[6]J. F. Streib, "Properties of a ferrite toroid transformer," Am. J. Phys. **32** (11), 24–26 (1964).
[7]J. W. Snider, "Magnetic hysteresis measurements with an integrating magnetometer," Am. J. Phys. **39** (8), 964–65 (1971).
[8]Gaylord P. Harnwell, *Principles of Electricity and Electromagnetism* (McGraw–Hill, New York, 1938), 1st ed., pp. 301–306.
[9]A. Edgar and J. W. Quilty, "A mutual inductance apparatus for measuring magnetic susceptibility and electrical conductivity," Am. J. Phy[s] 943–946 (1993).
[10]G. E. Everett and L. J. Bruner, "A new approach to the measure[ment] complex impedance in the undergraduate laboratory," Am. J. Phys. 67–69 (1969).
[11]Wavetek Co. Instruments Division, San Diego, CA 92123-1509.
[12]Cia Aços Especiais Itabira—ACESITA, Belo Horizonte, MG 301 Brazil, or any transformer nucleus.

Demonstrating Fresnel's model for optical activity

Benjamin S. Perkalskis and J. Reuben Freeman[a)]
Jerusalem College of Technology, Machon Lev, 21 Havaad Haleumi Street, Jerusalem, Israel 91160

(Received 21 July 1997; accepted 12 November 1997)

Linearly polarized light can be considered as a collinear superposition of a circularly polarized right-handed (Rh) component and a circularly polarized left-handed (Lh) component. To account phenomenologically for optical activity, Fresnel proposed a simple circular-birefringence model where the speed of light propagating through an optically active material is different for the Rh and Lh components. To test his idea by spatially separating the Rh and Lh components, Fresnel constructed a multiple prism[1,2] composed of crystal quartz prisms (with angles 152°, 14°, 14°) of the dextro-rotary≡right-handed type (R) and of the laevo-rotary≡left-handed type (L). The experimental res[ult] rather delicate—a mere 4 sec of angular separation f[or a] sodium light source. So even at a viewing distance of 1[...] the spatial separation between the Rh and Lh compone[nts] no more than a centimeter. The difference in the inde[x of] refraction between the R-type quartz and the L-type qua[rtz] small: 7.1×10^{-5} along the optic axis.[3]

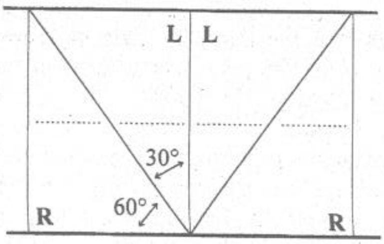

Fig. 1. Prism assembly of two R-type and two L-type quartz prisms. The optic axis direction is shown as a dotted line.

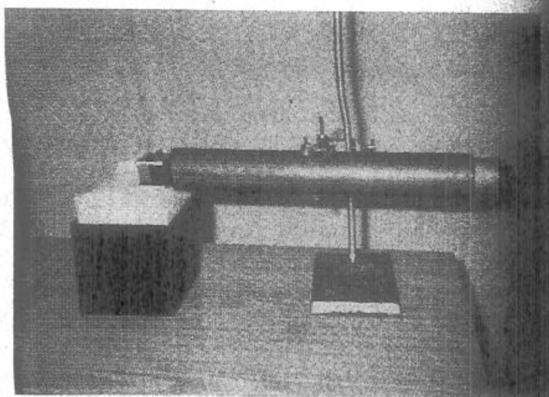

Fig. 3. Our prism assembly and telescope.

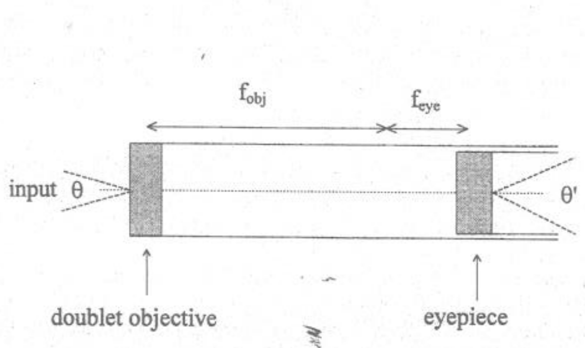

Fig. 2. Telescope assembly of objective focal length f_{obj} and occular focal length f_{eye}. The input angular separation θ is magnified to θ' according to Eq. (1).

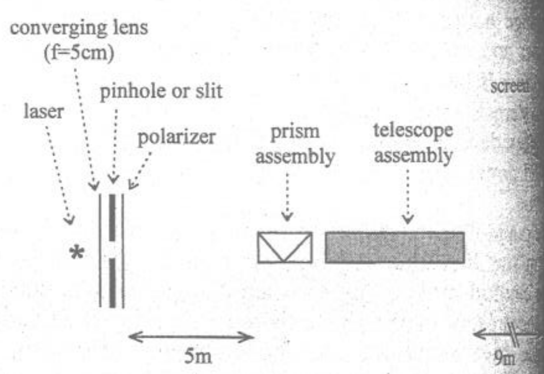

Fig. 4. Experimental layout.

ven though Fresnel's experiment is described in optics s, it has not been easily amenable to actual demonstra- We show here how a variant of Fresnel's experiment be readily performed to achieve a 3- to 5-cm separation e Rh and Lh components of linearly polarized light from mW helium–neon laser.

o start, one needs two R-type and two L-type quartz ms, each with angles 30°, 60°, 90° and with the optical parallel to the base opposite the 30° angle. These can be ined from an appropriate optical components supplier.[4] her option is to carefully take apart old Cornu prisms in water—each one yields one R-type and one L-type z prism. Such Cornu prisms may be found in older ul- olet spectrometers lying unused in physics storerooms. mbine the prisms as shown in Fig. 1. The angular sepa- n capability of this prism assembly is even less than that e Fresnel multiple prism. But the angular separation can gnificantly enhanced by an astronomical telescope con- g of an occular (focal length f_{eye}) and doublet-objective l length $f_{obj} \gg f_{eye}$). The telescope assembly is sketched g. 2. Our composite prism and telescope assembly are n in Fig. 3.

r small angles, the input angular separation θ and the t angular separation θ' satisfy[5]

$$\approx (f_{obj}/f_{eye})\,\theta. \qquad (1)$$

With $f_{obj}=40$ cm and $f_{eye}=1$ cm, the angular separation is enhanced by a factor of 40. The overall experiment layout is sketched in Fig. 4.

Two spots, about 4 cm apart, are clearly visible on the screen. To verify that they correspond to circularly polarized light, analyze each separately at the screen with a polaroid. Rotating the polaroid doesn't affect the intensity. To show that the spots are of opposite circular polarizations (one Rh and the other Lh), introduce a quarter wave plate (which converts circularly polarized light to linearly polarized light) followed by a polaroid. As the Polaroid is rotated, one spot vanishes when the other is at maximum intensity—as expected from orthogonal linear polarizations.

ACKNOWLEDGMENT

We are grateful for the assistance of L. Ritchie.

[a]Electronic mail: freeman@brachot.jct.ac.il

[1]E. Hecht, *Optics* (Addison–Wesley, Reading, MA, 1987), p. 311.
[2]F. A. Jenkins and H. E. White, *Fundamentals of Optics* (McGraw–Hill, New York, 1985), p. 589.
[3]Reference 1, p. 312.
[4]Halbo Optics, 83 Haltwhistle Road, Western Industrial Area, South Woodham Ferrers, Essex CM3 5ZA, England. Home page: http://www.halbo.com.
[5]Reference 2, p. 204.

THE AIM OF PHYSICS

[Physics today is] not in harmony. Quantum mechanics has no imaginative conception. If you are satisfied to say that physics is nothing but operating a formalism to get results, and operating equipment to get results, in order to obtain results which agree, all right. But if you say that physics aims to understand what's happening imaginatively, then I don't think that it's doing that. Neither relativitiy nor quantum theory is clear. And the relation between relativity and quantum theory is even less clear.

David Joseph Bohm, in *A Question of Physics: Conversations in Physics and Biology*, conducted by Paul Buckley and F. David Peat (Routledge and Kegan Paul, London 1979), p. 131.

RUBBISH

Victor Henri...recalled...that, while visiting Paris, he received from Langevin a copy of ''the very remarkable thesis of de Broglie''; back in Zurich and having not very well understood what it was all about, he gave it to Schrödinger, who after two weeks returned it to him with the words: ''That's rubbish.'' When visiting Langevin again, Henri reported what Schrödinger had said. Whereupon Langevin replied: ''I think Schrödinger is wrong; he must look at it again.'' Henri, having returned to Zurich, told Schrödinger: ''You ought to read de Broglie's thesis again; Langevin thinks this is a very good work''; Schrödinger did so and ''began his work.''

Max Jammer, *The Conceptual Development of Quantum Mechanics* (McGraw-Hill, New York, 1966), p. 258.