

*The Table of Contents is a total listing of Parts A and B.  
Part A consists of pages 030301(R)–032511, and Part B pages 032701–039901(E).*

## PART A

### RAPID COMMUNICATIONS

#### Quantum information

- Robust Mølmer-Sørensen gate for neutral atoms using rapid adiabatic Rydberg dressing (7 pages) . . . . . 030301(R)  
Anupam Mitra, Michael J. Martin, Grant W. Biedermann, Alberto M. Marino, Pablo M. Poggi,  
and Ivan H. Deutsch

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

- Polarization-dependent high-intensity Kapitza-Dirac effect in strong laser fields (6 pages) . . . . . 031401(R)  
Birger Böning, Willi Paufler, and Stephan Fritzsche

#### Matter waves and collective properties of cold atoms and molecules

- Emission of correlated jets from a driven matter-wave soliton in a quasi-one-dimensional geometry (5 pages) . . . . . 031601(R)  
Tadej Mežnaršič, Rok Žitko, Tina Arh, Katja Gosar, Erik Zupanič, and Peter Jeglič

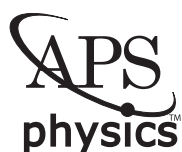
#### Quantum optics, physics of lasers, nonlinear optics, classical optics

- Tuning between photon-number and quadrature measurements with weak-field homodyne detection (5 pages) . . . . . 031801(R)  
G. S. Thekkadath, D. S. Phillips, J. F. F. Bulmer, W. R. Clements, A. Eckstein, B. A. Bell, J. Lugani,  
T. A. W. Wolterink, A. Lita, S. W. Nam, T. Gerrits, C. G. Wade, and I. A. Walmsley

## ARTICLES

#### Fundamental concepts

- Experimental investigation of entropic uncertainty relations and coherence uncertainty relations (6 pages) . . . . . 032101  
Zhi-Yong Ding, Huan Yang, Dong Wang, Hao Yuan, Jie Yang, and Liu Ye
- Aharonov-Bohm effect for bound states from the interaction of the magnetic quadrupole moment of a neutral particle with axial fields (6 pages) . . . . . 032102  
S. L. R. Vieira and K. Bakke
- Helstrom measurement: A nondestructive implementation (6 pages) . . . . . 032103  
Rui Han, Gerd Leuchs, and János A. Bergou



Copyright 2020 by American Physical Society



2469-9926(202003)101:3:B;1-5

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 101, NUMBER 3

MARCH 2020

|                                                                                                                                                            |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Linking invariant for the quench dynamics of a two-dimensional two-band Chern insulator ( <i>9 pages</i> ) . . . . .                                       | 032104 |
| Xin Chen, Ce Wang, and Jinlong Yu                                                                                                                          |        |
| Supersymmetry shielding the scaling symmetry of conformal quantum mechanics ( <i>9 pages</i> ) . . . . .                                                   | 032105 |
| J. V. S. Scursulim, A. A. Lima, U. Camara da Silva, and G. M. Sotkov                                                                                       |        |
| Certified quantum measurement of Majorana fermions ( <i>12 pages</i> ) . . . . .                                                                           | 032106 |
| Abu Ashik Md. Irfan, Karl Mayer, Gerardo Ortiz, and Emanuel Knill                                                                                          |        |
| Decoherence framework for Wigner's-friend experiments ( <i>22 pages</i> ) . . . . .                                                                        | 032107 |
| Armando Relaño                                                                                                                                             |        |
| Possible signals in differentiating the quantum radiation reaction from the classical one ( <i>8 pages</i> ) . . . . .                                     | 032108 |
| X. B. Li, B. Qiao, Y. L. Liao, J. Wang, L. F. Gan, C. T. Zhou, S. P. Zhu, and X. T. He                                                                     |        |
| Quasi-inversion of qubit channels ( <i>9 pages</i> ) . . . . .                                                                                             | 032109 |
| Vahid Karimipour, Fabio Benatti, and Roberto Floreanini                                                                                                    |        |
| Boltzmann entropy for quantum field systems ( <i>8 pages</i> ) . . . . .                                                                                   | 032110 |
| Kyo Yoshida                                                                                                                                                |        |
| Coherent confinement and unidirectional dynamics of a wave packet induced by a non-Hermitian<br>Su-Schrieffer-Heeger segment ( <i>10 pages</i> ) . . . . . | 032111 |
| K. L. Zhang and Z. Song                                                                                                                                    |        |
| Two-qubit quantum probes for the temperature of an Ohmic environment ( <i>8 pages</i> ) . . . . .                                                          | 032112 |
| Francesca Gebbia, Claudia Benedetti, Fabio Benatti, Roberto Floreanini,<br>Matteo Bina, and Matteo G. A. Paris                                             |        |
| Counterintuitive role of geometry in transport by quantum walks ( <i>8 pages</i> ) . . . . .                                                               | 032113 |
| J. Mareš, J. Novotný, M. Štefaňák, and I. Jex                                                                                                              |        |
| Bayesian multiparameter quantum metrology with limited data ( <i>10 pages</i> ) . . . . .                                                                  | 032114 |
| Jesús Rubio and Jacob Dunningham                                                                                                                           |        |
| Enhancement in the performance of a quantum battery by ordered and disordered interactions ( <i>11 pages</i> ) . . . . .                                   | 032115 |
| Srijon Ghosh, Titas Chanda, and Aditi Sen(De)                                                                                                              |        |
| Validity of many-mode Floquet theory with commensurate frequencies ( <i>11 pages</i> ) . . . . .                                                           | 032116 |
| A. N. Poertner and J. D. D. Martin                                                                                                                         |        |
| Position and spin in relativistic quantum mechanics ( <i>19 pages</i> ) . . . . .                                                                          | 032117 |
| Liping Zou, Pengming Zhang, and Alexander J. Silenko                                                                                                       |        |
| Quantum-clustered two-photon walks ( <i>10 pages</i> ) . . . . .                                                                                           | 032118 |
| David S. Simon, Shuto Osawa, and Alexander V. Sergienko                                                                                                    |        |
| Spectral magnetization ratchets with discrete-time quantum walks ( <i>10 pages</i> ) . . . . .                                                             | 032119 |
| A. Mallick, M. V. Fistul, P. Kaczynska, and S. Flach                                                                                                       |        |
| Controlling one-way quantum steering in a modulated optomechanical system ( <i>7 pages</i> ) . . . . .                                                     | 032120 |
| Chang-Geng Liao, Hong Xie, Rong-Xin Chen, Ming-Yong Ye, and Xiu-Min Lin                                                                                    |        |

(Continued)

**Quantum information**

|                                                                                                                                                                      |        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Multipartite entanglement measure and complete monogamy relation ( <i>17 pages</i> ) . . . . .                                                                       | 032301 |
| Yu Guo and Lin Zhang                                                                                                                                                 |        |
| Verification of high-dimensional entanglement generated in quantum interference ( <i>9 pages</i> ) . . . . .                                                         | 032302 |
| Yuanyuan Chen, Sebastian Ecker, Jessica Bavaresco, Thomas Scheidl, Lixiang Chen,<br>Fabian Steinlechner, Marcus Huber, and Rupert Ursin                              |        |
| Quantum state reduction: Generalized bipartitions from algebras of observables ( <i>41 pages</i> ) . . . . .                                                         | 032303 |
| Oleg Kabernik, Jason Pollack, and Ashmeet Singh                                                                                                                      |        |
| Quantum Boltzmann machine algorithm with dimension-expanded equivalent Hamiltonian ( <i>15 pages</i> ) . . . . .                                                     | 032304 |
| Tailong Xiao, Dongyun Bai, Jianping Fan, and Guihua Zeng                                                                                                             |        |
| Steered quantum coherence as a signature of quantum phase transitions in spin chains ( <i>8 pages</i> ) . . . . .                                                    | 032305 |
| Ming-Liang Hu, Yun-Yue Gao, and Heng Fan                                                                                                                             |        |
| Sub-shot-noise-limited fiber-optic quantum receiver ( <i>5 pages</i> ) . . . . .                                                                                     | 032306 |
| M. L. Shcherbatenko, M. S. Elezov, G. N. Goltsman, and D. V. Sych                                                                                                    |        |
| Quantum algorithm for solving linear differential equations: Theory and experiment ( <i>13 pages</i> ) . . . . .                                                     | 032307 |
| Tao Xin, Shijie Wei, Jianlian Cui, Junxiang Xiao, Iñigo Arrazola, Lucas Lamata,<br>Xiangyu Kong, Dawei Lu, Enrique Solano, and Guilu Long                            |        |
| ☞ Circuit-centric quantum classifiers ( <i>8 pages</i> ) . . . . .                                                                                                   | 032308 |
| Maria Schuld, Alex Bocharov, Krysta M. Svore, and Nathan Wiebe                                                                                                       |        |
| Conditional probability distributions of finite absorbing quantum walks ( <i>13 pages</i> ) . . . . .                                                                | 032309 |
| Parker Kuklinski                                                                                                                                                     |        |
| Encoding of matrix product states into quantum circuits of one- and two-qubit gates ( <i>7 pages</i> ) . . . . .                                                     | 032310 |
| Shi-Ju Ran                                                                                                                                                           |        |
| Collective optimization for variational quantum eigensolvers ( <i>8 pages</i> ) . . . . .                                                                            | 032311 |
| Dan-Bo Zhang and Tao Yin                                                                                                                                             |        |
| High-dimensional entanglement between a photon and a multiplexed atomic quantum memory ( <i>9 pages</i> ) . . . . .                                                  | 032312 |
| C. Li, Y.-K. Wu, W. Chang, S. Zhang, Y.-F. Pu, N. Jiang, and L.-M. Duan                                                                                              |        |
| Combining the synergistic control capabilities of modeling and experiments: Illustration of finding<br>a minimum-time quantum objective ( <i>6 pages</i> ) . . . . . | 032313 |
| Qi-Ming Chen, Xiaodong Yang, Christian Arenz, Re-Bing Wu, Xinhua Peng, István Pelczer,<br>and Herschel Rabitz                                                        |        |
| Measuring the similarity of graphs with a Gaussian boson sampler ( <i>11 pages</i> ) . . . . .                                                                       | 032314 |
| Maria Schuld, Kamil Brádler, Robert Israel, Daiqin Su, and Brajesh Gupta                                                                                             |        |
| Progress towards practical qubit computation using approximate Gottesman-Kitaev-Preskill codes ( <i>31 pages</i> ) . . . .                                           | 032315 |
| Ilan Tzitrin, J. Eli Bourassa, Nicolas C. Menicucci, and Krishna Kumar Sabapathy                                                                                     |        |
| Discriminating bipartite mixed states by local operations ( <i>11 pages</i> ) . . . . .                                                                              | 032316 |
| Jin-Hua Zhang, Fu-Lin Zhang, Zhi-Xi Wang, Le-Min Lai, and Shao-Ming Fei                                                                                              |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 101, NUMBER 3

MARCH 2020

|                                                                                                                                                                                                      |        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Analytical percolation theory for topological color codes under qubit loss ( <i>14 pages</i> ) . . . . .                                                                                             | 032317 |
| David Amaro, Jemma Bennett, Davide Vodola, and Markus Müller                                                                                                                                         |        |
| Three-tangle of a general three-qubit state in the representation of Majorana stars ( <i>8 pages</i> ) . . . . .                                                                                     | 032318 |
| Chon-Fai Kam and Ren-Bao Liu                                                                                                                                                                         |        |
| Phase-coding quantum-key-distribution system based on Sagnac–Mach–Zehnder interferometers ( <i>6 pages</i> ) . . . . .                                                                               | 032319 |
| Xiao-Tian Song, Dong Wang, Xiao-Ming Lu, Da-Jun Huang, Di Jiang, Li-Xian Li, Xi Fang, Yi-Bo Zhao, and Liang-Jiang Zhou                                                                               |        |
| Mesoscopic spin systems as quantum entanglers ( <i>19 pages</i> ) . . . . .                                                                                                                          | 032320 |
| Maryam Sadat Mirkamali and David G. Cory                                                                                                                                                             |        |
| Scalable quantum tomography with fidelity estimation ( <i>11 pages</i> ) . . . . .                                                                                                                   | 032321 |
| Jun Wang, Zhao-Yu Han, Song-Bo Wang, Zeyang Li, Liang-Zhu Mu, Heng Fan, and Lei Wang                                                                                                                 |        |
| Flexible scheme for the implementation of nonadiabatic geometric quantum computation ( <i>16 pages</i> ) . . . . .                                                                                   | 032322 |
| Yi-Hao Kang, Zhi-Cheng Shi, Bi-Hua Huang, Jie Song, and Yan Xia                                                                                                                                      |        |
| Variational quantum algorithms for dimensionality reduction and classification ( <i>11 pages</i> ) . . . . .                                                                                         | 032323 |
| Jin-Min Liang, Shu-Qian Shen, Ming Li, and Lei Li                                                                                                                                                    |        |
| Mediator-assisted cooling in quantum annealing ( <i>8 pages</i> ) . . . . .                                                                                                                          | 032324 |
| M. Pino and J. J. García-Ripoll                                                                                                                                                                      |        |
| Quantum algorithms for disordered physics ( <i>5 pages</i> ) . . . . .                                                                                                                               | 032325 |
| Andrei Alexandru, Paulo F. Bedaque, and Scott Lawrence                                                                                                                                               |        |
| Optimizing short stabilizer codes for asymmetric channels ( <i>20 pages</i> ) . . . . .                                                                                                              | 032326 |
| Alex Rigby, J. C. Olivier, and Peter Jarvis                                                                                                                                                          |        |
| Robust inference of memory structure for efficient quantum modeling of stochastic processes ( <i>9 pages</i> ) . . . . .                                                                             | 032327 |
| Matthew Ho, Mile Gu, and Thomas J. Elliott                                                                                                                                                           |        |
| Characterizing quantum correlations in a fixed-input $n$ -local network scenario ( <i>10 pages</i> ) . . . . .                                                                                       | 032328 |
| Kaushiki Mukherjee, Biswajit Paul, and Arup Roy                                                                                                                                                      |        |
| Implementing a multi-target-qubit controlled-NOT gate with logical qubits outside a decoherence-free subspace and its application in creating quantum entangled states ( <i>13 pages</i> ) . . . . . | 032329 |
| Chui-Ping Yang, Qi-Ping Su, Yu Zhang, and Franco Nori                                                                                                                                                |        |
| Theory of robust multiqubit nonadiabatic gates for trapped ions ( <i>14 pages</i> ) . . . . .                                                                                                        | 032330 |
| Yotam Shapira, Ravid Shaniv, Tom Manovitz, Nitzan Akerman, Lee Peleg, Lior Gazit, Roei Ozeri, and Ady Stern                                                                                          |        |
| Operational characterization of incompatibility of quantum channels with quantum state discrimination ( <i>7 pages</i> ) . . . . .                                                                   | 032331 |
| Junki Mori                                                                                                                                                                                           |        |
| Verifiable hybrid secret sharing with few qubits ( <i>15 pages</i> ) . . . . .                                                                                                                       | 032332 |
| Victoria Lipinska, Gláucia Murta, Jérémy Ribeiro, and Stephanie Wehner                                                                                                                               |        |
| Fault-tolerant quantum error correction on near-term quantum processors using flag and bridge qubits ( <i>11 pages</i> ) . . . . .                                                                   | 032333 |
| Lingling Lao and Carmen G. Almudever                                                                                                                                                                 |        |

(Continued)

|                                                                                                                                                       |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Quantum soft filtering for the improved security analysis of the coherent one-way quantum-key-distribution protocol ( <i>7 pages</i> ) . . . . .      | 032334 |
| D. A. Kronberg, A. S. Nikolaeva, Y. V. Kurochkin, and A. K. Fedorov                                                                                   |        |
| Enhancement of spontaneous entanglement generation via coherent quantum feedback ( <i>7 pages</i> ) . . . . .                                         | 032335 |
| Bin Zhang, Sujian You, and Mei Lu                                                                                                                     |        |
| Continuous-time quantum walks on planar lattices and the role of the magnetic field ( <i>26 pages</i> ) . . . . .                                     | 032336 |
| Luca Razzoli, Matteo G. A. Paris, and Paolo Bordone                                                                                                   |        |
| Boundary-induced effect encoded in the corrections to the geometric phase acquired by a bipartite two-level system ( <i>13 pages</i> ) . . . . .      | 032337 |
| Ludmila Viotti, Fernando C. Lombardo, and Paula I. Villar                                                                                             |        |
| Neural ensemble decoding for topological quantum error-correcting codes ( <i>8 pages</i> ) . . . . .                                                  | 032338 |
| Milap Sheth, Sara Zafar Jafarzadeh, and Vlad Gheorghiu                                                                                                |        |
| Quantum algorithm for spectral projection by measuring an ancilla iteratively ( <i>17 pages</i> ) . . . . .                                           | 032339 |
| Yanzhu Chen and Tzu-Chieh Wei                                                                                                                         |        |
| High-dimensional quantum key distribution based on mutually partially unbiased bases ( <i>8 pages</i> ) . . . . .                                     | 032340 |
| Fumin Wang, Pei Zeng, Jiapeng Zhao, Boris Braverman, Yiyu Zhou, Mohammad Mirhosseini, Xiaoli Wang, Hong Gao, Fuli Li, Robert W. Boyd, and Pei Zhang   |        |
| Classical analog of the quantum marginal problem ( <i>6 pages</i> ) . . . . .                                                                         | 032341 |
| Olga Leskovanová and Ladislav Mišta, Jr.                                                                                                              |        |
| Concurrence of multiqubit bound entangled states constructed from unextendible product bases ( <i>10 pages</i> ) . . . . .                            | 032342 |
| Mohamed Nawareg                                                                                                                                       |        |
| ☞ Verifying multipartite entangled Greenberger-Horne-Zeilinger states via multiple quantum coherences ( <i>10 pages</i> ) . . . . .                   | 032343 |
| Ken X. Wei, Isaac Lauer, Srikanth Srinivasan, Neereja Sundaresan, Douglas T. McClure, David Toyli, David C. McKay, Jay M. Gambetta, and Sarah Sheldon |        |
| Monogamy relations for the generalized $W$ -class states beyond qubits ( <i>11 pages</i> ) . . . . .                                                  | 032344 |
| Xian Shi and Lin Chen                                                                                                                                 |        |
| Entanglement of microwave-optical modes in a strongly coupled electro-optomechanical system ( <i>9 pages</i> ) . . . . .                              | 032345 |
| Changchun Zhong, Xu Han, Hong X. Tang, and Liang Jiang                                                                                                |        |
| Depth optimization of quantum search algorithms beyond Grover's algorithm ( <i>12 pages</i> ) . . . . .                                               | 032346 |
| Kun Zhang and Vladimir E. Korepin                                                                                                                     |        |
| Limited-control metrology approaching the Heisenberg limit without entanglement preparation ( <i>11 pages</i> ) . . . . .                             | 032347 |
| Benedikt Tratzmiller, Qiong Chen, Ilai Schwartz, Susana F. Huelga, and Martin B. Plenio                                                               |        |
| Experimental realization of a local-to-global noise transition in a two-qubit optical simulator ( <i>7 pages</i> ) . . . . .                          | 032348 |
| Claudia Benedetti, Valeria Vento, Stefano Olivares, Matteo G. A. Paris, and Simone Cialdi                                                             |        |
| Properties of phonon modes of an ion-trap quantum computer in the Aubry phase ( <i>9 pages</i> ) . . . . .                                            | 032349 |
| Justin Loye, José Lages, and Dima L. Shepelyansky                                                                                                     |        |
| Selective interactions in the quantum Rabi model ( <i>10 pages</i> ) . . . . .                                                                        | 032350 |
| L. Cong, S. Felicetti, J. Casanova, L. Lamata, E. Solano, and I. Arrazola                                                                             |        |

(Continued)

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

|                                                                                                                                                                     |        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Stark shift and width of x-ray lines from highly charged ions in dense plasmas ( <i>6 pages</i> ) . . . . .                                                         | 032501 |
| M. F. Gu and P. Beiersdorfer                                                                                                                                        |        |
| Accurate real-time evolution of electron densities and ground-state properties from generalized Kohn-Sham theory ( <i>7 pages</i> ) . . . . .                       | 032502 |
| M. J. P. Hodgson and J. Wetherell                                                                                                                                   |        |
| Dielectronic resonances of $LMn$ and $LNn$ ( $n \geq 4$ ) series in highly charged $M$ -shell tungsten ions ( <i>8 pages</i> ) . . . . .                            | 032503 |
| Dipti, A. Borovik, Jr., R. Silwal, J. M. Dreiling, A. C. Gall, E. Takacs, and Yu. Ralchenko                                                                         |        |
| Accurate reproduction of strongly repulsive interatomic potentials ( <i>7 pages</i> ) . . . . .                                                                     | 032504 |
| Susi Lehtola                                                                                                                                                        |        |
| Role of electron correlation in the $\mathcal{P}$ , $\mathcal{T}$ -odd effects of CdH: A relativistic coupled-cluster investigation ( <i>8 pages</i> ) . . . . .    | 032505 |
| Kaushik Talukdar, Malaya K. Nayak, Nayana Vaval, and Sourav Pal                                                                                                     |        |
| Nonequilibrium effects in the Casimir force between two similar metallic plates kept at different temperatures ( <i>9 pages</i> ) . . . . .                         | 032506 |
| G.-L. Ingold, G. L. Klimchitskaya, and V. M. Mostepanenko                                                                                                           |        |
| Quantum Brownian motion of a particle from Casimir-Polder interactions ( <i>14 pages</i> ) . . . . .                                                                | 032507 |
| Kanupriya Sinha and Yiğit Subaşı                                                                                                                                    |        |
| Relativistic eigenchannel $R$ -matrix studies of the strong intrashell electron correlations in highly charged $\text{Ar}^{13+}$ ions ( <i>10 pages</i> ) . . . . . | 032508 |
| Li-Jun Dou, Rui Jin, Rui Sun, Lu-You Xie, Zhong-Kui Huang, Jia-Ming Li, Xin-Wen Ma, and Xiang Gao                                                                   |        |
| Benchmarking calculations with spectroscopic accuracy of excitation energies and wavelengths in sulfur-like tungsten ( <i>11 pages</i> ) . . . . .                  | 032509 |
| Chun Yu Zhang, Kai Wang, Michel Godefroid, Per Jönsson, Ran Si, and Chong Yang Chen                                                                                 |        |
| Capturing multireference excited states by constrained-density-functional theory ( <i>6 pages</i> ) . . . . .                                                       | 032510 |
| Nell Karpinski, Pablo Ramos, and Michele Pavanello                                                                                                                  |        |
| Self-energy-corrected Dirac wave functions for advanced QED calculations in highly charged ions ( <i>11 pages</i> ) . . . . .                                       | 032511 |
| Natalia S. Oreshkina, Halil Cakir, Bastian Sikora, Vladimir A. Yerokhin, Vincent Debierre, Zoltán Harman, and Christoph H. Keitel                                   |        |

**PART B****Atomic and molecular collisions and interactions**

|                                                                                                                           |        |
|---------------------------------------------------------------------------------------------------------------------------|--------|
| Dynamic scaling of photo-double-ionization to electron impact ( <i>6 pages</i> ) . . . . .                                | 032701 |
| Anatoli S. Kheifets                                                                                                       |        |
| Long-range interaction of $\text{Li}(2^2S)\text{-Li}(2^2S)\text{-Li}^+(1^1S)$ ( <i>9 pages</i> ) . . . . .                | 032702 |
| Pei-Gen Yan, Li-Yan Tang, Zong-Chao Yan, and James F. Babb                                                                |        |
| Collisions between ultracold atoms and cold molecules in a dual electrostatic-magnetic trap ( <i>11 pages</i> ) . . . . . | 032703 |
| N. J. Fitch, L. P. Parazzoli, and H. J. Lewandowski                                                                       |        |
| Joint theoretical and experimental study on elastic electron scattering from bismuth ( <i>9 pages</i> ) . . . . .         | 032704 |
| B. Predojević, D. Šević, B. P. Marinković, R. P. McEachran, F. Blanco, G. García, and M. J. Brunger                       |        |

*(Continued)*

# CONTENTS - Continued

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 101, NUMBER 3

MARCH 2020

|                                                                                                                                                                                               |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| $C_6$ coefficients for interacting Rydberg atoms and alkali-metal dimers (12 pages) . . . . .                                                                                                 | 032705 |
| Vanessa Olaya, Jesús Pérez-Ríos, and Felipe Herrera                                                                                                                                           |        |
| Anomalous neutralization characteristics in $\text{Na}^+$ neutralization on Al(111) surfaces (8 pages) . . . . .                                                                              | 032706 |
| Pinyang Liu, Liyuan Yin, Zheng Zhang, Bin Ding, Yuanqing Shi, Yin Li, Xin Zhang, Xiaoxun Song, Yanling Guo, Lin Chen, Ximeng Chen, Ivan K. Gainullin, and Vladimir A. Esaulov                 |        |
| <b>Atomic and molecular processes in external fields, including interactions with strong fields and short pulses</b>                                                                          |        |
| Electron trapping in strong-field dissociative frustrated ionization of CO molecules (8 pages) . . . . .                                                                                      | 033401 |
| Wenbin Zhang, Peifen Lu, Xiaochun Gong, Hui Li, Qinying Ji, Kang Lin, Junyang Ma, Hanxiao Li, Fenghao Sun, Junjie Qiang, Fei Chen, Jihong Tong, and Jian Wu                                   |        |
| Efficiency of core-level interatomic Coulombic decay in rare-gas dimers (10 pages) . . . . .                                                                                                  | 033402 |
| Liping Liu, Přemysl Kolorenč, and Kirill Gokhberg                                                                                                                                             |        |
| Enhancing frustrated double ionization with no electronic correlation in triatomic molecules using counter-rotating two-color circular laser fields (7 pages) . . . . .                       | 033403 |
| G. P. Katsoulis, R. Sarkar, and A. Emmanouilidou                                                                                                                                              |        |
| 4d and 5p photoabsorption in laser-produced thulium plasmas (8 pages) . . . . .                                                                                                               | 033404 |
| R. Stefanuik, E. Sokell, E. Long, N. Krstulovic, P. Hayden, M. Mahmood, G. O'Sullivan, and P. Dunne                                                                                           |        |
| Evidence of ac-Stark-shifted resonances in intense two-color circularly polarized laser fields (8 pages) . . . . .                                                                            | 033405 |
| Philipp Stammer, Serguei Patchkovskii, and Felipe Morales                                                                                                                                     |        |
| Spiral nuclear momentum distribution for the dissociation of $\text{H}_2^+$ in a circularly polarized laser pulse (6 pages) . . . . .                                                         | 033406 |
| Zhen Chen, Pei-Lun He, and Feng He                                                                                                                                                            |        |
| Photo-double-ionization of water at 20 eV above threshold (9 pages) . . . . .                                                                                                                 | 033407 |
| J. M. Randazzo, G. Turri, P. Bolognesi, J. Mathis, L. U. Ancarani, and L. Avaldi                                                                                                              |        |
| Development of a technique for the precise determination of atomic lifetimes based on photon echoes (13 pages) . . . . .                                                                      | 033408 |
| H. C. Beica, A. Pouliot, P. Dowling, A. Carew, T. Vacheresse, G. Carlse, L. Marmet, and A. Kumarakrishnan                                                                                     |        |
| Dependence of direct and rescattered photoelectron spectra of fluorine anions on orbital symmetry in a short laser pulse (8 pages) . . . . .                                                  | 033409 |
| Jian-Hong Chen, Xiang-Ru Xiao, Song-Feng Zhao, and Liang-You Peng                                                                                                                             |        |
| Enhanced high-order harmonic generation in semiconductors by excitation with multicolor pulses (7 pages) . . . . .                                                                            | 033410 |
| Xiaohong Song, Shidong Yang, Ruixin Zuo, Torsten Meier, and Weifeng Yang                                                                                                                      |        |
| Inner-shell photodetachment of $\text{C}_n^-$ ions (4 pages) . . . . .                                                                                                                        | 033411 |
| N. Douguet, S. Fonseca dos Santos, and T. N. Rescigno                                                                                                                                         |        |
| Signatures of the orbital angular momentum of an infrared light beam in the two-photon transition matrix element: A step toward attosecond chronoscopy of photoionization (5 pages) . . . . . | 033412 |
| Sucharita Giri, Misha Ivanov, and Gopal Dixit                                                                                                                                                 |        |
| Cooper minimum of high-order harmonic spectra from an MgO crystal in an ultrashort laser pulse (6 pages) . . . . .                                                                            | 033413 |
| Yiting Zhao, Xiaoqin Xu, Shicheng Jiang, Xi Zhao, Jigen Chen, and Yujun Yang                                                                                                                  |        |
| Modulation spectroscopy of Rydberg atoms in an optical lattice (12 pages) . . . . .                                                                                                           | 033414 |
| V. S. Malinovsky, K. R. Moore, and G. Raithel                                                                                                                                                 |        |

(Continued)

|                                                                                                                                                         |        |
|---------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Rescattering time-energy analysis of high-order above-threshold ionization in few-cycle laser fields ( <i>5 pages</i> ) . . .                           | 033415 |
| Li Guo, Shi Chen, Mingqing Liu, Zheng Shu, Shilin Hu, Ronghua Lu, Shensheng Han, and Jing Chen                                                          |        |
| Accurate retrieval of ionization times by means of the phase-of-the-phase spectroscopy, and its limits ( <i>7 pages</i> ) . . .                         | 033416 |
| D. Würzler, S. Skruszewicz, A. M. Sayler, D. Zille, M. Möller, P. Wustelt, Y. Zhang,<br>J. Tiggesbäumker, and G. G. Paulus                              |        |
| <b>Matter waves and collective properties of cold atoms and molecules</b>                                                                               |        |
| Pairing in two-dimensional Fermi gases with a coordinate-space potential ( <i>8 pages</i> ) . . . . .                                                   | 033601 |
| Tash Zielinski, Bernard Ross, and Alexandros Gezerlis                                                                                                   |        |
| Influence of atomic motion on the collective effects in dense and cold atomic ensembles ( <i>6 pages</i> ) . . . . .                                    | 033602 |
| A. S. Kuraptsev and I. M. Sokolov                                                                                                                       |        |
| Unconventional pairing in one-dimensional systems of a few mass-imbalanced ultracold fermions ( <i>8 pages</i> ) . . . .                                | 033603 |
| Patrycja Łydźba and Tomasz Sowiński                                                                                                                     |        |
| Controllable finite-momenta dynamical quasicondensation in the periodically driven one-dimensional<br>Fermi-Hubbard model ( <i>17 pages</i> ) . . . . . | 033604 |
| Matthew W. Cook and Stephen R. Clark                                                                                                                    |        |
| Quasithermalization of collisionless particles in quadrupole potentials ( <i>15 pages</i> ) . . . . .                                                   | 033605 |
| Johnathan Lau, Olga Goulko, Thomas Reimann, Daniel Suchet, Cédric Enesa,<br>Frédéric Chevy, and Carlos Lobo                                             |        |
| Accurate trajectory alignment in cold-atom interferometers with separated laser beams ( <i>10 pages</i> ) . . . . .                                     | 033606 |
| M. Altorio, L. A. Sidorenkov, R. Gautier, D. Savoie, A. Landragin, and R. Geiger                                                                        |        |
| Floquet topological phases with fourfold-degenerate edge modes in a driven spin-1/2 Creutz ladder ( <i>9 pages</i> ) . .                                | 033607 |
| Longwen Zhou and Qianqian Du                                                                                                                            |        |
| Quantum Joule expansion of one-dimensional systems ( <i>18 pages</i> ) . . . . .                                                                        | 033608 |
| Jin Zhang, Y. Meurice, and S.-W. Tsai                                                                                                                   |        |
| Dynamics of Bose-Einstein recondensation in higher bands ( <i>11 pages</i> ) . . . . .                                                                  | 033609 |
| Vaibhav Sharma, Sayan Choudhury, and Erich J. Mueller                                                                                                   |        |
| Effects of atom numbers on the miscibility-immiscibility transition of a binary Bose-Einstein condensate ( <i>9 pages</i> )                             | 033610 |
| Lin Wen, Hui Guo, Ya-Jun Wang, Ai-Yuan Hu, Hiroki Saito, Chao-Qing Dai, and Xiao-Fei Zhang                                                              |        |
| Inducing and controlling magnetism in the honeycomb lattice through a harmonic trapping potential ( <i>6 pages</i> ) . .                                | 033611 |
| K. Baumann, A. Valli, A. Amaricci, and M. Capone                                                                                                        |        |
| Dissipative dynamics and cooling rates of trapped impurity atoms immersed in a reservoir gas ( <i>14 pages</i> ) . . . . .                              | 033612 |
| R. G. Lena and A. J. Daley                                                                                                                              |        |
| Phase separation in trapped dipolar Fermi gases ( <i>6 pages</i> ) . . . . .                                                                            | 033613 |
| Takahiko Miyakawa, Shin Nakamura, and Hiroyuki Yabu                                                                                                     |        |
| Measurement of the 671-nm tune-out wavelength of $^7\text{Li}$ by atom interferometry ( <i>11 pages</i> ) . . . . .                                     | 033614 |
| B. Décamps, J. Vigué, A. Gauguier, and M. Büchner                                                                                                       |        |
| Floquet analysis of time-averaged trapping potentials ( <i>12 pages</i> ) . . . . .                                                                     | 033615 |
| Oliver A. D. Sandberg, Matthew T. Reeves, and Matthew J. Davis                                                                                          |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 101, NUMBER 3

MARCH 2020

|                                                                                                                                                                                                 |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Pair correlation of atoms scattered from colliding Bose-Einstein quasicondensates ( <i>14 pages</i> ) . . . . .                                                                                 | 033616 |
| Paweł Zin, Tomasz Wasak, Denis Boiron, and Christoph I. Westbrook                                                                                                                               |        |
| Thermodynamics of spin-orbit-coupled bosons in two dimensions from the complex Langevin method ( <i>8 pages</i> ) . . . . .                                                                     | 033617 |
| Felipe Attanasio and Joaquín E. Drut                                                                                                                                                            |        |
| Excitation spectrum and supersolidity of a two-leg bosonic ring ladder ( <i>11 pages</i> ) . . . . .                                                                                            | 033618 |
| Nicolas Victorin, Paolo Pedri, and Anna Minguzzi                                                                                                                                                |        |
| Spatial structure of the pair wave function and the density correlation functions throughout the BEC-BCS crossover ( <i>10 pages</i> ) . . . . .                                                | 033619 |
| J. C. Obeso-Jureidini and V. Romero-Rochín                                                                                                                                                      |        |
| Fermionic versus bosonic behavior of confined Wigner molecules ( <i>11 pages</i> ) . . . . .                                                                                                    | 033620 |
| Eloisa Cuestas, P. Alexander Bouvrie, and Ana P. Majtey                                                                                                                                         |        |
| <b>Quantum optics, physics of lasers, nonlinear optics, classical optics</b>                                                                                                                    |        |
| Semiclassical analysis of dark-state transient dynamics in waveguide circuit QED ( <i>13 pages</i> ) . . . . .                                                                                  | 033801 |
| E. Wiegand, B. Rousseaux, and G. Johansson                                                                                                                                                      |        |
| Feasibility study of a coherent feedback squeezer ( <i>16 pages</i> ) . . . . .                                                                                                                 | 033802 |
| Shota Yokoyama, Daniel Peace, Warit Asavanant, Takeyoshi Tajiri, Ben Haylock, Moji Ghadimi, Mirko Lobino, Elanor H. Huntington, and Hidehiro Yonezawa                                           |        |
| Quasiprobability currents on the sphere ( <i>11 pages</i> ) . . . . .                                                                                                                           | 033803 |
| Iván F. Valtierra, Andrei B. Klimov, Gerd Leuchs, and Luis L. Sánchez-Soto                                                                                                                      |        |
| Probe response of a cavity-optomechanical system coupling to a frequency-dependent bath ( <i>8 pages</i> ) . . . . .                                                                            | 033804 |
| Wei Jiang, Rui Yang, Tian-Hui Qiu, and Guo-Jian Yang                                                                                                                                            |        |
| Dynamics and transport properties of Floquet topological edge modes in coupled photonic waveguides ( <i>9 pages</i> ) . . . . .                                                                 | 033805 |
| J. Petráček and V. Kuzmiak                                                                                                                                                                      |        |
| Suppression of quantum noise by two-mode squeezed states for photon propagation under conditions of electromagnetically induced transparency and four-wave mixing ( <i>16 pages</i> ) . . . . . | 033806 |
| Qi Zhang and Guoxiang Huang                                                                                                                                                                     |        |
| Adiabatic geometric phase in fully nonlinear three-wave mixing ( <i>8 pages</i> ) . . . . .                                                                                                     | 033807 |
| Yongyao Li, Ofir Yesharim, Inbar Hurvitz, Aviv Karnieli, Shenhe Fu, Gil Porat, and Ady Arie                                                                                                     |        |
| Spectral invariance and scaling law for nonstationary optical fields ( <i>7 pages</i> ) . . . . .                                                                                               | 033808 |
| Chaoliang Ding, Matias Koivurova, Tero Setälä, Jari Turunen, and Ari T. Friberg                                                                                                                 |        |
| Generating NOON states in circuit QED using a multiphoton resonance in the presence of counter-rotating interactions ( <i>14 pages</i> ) . . . . .                                              | 033809 |
| Shi-fan Qi and Jun Jing                                                                                                                                                                         |        |
| Entanglement beating in a cavity optomechanical system under two-field driving ( <i>12 pages</i> ) . . . . .                                                                                    | 033810 |
| Chang-Sheng Hu, Zhi-Qiang Liu, Ye Liu, Li-Tuo Shen, Huaizhi Wu, and Shi-Biao Zheng                                                                                                              |        |
| Mechanism of formation of an inverse energy flow in a sharp focus ( <i>12 pages</i> ) . . . . .                                                                                                 | 033811 |
| V. V. Kotlyar, S. S. Stafeev, A. G. Nalimov, A. A. Kovalev, and A. P. Porfirev                                                                                                                  |        |

(Continued)

# CONTENTS - *Continued*

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 101, NUMBER 3

MARCH 2020

|                                                                                                                                                       |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Optomechanical generation of a mechanical catlike state by phonon subtraction (7 pages) . . . . .                                                     | 033812 |
| Itay Shomroni, Liu Qiu, and Tobias J. Kippenberg                                                                                                      |        |
| Third-order parametric down-conversion: A stimulated approach (13 pages) . . . . .                                                                    | 033813 |
| Francisco A. Domínguez-Serna, Alfred B. U'Ren, and Karina Garay-Palmett                                                                               |        |
| Tailoring inhomogeneous $\mathcal{PT}$ -symmetric fiber-Bragg-grating spectra (12 pages) . . . . .                                                    | 033814 |
| S. Vignesh Raja, A. Govindarajan, A. Mahalingam, and M. Lakshmanan                                                                                    |        |
| Optical interference effects on the Casimir-Lifshitz force in multilayer structures (8 pages) . . . . .                                               | 033815 |
| Victoria Estesó, Sol Carretero-Palacios, and Hernán Míguez                                                                                            |        |
| Quantum experiments and hypergraphs: Multiphoton sources for quantum interference, quantum computation, and quantum entanglement (13 pages) . . . . . | 033816 |
| Xuemei Gu, Lijun Chen, and Mario Krenn                                                                                                                |        |
| Quantization of graphene plasmons (14 pages) . . . . .                                                                                                | 033817 |
| Beatriz A. Ferreira, B. Amorim, A. J. Chaves, and N. M. R. Peres                                                                                      |        |
| Scattering singularities of optical waveguides under complex modulation (8 pages) . . . . .                                                           | 033818 |
| Qingjie Liu, Chengzhi Qin, Bing Wang, and Peixiang Lu                                                                                                 |        |
| Computational ghost imaging with discrete stochastic sources (5 pages) . . . . .                                                                      | 033819 |
| Chong Wang, Rui-Jun Lan, Cheng Ren, and De-Zhong Cao                                                                                                  |        |
| High-order exceptional points in supersymmetric arrays (10 pages) . . . . .                                                                           | 033820 |
| S. M. Zhang, X. Z. Zhang, L. Jin, and Z. Song                                                                                                         |        |
| Determination of the electric field and its Hilbert transform in femtosecond electro-optic sampling (17 pages) . . . . .                              | 033821 |
| P. Sulzer, K. Oguchi, J. Huster, M. Kizmann, T. L. M. Guedes, A. Liehl, C. Beckh, A. S. Moskalenko, G. Burkard, D. V. Seletskiy, and A. Leitenstorfer |        |
| Theory of dipole radiation near a Dirac photonic crystal (8 pages) . . . . .                                                                          | 033822 |
| J. Perczel and M. D. Lukin                                                                                                                            |        |
| Generalized Hong-Ou-Mandel quantum interference with phase-randomized weak coherent states (10 pages) . . . . .                                       | 033823 |
| Yu-Zhe Zhang, Kejin Wei, and Feihu Xu                                                                                                                 |        |
| Coincidence counts and stimulated emission resulting from weak pulsed-field-atom interactions (13 pages) . . . . .                                    | 033824 |
| P. R. Berman and A. Kuzmich                                                                                                                           |        |
| Transient dynamics of nonlinear magneto-optical rotation in the presence of a transverse magnetic field (8 pages) . . . . .                           | 033825 |
| Raghwinder Singh Grewal and Szymon Pustelny                                                                                                           |        |
| Polarization dynamics of a vector cavity soliton in a birefringent fiber resonator (9 pages) . . . . .                                                | 033826 |
| Maitrayee Saha, Samudra Roy, and Shailendra K. Varshney                                                                                               |        |
| Generalized coherent-squeezed-state expansion for the super-radiant phase transition (7 pages) . . . . .                                              | 033827 |
| Xiang-You Chen, Yu-Yu Zhang, Libin Fu, and Hang Zheng                                                                                                 |        |
| Stopping light using a transient Bragg grating (13 pages) . . . . .                                                                                   | 033828 |
| Tal A. Weiss and Yonatan Sivan                                                                                                                        |        |
| Optimal optomechanical coupling strength in multimembrane systems (11 pages) . . . . .                                                                | 033829 |
| David C. Newsom, Fernando Luna, Vitaly Fedoseev, Wolfgang Löffler, and Dirk Bouwmeester                                                               |        |

(Continued)

# CONTENTS - Continued

PHYSICAL REVIEW A

THIRD SERIES, VOLUME 101, NUMBER 3

MARCH 2020

|                                                                                                                                                                                                    |        |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Conversion and storage of modes with orbital angular momentum in a quantum memory scheme (11 pages) . . . . .                                                                                      | 033830 |
| E. A. Vashukevich, T. Yu. Golubeva, and Yu. M. Golubev                                                                                                                                             |        |
| Quasiclassical modeling of cavity quantum electrodynamics (17 pages) . . . . .                                                                                                                     | 033831 |
| Tao E. Li, Hsing-Ta Chen, Abraham Nitzan, and Joseph E. Subotnik                                                                                                                                   |        |
| Optical-depth scaling of light scattering from a dense and cold atomic $^{87}\text{Rb}$ gas (9 pages) . . . . .                                                                                    | 033832 |
| K. J. Kemp, S. J. Roof, M. D. Havey, I. M. Sokolov, D. V. Kupriyanov, and W. Guerin                                                                                                                |        |
| Stabilized narrow-beam emission from broad-area semiconductor lasers (5 pages) . . . . .                                                                                                           | 033833 |
| Judith Medina Pardell, Ramon Herrero, Muriel Botey, and Kestutis Staliunas                                                                                                                         |        |
| Optimal estimation with quantum optomechanical systems in the nonlinear regime (19 pages) . . . . .                                                                                                | 033834 |
| Fabienne Schneider, Sofia Qvarfort, Alessio Serafini, André Xuereb, Daniel Braun, Dennis Rätzel, and David Edward Bruschi                                                                          |        |
| Formation mechanism of correspondence imaging with thermal light (10 pages) . . . . .                                                                                                              | 033835 |
| Jian Leng, Wen-Kai Yu, and Shuo-Fei Wang                                                                                                                                                           |        |
| Coupled-mode-induced transparency and attenuation resulting from cross-polarization coupling (9 pages) . . . . .                                                                                   | 033836 |
| Khoa V. Bui and A. T. Rosenberger                                                                                                                                                                  |        |
| Controlling photonic spin Hall effect based on tunable surface plasmon resonance with an $N$ -type coherent medium (8 pages) . . . . .                                                             | 033837 |
| Ren-Gang Wan and M. Suhail Zubairy                                                                                                                                                                 |        |
| Direct temporal mode measurement of photon pairs by stimulated emission (7 pages) . . . . .                                                                                                        | 033838 |
| Xin Chen, Xiaoying Li, and Z. Y. Ou                                                                                                                                                                |        |
| Dissipative time crystal in an asymmetric nonlinear photonic dimer (9 pages) . . . . .                                                                                                             | 033839 |
| Kilian Seibold, Riccardo Rota, and Vincenzo Savona                                                                                                                                                 |        |
| Progress toward third-order parametric down-conversion in optical fibers (10 pages) . . . . .                                                                                                      | 033840 |
| Andrea Cavanna, Jonas Hammer, Cameron Okoth, Erasto Ortiz-Ricardo, Hector Cruz-Ramirez, Karina Garay-Palmett, Alfred B. U'Ren, Michael H. Frosz, Xin Jiang, Nicolas Y. Joly, and Maria V. Chekhova |        |
| Dipole resonances of nonabsorbing dielectric nanospheres in the optical range: Approximate explicit conditions for high- and moderate-refractive-index materials (12 pages) . . . . .              | 033841 |
| F. López-Tejeira                                                                                                                                                                                   |        |
| Instability suppression of vector vortex solitons in nonlocal nonlinear media (8 pages) . . . . .                                                                                                  | 033842 |
| Huicong Zhang, Zhiwei Weng, Qian Shou, Qi Guo, and Wei Hu                                                                                                                                          |        |
| Effect of atmospheric turbulence on timing instability for partially reciprocal two-way optical time transfer links (9 pages) . . . . .                                                            | 033843 |
| Michael T. Taylor, Aniceto Belmonte, Leo Hollberg, and Joseph M. Kahn                                                                                                                              |        |

## ERRATA

|                                                                                                                 |           |
|-----------------------------------------------------------------------------------------------------------------|-----------|
| Erratum: Non-Gibbs states on a Bose-Hubbard lattice [Phys. Rev. A <b>99</b> , 023603 (2019)] (1 page) . . . . . | 039901(E) |
| Alexander Yu. Cherny, Thomas Engl, and Sergej Flach                                                             |           |