



Illustration of the 105-qubit Zuchongzhi 3.0 superconducting quantum processor. Selected for a Viewpoint in *Physics Magazine* and for an Editors' Suggestion. [D. Gao *et al.*, Phys. Rev. Lett. **134**, 090601 (2025)]

NEWSPAPER

PHYSICAL REVIEW LETTERS

Contents

Articles published 1 March–7 March 2025

VOLUME 134, NUMBER 9

7 March 2025

Quantum Information, Science, and Technology

Randomness versus Nonlocality in Multiple-Input and Multiple-Output Quantum Scenario	090201
Chao Zhang, Yi Li, Xiao-Min Hu, Yu Xiang, Chuan-Feng Li, Guang-Can Guo, Jordi Tura, Qihuang Gong, Qiongyi He, and Bi-Heng Liu	
Computable Entanglement Cost under Positive Partial Transpose Operations	090202
Ludovico Lami, Francesco Anna Mele, and Bartosz Regula	
Frustration Elimination and Excited State Search in Coherent Ising Machines	090401
Zheng-Yang Zhou, Clemens Gneiting, J. Q. You, and Franco Nori	
Engineering Nonequilibrium Steady States through Floquet Liouvillians	090402
Weijian Chen, Maryam Abbasi, Serra Erdamar, Jacob Muldoon, Yogesh N. Joglekar, and Kater W. Murch	
Establishing a New Benchmark in Quantum Computational Advantage with 105-qubit Zuchongzhi 3.0 Processor	090601
Dongxin Gao <i>et al.</i>	
Lowering Connectivity Requirements for Bivariate Bicycle Codes Using Morphing Circuits	090602
Mackenzie H. Shaw and Barbara M. Terhal	
Low-Cost Noise Reduction for Clifford Circuits	090603
Nicolas Delfosse and Edwin Tham	
Stability of Classical Shadows under Gate-Dependent Noise	090801
Raphael Brieger, Markus Heinrich, Ingo Roth, and Martin Kliesch	
Semidefinite Relaxations for High-Dimensional Entanglement in the Steering Scenario	090802
Nicola D'Alessandro, Carles Roch i Carceller, and Armin Tavakoli	

Cosmology, Astrophysics, and Gravitation

Fundamental Physics with the Lyman-Alpha Forest: Constraints on the Growth of Structure and Neutrino Masses from SDSS with Effective Field Theory	091001
Mikhail M. Ivanov, Michael W. Toomey, and Naim Göksel Karaçaylı	

Particles and Fields

Holographic Correlators with Bogomol'nyi-Prasad-Sommerfield Bound States in $\mathcal{N} = 4$ Supersymmetric Yang-Mills Theory	091602
Francesco Aprile, Stefano Giusto, and Rodolfo Russo	
Dissipation and Decay of Three-Dimensional Holographic Quantum Turbulence	091603
Hua-Bi Zeng, Chuan-Yin Xia, Wei-Can Yang, Yu Tian, and Makoto Tsubota	
Measurement of Atmospheric Neutrino Oscillation Parameters Using Convolutional Neural Networks with 9.3 Years of Data in IceCube DeepCore	091801
R. Abbasi <i>et al.</i> (IceCube Collaboration)	
Next-to-Leading-Order Weak-Annihilation Correction to Rare $B \rightarrow \{K, \pi\} \ell^+ \ell^-$ Decays	091901
Yong-Kang Huang, Yue-Long Shen, Chao Wang, and Yu-Ming Wang	

(Continued Inside)



This paper was highlighted in the APS publication *Physics* (physics.aps.org). By suggesting a few manuscripts each week, we hope to promote reading across fields. Please see our Announcement Phys. Rev. Lett. 98, 010001 (2007).

Copyright 2025 American Physical Society



0031-9007(20250307)134:9;1-#

Nuclear Physics

- Increasing Octupole Collectivity across the $Z = 64$ Isotopic Chain: $B(E3)$ Values in ^{150}Gd 092501
S. Pascu *et al.*

Atomic, Molecular, and Optical Physics

- Turning on the Fluorescence from Isolated GFP Chromophore Anions at Cryogenic Temperatures 093001
Thomas Toft Lindkvist, Iden Djavani-Tabrizi, Lars Henrik Andersen, and Steen Brøndsted Nielsen
- Sequential Synchronous Mechanism for Double-Electron Capture: Insights into Unforeseen Large Cross Sections
in Low-Energy $\text{Sn}^{3+} + \text{H}_2$ Collisions 093002
Lamberto Oltra, Luis Méndez, Ismanuel Rabadán, Klaas Bijlsma, Emiel de Wit, and Ronnie Hoekstra
- Smallness of the Nuclear Polarization Effect in the Hyperfine Structure of Heavy Muonic Atoms as a Stimulus for
Next-Generation Experiments 093003
J. Vandeleur, G. Sanamyan, O. R. Smits, I. A. Valuev, N. S. Oreshkina, and J. S. M. Ginges
- Exploring the Dynamical Interplay between Mass-Energy Equivalence, Interactions, and Entanglement in an
Optical Lattice Clock 093201
Anjun Chu, Victor J. Martínez-Lahuerta, Maya Miklos, Kyungtae Kim, Peter Zoller, Klemens Hammerer,
Jun Ye, and Ana Maria Rey
- Spin-Polarized Photoelectrons in the Vicinity of Spectral Features 093202
Stefanos Carlström, Rezvan Tahouri, Asimina Papoulia, Jan Marcus Dahlström, Misha Yu Ivanov,
Olga Smirnova, and Serguei Patchkovskii
-  Dynamical Formation of Multiple Quantum Droplets in a Bose-Bose Mixture 093401
L. Cavicchioli, C. Fort, F. Ancilotto, M. Modugno, F. Minardi, and A. Burchianti
-  Test of Nonlocal Energy Alteration between Two Quantum Memories 093601
Jian-Peng Dou, Feng Lu, Hao Tang, and Xian-Min Jin
- Thouless Pumping in a Driven-Dissipative Kerr Resonator Array 093801
S. Ravets, N. Pernet, N. Mostaan, N. Goldman, and J. Bloch
- Entangled-Beam Reflectometry and Goos-Hänchen Shift 093802
Q. Le Thien, R. Pynn, and G. Ortiz
- Observation of a Giant Goos-Hänchen Shift for Matter Waves 093803
S. McKay, V. O. de Haan, J. Leiner, S. R. Parnell, R. M. Dalgliesh, P. Boeni, L. J. Bannenberg,
Q. Le Thien, D. V. Baxter, G. Ortiz, and R. Pynn
- Mid-Infrared Energy Deposition Spectroscopy 093804
Jiaze Yin, Christian Pfluegl, Chu C. Teng, Rylie Bolarinho, Guo Chen, Xinrui Gong, Dashan Dong,
Daryoosh Vakhshoori, and Ji-Xin Cheng
- Resolving the Orientations of and Angular Separation Between a Pair of Dipole Emitters 093805
Yiyang Chen, Yuanxin Qiu, and Matthew D. Lew

Physics of Fluids, Earth & Planetary Science, and Climate

- Direct Measurement of the Viscocapillary Lift Force near a Liquid Interface 094001
Hao Zhang, Zaicheng Zhang, Aditya Jha, Yacine Amarouchene, Thomas Salez, Thomas Guérin,
Chaouqi Misbah, and Abdelhamid Maali
- Invariant Forms of Dissolution Fingers 094101
Stanisław Żukowski, Silvana Magni, Florian Osselin, Filip Dutka, Max Cooper,
Anthony J. C. Ladd, and Piotr Szymczak

Plasma and Solar Physics, Accelerators and Beams

-  First Measurement of Z Opacity Sample Evolution near Solar Interior Conditions Using
Time-Resolved Spectroscopy 095101
G. P. Loisel, J. E. Bailey, T. Nagayama, S. B. Hansen, G. S. Dunham, P. D. Gard, A. P. Colombo, A. D. Edens,
R. Speas, Q. Looker, M. Kimmel, J. L. Porter, E. C. Harding, G. A. Rochau, C. J. Fontes, J. P. Colgan,
C. Blancard, Ph. Cossé, G. Faussurier, F. Gilleron, J.-Ch. Pain, and D. Aberg

(Continued on Preceding Page)



This paper was highlighted in the APS publication *Physics* (physics.aps.org).

By suggesting a few manuscripts each week, we hope to promote reading across fields. Please see our Announcement Phys. Rev. Lett. 98, 010001 (2007)

Group Conductivity and Nonadiabatic Born Effective Charges of Disordered Metals, Warm Dense Matter, and Hot Dense Plasma	095102
Vidushi Sharma and Alexander J. White	
Measurement of Zero-Frequency Fluctuations Generated by Coupling between Alfvén Modes in the JET Tokamak	095103
J. Ruiz Ruiz, J. Garcia, M. Barnes, M. Dreval, C. Giroud, V. H. Hall-Chen, M. R. Hardman, J. C. Hillesheim, Y. Kazakov, S. Mazzi, B. S. Patel, F. I. Parra, A. A. Schekochihin, and Ž. Štancar (the JET Contributors and the EUROfusion Tokamak Exploitation Team)	
Condensed Matter and Materials	
 Universal Phenomenology of Charge-Spin Interconversion and Dynamics in Diffusive Systems with Spin-Orbit Coupling	096001
Tim Kokkeler, F. Sebastian Bergeret, and I. V. Tokatly	
Thermodynamic Evidence for Density Wave Order in a Two Dimensional ^4He Supersolid	096002
J. Knapp, J. Nyéki, H. Patel, F. Ziouzia, B. P. Cowan, and J. Saunders	
Automatic Process Exploration through Machine Learning Assisted Transition State Searches	096201
King Chun Lai, Patricia Poths, Sebastian Matera, Christoph Scheurer, and Karsten Reuter	
Intrinsic High-Fidelity Spin Polarization of Charged Vacancies in Hexagonal Boron Nitride	096202
W. Lee, V. S. Liu, Z. Zhang, S. Kim, R. Gong, X. Du, K. Pham, T. Poirier, Z. Hao, J. H. Edgar, P. Kim, C. Zu, E. J. Davis, and N. Y. Yao	
 Auroralike Light from a Polymer p - n Junction Emitting Free Electrons	096203
Dongze Wang and Jun Gao	
Independently Tunable Flat Bands and Correlations in a Graphene Double Moiré System	096204
Yimeng Wang, Jihang Zhu, G. William Burg, Anand Swain, Kenji Watanabe, Takashi Taniguchi, Yuebing Zheng, Allan H. MacDonald, and Emanuel Tutuc	
 Coherent Detection of the Oscillating Acoustoelectric Effect in Graphene	096301
Yicheng Mou, Jiayu Wang, Haonan Chen, Yingchao Xia, Hailong Li, Qing Yan, Xue Jiang, Yijia Wu, Wu Shi, Hua Jiang, X. C. Xie, and Cheng Zhang	
Domain-Wall Ferroelectric Polarons in a Two-Dimensional Rotor Lattice Model	096302
Florian Kluibenschedl, Georgios M. Koutentakis, Ragheed Alhyder, and Mikhail Lemeshko	
Landscapes of an Out-of-Equilibrium Anyonic Sea	096303
Gu Zhang, Igor Gornyi, and Yuval Gefen	
Chirality in the Kagome Metal CsV_3Sb_5	096401
H. J. Elmers, O. Tkach, Y. Lytvynenko, P. Yogi, M. Schmitt, D. Biswas, J. Liu, S. V. Chernov, Quynh Nguyen, M. Hoesch, D. Kutnyakhov, N. Wind, L. Wenthau, M. Scholz, K. Rossnagel, A. Gloskovskii, C. Schlueter, A. Winkelmann, A.-A. Haghighirad, T.-L. Lee, M. Sing, R. Claessen, M. Le Tacon, J. Demsar, G. Schönhense, and O. Fedchenko	
Connecting High-Field and High-Pressure Superconductivity in UTe_2	096501
T. Vasina, D. Aoki, A. Miyake, G. Seyfarth, A. Pourret, C. Marcenat, M. Amano Patino, G. Lapertot, J. Flouquet, J.-P. Brison, D. Braithwaite, and G. Knebel	
Signature of Preformed Pairs in Angle-Resolved Photoemission Spectroscopy	096502
Klemen Kovač, Alberto Nocera, Andrea Damascelli, Janez Bonča, and Mona Berciu	
Decoherence through Ancilla Anyon Reservoirs	096503
Nayan Myerson-Jain, Taylor L. Hughes, and Cenke Xu	
Many-Body Effects on High-Harmonic Generation in Hubbard Ladders	096504
Yuta Murakami, Thomas Hansen, Shintaro Takayoshi, Lars Bojer Madsen, and Philipp Werner	
Characterizing Dynamic Hybridization of Majorana Zero Modes for Universal Quantum Computing	096601
Themba Hodge, Eric Mascot, Dan Crawford, and Stephan Rachel	
Unconventional Spin Hall Magnetoresistance in Noncollinear Antiferromagnet/Heavy-Metal Stacks	096701
Tomohiro Uchimura, Jiahao Han, Ping Tang, Ju-Young Yoon, Yutaro Takeuchi, Yuta Yamane, Shun Kanai, Gerrit E. W. Bauer, Hideo Ohno, and Shunsuke Fukami	

(Continued on Preceding Page)



This paper was highlighted in the APS publication *Physics* (physics.aps.org).

By suggesting a few manuscripts each week, we hope to promote reading across fields. Please see our Announcement Phys. Rev. Lett. 98, 010001 (2007)

	Satisfaction and Violation of the Fluctuation-Dissipation Relation in Spin Ice Materials	096702
	F. Morineau, V. Cathelin, P. C. W. Holdsworth, S. R. Giblin, G. Balakrishnan, K. Matsuhira, C. Paulsen, and E. Lhotel	
	Mirror Chern Bands and Weyl Nodal Loops in Altermagnets	096703
	Daniil S. Antonenko, Rafael M. Fernandes, and Jörn W. F. Venderbos	
	Exploring Single-Photon Recoil on Free Electrons	096901
	Alexander Preimesberger, Dominik Hornof, Theo Dorfner, Thomas Schachinger, Martin Hrtoň, Andrea Konečná, and Philipp Haslinger	
	Bound States in the Continuum in Cylindrical All-Dielectric Metasurface Cavities	096902
	Pietro Brugnolo, Samel Arslanagić, and Rasmus E. Jacobsen	
	Raman Forbidden Layer-Breathing Modes in Layered Semiconductor Materials Activated by Phonon and Optical Cavity Effects	096903
	Miao-Ling Lin, Jiang-Bin Wu, Xue-Lu Liu, Tao Liu, Rui Mei, Heng Wu, Shan Guan, Jia-Liang Xie, Jun-Wei Luo, Lin-Wang Wang, Andrea C. Ferrari, and Ping-Heng Tan	
	Eliminating Surface Oxides of Superconducting Circuits with Noble Metal Encapsulation	097001
	Ray D. Chang, Nana Shumiya, Russell A. McLellan, Yifan Zhang, Matthew P. Bland, Faranak Bahrami, Junsik Mun, Chenyu Zhou, Kim Kisslinger, Guangming Cheng, Basil M. Smitham, Alexander C. Pakpour-Tabrizi, Nan Yao, Yimei Zhu, Mingzhao Liu, Robert J. Cava, Sarang Gopalakrishnan, Andrew A. Houck, and Nathalie P. de Leon	
	Statistical Physics; Classical, Nonlinear, and Complex Systems	
	Computing Nonequilibrium Responses with Score-Shifted Stochastic Differential Equations	097101
	Jérémie Klinger and Grant M. Rotskoff	
	Effective Grand Canonical Description of Condensation in Negative-Temperature Regimes	097102
	Stefano Iubini and Antonio Politi	
	Classical Origins of Landau-Incompatible Transitions	097103
	Abhishodh Prakash and Nick G. Jones	
	Partial Yet Definite Emergence of the Kardar-Parisi-Zhang Class in Isotropic Spin Chains	097104
	Kazumasa A. Takeuchi, Kazuaki Takasan, Ofer Busani, Patrik L. Ferrari, Romain Vasseur, and Jacopo De Nardis	
	Flux Hypothesis for Odd Transport Phenomena	097105
	Cory Hargus, Alhad Deshpande, Ahmad K. Omar, and Kranthi K. Mandadapu	
	Polymers, Chemical Physics, Soft Matter, and Biological Physics	
	Mesoscopic Dynamics in Molecular Liquids: Universality of Nondispersive Structural Mode and Its Reflection in Self-Atomic Motions	098001
	Arantxa Arbe, Silvia Arrese-Igor, María Dolores Ruiz-Martín, Bela Farago, Fernando Alvarez, Gøran J. Nilsen, and Juan Colmenero	
	Diffusioosmotic Reversal of Colloidal Focusing Direction in a Microfluidic T-Junction	098201
	Haoyu Liu and Amir A. Pahlavan	
	Crack Propagation by Activated Avalanches during Creep and Fatigue from Elastic Interface Theory	098202
	Tero Mäkinen, Lumi Tuokkola, Joonas Lahikainen, Ivan V. Lomakin, Juha Koivisto, and Mikko J. Alava	
	Mechanistic Picture for the Slow Arrhenius Process in Glass Forming Systems: The Collective Small Displacements Model	098203
	Ronald P. White, Simone Napolitano, and Jane E. G. Lipson	
	Activity-Driven Emulsification of Phase-Separating Binary Mixtures	098301
	Javier Díaz and Ignacio Pagonabarraga	
	Hotter Is Not Faster for a Melting RNA Hairpin	098401
	Huaping Li, E. M. Bahçeci, M. Sayar, and A. Kabakçioğlu	
	Comments	
	Comment on “Absence of Topological Protection of the Interface States in $\mathbb{Z}_2$ Photonic Crystals”	099301
	Xing-Xiang Wang, Toshikaze Kariyado, and Xiao Hu	

(Continued on Preceding Page)

Contents (Continued)

Xu <i>et al.</i> Reply	099302
Shupeng Xu, Yuhui Wang, and Ritesh Agarwal	

Errata

Erratum: Centrality-Dependent Modification of Jet-Production Rates in Deuteron-Gold Collisions at $\sqrt{s_{NN}} = 200$ GeV [Phys. Rev. Lett. 116 , 122301 (2016)]	099901
A. Adare <i>et al.</i> (PHENIX Collaboration)	



This paper was highlighted in the APS publication *Physics* (physics.aps.org).
By suggesting a few manuscripts each week, we hope to promote reading across fields. Please see our Announcement Phys. Rev. Lett. 98, 010001 (2007).

Physics
spotlighting exceptional research

The American Physical Society's free online publication, *Physics* (physics.aps.org), provides thought-provoking analysis and spotlights exceptional research.