Elegance in Crystal Symmetry FREE

Ted Janssen

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the Szilard–Tuck design the "most promising and most complete in technical detail" of early designs. Kerst believed it "would surely have succeeded were it not for the war in Europe."[5]

References

1. G. Dannen, http://www.dannen.com/budatalk.html.
2. G. Dannen, *Sci. Am.*, January 1997, p. 90.
3. Reichspatentamt [German patent office] to L. Szilard, 27 February 1929, document no. 35-611 p. 11. (The Albert Einstein Archives, Jewish National and University Library, Hebrew University of Jerusalem, Israel; Albert Einstein Duplicate Archive, Department of Rare Books and Special Collections, Princeton University Libraries.) Trans. G. Dannen, M. Healy.
4. L. Szilard to W. B. Mann, 27 February 1952, box 19, folder 13, Leo Szilard Papers (MSS 0032). (Mandeville Special Collections Library, University of California, San Diego.)
5. D. W. Kerst, *Nature* **157**, 94 (1946).

GENE DANNEN
(gene@dannen.com)
Corvallis, Oregon

Elegance in Crystal Symmetry

In N. David Mermin's column in the March 2000 issue of PHYSICS TODAY (page 11), I tasted the disappointment that the community of crystallographers has not en masse embraced his proposed description of periodic and aperiodic crystals, although it is so elegant. The explanation is simple. Mermin's approach, using only reciprocal (or Fourier) space, was not as new as he claimed. Early in the study of modulated structures, the symmetry was described using irreducible representations of space groups. This is, in fact, a formulation in reciprocal space. The phase factors appearing there are exactly the gauge transformations Mermin discusses.

In contrast, the description that has become standard uses either reciprocal space and three dimensions or direct space and more dimensions. These two formulations are equivalent, but sometimes one is more natural than the other. For example, the positions of atoms or the properties of tilings are more easily discussed in direct space than in reciprocal space. Mermin's approach is very close to the reciprocal space formulation of the standard approach. To apply his approach to the Penrose tiling, one must first calculate the Fourier transform—an unnecessary detour. Therefore, in my opinion, Mermin's approach is certainly elegant, but the standard approach proposed earlier is even more so.

The reason that a serious commission struggles a long time with the nomenclature is simple. The higher-dimensional space groups studied are not used only for electron wavefunctions of aperiodic crystals. Structures, atomic positions, and especially deviations like phason strains are more easily visualized in direct higher-dimensional space, and are described there by space groups. Furthermore, higher-dimensional space groups are relevant not only for physics and crystallography. Quasicrystals have inspired a strong and interesting development in mathematics, for instance, in which problems concerning model sets, diffracting sets, tilings, and other objects are studied using symmetry arguments. Other mathematical topics such as the characterization of Lie groups or spaces of constant curvature use higher-dimensional space groups. Therefore, it is useful to have a nomenclature that satisfies the needs of the different users—mathematicians, physicists, and crystallographers—and that is understood by these groups. Developing such a nomenclature is time-consuming and requires a broad perspective.

I agree with Mermin's statement about the role of elegance in science, but I think that at least one of his examples is not very well chosen.

TED JANSSEN
(ted@sci.kun.nl)
University of Nijmegen
Nijmegen, the Netherlands

MERMIN REPLIES: I'm glad that Ted Janssen sees some elegance in the approach to crystal symmetry that my collaborators and I developed for aperiodic crystals, and I'm pleased to return the compliment to the standard approach of him and his collaborators.

As far as I know, the precise connection was only recently spelled out between our phase (gauge) functions and the rather different phases (factor systems) that appear in the venerable theory of space-group representations.[1] This link offers a more direct and elementary route from crystal symmetry to some of the major physical applications of space-group representations.[2]

References:

1. A. Koenig, N. D. Mermin, *Phys. Rev. B* **56**, 13607 (1997).
2. A. Koenig, N. D. Mermin, *Am. J. Phys.* **68**, 525 (2000).

N. DAVID MERMIN
Cornell University
Ithaca, New York

Authors Amend Article on Strontium Ruthenate

Because of an unfortunate miscommunication among the authors, the following corrections were not made to the published version of our article "The Intriguing Superconductivity of Strontium Ruthenate," which appeared in the January 2001 issue of PHYSICS TODAY.

In the cover caption on page 5, the alpha and beta sheets are misidentified: The alpha sheet is orange; the beta is white.

In the last sentence of the first paragraph on page 42, the partially filled d-bands referred to parenthetically should be those of ruthenium or copper ions and not those of strontium or copper ions.

Yoshiteru Maeno's title at Kyoto University is associate professor of physics, not professor of physics. He is also affiliated with the Japan Science and Technology Corp's Core Research for Evolutional Science and Technology program.

On page 44, figure 3 is based on data from S. E. Barrett, *Physics Review B*, volume 41, p. 6283, 1990.

In the figure in the box on page 46, the unit on the axes is the pixel number, not the actual length (each pixel measures 7.5 mm × 7.5 mm).

On page 47, a phrase was omitted from the last sentence of the third paragraph under "Phase-sensitive probes." The sentence should begin: "Josephson tunneling of pairs between Sr_2RuO_4 and conventional superconductors consistent with the proposed *p*-wave state has been reported."

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YOSHITERU MAENO
MANFRED SIGRIST
Kyoto University, Kyoto, Japan
T. MAURICE RICE
Swiss Federal Research Institute of Technology
Zürich, Switzerland

Correction

December 2000, page 26—The bomb shown in the photograph is a B-61, not a B-83. ■