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John Essick, Harvey Gould, Claire A. Marrache-Kikuchi, Raina Olsen, Beth Parks,
B. Cameron Reed, Donald Salisbury, and Jan Tobochnik, *Editors*

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These brief summaries are designed to help readers easily see which articles will be most valuable to them. The online version contains links to the articles.

How the air slows a closing book

J. Pantaleone
92(1), p. 7, https://doi.org/10.1119/5.0106926
You could begin one of your undergraduate mechanics classes with this question: Suppose that you have a partially open book on a table, and you allow it to fall closed. Does it take the same time to close in air and in vacuum? This paper answers this question through both experimentation and a simple model based on mechanical energy conservation. A video abstract accompanies the online version of this paper.

DC power transported by two infinite parallel wires

Marc Boulé
92(1), p. 14, https://doi.org/10.1119/5.0121399
Instructors of E&M aim to teach our students that they can calculate energy and power either based on charges or fields (but not both together!). However, there are a limited number of geometries in which the equivalence of the two approaches can be explicitly shown. This paper extends that list to include power transmitted via two parallel wires carrying opposite currents. It is especially useful for introducing students to the bipolar coordinate system, which allows this system to be treated rather simply.

Expanding the range of validity of the simplest computation of the perihelion precession in Schwarzschild spacetime

Josep M. Pons
92(1), p. 23, https://doi.org/10.1119/5.0136332
It has long been a surprising result that a simple procedure for finding the perihelion shift of orbits in Schwarzschild spacetime yields correct results even when the eccentricity is large, since its justification is normally based on small eccentricities. This analysis justifies the procedure in a manner that can be utilized in undergraduate astrophysics courses, in particular to justify the simple treatment of Mercury's orbit.

Microscopic derivation of the collision properties of molecules in two systems at thermal equilibrium

Tongli Wei and Xiansheng Cao
92(1), p. 29, https://doi.org/10.1119/5.0128644
The relative speed of molecules at thermal equilibrium is an important parameter in kinetics. When teaching, we often present arguments for the average relative speed that are not actually valid. This paper presents a careful derivation not only of the relative speeds but also of the distribution function, both for all molecules and for molecules that collide.

Measuring relative humidity from evaporation with a wet-bulb thermometer: The psychrometer

Marie Corpart, Frédéric Restagno, and François Boulogne
92(2), p. 36, https://doi.org/10.1119/5.0154559
The measurement and control of relative humidity is important in fields as diverse as air conditioning and artwork conservation. A standard technique for measuring relative humidity is psychrometry, which involves two thermometers placed side-by-side. The bulb of one thermometer, the "wet bulb," is kept moistened with a water-soaked wrapping; the other, the "dry bulb," is exposed to the environment. Evaporative cooling causes the wet bulb to read a lower temperature than the dry bulb; the difference between the two readings can be used to determine the relative humidity. This paper develops a model for understanding this effect and describes the construction and operation of an advanced-laboratory apparatus for doing so. Measurements show good results in comparison to those reported by a commercial hygrometer.

Practical study of optical stellar interferometry

P. Rodríguez-Ovalle, A. Mendi-Martos, A. Angulo-Manzanas, I. Reyes-Rodríguez, M. Pérez-Arrieta, M. A. Illarramendi, and A. Sánchez-Lavega
92(1), p. 43, https://doi.org/10.1119/5.015446
This paper shows how stellar interferometry can be introduced to undergraduate or graduate students in a very simple manner: covering a telescope with a two-holed lid enables imaging the interferograms created by bright stars. The comparison between diffraction-based calculations and experiments illustrates the working principle of stellar interferometry and also the importance of the turbulence of the Earth's atmosphere in any ground-based astronomical observations. Appropriate for undergraduate astronomy class, as well as for an illustration of interferometry in optics classes.

A basic introduction to ultrastable optical cavities for laser stabilization

Jamie A. Boyd and Thierry Lahaye
92(1), p. 50, https://doi.org/10.1119/5.0161369
This paper provides a guide for building an ultrastable cavity as a means for stabilizing the frequency of a laser, a technique commonly required in research laboratories. An excellent theoretical review of the physics involved in designing and locking an extremely high-finesse cavity is provided, followed by a detailed description of a practical experimental setup for carrying out this technique. Characterization of the performance of the setup is given. The intended audience for this work includes workers setting up an ultrastable cavity in a research laboratory

for the first time as well as instructors designing advanced instructional laboratory courses on optics and laser-stabilization techniques.

Acoustic trapping in the undergraduate laboratory

Andrea Boskovic, Kate M. Jones, Alejandra Velasquez, Isabel P. Hardy, Maya L. Bulos, Ashley R. Carter, and Martin Wiklund

92(1), p. 59, https://doi.org/10.1119/5.0167269

A low-cost and easy-to-construct setup is presented that produces one- or two-dimensional acoustic trapping of micron-sized beads in water. It is demonstrated that the measured spacings of the trapping locations, which correspond to nodes in the standing acoustic wave that produces the trap, follow the expected theoretical relation and, with the addition of a microscope to determine the velocity of individual beads as they are being trapped, the acoustic trapping force is calculated. This work will be of interest to instructors seeking to include a biophysics-related experiment of contemporary research relevance in their instructional laboratory offering.

Concepts in Monte Carlo sampling

Gabriele Tartero and Werner Krauth

92(1), p. 65, https://doi.org/10.1119/5.0176853

Monte Carlo algorithms have been widely used since the 1950s and are constantly being improved beyond direct sampling and the Metropolis algorithm. Tartero and Krauth provide a self-contained introduction in the context of the one-dimensional anharmonic oscillator to lifted Markov chain Monte Carlo algorithms which violate local detailed balance but still satisfy global detailed balance needed to correctly simulate physical systems.

Wigner functions of the finite square-well bound states

P. Chen, Z. Q. Yang, Z. Z. Shi, Q. Y. Hou, and G. R. Jin

92(1), p. 78, https://doi.org/10.1119/5.0071891

The Wigner quasi-probability function was introduced in 1932 as a way to visualize quantum states in the classical limit and is currently used to simulate the time-evolution of coherent states. The Wigner function is comparable to a classical probability distribution with definite position and momentum. For non-classical states, one finds negative (and thus classically unphysical) probabilities at certain points in phase space, though the average over an area larger than $\hbar$ is always positive. This paper compares Wigner functions for the infinite potential well to the finite potential well and would be appropriate for introducing undergraduates to visualization techniques and/or the properties of non-classical states.