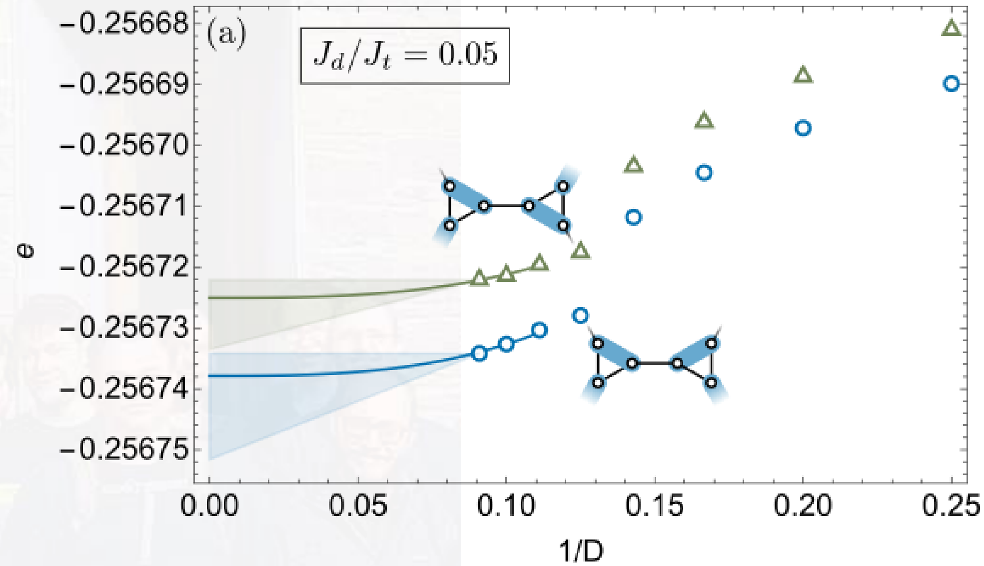

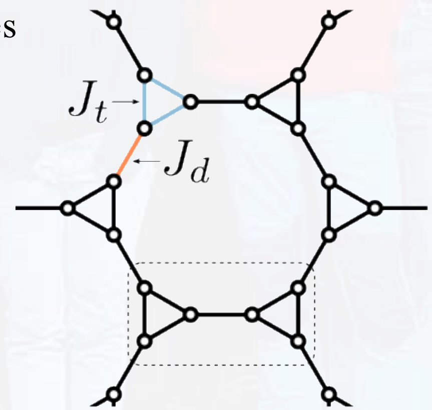

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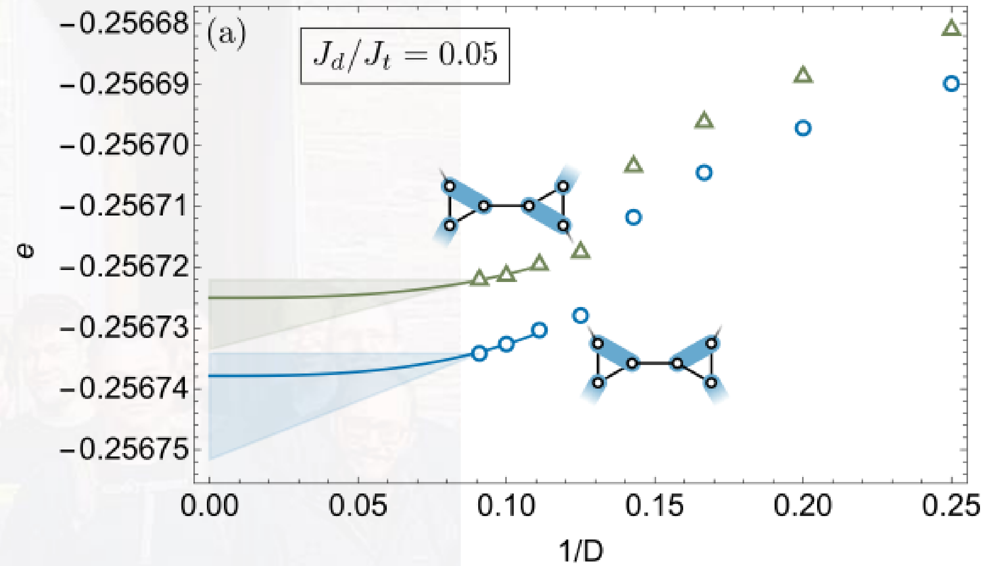
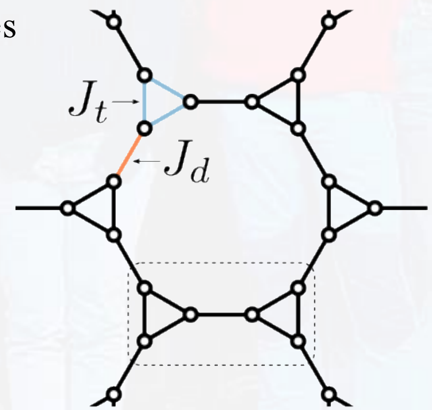
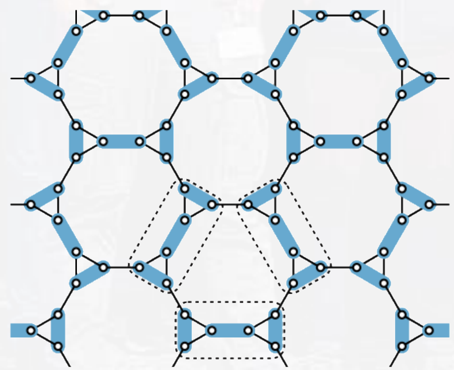
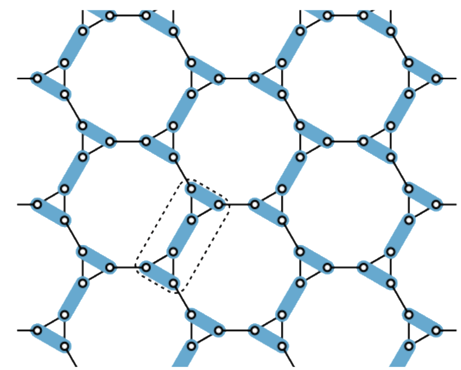




(c) $\sqrt{3} \times \sqrt{3}$ VBC



(d) Columnar VBC



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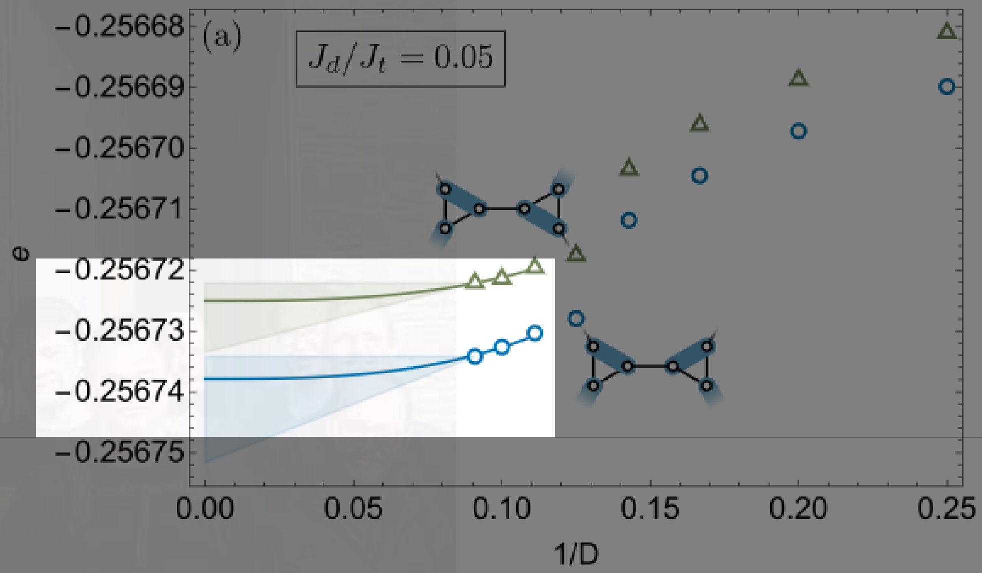
Energy difference ~10^{-5}

$1/D$ scaling is empirical



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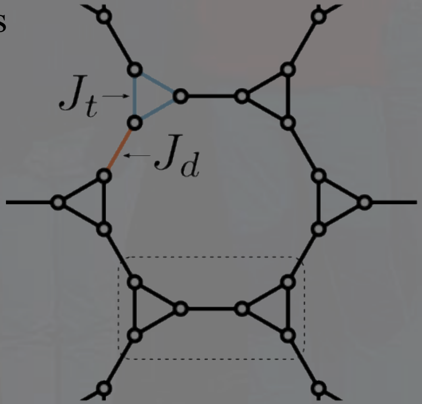
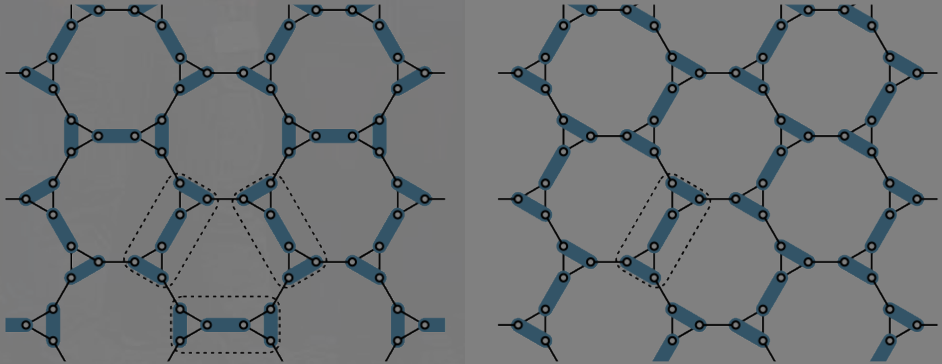


(c) $\sqrt{3} \times \sqrt{3}$ VBC

(d) Columnar VBC



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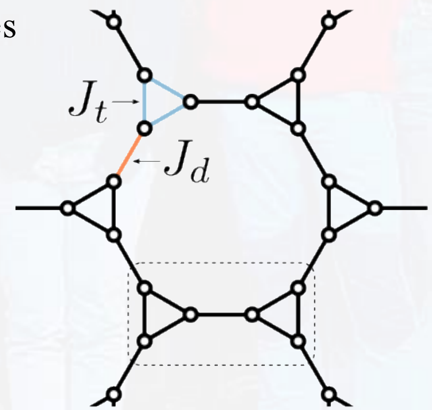
Frederic Mila

Kai P. Schmidt

Samuel Nyckees



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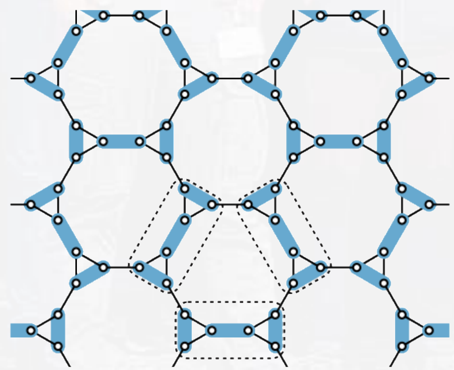

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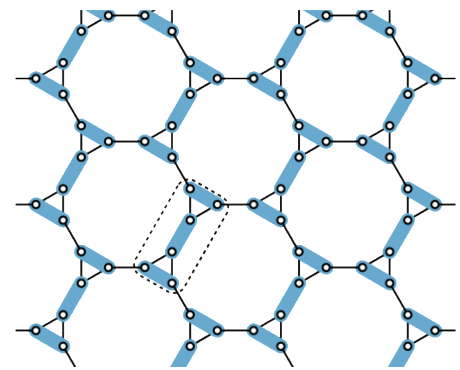

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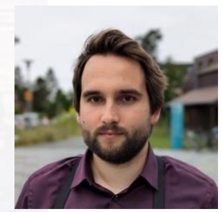
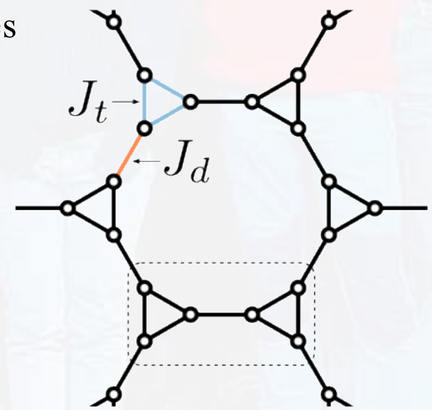
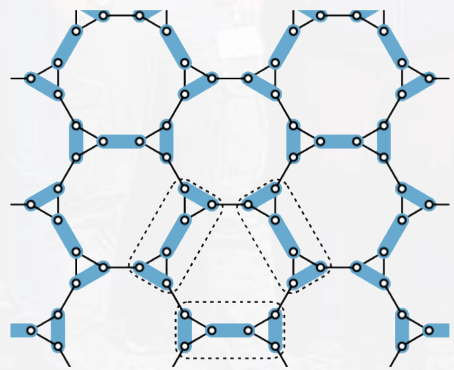


Jan Koziol



(c) $\sqrt{3} \times \sqrt{3}$ VBC



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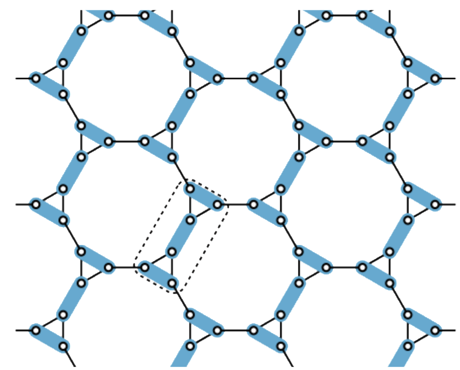
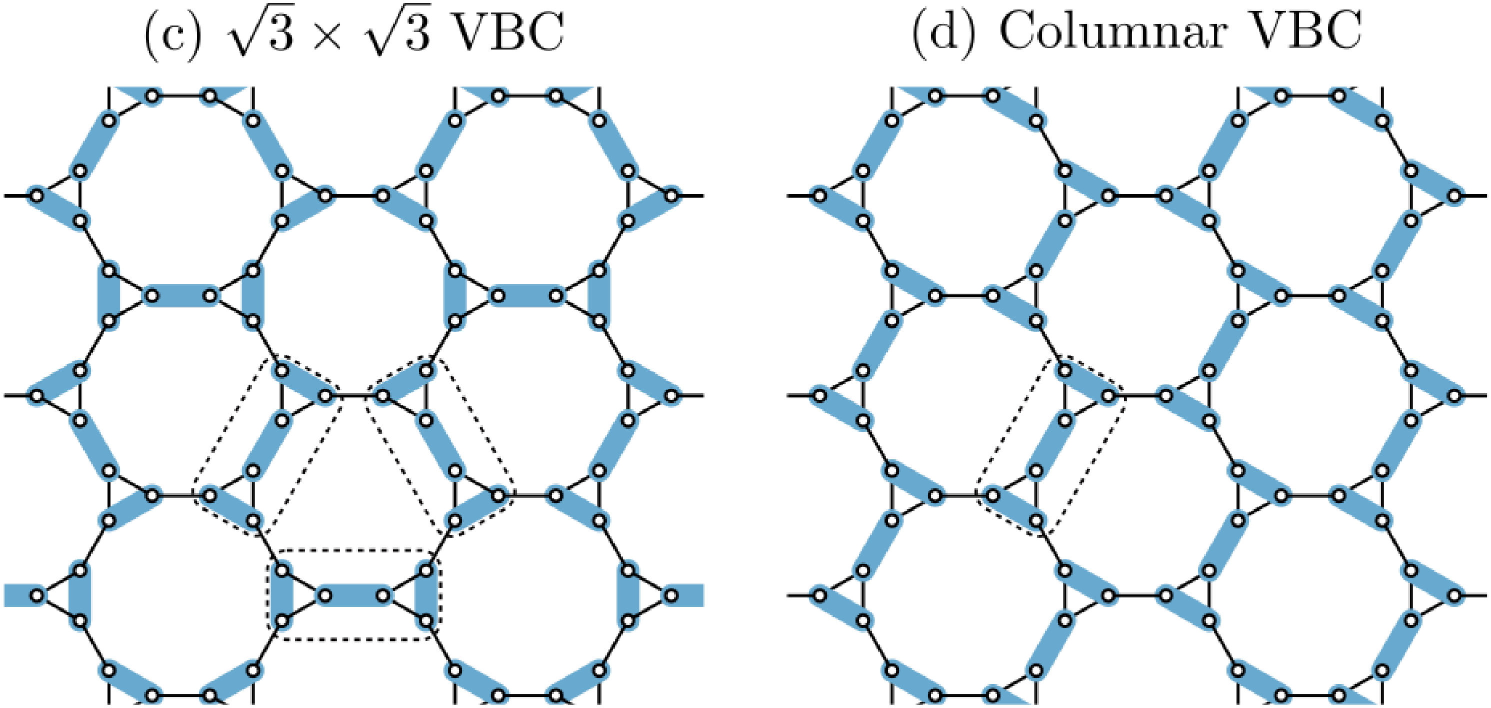
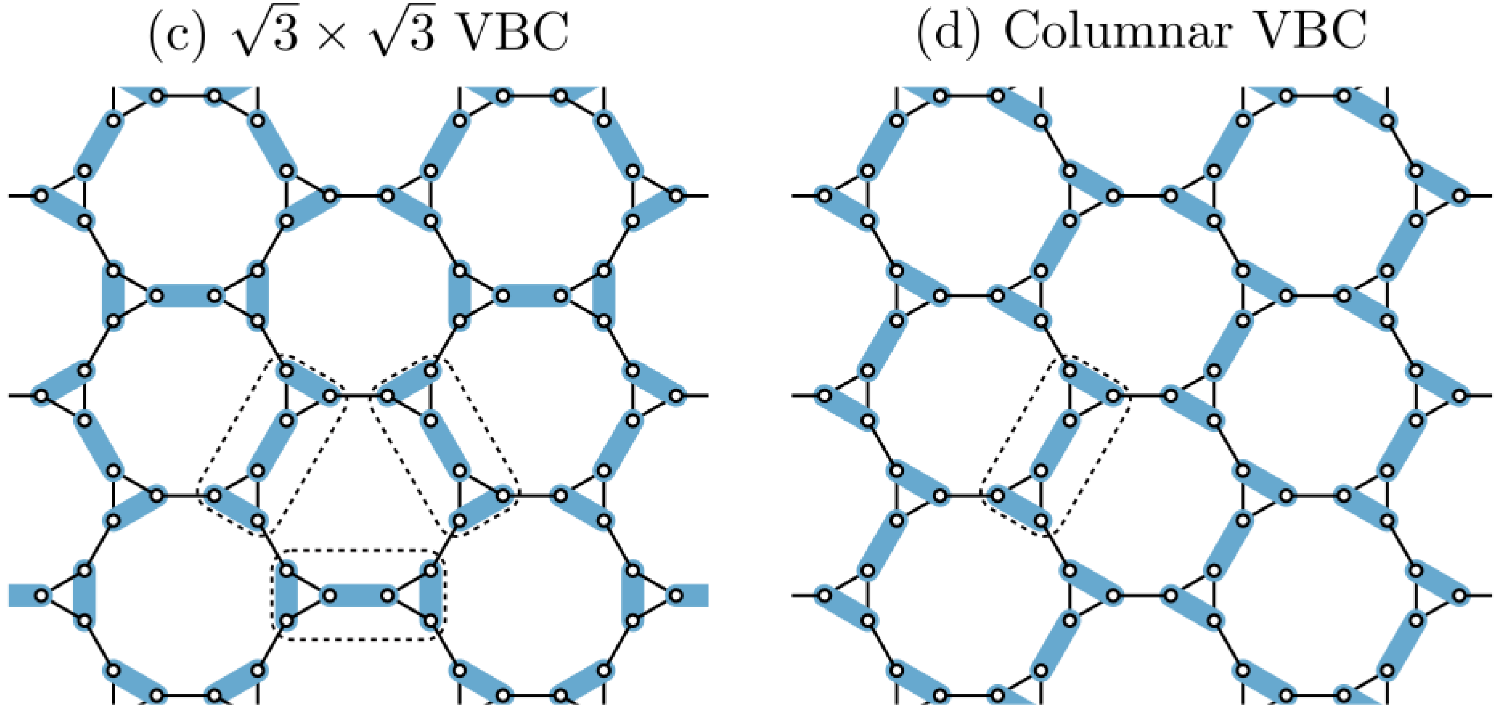
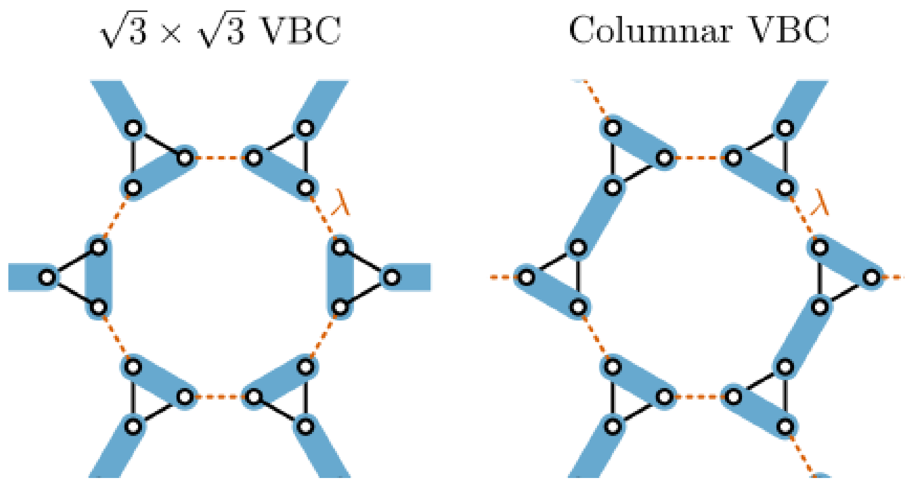




(c) $\sqrt{3} \times \sqrt{3}$ VBC
(d) Columnar VBC


(c) $\sqrt{3} \times \sqrt{3}$ VBC
(d) Columnar VBC


$\sqrt{3} \times \sqrt{3}$ VBC
Columnar VBC
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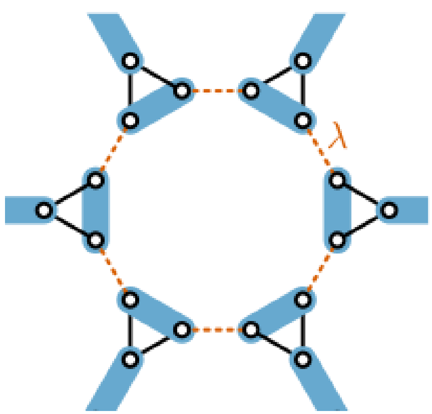
λ

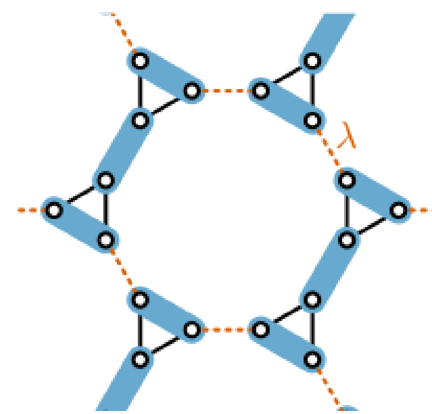
$$
\begin{aligned}
e^{\sqrt{3}\times\sqrt{3}}_{J_d=0.10} = &- 0.262500000000000 - 0.0898437499999978\lambda^2 \\
&- 0.138580322265618\lambda^3 - 0.690449120502133\lambda^4 \\
&- 3.14158093119301\lambda^5 - 18.8032247915941\lambda^6 \\
&- 126.418077170417\lambda^7
\end{aligned}
$$

$$
\begin{aligned}
e^{\text{columnar}}_{J_d=0.10} = &- 0.262500000000000 - 0.0898437499999979\lambda^2 \\
&- 0.138580322265618\lambda^3 - 0.690449120502132\lambda^4 \\
&- 3.141580931193\lambda^5 - 17.22003445278\lambda^6 \\
&- 101.071090052366\lambda^7
\end{aligned}
$$

$\sqrt{3} \times \sqrt{3}$ VBC



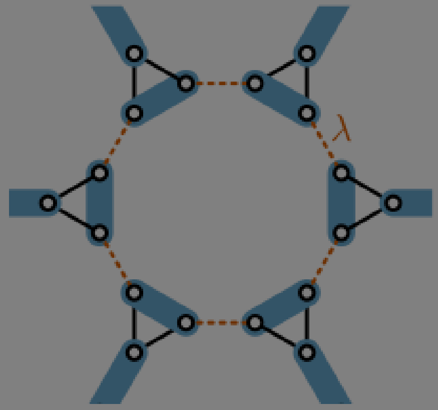
Columnar VBC



$$e^{\sqrt{3}\times\sqrt{3}}_{J_d=0.10} = -0.262500000000000 - 0.0898437499999978\lambda^2 - 0.138580322265618\lambda^3 - 0.690449120502133\lambda^4 - 3.14158093119301\lambda^5 - 18.8032247915941\lambda^6 - 126.418077170417\lambda^7$$

$$e^{\text{columnar}}_{J_d=0.10} = -0.262500000000000 - 0.0898437499999979\lambda^2 - 0.138580322265618\lambda^3 - 0.690449120502132\lambda^4 - 3.141580931193\lambda^5 - 17.22003445278\lambda^6 - 101.071090052366\lambda^7$$

$\sqrt{3}\times\sqrt{3}$ VBC



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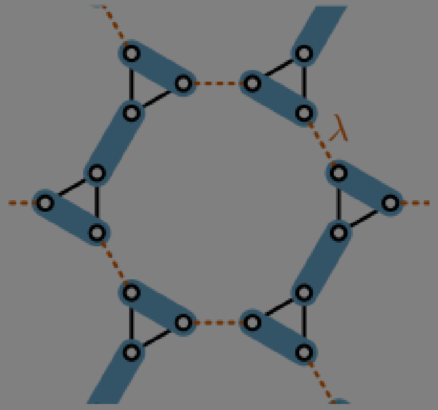
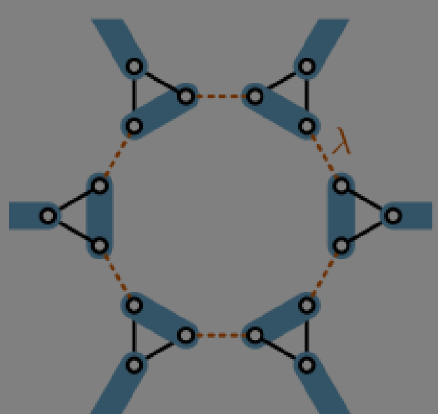


$$e^{\sqrt{3}\times\sqrt{3}}_{J_d=0.10} = -0.262500000000000 - 0.0898437499999978\lambda^2 - 0.138580322265618\lambda^3 - 0.690449120502133\lambda^4 - 3.14158093119301\lambda^5 - 18.8032247915941\lambda^6 - 126.418077170417\lambda^7$$

$$e^{\text{columnar}}_{J_d=0.10} = -0.262500000000000 - 0.0898437499999979\lambda^2 - 0.138580322265618\lambda^3 - 0.690449120502132\lambda^4 - 3.141580931193\lambda^5 - 17.22003445278\lambda^6 - 101.071090052366\lambda^7$$

$\sqrt{3} \times \sqrt{3}$ VBC



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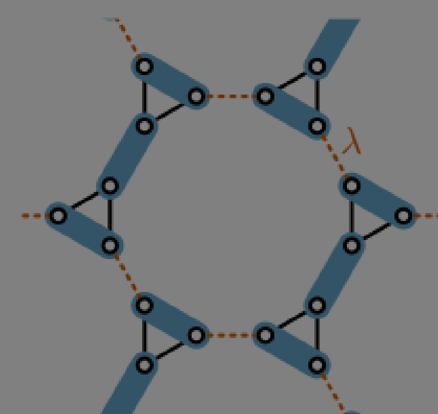

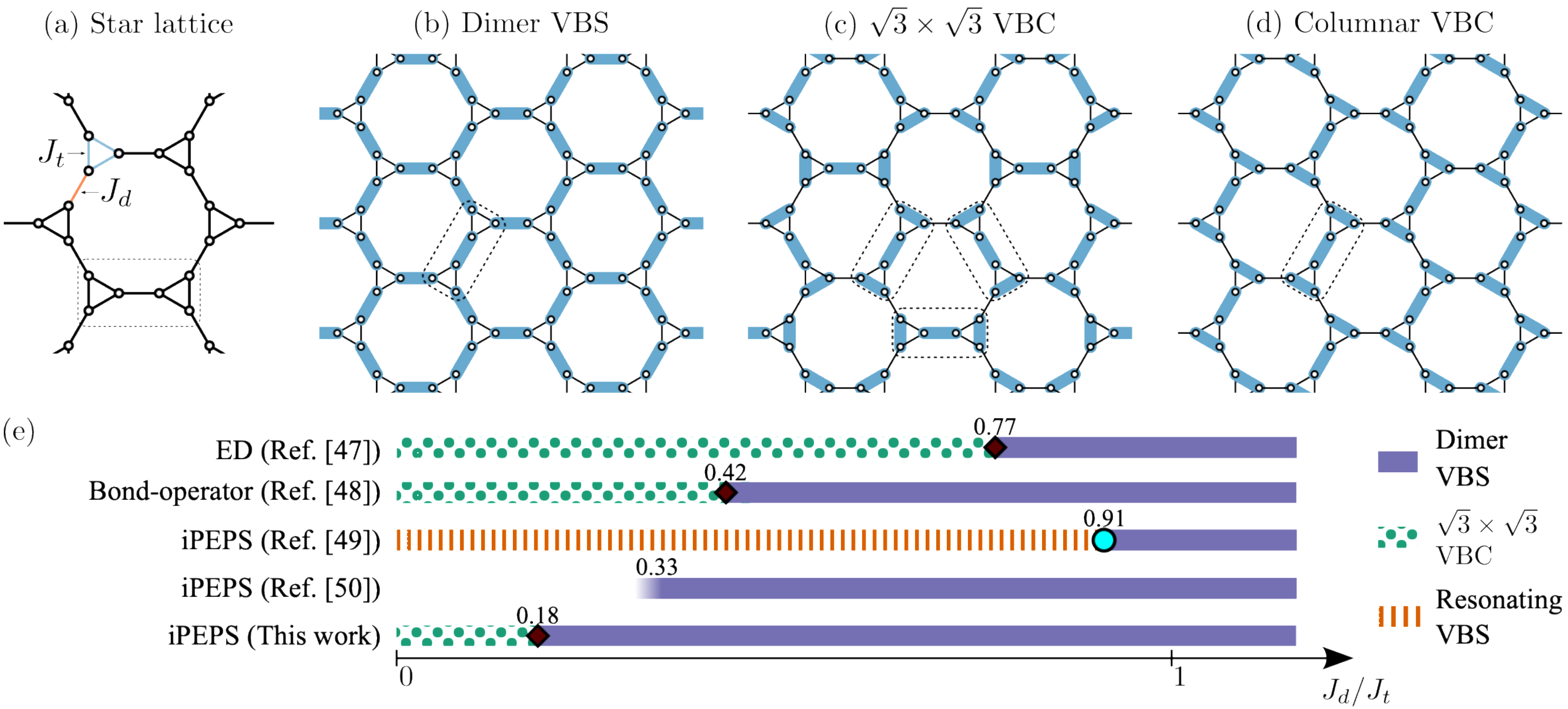

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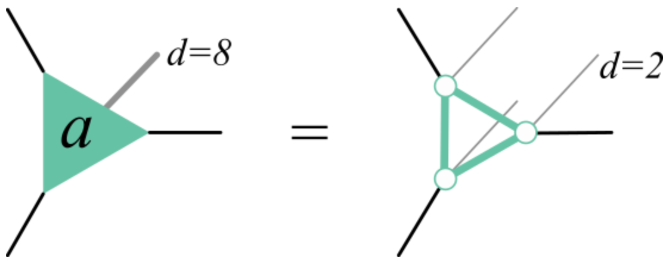

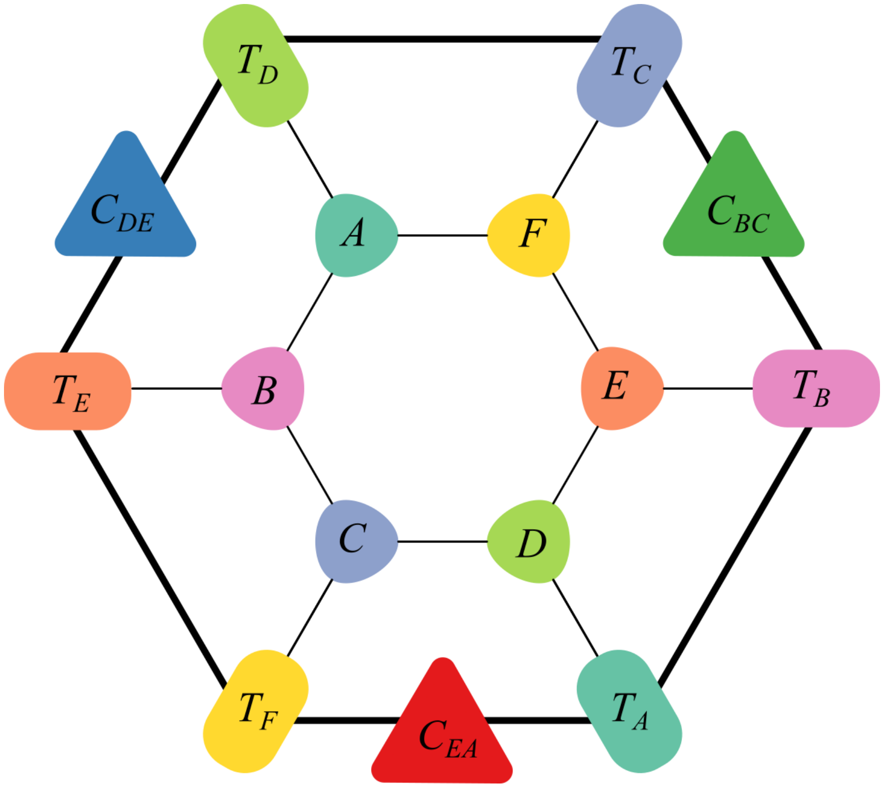

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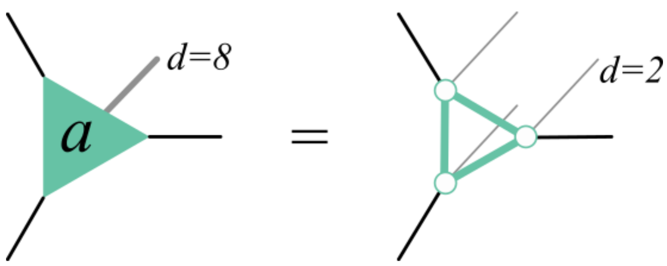
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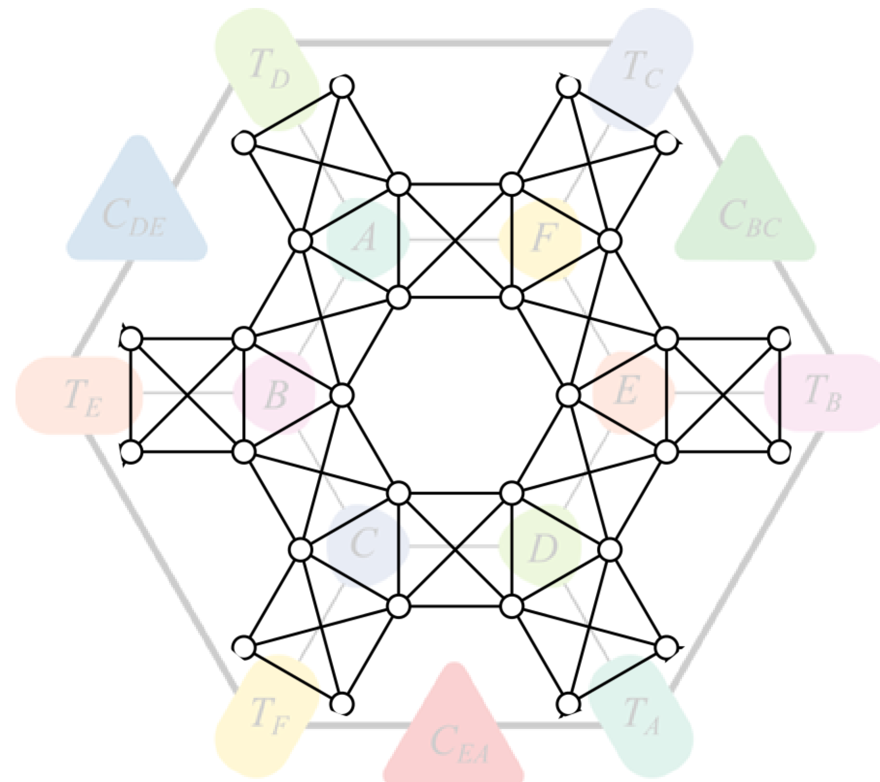
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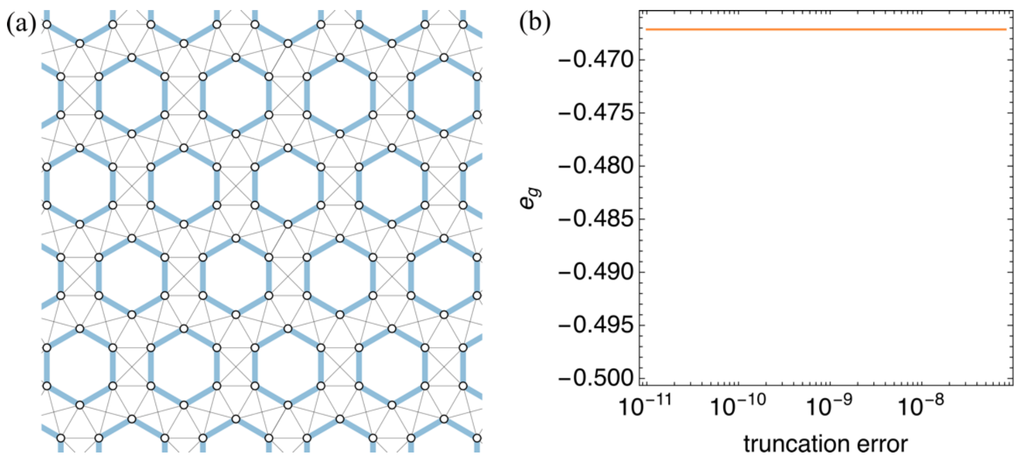
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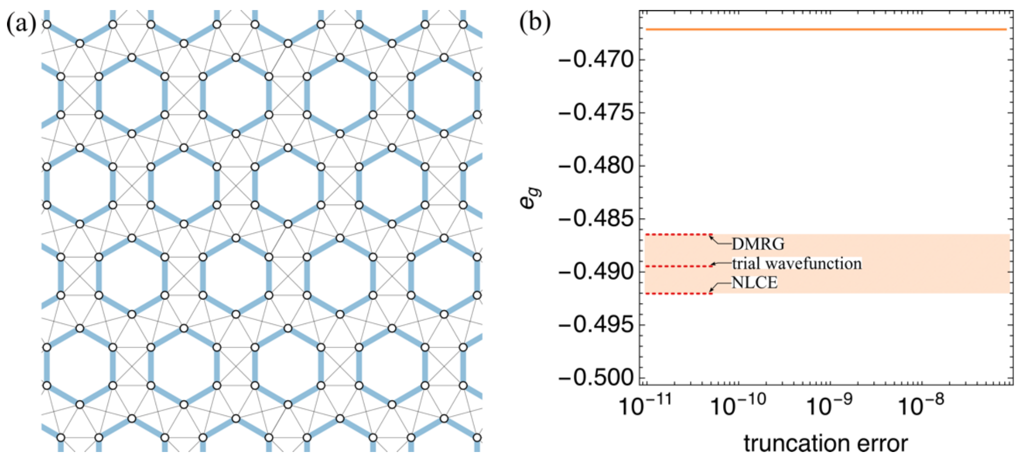

PHYSICAL REVIEW LETTERS **131,** 096702 (2023)

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Robin Schäfer,* Benedikt Placke,† Owen Benton,‡ and Roderich Moessner§
Max Planck Institute for the Physics of Complex Systems, Noethnitzer Strasse 38, 01187 Dresden, Germany

(Received 25 October 2022; accepted 22 July 2023; published 30 August 2023; corrected 3 October 2023)

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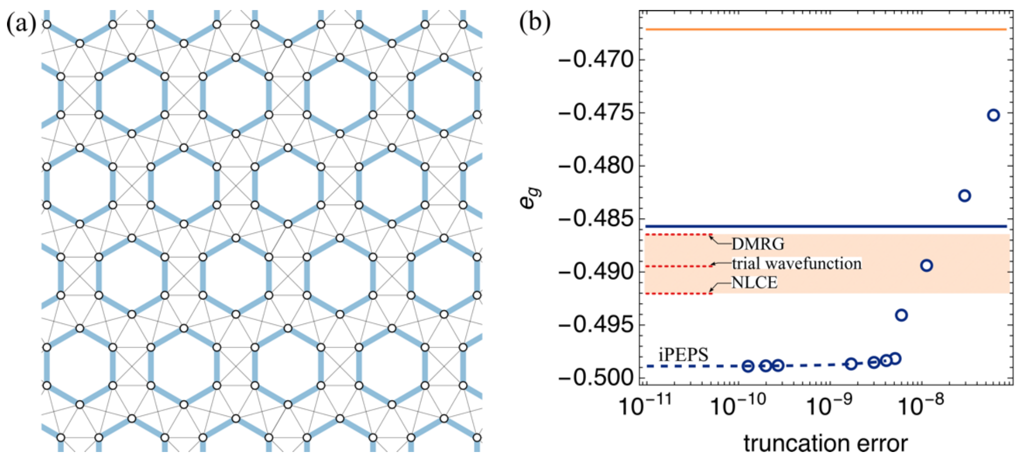

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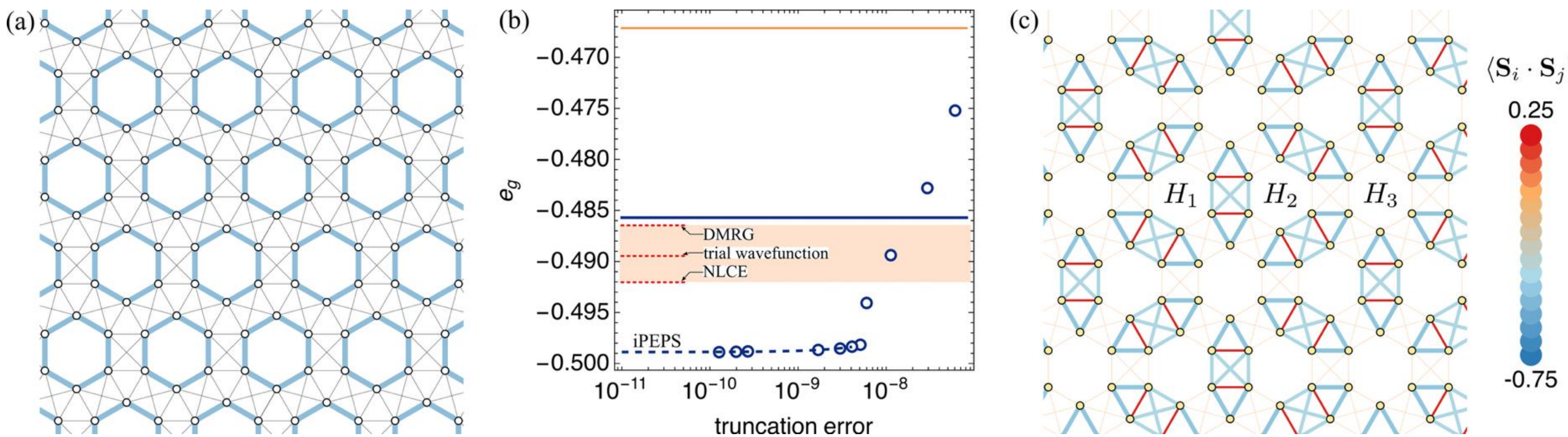

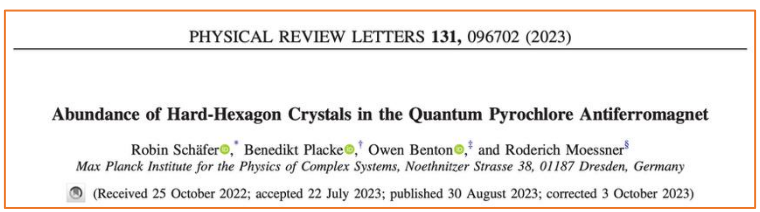
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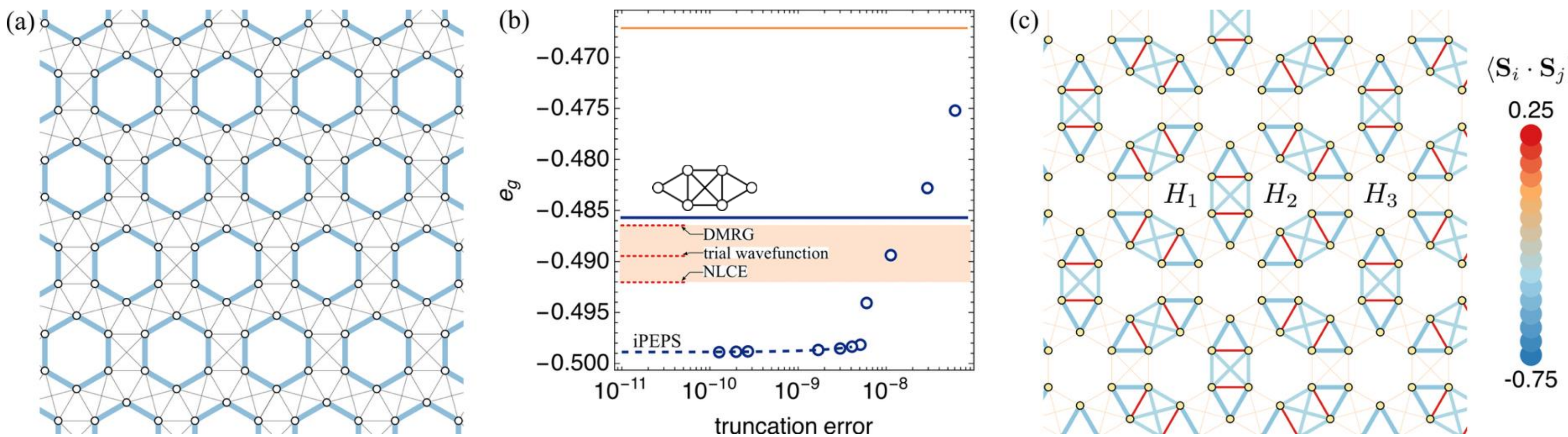

PHYSICAL REVIEW LETTERS **131,** 096702 (2023)

Abundance of Hard-Hexagon Crystals in the Quantum Pyrochlore Antiferromagnet

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Simplex Crystal Ground State and Magnetization Plateaus in the Spin-1/2 Heisenberg Model on the Ruby Lattice
Pratyay Ghosh, Frédéric Mila
arXiv:2512.14173

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Low-Energy Sector of the $S = 1/2$ Kagome Antiferromagnet

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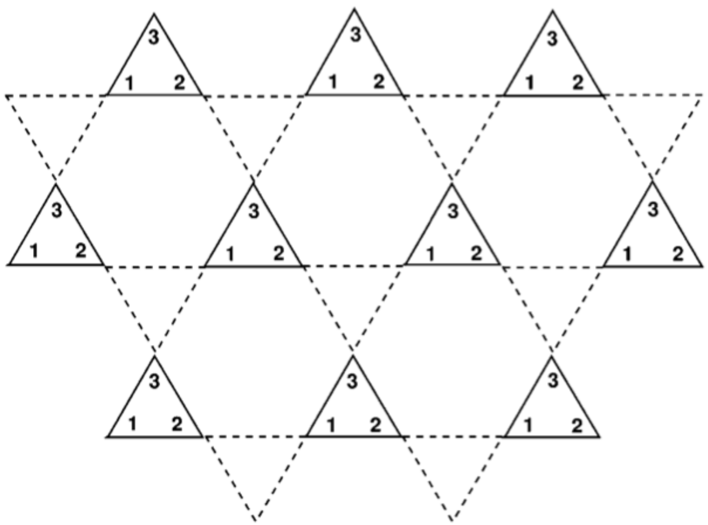
(Received 13 February 1998)



$$|\alpha R\rangle = \frac{1}{\sqrt{3}}(|-\alpha\alpha\alpha\rangle + \omega|\alpha-\alpha\alpha\rangle + \omega^2|\alpha\alpha-\alpha\rangle),$$
$$|\alpha L\rangle = \frac{1}{\sqrt{3}}(|-\alpha\alpha\alpha\rangle + \omega^2|\alpha-\alpha\alpha\rangle + \omega|\alpha\alpha-\alpha\rangle), \tag{1}$$

$$\tilde{H} = (J'/9)\sum_{\langle i,j\rangle}{}' \tilde{H}^{\sigma}_{ij}\tilde{H}^{\tau}_{ij}, \qquad \tilde{H}^{\sigma}_{ij} = \vec{\sigma}_i.\vec{\sigma}_j,$$
$$\tilde{H}^{\tau}_{ij} = [1-2(\alpha_{ij}\tau_i^- + \alpha_{ij}^2\tau_i^+)][1-2(\beta_{ij}\tau_j^- + \beta_{ij}^2\tau_j^+)], \tag{2}$$

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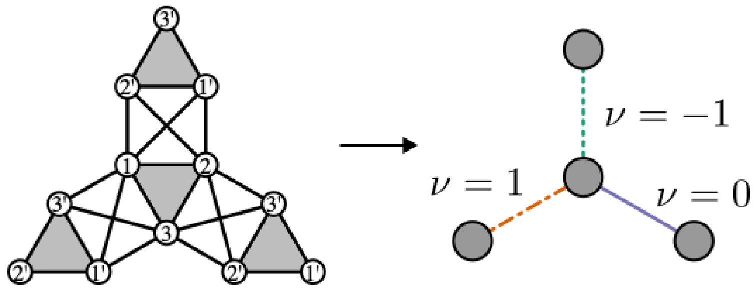
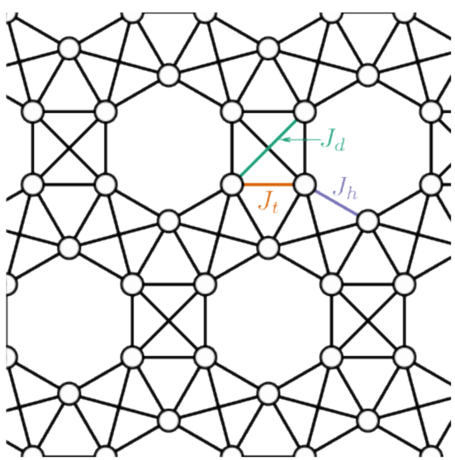


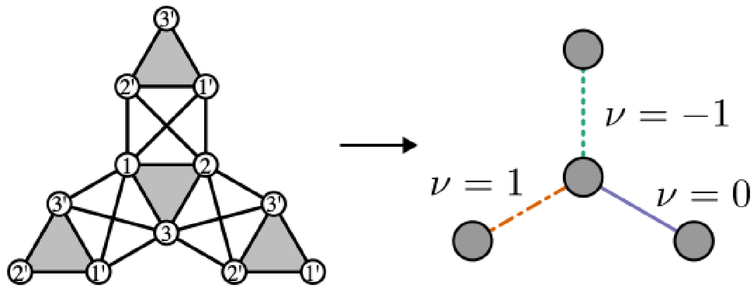
$$\tilde{H} = \frac{J}{18} \sum_{\langle i'j' \rangle} \tilde{H}^{\sigma}_{i'j'} \otimes \tilde{H}^{\tau}_{i'j'} \tag{A2}$$

with

$$\tilde{H}^{\sigma}_{i'j'} = \vec{\sigma_{i'}}.\vec{\sigma_{j'}}, \tag{A3a}$$

$$\tilde{H}^{\tau}_{i'j'} = \left(1 + \omega^{\nu}\tau^{+}_{i'} + \omega^{\overline{\nu}}\tau^{-}_{i'}\right)\left(1 + \omega^{\nu}\tau^{+}_{j'} + \omega^{\overline{\nu}}\tau^{-}_{j'}\right) \tag{A3b}$$





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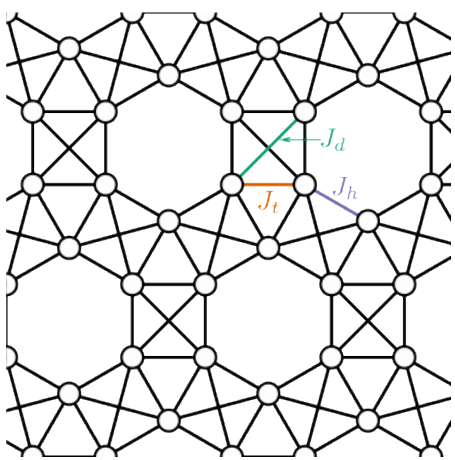

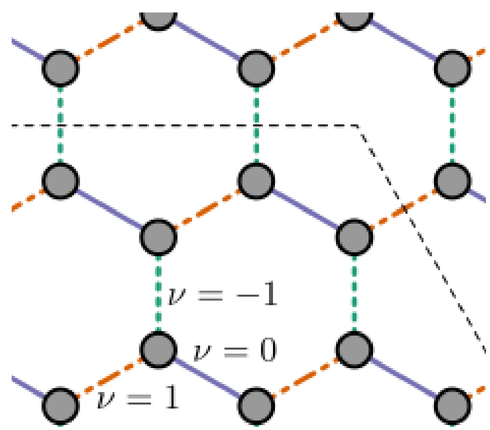

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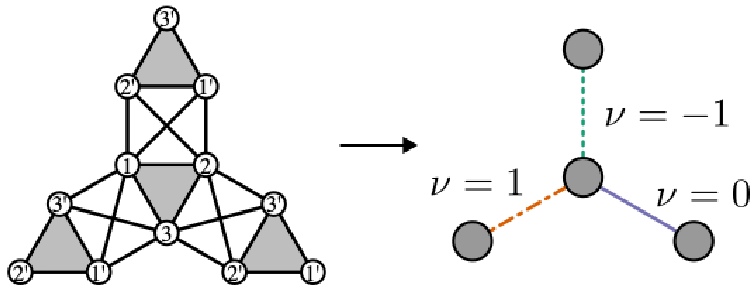

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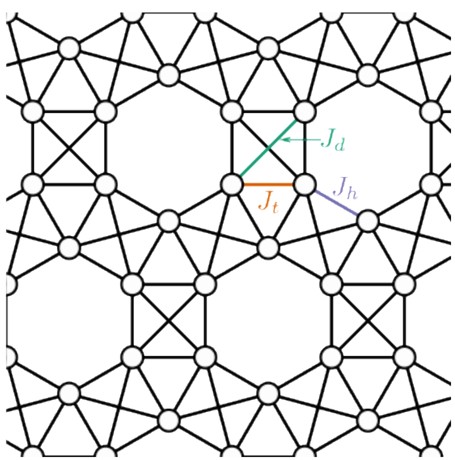

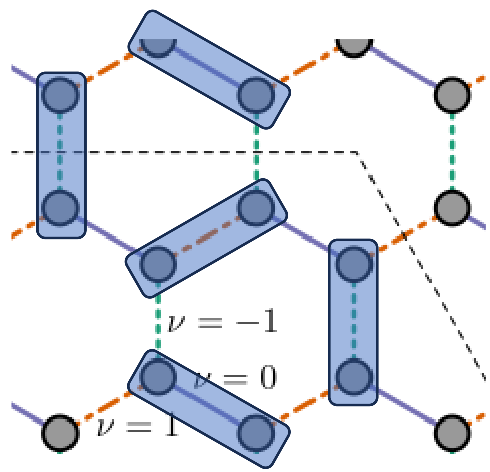

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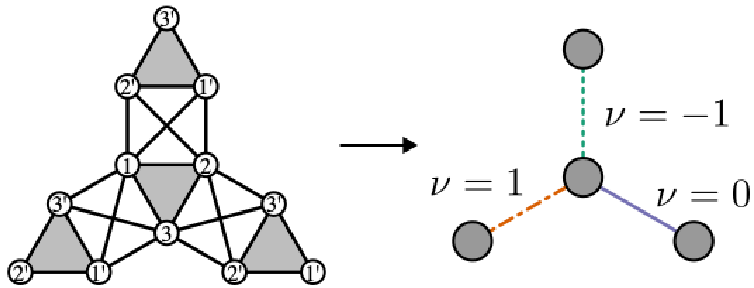

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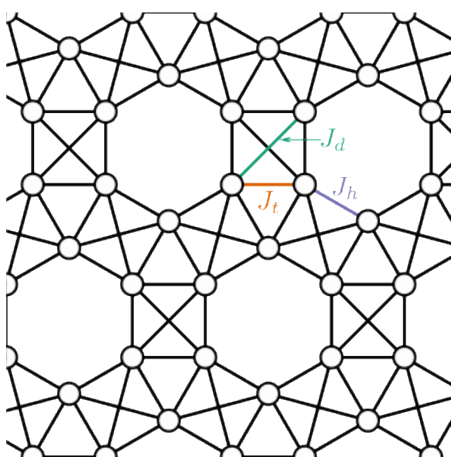

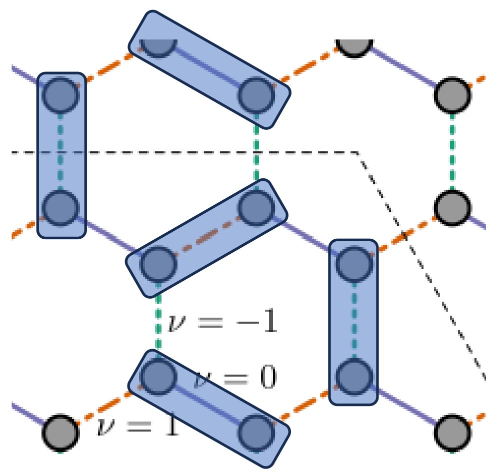

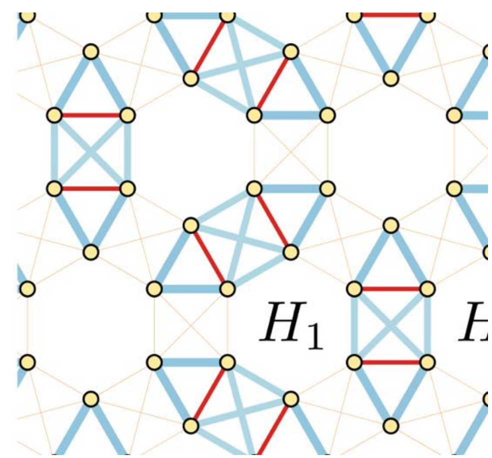

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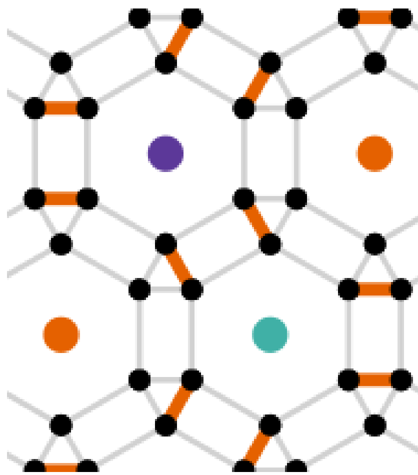

PHYSICAL REVIEW RESEARCH **6**, 033339 (2024)

Order-by-disorder in the antiferromagnetic J_1-J_2-J_3 transverse-field Ising model on the ruby lattice

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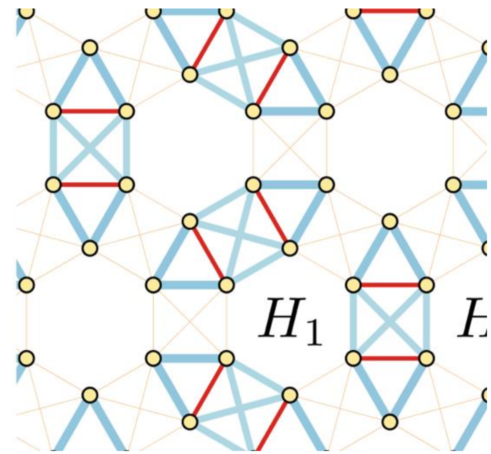

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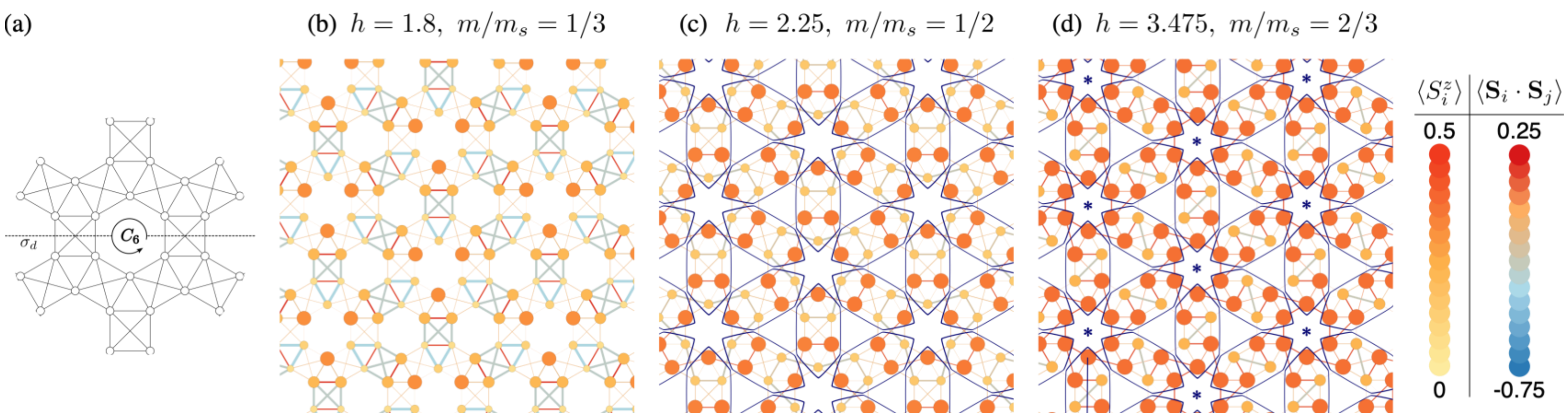

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