
News

A REPORT ON THE MIDWINTER SOLID-STATE RESEARCH CONFERENCE

The 1970 Midwinter Solid-State Research Conference was held at Newport Beach, California, during January 18–23, 1970. The subject of this year's conference was "critical phenomena." Because of the remarkable similarity in the behavior of quite different systems near a phase transition, any conference on critical phenomena should include people of quite diverse backgrounds and interests. The organizers of this conference did an especially fine job of presenting a balanced program in the field. Topics covered in the conference include work on Ising-like systems, neutron scattering from magnetic systems, static and dynamic phenomena near liquid–gas transitions and near the superfluid transition, light scattering from fluids, and sound propagation in magnetic and other systems.

The conference was arranged into scheduled morning and evening sessions, with the afternoons being available for informal discussions. The theorists spontaneously organized a "theoretical jamboree" during the afternoons where the details of recent work were discussed at some length.

The conference opened with considerations of the simplest system exhibiting a phase transition, namely the Ising model. Michael Wortis (U. of Illinois) discussed numerical calculations using the three-dimensional Ising model and stated that the results apparently do not satisfy the Kadanoff–Widom static scaling laws. Jens Als-Nielsen (Brookhaven) then presented some experimental neutron-scattering measurements on β -brass which agreed quite well with the Ising-model predictions. Lester Guttman (Argonne) discussed X-ray scattering work on order–disorder transitions and pointed out that there are materials such as Fe_3Al , as yet having been little studied, which have one order–disorder transition that is Ising-like.

The general topic of neutron scattering on magnetic systems was discussed by Michael Schulhoff (Brandeis U.). L. M. Corliss (Brookhaven) then presented neutron-scattering measurements on RbMnF_3 which supported the dynamical scaling theory of Halperin and Hohenberg. J. P. Cotton (Commissariat A l'Energie Atomique) presented measurements of the spin diffusion constant in Fe, and Franz Wegner

(Institut Max von Laue) talked about some spin-dynamics calculations for anisotropic magnetic systems.

An important goal of workers in the field is the generation of equations of state which describe the behavior of systems in the critical region. Such work was discussed by J. D. Litster (MIT) and also by J. M. H. Levelt-Sengers (NBS), who presented as well experimental data on several magnetic and liquid-gas systems.

Michael Moldover (U. of Minnesota) presented the results of specific-heat measurements in ^3He - ^4He mixtures near the λ -line. Measurements of the sound velocity in the kilohertz range for ^4He near the critical point were discussed by Martin Barmatz (Bell Labs.), with agreement being found with the theoretical work of Kawasaki. Pierre Hohenberg (Bell Labs.) described the effects of gravitation on the interpretation of experimental measurements near phase transitions involving significant density variation.

Gunter Ahlers (Bell Labs.) presented experimental measurements near the superfluid transition in ^4He that tested the predictions of static and dynamic scaling. In particular, measurements of the specific heat appeared to disagree with the predictions of static scaling. Disagreements with theoretical predictions regarding specific-heat measurements in magnetic systems were also pointed out by Dale Teany (IBM). Henry Kierstead (Argonne) presented measurements of $\partial P/\partial T$, and Richard Williams (U. of California, Los Angeles) discussed recent measurements of sound attenuation near the λ -point in ^4He . Michael Revzen (U. of California, Los Angeles) described calculations on the onset of superfluidity in ^4He films.

Superconductivity, being well described by a mean field theory in the region accessible to experiment, should not in the strictest sense be classified as a critical phenomenon. However, Bert Halperin (Harvard U.) gave an excellent review of many of the mean-field calculations of the past few years and also discussed some recent work on one-dimensional systems. Reasonable experimental agreement with this latter work was described by R. D. Parks (U. of Rochester).

G. Baker (Brookhaven) and J. Essam (Brookhaven) discussed a theoretical calculation of the specific heat in which one of the complexities of real physical systems, namely lattice distortion, was included.

Light-scattering experiments were also given considerable attention. The general situation was discussed by Herman Cummins (Johns Hopkins U.), with specific work being presented on the cyclohexane-aniline system by B. Volochine (Commissariat A l'Energie Atomique) and on Brillouin scattering in xenon, by David Cannell (MIT). W. Webb (Cornell U.) talked about the observation of surface modes in critical mixtures by light-scattering techniques.

B. Lüthi (Rutgers U.) discussed sound attenuation in magnetic systems in the low-frequency regime. He pointed out that, while there is good agreement between experiment and the theories of Kawasaki and of Kadanoff and Laramore for the rare-earth metals, there is a general catastrophe as far as the insulating antiferromagnets are concerned. Kyozi Kawasaki (U. of Illinois) described some work in which the theory of sound attenuation is extended to the high-frequency regime.

The liquid-gas transition of SF_6 is of particular interest because of the poor agreement between experiment and the theory of Kadanoff and Swift which appears

to work well otherwise. Joseph Lastovka (MIT) presented experimental measurements of the thermal conductivity which did not exhibit the behavior predicted by the theory for the low-frequency regime. Norman Ford (U. of Massachusetts) presented measurements of the thermal conductivity of SF_6 obtained by light scattering. These measurements were not inconsistent with the theoretical predictions, but it is doubtful that they were in the low-frequency regime.

Most of the work described at the conference involved second-order phase transitions. However, the first-order transition in NH_4Cl was discussed by George Fredericks (U. of Illinois). Dale Teany (IBM) discussed a "critical-point" phenomenon that has received little attention thus far—nematic-isotropic transitions in liquid crystals. In these systems, the order parameter is the anisotropic part of the dielectric tensor. Julio Gonzalo (Nuclear Center, Puerto Rico) presented measurements in ferroelectrics in which mean-field-theory values were obtained. Because of the long-range forces involved, this was felt to be reasonable.

A major area of theoretical interest involved attempts to understand the small but persistent departures from the scaling laws that have been found in numerical work on three-dimensional systems and in actual experiments. In an effort to understand the experimental work of Ahlers, Michael Fisher (Cornell U.) was forced to abandon the usual scaling formulations and introduce "four function scaling." Leo Kadanoff (Brown U.) discussed some attempts to understand the discrepancies in terms of the symmetry and dimensionality of the ground state of the system. He also spoke in some detail at the "theoretical jamboree" about some recent attempts to better understand the two-dimensional Ising model in terms of an operator-algebra formalism. Ken Wilson (SLAC) told of some of his quantum-field-theoretic work which closely parallels the operator algebra of Kadanoff, and Peter Feibelman (U. of Illinois) discussed some recent work of Migdal and Polykov.

Other approaches to understanding the breakdown of scaling were given by John Wheeler (U. of California, San Diego), who spoke of attempts to understand the problem in terms of surfaces representing equations of state, and by Michael Coopersmith (U. of Virginia), who talked about basing an analysis of the problem upon the branch points of the free energy as the phase transition occurs. Robert Griffiths (Carnegie-Mellon U.) talked about the dependence of the critical indices on a parameter, and Richard Ferrell (U. of Maryland) discussed avoiding the complexities of the hydrodynamic equations in calculating transport coefficients by using sum rules.

In the opinion of the writer, the main points brought out in the conference can be briefly summarized as follows:

1. The two-parameter Kadanoff-Widom scaling laws are in real trouble as far as predicting the relationships between the static critical exponents in three-dimensional systems, the deviation from the scaling laws being small, but nevertheless real.
2. There are still some rather large discrepancies between theory and experiment regarding some of the transport coefficients. The problem here is that the systems which at first hand appear to most closely correspond to the idealized models of the theorists are the ones which exhibit the largest discrepancies.

It was felt by many of those attending the conference that point 1 indicates a real conceptual lack in our understanding of the nature of the phase transition, while the large discrepancies mentioned in point 2 are probably due only to a lack of understanding of the coupling between different transport processes at the phase transition.

The conference was sponsored by the University of California at Irvine. The conference co-chairmen were Leo P. Kadanoff (Brown U.) and George F. Reiter (U. of California, Irvine). No conference proceedings are to be published.

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CALENDAR OF MEETINGS

The calendar contains information on forthcoming meetings of interest to our readers. We list, as accurately as possible, the date, the title of the meeting, the sponsoring organization, the location, the organization, individual, or publication that should be consulted for further details, and any other useful information about the particular meeting. The Journal will be happy to receive information on meetings planned for the future.

Send the information to:

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| August 11-14 1970 | Symposium, International Federation of Automatic Control; Kyoto, Japan (write: Dept. of Electronics, Faculty of Engineering, University of Kyoto, Yoshida-Honmachi, Sakyo-Ku, Kyoto, Japan). |
| August 25-28 1970 | Institute of Mathematical Statistics, 33rd Annual Meeting; Laramie, Wyoming (contact: Prof. Leo Katz, Executive Secretary, Statistical Laboratory, Michigan State University, East Lansing, Mich. 48823). |
| September 4-10 1970 | Low-Temperature Physics; IUPAP; Kyoto, Japan (contact: T. Sugawara, Institute for Solid-State Physics, U. of Tokyo, 7-21-1 Rappongi, Minato-Ku, Tokyo, Japan). |
| September 9-14 1970 | Second World Conference; <i>Econometric Society</i> ; Cambridge, England (contact: Professor D. W. Jorgenson, Dept. of Economics, Harvard University, Cambridge, Mass. 02138). |

December 27-30 1970 North American Winter Meeting; *Econometric Society*; Detroit, Mich. (write: P.O. Box 1264, Yale Station, New Haven, Connecticut 06520).

December 28-30 1970 Meeting; *American Physical Society*; Stanford University (see: *Bull. Am. Phys. Soc.*).