

## CONTENTS - *Continued*

| PHYSICAL REVIEW A                                                                                                                                     | THIRD SERIES, VOLUME 100, NUMBER 1 | JULY 2019 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------|
| Information-theoretical approach to the many-particle hierarchy problem (5 pages) . . . . .                                                           |                                    | 013854    |
| Boris Melcher, Boris Gulyak, and Jan Wiersig                                                                                                          |                                    |           |
| Critical phenomena and nonlinear dynamics in a spin ensemble strongly coupled to a cavity. I. Semiclassical approach (10 pages) . . . . .             |                                    | 013855    |
| Dmitry O. Krimer, Matthias Zens, and Stefan Rotter                                                                                                    |                                    |           |
| Critical phenomena and nonlinear dynamics in a spin ensemble strongly coupled to a cavity. II. Semiclassical-to-quantum boundary (11 pages) . . . . . |                                    | 013856    |
| Matthias Zens, Dmitry O. Krimer, and Stefan Rotter                                                                                                    |                                    |           |
| Solenoidal optical forces from a plasmonic Archimedean spiral (8 pages) . . . . .                                                                     |                                    | 013857    |
| Mohammad Asif Zaman, Punag Padhy, and Lambertus Hesselink                                                                                             |                                    |           |
| <b>COMMENTS</b>                                                                                                                                       |                                    |           |
| Comment on “Analysis of recent interpretations of the Abraham-Minkowski problem” (5 pages) . . . . .                                                  |                                    | 017801    |
| Mikko Partanen and Jukka Tulkki                                                                                                                       |                                    |           |
| Reply to “Comment on ‘Analysis of recent interpretations of the Abraham-Minkowski problem’ ” (2 pages) . . . . .                                      |                                    | 017802    |
| Iver Brevik                                                                                                                                           |                                    |           |
| <b>ERRATA</b>                                                                                                                                         |                                    |           |
| Erratum: Memory effect and non-Markovian dynamics in an open quantum system [Phys. Rev. A <b>99</b> , 052119 (2019)] (1 page) . . . . .               |                                    | 019901(E) |
| Fujing Liu, Xing-Xiang Zhou, and Zheng-Wei Zhou                                                                                                       |                                    |           |
| Erratum: Electron correlations in the antiproton energy-loss distribution in He [Phys. Rev. A <b>98</b> , 012707 (2018)] (2 pages) . . . . .          |                                    | 019902(E) |
| S. Borbély, X.-M. Tong, S. Nagele, J. Feist, I. Březinová, F. Lackner, L. Nagy, K. Tókési, and J. Burgdörfer                                          |                                    |           |

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                                                                                |        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Bloch-Messiah reduction for twin beams of light (17 pages) . . . . .                                                                                           | 013837 |
| D. B. Horoshko, L. La Volpe, F. Arzani, N. Treps, C. Fabre, and M. I. Kolobov                                                                                  |        |
| Simulating frustrated antiferromagnets with quadratically driven QED cavities (7 pages) . . . . .                                                              | 013838 |
| Riccardo Rota and Vincenzo Savona                                                                                                                              |        |
| Near-100% two-photon-like coincidence-visibility dip with classical light and the role of complementarity (10 pages) . . . . .                                 | 013839 |
| Simanraj Sadana, Debadrita Ghosh, Kaushik Joarder, A. Naga Lakshmi, Barry C. Sanders, and Urbasi Sinha                                                         |        |
| Transport and entanglement for single photons in optical waveguide ladders (13 pages) . . . . .                                                                | 013840 |
| Junhua Dong, Qian Jiang, Qingmei Hu, Bingsuo Zou, and Yongyou Zhang                                                                                            |        |
| Dynamical Lamb effect in a superconducting circuit (8 pages) . . . . .                                                                                         | 013841 |
| Mirko Amico, Oleg L. Berman, and Roman Ya. Kezerashvili                                                                                                        |        |
| Robustness of distributed nonclassicality against local Gaussian noise (10 pages) . . . . .                                                                    | 013842 |
| Sagnik Garai and J. Solomon Ivan                                                                                                                               |        |
| Steady-state population inversion of multiple $\Xi$ -type atoms by the squeezed vacuum in a waveguide (10 pages) . . . . .                                     | 013843 |
| Jieyu You, Zeyang Liao, and M. Suhail Zubairy                                                                                                                  |        |
| Coherent generation and manipulation of stationary light pulses encoded in degrees of freedom of polarization and orbital angular momentum (8 pages) . . . . . | 013844 |
| Tianhui Qiu, Hui Li, and Min Xie                                                                                                                               |        |
| Stochastic numerical simulations of a fully spatiotemporal Hong-Ou-Mandel dip (9 pages) . . . . .                                                              | 013845 |
| Fabrice Devaux, Alexis Mosset, and Eric Lantz                                                                                                                  |        |
| Second-order Talbot self-imaging effect in the time domain (7 pages) . . . . .                                                                                 | 013846 |
| Hong-Guo Li, Rui-Xue Zhang, Zhan-Dong Liu, and Zong-Guo Li                                                                                                     |        |
| ☞ Optimal pulse propagation in an inhomogeneously gas-filled hollow-core fiber (13 pages) . . . . .                                                            | 013847 |
| Roman Sulzbach, Thorsten Peters, and Reinhold Walser                                                                                                           |        |
| Heat-induced soliton self-frequency redshift in the ultrafast nonlinear dynamics of active plasmonic waveguides (6 pages) . . . . .                            | 013848 |
| Ambareesh Sahoo, Andrea Marini, and Samudra Roy                                                                                                                |        |
| Energy-flow velocities of nondiffracting localized waves (10 pages) . . . . .                                                                                  | 013849 |
| Peeter Saari, Ott Rebane, and Ioannis Besieris                                                                                                                 |        |
| ☞ Optical attenuation without absorption (8 pages) . . . . .                                                                                                   | 013850 |
| I. C. Nodurft, R. A. Brewster, T. B. Pittman, and J. D. Franson                                                                                                |        |
| Single-step quantum state engineering in traveling optical fields (9 pages) . . . . .                                                                          | 013851 |
| Gabor Mogyorosi, Peter Adam, Emese Molnar, and Matyas Mechler                                                                                                  |        |
| Multiphoton resonances in nitrogen-vacancy defects in diamond (8 pages) . . . . .                                                                              | 013852 |
| Sergei Masis, Nir Alfasi, Roei Levi, Oleg Shtempluck, and Eyal Buks                                                                                            |        |
| Sub-hertz optomechanically induced transparency with a kilogram-scale mechanical oscillator (9 pages) . . . . .                                                | 013853 |
| T. Bodiya, V. Sudhir, C. Wipf, N. Smith, A. Buikema, A. Kontos, H. Yu, and N. Mavalvala                                                                        |        |

(Continued)

# CONTENTS - *Continued*

| PHYSICAL REVIEW A                                                                                                                                         | THIRD SERIES, VOLUME 100, NUMBER 1 | JULY 2019 |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------|
| Transport of light through a dense ensemble of cold atoms in a static electric field (9 pages) . . . . .                                                  |                                    | 013821    |
| S. E. Skipetrov and I. M. Sokolov                                                                                                                         |                                    |           |
| Transfer of orbital angular momentum of light using electromagnetically induced transparency (5 pages) . . . . .                                          |                                    | 013822    |
| Hai-Hua Wang, Jing Wang, Zhi-Hui Kang, Lei Wang, Jin-Yue Gao, Yi Chen, and Xiao-Jun Zhang                                                                 |                                    |           |
| Role of generalized parity in the symmetry of the fluorescence spectrum from two-level systems under periodic frequency modulation (14 pages) . . . . .   |                                    | 013823    |
| Yiying Yan, Zhiguo Lü, JunYan Luo, and Hang Zheng                                                                                                         |                                    |           |
| Coupling quasi-phase-matching: Entanglement buildup in $\chi^{(2)}$ nonlinear-waveguide arrays (8 pages) . . . . .                                        |                                    | 013824    |
| David Barral, Nadia Belabas, Kamel Bencheikh, and Juan Ariel Levenson                                                                                     |                                    |           |
| Quantum phase transition and interference trapping of populations in a coupled-resonator waveguide (9 pages) . . . . .                                    |                                    | 013825    |
| Lei Qiao, Ya-Ju Song, and Chang-Pu Sun                                                                                                                    |                                    |           |
| Optomechanical heat transfer between molecules in a nanoplasmonic cavity (9 pages) . . . . .                                                              |                                    | 013826    |
| S. Mahmoud Ashrafi, R. Malekfar, A. R. Bahrapour, and Johannes Feist                                                                                      |                                    |           |
| Stern-Gerlach deflection of optical Thirring solitons in a coherent atomic system (8 pages) . . . . .                                                     |                                    | 013827    |
| Zhiming Chen, Hongqiang Xie, Qun Li, and Guoxiang Huang                                                                                                   |                                    |           |
| Rapid cooling of a strain-coupled oscillator by an optical phase-shift measurement (7 pages) . . . . .                                                    |                                    | 013828    |
| Signe Seidelin, Yann Le Coq, and Klaus Mølmer                                                                                                             |                                    |           |
| Optical-frequency-comb generation with collinear acousto-optic diffraction: Theory and simulations (14 pages) . . . . .                                   |                                    | 013829    |
| Sergey N. Mantsevich, Andrey S. Voloshin, and Konstantin B. Yushkov                                                                                       |                                    |           |
| Multiple-wavelength conversion based on the anomalous Doppler effect induced by dynamic tuning in a self-collimation photonic crystal (5 pages) . . . . . |                                    | 013830    |
| Xingping Zhou, Samit Kumar Gupta, Guangxu Su, Peng Zhan, Minghui Lu, and Zhenlin Wang                                                                     |                                    |           |
| Linear and quadratic reservoir engineering of non-Gaussian states (17 pages) . . . . .                                                                    |                                    | 013831    |
| Matteo Brunelli and Oussama Houhou                                                                                                                        |                                    |           |
| All-optical spin-orbit coupling of light using electromagnetically induced transparency (8 pages) . . . . .                                               |                                    | 013832    |
| Lu Zhao                                                                                                                                                   |                                    |           |
| Multiplexing heralded single photons in orbital-angular-momentum space (8 pages) . . . . .                                                                |                                    | 013833    |
| Shi-long Liu, Qiang Zhou, Zhi-yuan Zhou, Shi-kai Liu, Yan Li, Yin-hai Li, Chen Yang, Zhao-huai Xu, Guang-can Guo, and Bao-sen Shi                         |                                    |           |
| Generic singularities of scattering coefficients and a paradox of resonant wave scattering (7 pages) . . . . .                                            |                                    | 013834    |
| Yaroslav A. Brynkin and Michael I. Tribelsky                                                                                                              |                                    |           |
| Optical-force laws for guided light in linear media (7 pages) . . . . .                                                                                   |                                    | 013835    |
| Thales Fernando Damasceno Fernandes and Pierre-Louis de Assis                                                                                             |                                    |           |
| Self-focusing of multiple interacting Laguerre-Gauss beams in Kerr media (9 pages) . . . . .                                                              |                                    | 013836    |
| Lucas Sá and Jorge Vieira                                                                                                                                 |                                    |           |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                                                                                                                                                                                                                           |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Theory for cavity cooling of levitated nanoparticles via coherent scattering: Master equation approach (25 pages)<br>C. Gonzalez-Ballester, P. Maurer, D. Windey, L. Novotny, R. Reimann, and O. Romero-Isart                                                                                             | 013805 |
| Optical spatial dispersion in terms of Jones calculus (17 pages) .....<br>S. Yu. Nastyshyn, I. M. Bolesta, S. A. Tsybulia, E. Lychkovskyy, Z. Ya. Fedorovych, D. Ye. Khaustov,<br>Ye. Ryzhov, P. I. Vankevych, and Yu. A. Nastishin                                                                       | 013806 |
| Generation and dynamics of solitonic pulses due to pump amplitude modulation at normal group-velocity<br>dispersion (10 pages) .....<br>Valery E. Lobanov, Nikita M. Kondratiev, Artem E. Shitikov, Ramzil R. Galiev, and Igor A. Bilenko                                                                 | 013807 |
|  Probing photon statistics of coherent states by continuous wave mixing on a two-level system (5 pages) .....<br>A. Yu. Dmitriev, R. Shaikhaidarov, T. Hönigl-Decrinis, S. E. de Graaf, V. N. Antonov, and O. V. Astafiev | 013808 |
| Influence of higher-order stimulated Brillouin scattering on the occurrence of extreme events in self-pulsing fiber<br>lasers (7 pages) .....<br>Djamila Boukhaoui, Djouher Mallek, Abdelhamid Kellou, Hervé Leblond, François Sanchez, Thomas Godin,<br>and Ammar Hideur                                 | 013809 |
| Magnon heralding in cavity optomagnonics (15 pages) .....<br>Victor A. S. V. Bittencourt, Verena Feulner, and Silvia Viola Kusminski                                                                                                                                                                      | 013810 |
| Squeezed displaced entangled states in the quantum Rabi model (6 pages) .....<br>F. H. Maldonado-Villamizar, C. Huerta Alderete, and B. M. Rodríguez-Lara                                                                                                                                                 | 013811 |
| Multiple Fano interferences due to waveguide-mediated phase coupling between atoms (12 pages) .....<br>Debsuvra Mukhopadhyay and Girish S. Agarwal                                                                                                                                                        | 013812 |
| Selective and switchable optical amplification with mechanical driven oscillators (10 pages) .....<br>Tian-Xiang Lu, Ya-Feng Jiao, Hui-Lai Zhang, Farhan Saif, and Hui Jing                                                                                                                               | 013813 |
| Quantum enhancement of sensitivity achieved by photon-number-resolving detection in the dark port<br>of a two-path interferometer operating at high intensities (13 pages) .....<br>Jun-Yi Wu, Norifumi Toda, and Holger F. Hofmann                                                                       | 013814 |
| Effect of laser-frequency fluctuation on the decay rate of Rydberg coherence (9 pages) .....<br>Bongjune Kim, Ko-Tang Chen, Chia-Yu Hsu, Shih-Si Hsiao, Yu-Chih Tseng, Chin-Yuan Lee,<br>Shih-Lun Liang, Yi-Hua Lai, Julius Ruseckas, Gediminas Juzeliūnas, and Ite A. Yu                                 | 013815 |
| Two-mode Dicke model from nondegenerate polarization modes (7 pages) .....<br>Andrea Morales, Davide Dreon, Xiangliang Li, Alexander Baumgärtner, Philip Zupancic, Tobias Donner,<br>and Tilman Esslinger                                                                                                 | 013816 |
| Modification of a plasmonic nanoparticle lifetime by coupled quantum dots (8 pages) .....<br>Ahmad Salmanogli                                                                                                                                                                                             | 013817 |
| Stabilization of localized structures by inhomogeneous injection in Kerr resonators (9 pages) .....<br>Felix Tabbert, Tobias Frohoff-Hülsmann, Krassimir Panajotov, Mustapha Tlidi, and Svetlana V. Gurevich                                                                                              | 013818 |
| Quantum-induced birefringence in nonlinear optical materials (6 pages) .....<br>V. A. De Lorenci and L. H. Ford                                                                                                                                                                                           | 013819 |
| Quantum properties of light propagating in a coherent-population-oscillation storage medium (9 pages) .....<br>P. Neveu, F. Bretenaker, F. Goldfarb, and E. Brion                                                                                                                                         | 013820 |

(Continued)

|                                                                                                                                                                                  |        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Static-response theory and the roton-maxon spectrum of a flattened dipolar Bose-Einstein condensate (6 pages) . . . . .                                                          | 013620 |
| R. N. Bisset, P. B. Blakie, and S. Stringari                                                                                                                                     |        |
| Monitoring currents in cold-atom circuits (8 pages) . . . . .                                                                                                                    | 013621 |
| S. Safaei, L.-C. Kwek, R. Dumke, and L. Amico                                                                                                                                    |        |
| Observation of dynamical quantum phase transitions in a spinor condensate (6 pages) . . . . .                                                                                    | 013622 |
| H.-X. Yang, T. Tian, Y.-B. Yang, L.-Y. Qiu, H.-Y. Liang, A.-J. Chu, C. B. Dağ, Y. Xu, Y. Liu, and L.-M. Duan                                                                     |        |
| Exploring quantum signatures of chaos on a Floquet synthetic lattice (9 pages) . . . . .                                                                                         | 013623 |
| Eric J. Meier, Jackson Ang'ong'a, Fangzhao Alex An, and Bryce Gadway                                                                                                             |        |
| Towards a measurement of the Debye length in very large magneto-optical traps (11 pages) . . . . .                                                                               | 013624 |
| J. Barré, R. Kaiser, G. Labeyrie, B. Marcos, and D. Métivier                                                                                                                     |        |
| Quantum chaos in a Bose-Hubbard dimer with modulated tunneling (9 pages) . . . . .                                                                                               | 013625 |
| R. A. Kidd, M. K. Olsen, and J. F. Corney                                                                                                                                        |        |
| Controlled generation of dark-bright soliton complexes in two-component and spinor Bose-Einstein condensates (17 pages) . . . . .                                                | 013626 |
| A. Romero-Ros, G. C. Katsimiga, P. G. Kevrekidis, and P. Schmelcher                                                                                                              |        |
| Three-body constrained bosons in a double-well optical lattice (9 pages) . . . . .                                                                                               | 013627 |
| Suman Mondal, Sebastian Greschner, and Tapan Mishra                                                                                                                              |        |
| Many-body localization in continuum systems: Two-dimensional bosons (7 pages) . . . . .                                                                                          | 013628 |
| G. Bertoli, B. L. Altshuler, and G. V. Shlyapnikov                                                                                                                               |        |
| Glassy dynamics from quark confinement: Atomic quantum simulation of the gauge-Higgs model on a lattice (12 pages) . . . . .                                                     | 013629 |
| Jonghoon Park, Yoshihito Kuno, and Ikuo Ichinose                                                                                                                                 |        |
| Transverse instability and disintegration of a domain wall of a relative phase in coherently coupled two-component Bose-Einstein condensates (8 pages) . . . . .                 | 013630 |
| Kousuke Ihara and Kenichi Kasamatsu                                                                                                                                              |        |
| <b>Quantum optics, physics of lasers, nonlinear optics, classical optics</b>                                                                                                     |        |
| Mahaux-Weidenmüller approach to cavity quantum electrodynamics and complete resonant down-conversion of the single-photon frequency (15 pages) . . . . .                         | 013801 |
| M. Sumetsky                                                                                                                                                                      |        |
| Spatial control of spontaneous parametric down-conversion photon pairs through the use of apertured Bessel-Gauss pump beams (8 pages) . . . . .                                  | 013802 |
| Dalia Gutiérrez-López, Mónica Maldonado-Terrón, R. Josué Hernández, Verónica Vicuña-Hernández, Roberto Ramírez-Alarcón, Héctor Cruz-Ramírez, Rocío Jáuregui, and Alfred B. U'Ren |        |
| Perfect localization on flat-band binary one-dimensional photonic lattices (7 pages) . . . . .                                                                                   | 013803 |
| Gabriel Cáceres-Aravena and Rodrigo A. Vicencio                                                                                                                                  |        |
| Temporal coherence of a photon condensate: A quantum trajectory description (12 pages) . . . . .                                                                                 | 013804 |
| Wouter Verstraelen and Michiel Wouters                                                                                                                                           |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                                                              |        |
|----------------------------------------------------------------------------------------------------------------------------------------------|--------|
| ☞ Squeezed-field path-integral description of second sound in Bose-Einstein condensates ( <i>9 pages</i> ) . . . . .                         | 013602 |
| Ilias M. H. Seifie, Vijay Pal Singh, and L. Mathey                                                                                           |        |
| Few-boson localization in a continuum with speckle disorder ( <i>10 pages</i> ) . . . . .                                                    | 013603 |
| Pere Mujal, Artur Polls, Sebastiano Pilati, and Bruno Juliá-Díaz                                                                             |        |
| Finite-duration interaction quench in dilute attractively interacting Fermi gases: Emergence of preformed pairs ( <i>5 pages</i> ) . . . . . | 013604 |
| Johannes Kombe, Jean-Sébastien Bernier, Michael Köhl, and Corinna Kollath                                                                    |        |
| Anyon optics with time-of-flight two-particle interference of double-well-trapped interacting ultracold atoms ( <i>9 pages</i> ) . . . . .   | 013605 |
| Constantine Yannouleas and Uzi Landman                                                                                                       |        |
| Recurrence times of the small-size Lieb-Liniger Bose gas in the weak- and strong-coupling regimes ( <i>8 pages</i> ) . . .                   | 013606 |
| Eriko Kaminishi and Takashi Mori                                                                                                             |        |
| Simulation of the quantum dynamics of indistinguishable bosons with the method of coupled coherent states ( <i>15 pages</i> ) . . . . .      | 013607 |
| James A. Green and Dmitrii V. Shalashilin                                                                                                    |        |
| ☞ Stable production of a strongly interacting Bose-Einstein condensate via mode matching ( <i>7 pages</i> ) . . . . .                        | 013608 |
| E. J. Halperin, M. W. C. Sze, J. P. Corson, and J. L. Bohn                                                                                   |        |
| Pathway toward the formation of supermixed states in ultracold boson mixtures loaded in ring lattices ( <i>11 pages</i> ) . . . . .          | 013609 |
| Andrea Richaud and Vittorio Penna                                                                                                            |        |
| Probing quantum chaos in many-body quantum systems by the induced dissipation ( <i>5 pages</i> ) . . . . .                                   | 013610 |
| Anna A. Bychek, Pavel S. Muraev, and Andrey R. Kolovsky                                                                                      |        |
| Superfluid–Mott-insulator transition of ultracold superradiant bosons in a cavity ( <i>15 pages</i> ) . . . . .                              | 013611 |
| Rui Lin, Luca Papariello, Paolo Mognini, R. Chitra, and Axel U. J. Lode                                                                      |        |
| Pair formation in quenched unitary Bose gases ( <i>9 pages</i> ) . . . . .                                                                   | 013612 |
| S. Musolino, V. E. Colussi, and S. J. J. M. F. Kokkelmans                                                                                    |        |
| Nonequilibrium time evolution and rephasing in the quantum sine-Gordon model ( <i>21 pages</i> ) . . . . .                                   | 013613 |
| D. X. Horváth, I. Lovas, M. Kormos, G. Takács, and G. Zaránd                                                                                 |        |
| Three-body repulsive forces among identical bosons in one dimension ( <i>8 pages</i> ) . . . . .                                             | 013614 |
| M. Valiente                                                                                                                                  |        |
| Light propagation in systems involving two-dimensional atomic lattices ( <i>19 pages</i> ) . . . . .                                         | 013616 |
| Juha Javanainen and Renuka Rajapakse                                                                                                         |        |
| Two-component lattice bosons with cavity-mediated long-range interaction ( <i>9 pages</i> ) . . . . .                                        | 013617 |
| Xin Guan, Jingtao Fan, Xiaofan Zhou, Gang Chen, and Suotang Jia                                                                              |        |
| Parallel multicomponent interferometer with a spinor Bose-Einstein condensate ( <i>8 pages</i> ) . . . . .                                   | 013618 |
| Pengju Tang, Peng Peng, Zhihan Li, Xuzong Chen, Xiaopeng Li, and Xiaoji Zhou                                                                 |        |
| Effective approach to impurity dynamics in one-dimensional trapped Bose gases ( <i>12 pages</i> ) . . . . .                                  | 013619 |
| S. I. Mistakidis, A. G. Volosniev, N. T. Zinner, and P. Schmelcher                                                                           |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                                                                                                                                                           |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Measurements of $^{27}\text{Al}^+$ and $^{25}\text{Mg}^+$ magnetic constants for improved ion-clock accuracy (7 pages) . . . . .                                                                                                          | 013409 |
| S. M. Brewer, J.-S. Chen, K. Beloy, A. M. Hankin, E. R. Clements, C. W. Chou, W. F. McGrew, X. Zhang, R. J. Fasano, D. Nicolodi, H. Leopardi, T. M. Fortier, S. A. Diddams, A. D. Ludlow, D. J. Wineland, D. R. Leibrandt, and D. B. Hume |        |
| Multiring electrostatic guide for Rydberg positronium (12 pages) . . . . .                                                                                                                                                                | 013410 |
| M. H. Rayment, L. Gurung, R. E. Sheldon, S. D. Hogan, and D. B. Cassidy                                                                                                                                                                   |        |
| Controllable chip-based beam splitter for cold polar molecules (5 pages) . . . . .                                                                                                                                                        | 013411 |
| Xueyan Xu, Tao Yang, Shunyong Hou, and Jianping Yin                                                                                                                                                                                       |        |
| Contribution of Floquet-Bloch states to high-order harmonic generation in solids (11 pages) . . . . .                                                                                                                                     | 013412 |
| Jian-Zhao Jin, Hao Liang, Xiang-Ru Xiao, Mu-Xue Wang, Si-Ge Chen, Xiao-Yuan Wu, Qihuang Gong, and Liang-You Peng                                                                                                                          |        |
| Tuning nonthermal distributions to thermal ones in time-dependent Paul traps (18 pages) . . . . .                                                                                                                                         | 013413 |
| H. Landa                                                                                                                                                                                                                                  |        |
| Strong-field ionization of Ar atoms with a $45^\circ$ cross-linearly-polarized two-color laser field (6 pages) . . . . .                                                                                                                  | 013414 |
| Yiqi Fang, Chaoxiong He, Meng Han, Peipei Ge, Xiaoyang Yu, Xueyan Ma, Yongkai Deng, and Yunquan Liu                                                                                                                                       |        |
| Multiorbital and excitation effects on dissociative double ionization of CO molecules in strong circularly polarized laser fields (8 pages) . . . . .                                                                                     | 013415 |
| Xiaokai Li, Jiaqi Yu, Huiying Xu, Xitao Yu, Yizhang Yang, Zhenzhen Wang, Pan Ma, Chuncheng Wang, Fuming Guo, Yujun Yang, Sizuo Luo, and Dajun Ding                                                                                        |        |
| Evidence for cooling in an optical lattice by amplitude modulation (5 pages) . . . . .                                                                                                                                                    | 013416 |
| M. Arnal, V. Brunaud, G. Chatelain, C. Cabrera-Gutiérrez, E. Michon, P. Cheiney, J. Billy, and D. Guéry-Odelin                                                                                                                            |        |
|  Relativistic effects in the multiphoton ionization of hydrogenlike ions by ultrashort infrared laser pulses (8 pages) . . . . .                        | 013417 |
| Charles J. Joachain and Niels J. Kylstra                                                                                                                                                                                                  |        |
| Near-threshold photodetachment microscopy in the presence of a transverse magnetic field (13 pages) . . . . .                                                                                                                             | 013418 |
| K. Titimbo, X. J. Chen, and M. L. Du                                                                                                                                                                                                      |        |
| Application of the time-dependent surface flux method to the time-dependent multiconfiguration self-consistent-field method (8 pages) . . . . .                                                                                           | 013419 |
| Yuki Orimo, Takeshi Sato, and Kenichi L. Ishikawa                                                                                                                                                                                         |        |
| Atomic measurements of high-intensity VHF-band radio-frequency fields with a Rydberg vapor-cell detector (8 pages) . . . . .                                                                                                              | 013420 |
| Eric Paradis, Georg Raithel, and David A. Anderson                                                                                                                                                                                        |        |
| Entanglement and coherence in photoionization of $\text{H}_2$ by an ultrashort XUV laser pulse (12 pages) . . . . .                                                                                                                       | 013421 |
| Takanori Nishi, Erik Lötstedt, and Kaoru Yamanouchi                                                                                                                                                                                       |        |
| Coherence control in high-order harmonic generation with Laguerre-Gaussian beams (9 pages) . . . . .                                                                                                                                      | 013422 |
| Willi Paufler, Birger Böning, and Stephan Fritzsche                                                                                                                                                                                       |        |
| <b>Matter waves and collective properties of cold atoms and molecules</b>                                                                                                                                                                 |        |
| Interaction-driven topological switch in a $P$ -band honeycomb lattice (8 pages) . . . . .                                                                                                                                                | 013601 |
| Hua Chen and X. C. Xie                                                                                                                                                                                                                    |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                                                                                                                                               |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Model for investigating quantum reflection and quantum coherence in ultracold molecular collisions ( <i>10 pages</i> ) . . . . .                                                                                              | 012705 |
| Yan-Peng Bai, Jing-Lun Li, Gao-Ren Wang, and Shu-Lin Cong                                                                                                                                                                     |        |
| Two-center dielectronic recombination in slow atomic collisions ( <i>8 pages</i> ) . . . . .                                                                                                                                  | 012706 |
| A. Jacob, C. Müller, and A. B. Voitkiv                                                                                                                                                                                        |        |
| Spin asymmetry in electron-impact ionization ( <i>5 pages</i> ) . . . . .                                                                                                                                                     | 012707 |
| I. Bray, D. V. Fursa, A. S. Kadyrov, A. Müller, A. Borovik, Jr., and S. Schippers                                                                                                                                             |        |
| Resonance electron interaction with five-membered heterocyclic compounds: Vibrational Feshbach resonances and hydrogen-atom stripping ( <i>14 pages</i> ) . . . . .                                                           | 012708 |
| Stanislav A. Pshenichnyuk, Ilya I. Fabrikant, Alberto Modelli, Sylwia Ptasińska, and Alexei S. Komolov                                                                                                                        |        |
| Universality in a one-dimensional three-body system ( <i>14 pages</i> ) . . . . .                                                                                                                                             | 012709 |
| Lucas Happ, Matthias Zimmermann, Santiago I. Betelu, Wolfgang P. Schleich, and Maxim A. Efremov                                                                                                                               |        |
| Comparative experimental and theoretical study on electron scattering by propane ( <i>9 pages</i> ) . . . . .                                                                                                                 | 012710 |
| W. Y. Baek, T. Braunroth, M. U. Bug, F. Heimbach, H. Nettelbeck, and H. Rabus                                                                                                                                                 |        |
| Low-energy scattering properties of ground-state and excited-state positronium collisions ( <i>10 pages</i> ) . . . . .                                                                                                       | 012711 |
| Michael D. Higgins, Kevin M. Daily, and Chris H. Greene                                                                                                                                                                       |        |
| Multicenter distorted-wave approach for electron-impact ionization of molecules ( <i>8 pages</i> ) . . . . .                                                                                                                  | 012712 |
| Esam Ali and Don Madison                                                                                                                                                                                                      |        |
| <b>Atomic and molecular processes in external fields, including interactions with strong fields and short pulses</b>                                                                                                          |        |
| Cold, dense, atomic ion clouds produced by cryogenic buffer-gas cooling ( <i>3 pages</i> ) . . . . .                                                                                                                          | 013401 |
| Nishant Bhatt, Kosuke Kato, and Amar C. Vutha                                                                                                                                                                                 |        |
| Theoretical evidence for the sensitivity of charge-rearrangement-enhanced x-ray ionization to molecular size ( <i>9 pages</i> ) . . . . .                                                                                     | 013402 |
| Yajiang Hao (郝亚江), Ludger Inhester, Sang-Kil Son (손상길), and Robin Santra                                                                                                                                                      |        |
| Charge dynamics of a molecular ion immersed in a Rydberg-dressed atomic lattice gas ( <i>8 pages</i> ) . . . . .                                                                                                              | 013403 |
| Rick Mukherjee                                                                                                                                                                                                                |        |
| Correlation enhancement of high-order harmonic generation in Xe ( <i>6 pages</i> ) . . . . .                                                                                                                                  | 013404 |
| Alexander W. Bray, David Freeman, Sebastian Eckart, and Anatoli S. Kheifets                                                                                                                                                   |        |
| Three-dimensional spin-dependent dynamics in linearly polarized standing-wave fields ( <i>9 pages</i> ) . . . . .                                                                                                             | 013405 |
| Yongsheng Fu, Yu Liu, Chunhui Wang, Jiaolong Zeng, and Jianmin Yuan                                                                                                                                                           |        |
| Short- and long-term gain dynamics in $N_2^+$ air lasing ( <i>8 pages</i> ) . . . . .                                                                                                                                         | 013406 |
| Mathew Britton, Marianna Lytova, Patrick Laferrière, Peng Peng, Felipe Morales, Dong Hyuk Ko, Maria Richter, Pavel Polynkin, D. M. Villeneuve, Chunmei Zhang, Misha Ivanov, Michael Spanner, Ladan Arissian, and P. B. Corkum |        |
| Time-resolved buildup of two-slit-type interference from a single atom ( <i>10 pages</i> ) . . . . .                                                                                                                          | 013407 |
| Jonas Wätzel, Andrew James Murray, and Jamal Berakdar                                                                                                                                                                         |        |
| High-intensity two-frequency photoassociation spectroscopy of a weakly bound molecular state: Theory and experiment ( <i>11 pages</i> ) . . . . .                                                                             | 013408 |
| W. Y. Kon, J. A. Aman, J. C. Hill, T. C. Killian, and Kaden R. A. Hazzard                                                                                                                                                     |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                                                                                                                                                                               |        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Existence of the finite hydrogenic molecular chain $H_3$ and ion $H_2^-$ in a strong magnetic field (5 pages) . . . . .                                                                                                                                       | 012508 |
| D. J. Nader, J. C. López Vieyra, and A. V. Turbiner                                                                                                                                                                                                           |        |
| Approximating one-matrix functionals without generalized Pauli constraints (6 pages) . . . . .                                                                                                                                                                | 012509 |
| Oleg V. Gritsenko and Katarzyna Pernal                                                                                                                                                                                                                        |        |
|  QED theory of the specific mass shift in few-electron atoms (12 pages) . . . . .                                                                                              | 012510 |
| A. V. Malyshev, I. S. Anisimova, D. V. Mironova, V. M. Shabaev, and G. Plunien                                                                                                                                                                                |        |
| High-resolution measurements of $Cl^{15+}$ line shifts in hot, solid-density plasmas (5 pages) . . . . .                                                                                                                                                      | 012511 |
| P. Beiersdorfer, G. V. Brown, A. McKelvey, R. Shepherd, D. J. Hoarty, C. R. D. Brown, M. P. Hill,<br>L. M. R. Hobbs, S. F. James, J. Morton, and L. Wilson                                                                                                    |        |
|  Effect of vibrational excitation and spin-rotation coupling on Stern-Gerlach experiments:<br>A detailed case study on $GdSn_{15}$ as an asymmetric rotor (10 pages) . . . . . | 012512 |
| Thomas M. Fuchs and Rolf Schäfer                                                                                                                                                                                                                              |        |
| Nonrelativistic quantum electrodynamic Hamiltonian and photon-exchange interaction up to $m\alpha^8$ order (11 pages) . . . . .                                                                                                                               | 012513 |
| Wanping Zhou, Xuesong Mei, and Haoxue Qiao                                                                                                                                                                                                                    |        |
| Maxwell eigenmode approach to the Casimir-Lifshitz torque (15 pages) . . . . .                                                                                                                                                                                | 012514 |
| Wijnand Broer, John Yuh Han Liow, and Bing-Sui Lu                                                                                                                                                                                                             |        |
| Autoionization rates of core-excited magnesium Rydberg atoms in electric fields using the core fluorescence<br>as a reference (8 pages) . . . . .                                                                                                             | 012515 |
| D. Wehrli, M. Génévriez, and F. Merkt                                                                                                                                                                                                                         |        |
| (Spin-)density-functional theory for open-shell systems: Exact magnetization density functional for the half-filled<br>Hubbard trimer (10 pages) . . . . .                                                                                                    | 012516 |
| Carsten A. Ullrich                                                                                                                                                                                                                                            |        |
| Bethe logarithm for the helium atom (6 pages) . . . . .                                                                                                                                                                                                       | 012517 |
| Vladimir I. Korobov                                                                                                                                                                                                                                           |        |
| Optimal supercritical potentials for the electron-positron pair-creation rate (9 pages) . . . . .                                                                                                                                                             | 012518 |
| J. Unger, S. Dong, Q. Su, and R. Grobe                                                                                                                                                                                                                        |        |

## PART B

### Atomic and molecular collisions and interactions

|                                                                                                                                                              |        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| s-wave contacts of quantum gases in quasi-one-dimensional and quasi-two-dimensional traps (5 pages) . . . . .                                                | 012701 |
| Mingyuan He and Qi Zhou                                                                                                                                      |        |
| Effect of cascade transitions on the polarization of light emitted after electron-impact excitation of Zn<br>by spin-polarized electrons (7 pages) . . . . . | 012702 |
| K. Bartschat, O. Zatsarinny, C. J. Bostock, D. V. Fursa, I. Bray, and A. N. Grum-Grzhimailo                                                                  |        |
| Bare-carbon-ion-impact electron emission from adenine molecules: Differential and total cross-section<br>measurements (10 pages) . . . . .                   | 012703 |
| Shamik Bhattacharjee, Chandan Bagdia, Madhusree Roy Chowdhury, Anuvab Mandal, J. M. Monti,<br>Roberto D. Rivarola, and Lokesh C. Tribedi                     |        |
| Quasi-one-dimensional ultracold rigid-rotor collisions: Reactive and nonreactive cases (10 pages) . . . . .                                                  | 012704 |
| R. Vexiau, J.-M. Launay, and A. Simoni                                                                                                                       |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                                                                                                                                                                                                                                                                                 |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Superunsteerability as a quantifiable resource for random access codes assisted by Bell-diagonal states ( <i>10 pages</i> )<br>C. Jebarathinam, Debarshi Das, Som Kanjilal, R. Srikanth, Debasis Sarkar, Indrani Chattopadhyay,<br>and A. S. Majumdar                                                                                                           | 012344 |
| Efficient Bayesian credible-region certification for quantum-state tomography ( <i>18 pages</i> ) .....<br>Changhun Oh, Yong Siah Teo, and Hyunseok Jeong                                                                                                                                                                                                       | 012345 |
| Adaptive compressive tomography: A numerical study ( <i>11 pages</i> ) .....<br>D. Ahn, Y. S. Teo, H. Jeong, D. Koutný, J. Řeháček, Z. Hradil, G. Leuchs, and L. L. Sánchez-Soto                                                                                                                                                                                | 012346 |
| Einstein-Podolsky-Rosen entanglement between separated atomic ensembles ( <i>8 pages</i> ) .....<br>Wei Zhang, Ming-Xin Dong, Dong-Sheng Ding, Shuai Shi, Kai Wang, Shi-Long Liu, Zhi-Yuan Zhou,<br>Guang-Can Guo, and Bao-Sen Shi                                                                                                                              | 012347 |
| Local equivalence of qudit color codes and toric codes ( <i>21 pages</i> ) .....<br>Arun B. Alosious and Pradeep Kiran Sarvepalli                                                                                                                                                                                                                               | 012348 |
| Operator coherence dynamics in Grover's quantum search algorithm ( <i>10 pages</i> ) .....<br>Minghua Pan and Daowen Qiu                                                                                                                                                                                                                                        | 012349 |
| Quantum process tomography via optimal design of experiments ( <i>16 pages</i> ) .....<br>Yonatan Gazit, Hui Khoon Ng, and Jun Suzuki                                                                                                                                                                                                                           | 012350 |
| Simulating all quantum measurements using only projective measurements and postselection ( <i>11 pages</i> ) .....<br>Michał Oszmaniec, Filip B. Maciejewski, and Zbigniew Puchała                                                                                                                                                                              | 012351 |
| <b>Atomic and molecular structure and dynamics; high-precision measurements</b>                                                                                                                                                                                                                                                                                 |        |
| Precision measurement of the ionization energy and quantum defects of $^{39}\text{K I}$ ( <i>12 pages</i> ) .....<br>Michael Peper, Felix Helmrich, Jonas Butscher, Josef Anton Agner, Hansjürg Schmutz, Frédéric Merkt,<br>and Johannes Deiglmayr                                                                                                              | 012501 |
| Frequency shifts in noble-gas comagnetometers ( <i>6 pages</i> ) .....<br>W. A. Terrano, J. Meinel, N. Sachdeva, T. E. Chupp, S. Degenkolb, P. Fierlinger, F. Kuchler, and J. T. Singh                                                                                                                                                                          | 012502 |
| Isotopic variation of parity violation in atomic ytterbium: Description of the measurement method and analysis<br>of systematic effects ( <i>22 pages</i> ) .....<br>D. Antypas, A. M. Fabricant, J. E. Stalnaker, K. Tsigutkin, V. V. Flambaum, and D. Budker                                                                                                  | 012503 |
| Reevaluation of the nuclear electric quadrupole moment for $^{87}\text{Sr}$ by hyperfine structures and relativistic atomic<br>theory ( <i>8 pages</i> ) .....<br>Benquan Lu, Tingxian Zhang, Hong Chang, Jiguang Li, Yong Wu, and Jianguo Wang                                                                                                                 | 012504 |
| Self-interaction-free electric dipole polarizabilities for atoms and their ions using the Fermi-Löwdin<br>self-interaction correction ( <i>7 pages</i> ) .....<br>Kushantha P. K. Withanage, Sharmin Akter, Chandra Shahi, Rajendra P. Joshi, Carlos Diaz, Yoh Yamamoto,<br>Rajendra Zope, Tunna Baruah, John P. Perdew, Juan E. Peralta, and Koblar A. Jackson | 012505 |
| Recombination process for the hydrogen atom in the presence of blackbody radiation ( <i>7 pages</i> ) .....<br>D. Solov'yev, T. Zaliutdinov, A. Anikin, J. Triaskin, and L. Labzowsky                                                                                                                                                                           | 012506 |
| Double-minimum $3\ ^1\Sigma_u^+$ state in $\text{Rb}_2$ : Spectroscopic study and possible applications for cold-physics<br>experiments ( <i>7 pages</i> ) .....<br>A. Pashov, P. Kowalczyk, and W. Jastrzebski                                                                                                                                                 | 012507 |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                                                                                                             |        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Production of photonic universal quantum gates enhanced by machine learning ( <i>10 pages</i> ) . . . . .                                                                                   | 012326 |
| Krishna Kumar Sabapathy, Haoyu Qi, Josh Izaac, and Christian Weedbrook                                                                                                                      |        |
|  Maximum advantage of quantum illumination ( <i>5 pages</i> ) . . . . .                                     | 012327 |
| Shannon Ray, James Schneeloch, Christopher C. Tison, and Paul M. Alsing                                                                                                                     |        |
| Optimal measurement strategies for fast entanglement detection ( <i>12 pages</i> ) . . . . .                                                                                                | 012328 |
| N. Milazzo, D. Braun, and O. Giraud                                                                                                                                                         |        |
| Searching nonadiabatic holonomic quantum gates via an optimization algorithm ( <i>12 pages</i> ) . . . . .                                                                                  | 012329 |
| Feihao Zhang, Jiang Zhang, Pan Gao, and Guilu Long                                                                                                                                          |        |
| Modified belief propagation decoders for quantum low-density parity-check codes ( <i>21 pages</i> ) . . . . .                                                                               | 012330 |
| Alex Rigby, J. C. Olivier, and Peter Jarvis                                                                                                                                                 |        |
| Error reduction of quantum algorithms ( <i>6 pages</i> ) . . . . .                                                                                                                          | 012331 |
| Debajyoti Bera and Tharmashastha P.V.                                                                                                                                                       |        |
| Deterministic conversions between Greenberger-Horne-Zeilinger states and $W$ states of spin qubits<br>via Lie-transform-based inverse Hamiltonian engineering ( <i>12 pages</i> ) . . . . . | 012332 |
| Yi-Hao Kang, Zhi-Cheng Shi, Bi-Hua Huang, Jie Song, and Yan Xia                                                                                                                             |        |
| Faithful measure of quantum non-Gaussianity via quantum relative entropy ( <i>5 pages</i> ) . . . . .                                                                                       | 012333 |
| Jiyong Park, Jaehak Lee, Kyunghyun Baek, Se-Wan Ji, and Hyunchul Nha                                                                                                                        |        |
| Building quantum neural networks based on a swap test ( <i>9 pages</i> ) . . . . .                                                                                                          | 012334 |
| Jian Zhao, Yuan-Hang Zhang, Chang-Peng Shao, Yu-Chun Wu, Guang-Can Guo, and Guo-Ping Guo                                                                                                    |        |
| Measure of not-completely-positive qubit maps: The general case ( <i>5 pages</i> ) . . . . .                                                                                                | 012336 |
| Vinayak Jagadish, R. Srikanth, and Francesco Petruccione                                                                                                                                    |        |
| Entropy, purity, and fidelity in Majorana phase space ( <i>11 pages</i> ) . . . . .                                                                                                         | 012337 |
| Ria Rushin Joseph, Laura E. C. Rosales-Zárate, and Peter D. Drummond                                                                                                                        |        |
| Universal quantum computation in the surface code using non-Abelian islands ( <i>13 pages</i> ) . . . . .                                                                                   | 012338 |
| Katharina Laubscher, Daniel Loss, and James R. Wootton                                                                                                                                      |        |
| Fast and high-fidelity generation of steady-state entanglement using pulse modulation and parametric<br>amplification ( <i>11 pages</i> ) . . . . .                                         | 012339 |
| Ye-Hong Chen, Wei Qin, and Franco Nori                                                                                                                                                      |        |
| Noise in boson sampling and the threshold of efficient classical simulatability ( <i>14 pages</i> ) . . . . .                                                                               | 012340 |
| V. S. Shchesnovich                                                                                                                                                                          |        |
| Floquet-engineered quantum state manipulation in a noisy qubit ( <i>10 pages</i> ) . . . . .                                                                                                | 012341 |
| Eric Boyers, Mohit Pandey, David K. Campbell, Anatoli Polkovnikov, Dries Sels, and Alexander O. Sushkov                                                                                     |        |
| Multiplexed spin-wave-photon entanglement source using temporal multimode memories and<br>feedforward-controlled readout ( <i>8 pages</i> ) . . . . .                                       | 012342 |
| Yafei Wen, Pai Zhou, Zhongxiao Xu, Liang Yuan, Haoyi Zhang, Shengzhi Wang, Long Tian,<br>Shujing Li, and Hai Wang                                                                           |        |
| Protocol of a quantum walk in circuit QED ( <i>6 pages</i> ) . . . . .                                                                                                                      | 012343 |
| Jia-Qi Zhou, Ling Cai, Qi-Ping Su, and Chui-Ping Yang                                                                                                                                       |        |

(Continued)

# CONTENTS - *Continued*

| PHYSICAL REVIEW A                                                                                                                                                                     | THIRD SERIES, VOLUME 100, NUMBER 1 | JULY 2019 |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|-----------|
| Class of genuinely high-dimensionally-entangled states with a positive partial transpose (7 pages) . . . . .                                                                          |                                    | 012310    |
| Károly F. Pál and Tamás Vértesi                                                                                                                                                       |                                    |           |
| Decoding the three-dimensional toric codes and welded codes on cubic lattices (18 pages) . . . . .                                                                                    |                                    | 012311    |
| Abhishek Kulkarni and Pradeep Kiran Sarvepalli                                                                                                                                        |                                    |           |
| Three-dimensional surface codes: Transversal gates and fault-tolerant architectures (20 pages) . . . . .                                                                              |                                    | 012312    |
| Michael Vasmer and Dan E. Browne                                                                                                                                                      |                                    |           |
| Practical security of continuous-variable quantum key distribution with reduced optical attenuation (9 pages) . . . .                                                                 |                                    | 012313    |
| Yi Zheng, Peng Huang, Anqi Huang, Jinye Peng, and Guihua Zeng                                                                                                                         |                                    |           |
| Discerning quantum memories based on electromagnetically-induced-transparency and Autler-Townes-splitting protocols (15 pages) . . . . .                                              |                                    | 012314    |
| Anindya Rastogi, Erhan Saglamyurek, Taras Hrushevskyi, Scott Hubele, and Lindsay J. LeBlanc                                                                                           |                                    |           |
| $l_1$ -norm coherence of assistance (6 pages) . . . . .                                                                                                                               |                                    | 012315    |
| Ming-Jing Zhao, Teng Ma, Quan Quan, Heng Fan, and Rajesh Pereira                                                                                                                      |                                    |           |
| Quantum hacking of free-space continuous-variable quantum key distribution by using a machine-learning technique (11 pages) . . . . .                                                 |                                    | 012316    |
| Wenti Huang, Yiyu Mao, Cailang Xie, and Duan Huang                                                                                                                                    |                                    |           |
| Entanglement fluctuation theorems (20 pages) . . . . .                                                                                                                                |                                    | 012317    |
| Álvaro M. Alhambra, Lluís Masanes, Jonathan Oppenheim, and Christopher Perry                                                                                                          |                                    |           |
| Engineering asymmetric steady-state Einstein-Podolsky-Rosen steering in macroscopic hybrid systems (10 pages)                                                                         |                                    | 012318    |
| Xinyao Huang, Emil Zeuthen, Qihuang Gong, and Qiongyi He                                                                                                                              |                                    |           |
| Device-independent quantum secret sharing in arbitrary even dimensions (9 pages) . . . . .                                                                                            |                                    | 012319    |
| Sarbani Roy and Sourav Mukhopadhyay                                                                                                                                                   |                                    |           |
| Simulations of subatomic many-body physics on a quantum frequency processor (17 pages) . . . . .                                                                                      |                                    | 012320    |
| Hsuan-Hao Lu, Natalie Klco, Joseph M. Lukens, Titus D. Morris, Aaina Bansal, Andreas Ekström, Gaute Hagen, Thomas Papenbrock, Andrew M. Weiner, Martin J. Savage, and Pavel Lougovski |                                    |           |
| Continuous-variable entangled states of light carrying orbital angular momentum (7 pages) . . . . .                                                                                   |                                    | 012321    |
| A. Pecoraro, F. Cardano, L. Marrucci, and A. Porzio                                                                                                                                   |                                    |           |
| Four-spin cross relaxation in a hybrid quantum device (7 pages) . . . . .                                                                                                             |                                    | 012322    |
| Cheng Ma, Zhiling Wang, Yukai Wu, Zenghui Bao, Yipu Song, Hongyi Zhang, and Luming Duan                                                                                               |                                    |           |
| Optimal measurements for quantum fidelity between Gaussian states and its relevance to quantum metrology (10 pages) . . . . .                                                         |                                    | 012323    |
| Changhun Oh, Changhyoup Lee, Leonardo Banchi, Su-Yong Lee, Carsten Rockstuhl, and Hyunseok Jeong                                                                                      |                                    |           |
| Effects of decoherence on diabatic errors in Majorana braiding (7 pages) . . . . .                                                                                                    |                                    | 012324    |
| Zhen-Tao Zhang, Feng Mei, Xiang-Guo Meng, Bao-Long Liang, and Zhen-Shan Yang                                                                                                          |                                    |           |
| Free-space continuous-variable quantum key distribution of unidimensional Gaussian modulation using polarized coherent states in an urban environment (8 pages) . . . . .             |                                    | 012325    |
| Shi-Yang Shen, Ming-Wei Dai, Xue-Tao Zheng, Qi-Yao Sun, Guang-Can Guo, and Zheng-Fu Han                                                                                               |                                    |           |

(Continued)

|                                                                                                                                                                              |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Non-Abelian geometric phases in periodically driven systems ( <i>9 pages</i> ) . . . . .                                                                                     | 012127 |
| Viktor Novičenko and Gediminas Juzeliūnas                                                                                                                                    |        |
| All-creation and all-annihilation time-dependent $\mathcal{PT}$ -symmetric bosonic Hamiltonians: An infinite squeezing degree at a finite time ( <i>11 pages</i> ) . . . . . | 012128 |
| M. A. de Ponte, F. S. Luiz, O. S. Duarte, and M. H. Y. Moussa                                                                                                                |        |
| Active energy transport and the role of symmetry breaking in microscopic power grids ( <i>11 pages</i> ) . . . . .                                                           | 012129 |
| Julian Huber and Peter Rabl                                                                                                                                                  |        |
| Dynamical model for positive-operator-valued measures ( <i>9 pages</i> ) . . . . .                                                                                           | 012130 |
| A. De Pasquale, C. Foti, A. Cuccoli, V. Giovannetti, and P. Verrucchi                                                                                                        |        |
| Quantum reciprocity relations for fluctuations of position and momentum ( <i>7 pages</i> ) . . . . .                                                                         | 012131 |
| Mahasweta Pandit, Anindita Bera, Aditi Sen(De), and Ujjwal Sen                                                                                                               |        |
| Analog of Hamilton-Jacobi theory for the time-evolution operator ( <i>16 pages</i> ) . . . . .                                                                               | 012132 |
| Michael Vogl, Pontus Laurell, Aaron D. Barr, and Gregory A. Fiete                                                                                                            |        |
| Quantum synchronization in a collision model ( <i>11 pages</i> ) . . . . .                                                                                                   | 012133 |
| G. Karpat, İ. Yalçinkaya, and B. Çakmak                                                                                                                                      |        |
| Excitation energy transfer with initial system-bath correlations for coherent initial conditions in a toy donor-acceptor model ( <i>21 pages</i> ) . . . . .                 | 012134 |
| M. Qin, H. T. Cui, C. Y. Wang, Y. Q. Xu, and X. X. Yi                                                                                                                        |        |
| <b>Quantum information</b>                                                                                                                                                   |        |
| Operation and intrinsic error budget of a two-qubit cross-resonance gate ( <i>21 pages</i> ) . . . . .                                                                       | 012301 |
| Vinay Tripathi, Mostafa Khezri, and Alexander N. Korotkov                                                                                                                    |        |
| One-out-of- $m$ spacetime-constrained oblivious transfer ( <i>20 pages</i> ) . . . . .                                                                                       | 012302 |
| Damián Pitalúa-García                                                                                                                                                        |        |
| Engineering fidelity of the generalized Pauli channels via legitimate memory kernels ( <i>10 pages</i> ) . . . . .                                                           | 012303 |
| Katarzyna Siudzińska and Dariusz Chruściński                                                                                                                                 |        |
| Quantum algorithms for training Gaussian processes ( <i>5 pages</i> ) . . . . .                                                                                              | 012304 |
| Zhikuan Zhao, Jack K. Fitzsimons, Michael A. Osborne, Stephen J. Roberts, and Joseph F. Fitzsimons                                                                           |        |
| Experimental study of Shor's factoring algorithm using the IBM Q Experience ( <i>9 pages</i> ) . . . . .                                                                     | 012305 |
| Mirko Amico, Zain H. Saleem, and Muir Kumph                                                                                                                                  |        |
| Continuous-time quantum walks on dynamic graphs ( <i>13 pages</i> ) . . . . .                                                                                                | 012306 |
| Rebekah Herrman and Travis S. Humble                                                                                                                                         |        |
| Microwave-to-optical conversion via four-wave mixing in a cold ytterbium ensemble ( <i>9 pages</i> ) . . . . .                                                               | 012307 |
| Jacob P. Covey, Alp Sipahigil, and Mark Saffman                                                                                                                              |        |
| Indistinguishability-enabled coherence for quantum metrology ( <i>6 pages</i> ) . . . . .                                                                                    | 012308 |
| Alessia Castellini, Rosario Lo Franco, Ludovico Lami, Andreas Winter, Gerardo Adesso, and Giuseppe Compagno                                                                  |        |
| Description of composite bosons in discrete models ( <i>9 pages</i> ) . . . . .                                                                                              | 012309 |
| Paula Céspedes, Elena Rufeil-Fiori, P. Alexander Bouvrie, Ana P. Majtey, and Cecilia Cormick                                                                                 |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                                                                                                                            |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Resonant shortcuts for adiabatic rapid passage with only $z$ -field control ( <i>12 pages</i> ) . . . . .                                                                                                  | 012111 |
| Dionisis Stefanatos and Emmanuel Paspalakis                                                                                                                                                                |        |
| Phase-dependent topological interface state and spatial adiabatic passage in a generalized Su-Schrieffer-Heeger model ( <i>9 pages</i> ) . . . . .                                                         | 012112 |
| Lei Du, Jin-Hui Wu, M. Artoni, and G. C. La Rocca                                                                                                                                                          |        |
| Single-world consistent interpretation of quantum mechanics from fundamental time and length uncertainties ( <i>12 pages</i> ) . . . . .                                                                   | 012113 |
| Rodolfo Gambini, Luis Pedro García-Pintos, and Jorge Pullin                                                                                                                                                |        |
| Compatibility of causal hidden-variable theories with a delayed-choice experiment ( <i>7 pages</i> ) . . . . .                                                                                             | 012114 |
| He-Liang Huang, Yi-Han Luo, B. Bai, Y.-H. Deng, H. Wang, Q. Zhao, H.-S. Zhong, Y.-Q. Nie, W.-H. Jiang, X.-L. Wang, Jun Zhang, Li Li, Nai-Le Liu, Tim Byrnes, J. P. Dowling, Chao-Yang Lu, and Jian-Wei Pan |        |
| Realization of a causal-modeled delayed-choice experiment using single photons ( <i>7 pages</i> ) . . . . .                                                                                                | 012115 |
| Shang Yu, Yong-Nan Sun, Wei Liu, Zhao-Di Liu, Zhi-Jin Ke, Yi-Tao Wang, Jian-Shun Tang, Chuan-Feng Li, and Guang-Can Guo                                                                                    |        |
| Binary discrimination in two-level quantum systems via hypothesis testing ( <i>6 pages</i> ) . . . . .                                                                                                     | 012116 |
| Beili Gong and Wei Cui                                                                                                                                                                                     |        |
| Dynamical chaotic phases and constrained quantum dynamics ( <i>10 pages</i> ) . . . . .                                                                                                                    | 012117 |
| André M. Timpanaro, Sascha Wald, Fernando Semião, and Gabriel T. Landi                                                                                                                                     |        |
| Synchronous measurement of inertial rotation and magnetic field using a K-Rb- $^{21}\text{Ne}$ comagnetometer ( <i>7 pages</i> ) . . . . .                                                                 | 012118 |
| Wei Quan, Kai Wei, Tian Zhao, Hairong Li, and Yueyang Zhai                                                                                                                                                 |        |
| Testing collapse models with levitated nanoparticles: Detection challenge ( <i>13 pages</i> ) . . . . .                                                                                                    | 012119 |
| A. Vinante, A. Pontin, M. Rashid, M. Toroš, P. F. Barker, and H. Ulbricht                                                                                                                                  |        |
| Non-Markovianity, information backflow, and system-environment correlation for open-quantum-system processes ( <i>16 pages</i> ) . . . . .                                                                 | 012120 |
| Yun-Yi Hsieh, Zheng-Yao Su, and Hsi-Sheng Goan                                                                                                                                                             |        |
| Ruling out the class of statistical processes involving two noninteracting identical particles in two modes ( <i>6 pages</i> ) . . . . .                                                                   | 012121 |
| S. Aravinda                                                                                                                                                                                                |        |
| Maxwell quantum mechanics ( <i>8 pages</i> ) . . . . .                                                                                                                                                     | 012122 |
| Margaret Hawton                                                                                                                                                                                            |        |
| Local measurement uncertainties impose a limit on nonlocal quantum correlations ( <i>8 pages</i> ) . . . . .                                                                                               | 012123 |
| Holger F. Hofmann                                                                                                                                                                                          |        |
| Wigner current for open quantum systems ( <i>10 pages</i> ) . . . . .                                                                                                                                      | 012124 |
| William F. Braasch, Jr., Oscar D. Friedman, Alexander J. Rimberg, and Miles P. Blencowe                                                                                                                    |        |
| Weak value amplification for nonunitary evolution ( <i>6 pages</i> ) . . . . .                                                                                                                             | 012125 |
| Wei-Tao Liu, Julián Martínez-Rincón, and John C. Howell                                                                                                                                                    |        |
| Swift heat transfer by fast-forward driving in open quantum systems ( <i>15 pages</i> ) . . . . .                                                                                                          | 012126 |
| Tamiro Villazon, Anatoli Polkovnikov, and Anushya Chandran                                                                                                                                                 |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 100, NUMBER 1

JULY 2019

|                                                                                                              |           |
|--------------------------------------------------------------------------------------------------------------|-----------|
| Time fractals and discrete scale invariance with trapped ions ( <i>4 pages</i> ) . . . . .                   | 011403(R) |
| Dean Lee, Jacob Watkins, Dillon Frame, Gabriel Given, Rongzheng He,<br>Ning Li, Bing-Nan Lu, and Avik Sarkar |           |

## Quantum optics, physics of lasers, nonlinear optics, classical optics

|                                                                                                                                      |           |
|--------------------------------------------------------------------------------------------------------------------------------------|-----------|
| Dual-frequency spin-resonance spectroscopy of diamond nitrogen-vacancy centers in zero magnetic field ( <i>5 pages</i> ) . . . . .   | 011801(R) |
| A. K. Dmitriev, H. Y. Chen, G. D. Fuchs, and A. K. Vershovskii                                                                       |           |
| Effective breaking of the action-reaction principle using spatial solitons ( <i>6 pages</i> ) . . . . .                              | 011802(R) |
| Alessandro Alberucci, Chandroth P. Jisha, Ulf Peschel, and Stefan Nolte                                                              |           |
| Resonant nonlinear refraction of 4.3- $\mu\text{m}$ light in CO <sub>2</sub> gas ( <i>6 pages</i> ) . . . . .                        | 011803(R) |
| J. J. Pigeon, D. Tovey, S. Ya. Tochitsky, G. J. Louwrens, I. Ben-Zvi, D. Martyshkin,<br>V. Fedorov, K. Karki, S. Mirov, and C. Joshi |           |

## ARTICLES

### Fundamental concepts

|                                                                                                                                                                       |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Role of information backflow in the emergence of quantum Darwinism ( <i>7 pages</i> ) . . . . .                                                                       | 012101 |
| Nadia Milazzo, Salvatore Lorenzo, Mauro Paternostro, and G. Massimo Palma                                                                                             |        |
| Nonlocality distillation and quantum voids ( <i>8 pages</i> ) . . . . .                                                                                               | 012102 |
| S. G. A. Brito, M. G. M. Moreno, A. Rai, and R. Chaves                                                                                                                |        |
| Pulse engineering for population control under dephasing and dissipation ( <i>7 pages</i> ) . . . . .                                                                 | 012103 |
| I. Medina and F. L. Semião                                                                                                                                            |        |
| Threshold effects in electron-positron pair creation from the vacuum: Stabilization and longitudinal versus transverse momentum sharing ( <i>10 pages</i> ) . . . . . | 012104 |
| K. Krajewska and J. Z. Kamiński                                                                                                                                       |        |
| Chirality from quantum walks without a quantum coin ( <i>19 pages</i> ) . . . . .                                                                                     | 012105 |
| Giacomo Mauro D'Ariano, Marco Erba, and Paolo Perinotti                                                                                                               |        |
| Robustness of quantum-enhanced adaptive phase estimation ( <i>17 pages</i> ) . . . . .                                                                                | 012106 |
| Pantita Palittapongarnpim and Barry C. Sanders                                                                                                                        |        |
| Open-quantum-system dynamics: Recovering positivity of the Redfield equation via the partial secular approximation ( <i>14 pages</i> ) . . . . .                      | 012107 |
| Donato Farina and Vittorio Giovannetti                                                                                                                                |        |
| Twisted localized solutions of the Dirac equation: Hopfionlike states of relativistic electrons ( <i>5 pages</i> ) . . . . .                                          | 012108 |
| Iwo Białynicki-Birula and Zofia Białynicka-Birula                                                                                                                     |        |
| Toward ultrahigh sensitivity in weak-value amplification ( <i>6 pages</i> ) . . . . .                                                                                 | 012109 |
| Jingzheng Huang, Yanjia Li, Chen Fang, Hongjing Li, and Guihua Zeng                                                                                                   |        |
| Optimal quantum optical control of spin in diamond ( <i>12 pages</i> ) . . . . .                                                                                      | 012110 |
| Jiazhao Tian, Tianyi Du, Yu Liu, Haibin Liu, Fangzhou Jin, Ressa S. Said, and Jianming Cai                                                                            |        |

(Continued)

*The Table of Contents is a total listing of Parts A and B.  
Part A consists of pages 010101(R)–012518, and Part B pages 012701–019902(E).*

## PART A

### RAPID COMMUNICATIONS

#### Fundamental concepts

- Understanding detailed balance for an electron-radiation system through mixed quantum-classical electrodynamics (6 pages) . . . . . 010101(R)  
Hsing-Ta Chen, Tao E. Li, Abraham Nitzan, and Joseph E. Subotnik
- Eternal life of entropy in non-Hermitian quantum systems (7 pages) . . . . . 010102(R)  
Andreas Fring and Thomas Frith

#### Quantum information

- Robust fault tolerance for continuous-variable cluster states with excess antisqueezing (5 pages) . . . . . 010301(R)  
Blayne W. Walshe, Lucas J. Mensen, Ben Q. Baragiola, and Nicolas C. Menicucci
- Experimental error mitigation via symmetry verification in a variational quantum eigensolver (6 pages) . . . . . 010302(R)  
R. Sagastizabal, X. Bonet-Monroig, M. Singh, M. A. Rol, C. C. Bultink, X. Fu, C. H. Price, V. P. Ostroukh,  
N. Muthusubramanian, A. Bruno, M. Beekman, N. Haider, T. E. O'Brien, and L. DiCarlo

#### Atomic and molecular structure and dynamics; high-precision measurements

- Dipolar and scalar  $^3\text{He}$ - $^{129}\text{Xe}$  frequency shifts in stemless cells (5 pages) . . . . . 010501(R)  
M. E. Limes, N. Dural, M. V. Romalis, E. L. Foley, T. W. Kornack, A. Nelson, L. R. Grisham, and J. Vaara
- QED radiative corrections to the  $^2P_{1/2}$ - $^2P_{3/2}$  fine structure in fluorinelike ions (5 pages) . . . . . 010502(R)  
A. V. Volotka, M. Bilal, R. Beerwerth, X. Ma, Th. Stöhlker, and S. Fritzsche

#### Atomic and molecular processes in external fields, including interactions with strong fields and short pulses

- Fluorescence polarization as a precise tool for understanding nonsequential many-photon ionization (6 pages) . . . 011401(R)  
J. Hofbrucker, A. V. Volotka, and S. Fritzsche
- Probing nonlocal spatial correlations in quantum gases with ultra-long-range Rydberg molecules (5 pages) . . . . . 011402(R)  
J. D. Whalen, S. K. Kanungo, R. Ding, M. Wagner, R. Schmidt, H. R. Sadeghpour, S. Yoshida,  
J. Burgdörfer, F. B. Dunning, and T. C. Killian



Copyright 2019 by American Physical Society

(Continued)



2469-9926(201907)100:1:B;1-Z

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

The editors and referees of PRA find these papers to be of particular interest, importance, or clarity. Please see our Announcement Phys. Rev. A 88, 020001 (2013).