Galaxies of the Sc I luminosity class, which have well-defined spiral patterns, appear in *A Revised Shapley-Ames Catalog of Bright Galaxies*, by A. Sandage and G. A. Tammann (157 pp. Carnegie Institution of Washington, 1981. $29.00). The book describes magnitudes, types and redshifts of galaxies in the original Harvard survey, updated to Summer 1980 and provides both a selection of photographs that illustrate the luminosity classification and a list of additional galaxies that satisfy the magnitude limit of the original catalog. Data for 1246 galaxies are included.

such as functional integrals (including fermions), which are particularly suitable for understanding gauge theories.

There certainly continues to exist a demand in the high energy community for a good reference work on the fundamentals of gauge theories. A 1973 review article on the subject by Benjamin Lee and Ernst Abers remains by far *Physics Reports*' most popular reprint. On purely formal questions, this monograph by Faddeev and Slavnov is somewhat more complete, though its description of actual physics situations is rather spare. But it has probably outlived most of its usefulness. It assumes the reader is perfectly well versed in state-of-the-art quantum field theory *circa* 1971, and the presentation is so terse and linear that little distinction is made between points that are subtle, fundamental or trivial. I suspect that those with sufficient background to follow the presentation are by now as familiar with the subject as they wish to be. Also, the point of view is narrowly confined to the perturbative approach, which is totally inadequate for confronting the basic problems of gauge theory today. Further, for those current applications of gauge theory which use perturbative calculations, *Gauge Fields* is both overly formal and too incomplete to serve as an introduction.

For people wishing to learn the subject, it is absurd, though woefully common, to require that they progress systematically through the full historical development. What is needed is to incorporate the gauge theory perspective into some new textbooks on relativistic quantum mechanics.

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Nuclear Reactions with Heavy Ions

R. Bass
418 pp. Springer, New York, 1980. $48.40

Until a few years ago, advanced graduate students and specialists in other areas could rapidly acquire a broad working knowledge of heavy-ion nuclear science by studying topical conference proceedings and following the current literature. With the explosive growth of the field in diverse directions over the last decade, new researchers now face a formidable task in gaining a comparable orientation, and students, in particular, often fail to perceive the underlying unity of the subject.

In *Nuclear Reactions with Heavy Ions*, Reiner Bass provides a very useful introduction to a substantial portion of the field. Written for the readers described above, the book contains relatively thorough, critical surveys of five major areas of current research interest: resonances and related phenomena in light systems; quasi-elastic scattering and transfer reactions in heavier systems; deep-inelastic processes; complete fusion reactions; and compound nucleus decay. In each of these areas, data drawn from a variety of representative experiments are presented and discussed in terms of straightforward models that help bring out the underlying physics. Controversial or tentative interpretations are labeled as such, and in many cases, several alternative viewpoints are outlined and contrasted. The treatment tends to be phenomenological, and developments along more purely theoretical lines are not considered in any detail. This approach will appeal particularly to experimentalists.

Some important topics, such as the time-dependent Hartree–Fock approach to deep-inelastic collisions, are mentioned only briefly, but these can be addressed through the very extensive reference lists included with each chapter. An appendix contains a list of relevant and generally available conference proceedings. Omitted altogether from the book are discussions of relativistic reactions, the role of heavy ions in atomic, surface and applied physics, nuclear spectroscopy with heavy ions, and instrumentation.

Bass has achieved his goal of providing an introductory, critical survey of heavy-ion nuclear reactions at energies below 10 MeV per nucleon. The book could be used very advantageously to enrich an advanced graduate course, and, supplemented by the current literature, it should be uniquely valuable to anyone embarking on heavy-ion research.

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Molecular Hydrodynamics

J. P. Boon, S. Yip
417 pp. McGraw-Hill, New York, 1981. $49.95

The microscopic structure of fluids has been one of the most persistently active fields in theoretical physics in recent decades. A series of surges in the literature has occurred as each subfield has expanded, matured and become routine. The study of the basic equilibrium properties of uniform simple fluids completed its cycle in the 60s, producing progeny that are now flourishing. Almost certainly, the most important of these concerns time correlations in uniform fluids: the theoretical underpinning of the general theory of linear transport. Despite the voluminous literature accumulated, there has existed until now no treatment of sufficient depth and breadth to do justice to the topic. To provide such a treatment is the intent of the monograph under review, a collaboration by two accomplished professionals.

On a technical level, the overall problem treated is that of determining the time correlations between microscopic observables in a uniform classical fluid in thermal equilibrium. For example, one might ask for the time development of the velocity distribution of a particle whose initial velocity is known. This situation is typical in that the input information is insufficient to fix the subsequent many-particle dynamics. Instead, one has an initial thermal distribution conditioned upon knowledge of the mean values of a set of characteristic observables; starting from these, one can then—in principle—follow the ensuing time development of the full distribution function, but this is neither necessary nor sufficient to describe the physics. Rather it is the time development of the same mean values that is desired, for it offers the possibility of a closed dynamics, microscopically valid, of local properties of the fluid—a molecular hydrodynamics. Thus, not only can one envision a first-principles derivation of linear hydrodynamics, but one can also ask questions about a range of wave numbers and frequencies beyond the usual scope of hydrodynamics, a range requiring such experimental tools as neutron scattering or theoretical tools as computer simulation for assessment of the answers.

Several threads are woven into the text to provide a natural unification. First is the concept of a "memory" function. The dynamics of the correlations, or equivalently, those of the response, say $R(t)$, to an initial constraint, depend not only upon the observable being followed at the time in question, but also upon all of the invisible degrees of freedom. Hence, one cannot write $dR/dt = KR$ for some (operator) K, but rather $dR(t)/dt = \int K(t') \times R(t-t')dt'$. Then $K(t')$, which decreases as one goes back in time, is the memory function. A second, associated, thread is the projection technique, which formalizes the averaging over the invisible degrees of freedom. A third is the choice of a particular set of observables to concentrate on, here, the one-body phase-space distribution, in terms of which the primitive local variables of the fluid can be expressed. A fourth is the use of exact relations—sum rules—to direct interpolation between solved special cases. A final thread is the extensive reference to computer simulation both to assess the detailed validity of approximations that are made, and indeed to motivate them.

Considering the scope of the material in this book, it is quite well organized. A short introductory chapter is followed by an extensive, yet succinct, review of the concepts, basic tools, and basic approximations of the subject. In-depth analysis starts with self-diffusion as represented by the velocity autocorrelation function and continues with a discussion of anomalous long-time dependence. Extension to the full time-dependent self-distribution follows, with versions for several different models. The stage is then set for a return to the principal topic of time-dependent density–density correlations, and its relation to linear transport. The latter is used to predict and interpret the