



Illustration of an imaging process for atomic  $d$ -wave scattering: the scattered distribution is projected onto the  $yz$  plane by laser-light absorption. The quantum nature of slow-atom collisions has been demonstrated by imaging collisions of ultracold Rb atoms and showing the effect of interference between outgoing  $s$  and  $d$  partial waves. See article 173201, as well as the related article 173202.



## PHYSICAL REVIEW LETTERS

### Contents

Articles published 16 October–22 October 2004

VOLUME 93, NUMBER 17

22 October 2004

#### General Physics: Statistical and Quantum Mechanics, Quantum Information, etc.

|                                                                                                                                               |        |
|-----------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Local Molecular Dynamics with Coulombic Interactions .....                                                                                    | 170201 |
| Jörg Rottler and A.C. Maggs                                                                                                                   |        |
| Quantum Monte Carlo Algorithm Based on Two-Body Density Functional Theory for Fermionic Many-Body Systems: Application to $^3\text{He}$ ..... | 170202 |
| Balázs Hetényi, L. Brualla, and S. Fantoni                                                                                                    |        |
| Unified Derivation of Tunneling Times from Decoherence Functionals .....                                                                      | 170401 |
| Norifumi Yamada                                                                                                                               |        |
| Spontaneous Macroscopic Spin Polarization in Independent Spinor Bose-Einstein Condensates .....                                               | 170402 |
| Mark H. Wheeler, Kevin M. Mertes, Jessie D. Erwin, and David S. Hall                                                                          |        |
| Atom-Dimer Scattering for Confined Ultracold Fermion Gases .....                                                                              | 170403 |
| C. Mora, R. Egger, A.O. Gogolin, and A. Komnik                                                                                                |        |
| Experimental Purification of Single Qubits .....                                                                                              | 170501 |
| M. Ricci, F. De Martini, N.J. Cerf, R. Filip, J. Fiurášek, and C. Macchiavello                                                                |        |
| Security of Quantum Key Distribution with Coherent States and Homodyne Detection .....                                                        | 170502 |
| S. Iblisdir, G. Van Assche, and N.J. Cerf                                                                                                     |        |
| Distillation Protocols: Output Entanglement and Local Mutual Information .....                                                                | 170503 |
| Michał Horodecki, Jonathan Oppenheim, Aditi Sen(De), and Ujjwal Sen                                                                           |        |
| Quantum Cryptography Without Switching .....                                                                                                  | 170504 |
| Christian Weedbrook, Andrew M. Lance, Warwick P. Bowen, Thomas Symul, Timothy C. Ralph, and Ping Koy Lam                                      |        |
| Efficient Simulations of Gas-Grain Chemistry in Interstellar Clouds .....                                                                     | 170601 |
| Azi Lipshtat and Ofer Biham                                                                                                                   |        |
| Eigenmodes and Thermodynamics of a Coulomb Chain in a Harmonic Potential .....                                                                | 170602 |
| Giovanna Morigi and Shmuel Fishman                                                                                                            |        |
| Limit on the Present Temporal Variation of the Fine Structure Constant .....                                                                  | 170801 |
| E. Peik, B. Lipphardt, H. Schnatz, T. Schneider, Chr. Tamm, and S.G. Karshenboim                                                              |        |
| Direct Observation of Charge Inversion by Multivalent Ions as a Universal Electrostatic Phenomenon .....                                      | 170802 |
| K. Besteman, M.A. Zevenbergen, H.A. Heering, and S.G. Lemay                                                                                   |        |

#### Gravitation and Astrophysics

|                                                                              |        |
|------------------------------------------------------------------------------|--------|
| Antineutrino Spectroscopy with Large Water Čerenkov Detectors .....          | 171101 |
| John F. Beacom and Mark R. Vagins                                            |        |
| Rotating Black Holes in Higher Dimensions with a Cosmological Constant ..... | 171102 |
| G.W. Gibbons, H. Lü, Don N. Page, and C.N. Pope                              |        |

(Continued on Third Cover)



## Contents (Continued)

|                                                                                                                                                                                            |        |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| <sup>60</sup> Fe Anomaly in a Deep-Sea Manganese Crust and Implications for a Nearby Supernova Source .....                                                                                | 171103 |
| K. Knie, G. Korschinek, T. Faestermann, E. A. Dorfi, G. Rugel, and A. Wallner                                                                                                              |        |
| Chameleon Fields: Awaiting Surprises for Tests of Gravity in Space .....                                                                                                                   | 171104 |
| Justin Khoury and Amanda Weltman                                                                                                                                                           |        |
| <b>Elementary Particles and Fields</b>                                                                                                                                                     |        |
| $J/\Psi$ Production in $pp$ Collisions at $\sqrt{s} = 200$ GeV at the BNL Relativistic Heavy Ion Collider .....                                                                            | 171801 |
| Fred Cooper, Ming X. Liu, and Gouranga C. Nayak                                                                                                                                            |        |
| <b>Nuclear Physics</b>                                                                                                                                                                     |        |
| New Half-Life Measurement of <sup>182</sup> Hf: Improved Chronometer for the Early Solar System .....                                                                                      | 172501 |
| C. Vockenhuber, F. Oberli, M. Bichler, I. Ahmad, G. Quitté, M. Meier, A. N. Halliday, D.-C. Lee,<br>W. Kutschera, P. Steier, R. J. Gehrke, and R. G. Helmer                                |        |
| Chiral Bands, Dynamical Spontaneous Symmetry Breaking, and the Selection Rule for Electromagnetic Transitions<br>in the Chiral Geometry .....                                              | 172502 |
| T. Koike, K. Starosta, and I. Hamamoto                                                                                                                                                     |        |
| <b>Atomic, Molecular, and Optical Physics</b>                                                                                                                                              |        |
| Lack of Hohenberg-Kohn Theorem for Excited States .....                                                                                                                                    | 173001 |
| R. Gaudoin and K. Burke                                                                                                                                                                    |        |
| Can a Quantum Nondemolition Measurement Improve the Sensitivity of an Atomic Magnetometer? .....                                                                                           | 173002 |
| M. Auzinsh, D. Budker, D. F. Kimball, S. M. Rochester, J. E. Stalnaker, A. O. Sushkov, and V. V. Yashchuk                                                                                  |        |
| Mixed Quantum-Classical Treatment of Vibrational Decoherence .....                                                                                                                         | 173003 |
| C. Meier                                                                                                                                                                                   |        |
| Imaging of $s$ and $d$ Partial-Wave Interference in Quantum Scattering of Identical Bosonic Atoms .....                                                                                    | 173201 |
| Nicholas R. Thomas, Niels Kjærgaard, Paul S. Julienne, and Andrew C. Wilson                                                                                                                |        |
| Interferometric Determination of the $s$ and $d$ -Wave Scattering Amplitudes in <sup>87</sup> Rb .....                                                                                     | 173202 |
| Ch. Buggle, J. Léonard, W. von Klitzing, and J. T. Walraven                                                                                                                                |        |
| Femtosecond Interatomic Coulombic Decay in Free Neon Clusters: Large Lifetime Differences between Surface and<br>Bulk .....                                                                | 173401 |
| G. Öhrwall, M. Tchapyguine, M. Lundwall, R. Feifel, H. Bergersen, T. Rander, A. Lindblad, J. Schulz,<br>S. Peredkov, S. Barth, S. Marburger, U. Hergenhahn, S. Svensson, and O. Björneholm |        |
| Evaluation of Two-Photon Nonlinearity by a Semiclassical Method .....                                                                                                                      | 173601 |
| Kazuki Koshino and Hajime Ishihara                                                                                                                                                         |        |
| <b>Nonlinear Dynamics, Fluid Dynamics, Classical Optics, etc.</b>                                                                                                                          |        |
| Connection between Phase Singularities and the Radiation Pattern of a Slit in a Metal Plate .....                                                                                          | 173901 |
| Hugo F. Schouten, Taco D. Visser, Greg Gbur, Daan Lenstra, and Hans Blok                                                                                                                   |        |
| Self-Compression of Ultrashort Pulses through Ionization-Induced Spatiotemporal Reshaping .....                                                                                            | 173902 |
| Nicholas L. Wagner, Emily A. Gibson, Tenio Popmintchev, Ivan P. Christov, Margaret M. Murnane, and<br>Henry C. Kapteyn                                                                     |        |
| Time Reversal of Light with Linear Optics and Modulators .....                                                                                                                             | 173903 |
| Mehmet Fatih Yanik and Shanhui Fan                                                                                                                                                         |        |
| Experimental Relevance of Global Properties of Time-Delayed Feedback Control .....                                                                                                         | 174101 |
| Clemens von Loewenich, Hartmut Benner, and Wolfram Just                                                                                                                                    |        |
| Chimera States for Coupled Oscillators .....                                                                                                                                               | 174102 |
| Daniel M. Abrams and Steven H. Strogatz                                                                                                                                                    |        |
| Temporal Chaos Versus Spatial Mixing in Reaction-Advection-Diffusion Systems .....                                                                                                         | 174501 |
| Arthur V. Straube, Markus Abel, and Arkady Pikovsky                                                                                                                                        |        |
| <b>Plasma and Beam Physics</b>                                                                                                                                                             |        |
| Three-Species Collisionless Reconnection: Effect of O <sup>+</sup> on Magnetotail Reconnection .....                                                                                       | 175001 |
| M. A. Shay and M. Swisdak                                                                                                                                                                  |        |

(Continued on Preceding Page)

*Contents (Continued)*

|                                                                                                                                          |        |
|------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Hamiltonian Description of Low-Temperature Relativistic Plasmas .....                                                                    | 175002 |
| B.A. Shadwick, G.M. Tarkenton, and E.H. Esarey                                                                                           |        |
| Hall Magnetic Reconnection Rate .....                                                                                                    | 175003 |
| J.D. Huba and L.I. Rudakov                                                                                                               |        |
| <b>Condensed Matter: Structure, etc.</b>                                                                                                 |        |
| Surface of a $^3\text{He}$ Crystal: Crossover from Quantum to Classical Behavior .....                                                   | 175301 |
| I.A. Todoshchenko, H. Alles, H.J. Junes, A.Ya. Parshin, and V. Tsepelin                                                                  |        |
| Mechanical Heterogeneities in Model Polymer Glasses at Small Length Scales .....                                                         | 175501 |
| Kenji Yoshimoto, Tushar S. Jain, Kevin Van Workum, Paul F. Nealey, and Juan J. de Pablo                                                  |        |
| Structural Influence of Erbium Centers on Silicon Nanocrystal Phase Transitions .....                                                    | 175502 |
| Robert A. Senter, Cristian Pantea, Yuejian Wang, Haozhe Liu, T. Waldek Zerda, and Jeffery L. Coffey                                      |        |
| “Learn on the Fly”: A Hybrid Classical and Quantum-Mechanical Molecular Dynamics Simulation .....                                        | 175503 |
| Gabor Csányi, T. Albaret, M.C. Payne, and A. De Vita                                                                                     |        |
| Experimental Evidence for a Zigzag Bifurcation in Bulk Lamellar Eutectic Growth .....                                                    | 175701 |
| Silvère Akamatsu, Sabine Bottin-Rousseau, and Gabriel Faivre                                                                             |        |
| Universal Critical Behavior of Noisy Coupled Oscillators .....                                                                           | 175702 |
| Thomas Risler, Jacques Prost, and Frank Jülicher                                                                                         |        |
| Atom Incorporation at Edge Defects in Clusters .....                                                                                     | 176101 |
| Shi Cai Wang and Gert Ehrlich                                                                                                            |        |
| <b>Condensed Matter: Electronic Properties, etc.</b>                                                                                     |        |
| Low Energy Electronic States and Triplet Pairing in Layered Cobaltate .....                                                              | 176401 |
| G. Khaliullin, W. Koshibae, and S. Maekawa                                                                                               |        |
| Spin Splitting Induced by Spin-Orbit Interaction in Chiral Nanotubes .....                                                               | 176402 |
| L. Chico, M.P. López-Sancho, and M.C. Muñoz                                                                                              |        |
| “Lagrange Functions”: A Family of Powerful Basis Sets for Real-Space Order- $N$ Electronic Structure Calculations .....                  | 176403 |
| Kálmán Varga, Zhenyu Zhang, and Sokrates T. Pantelides                                                                                   |        |
| Quantum Versus Jahn-Teller Orbital Physics in $\text{YVO}_3$ and $\text{LaVO}_3$ .....                                                   | 176404 |
| Zhong Fang and Naoto Nagaosa                                                                                                             |        |
| Noise at the Crossover from Wigner Liquid to Wigner Glass .....                                                                          | 176405 |
| C. Reichhardt and C.J. Olson Reichhardt                                                                                                  |        |
| Current-Induced Spin Polarization in Strained Semiconductors .....                                                                       | 176601 |
| Y.K. Kato, R.C. Myers, A.C. Gossard, and D.D. Awschalom                                                                                  |        |
| One-Dimensional Conduction in Charge-Density-Wave Nanowires .....                                                                        | 176602 |
| E. Slot, M.A. Holst, H.S. van der Zant, and S.V. Zaitsev-Zotov                                                                           |        |
| Kondo Temperature of Magnetic Impurities at Surfaces .....                                                                               | 176603 |
| P. Wahl, L. Diekhöner, M.A. Schneider, L. Vitali, G. Wittich, and K. Kern                                                                |        |
| Current-Induced Excitations in Single Cobalt Ferromagnetic Layer Nanopillars .....                                                       | 176604 |
| B. Özyilmaz, A.D. Kent, J.Z. Sun, M.J. Rooks, and R.H. Koch                                                                              |        |
| Band Structure versus Dynamical Exchange-Correlation Effects in Surface Plasmon Energy and Damping: A First-Principles Calculation ..... | 176801 |
| V.M. Silkin, E.V. Chulkov, and P.M. Echenique                                                                                            |        |
| Double-Dot Charge Qubit and Transport via Dissipative Cotunneling .....                                                                  | 176802 |
| Mei-Rong Li and Karyn Le Hur                                                                                                             |        |
| Kondo Effect in a Many-Electron Quantum Ring .....                                                                                       | 176803 |
| A. Fuhrer, T. Ihn, K. Ensslin, W. Wegscheider, and M. Bichler                                                                            |        |
| New Class of Level Statistics in Correlated Disordered Chains .....                                                                      | 176804 |
| Pedro Carpena, Pedro Bernaola-Galván, and Plamen Ch. Ivanov                                                                              |        |
| Nonlinear Wigner Solid Transport on the Free Surface of Normal and Superfluid $^3\text{He}$ .....                                        | 176805 |
| Keiya Shirahama, Yuri P. Monarkha, and Kimitoshi Kono                                                                                    |        |
| Determination of the Intershell Conductance in Multiwalled Carbon Nanotubes .....                                                        | 176806 |
| B. Bourlon, C. Miko, L. Forró, D.C. Glattli, and A. Bachtold                                                                             |        |

*(Continued on Preceding Page)*

*Contents (Continued)*

|                                                                                                                                                                                     |        |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|
| Fermi-Edge Singularities in the Mesoscopic X-Ray Edge Problem .....                                                                                                                 | 176807 |
| Martina Hentschel, Denis Ullmo, and Harold U. Baranger                                                                                                                              |        |
| Evidence of a First-Order Phase Transition Between Wigner-Crystal and Bubble Phases of 2D Electrons in Higher Landau Levels .....                                                   | 176808 |
| R.M. Lewis, Yong Chen, L.W. Engel, D.C. Tsui, P.D. Ye, L.N. Pfeiffer, and K.W. West                                                                                                 |        |
| Electron Correlation in the Second Landau Level: A Competition Between Many Nearly Degenerate Quantum Phases .....                                                                  | 176809 |
| J.S. Xia, W. Pan, C.L. Vicente, E.D. Adams, N.S. Sullivan, H.L. Stormer, D.C. Tsui, L.N. Pfeiffer, K.W. Baldwin, and K.W. West                                                      |        |
| Suppression of Timing Errors in Short Overdamped Josephson Junctions .....                                                                                                          | 177001 |
| Andrey L. Pankratov and Bernardo Spagnolo                                                                                                                                           |        |
| Spontaneous Flux Lattices in Ferromagnetic Spin-Triplet Superconductors .....                                                                                                       | 177002 |
| Sumanta Tewari, D. Belitz, T.R. Kirkpatrick, and John Toner                                                                                                                         |        |
| Phonon Dispersion Curves of a BC <sub>3</sub> Honeycomb Epitaxial Sheet .....                                                                                                       | 177003 |
| H. Yanagisawa, T. Tanaka, Y. Ishida, M. Matsue, E. Rokuta, S. Otani, and C. Oshima                                                                                                  |        |
| Spin-Liquid versus Dimerized Ground States in a Frustrated Heisenberg Antiferromagnet .....                                                                                         | 177004 |
| Luca Capriotti, Douglas J. Scalapino, and Steven R. White                                                                                                                           |        |
| Evidence for Vortices in the Pseudogap Region of Y <sub>1-x</sub> Pr <sub>x</sub> Ba <sub>2</sub> Cu <sub>3</sub> O <sub>7</sub> from Angular Magnetoresistivity Measurements ..... | 177005 |
| V. Sandu, E. Cimpoiu, T. Katuwal, Shi Li, M.B. Maple, and C.C. Almasan                                                                                                              |        |
| Nondestructive Readout for a Superconducting Flux Qubit .....                                                                                                                       | 177006 |
| A. Lupascu, C.J. Verwijs, R.N. Schouten, C.J. Harmans, and J.E. Mooij                                                                                                               |        |
| Fermi Surface Topology of Ca <sub>1.5</sub> Sr <sub>0.5</sub> RuO <sub>4</sub> Determined by Angle-Resolved Photoelectron Spectroscopy .....                                        | 177007 |
| S.-C. Wang, H.-B. Yang, A.K. Sekharan, S. Souma, H. Matsui, T. Sato, T. Takahashi, Chenxi Lu, Jiandi Zhang, R. Jin, D. Mandrus, E.W. Plummer, Z. Wang, and H. Ding                  |        |
| Unusual Directional Dependence of Exchange Energies in GaAs Diluted with Mn: Is the RKKY Description Relevant? .....                                                                | 177201 |
| Priya Mahadevan, Alex Zunger, and D.D. Sarma                                                                                                                                        |        |
| Thermal Conductivity of Geometrically Frustrated, Ferroelectric YMnO <sub>3</sub> : Extraordinary Spin-Phonon Interactions ...                                                      | 177202 |
| P.A. Sharma, J.S. Ahn, N. Hur, S. Park, Sung Baek Kim, Seongsu Lee, J.-G. Park, S. Guha, and S-W. Cheong                                                                            |        |
| Diffusive Transport in Spin-1 Chains at High Temperatures .....                                                                                                                     | 177203 |
| J. Karadamoglou and X. Zotos                                                                                                                                                        |        |
| Spin Order in One-Dimensional Kondo and Hund Lattices .....                                                                                                                         | 177204 |
| D.J. Garcia, K. Hallberg, B. Alascio, and M. Avignon                                                                                                                                |        |
| Monolayer Resolved Oscillating Hyperfine Fields in Epitaxial Face-Centered-Tetragonal Co(001) Films .....                                                                           | 177205 |
| H. Wieldraaijer, W.J. de Jonge, and J.T. Kohlhepp                                                                                                                                   |        |
| Anisotropic Ferromagnetism in Substituted Zinc Oxide .....                                                                                                                          | 177206 |
| M. Venkatesan, C.B. Fitzgerald, J.G. Lunney, and J.M. Coey                                                                                                                          |        |
| Chirality Distribution and Transition Energies of Carbon Nanotubes .....                                                                                                            | 177401 |
| H. Telg, J. Maultzsch, S. Reich, F. Hennrich, and C. Thomsen                                                                                                                        |        |
| Structural Anomalies and Multiferroic Behavior in Magnetically Frustrated TbMn <sub>2</sub> O <sub>5</sub> .....                                                                    | 177402 |
| L.C. Chapon, G.R. Blake, M.J. Gutmann, S. Park, N. Hur, P.G. Radaelli, and S-W. Cheong                                                                                              |        |
| Size-Dependent Optical Properties of VO <sub>2</sub> Nanoparticle Arrays .....                                                                                                      | 177403 |
| R. Lopez, L.C. Feldman, and R.F. Haglund, Jr.                                                                                                                                       |        |
| <b>Soft Matter, Biological, and Interdisciplinary Physics</b>                                                                                                                       |        |
| Do Spherical Polyelectrolyte Brushes Interdigitate? .....                                                                                                                           | 177801 |
| A.V. Korobko, W. Jesse, S.U. Egelhaaf, A. Lapp, and J.R. van der Maarel                                                                                                             |        |
| Enhancement of Association Rates by Nonspecific Binding to DNA and Cell Membranes .....                                                                                             | 178101 |
| Huan-Xiang Zhou and Attila Szabo                                                                                                                                                    |        |
| Species Abundance Patterns in Complex Evolutionary Dynamics .....                                                                                                                   | 178102 |
| Kei Tokita                                                                                                                                                                          |        |

*(Continued on Preceding Page)*

*Contents (Continued)*

|                                                                                                                                   |        |
|-----------------------------------------------------------------------------------------------------------------------------------|--------|
| Critical Scale Invariance in a Healthy Human Heart Rate .....                                                                     | 178103 |
| Ken Kiyono, Zbigniew R. Struzik, Naoko Aoyagi, Seiichiro Sakata, Junichiro Hayano, and<br>Yoshiharu Yamamoto                      |        |
| Self-Diffusion in Sheared Colloidal Suspensions: Violation Of Fluctuation-Dissipation Relation .....                              | 178301 |
| Grzegorz Szamel                                                                                                                   |        |
| Strong Temperature Dependence of Irradiation Effects in Organic Layers .....                                                      | 178302 |
| P. Feulner, T. Niedermayer, K. Eberle, R. Schneider, D. Menzel, A. Baumer, E. Schmich, A. Shaporenko,<br>Y. Tai, and M. Zharnikov |        |
| Scale Dependence and Localization of the Deformation of Arctic Sea Ice .....                                                      | 178501 |
| David Marsan, Harry Stern, Ron Lindsay, and Jérôme Weiss                                                                          |        |
| <b>Errata</b>                                                                                                                     |        |
| Erratum: Are Cluster Magnetic Fields Primordial? [Phys. Rev. Lett. <b>91</b> , 251301 (2003)] .....                               | 179901 |
| Robi Banerjee and Karsten Jedamzik                                                                                                |        |