article serves as a basic introduction to the concepts but does not include the newest results. Furthermore, the lack of organization in the additional references seriously reduces their usefulness.

The multioscillator ring laser gyroscope, a particular second-generation design to replace the commercially available basic RLGs, is described in volume 4 by H. Statz, T. A. Dorschner, M. Holtz and I. W. Smith. This seems like an overly sophisticated development to discuss in a general laser handbook. A broader discussion of simpler RLGs, a brief description of the multioscillator RLG and an introduction to fiber gyros, along with a comparison of all three, would have held the most interest. There is undoubtedly serious commercial interest in the multioscillator RLG, and the article contains some fascinating discussions of out-of-plane resonators and magnetic mirrors. However, I doubt that this technology will have the general impact on quantum electronics that the other subjects in the volume will have.

Volume 5 contains an exciting discussion of uv and vacuum uv sources, including lasers and nonlinear processes such as harmonics and stimulated Raman scattering, by John F. Reintjes, a world-renowned specialist in short-wavelength generation by frequency conversion. Tables detail uv wavelengths available from atomic–ion, molecular, rare gas excimer, halide and dye lasers. Descriptions include operating powers, efficiencies, spectral characteristics and schematic diagrams of laser system designs, but no theoretical background. By contrast, the use of nonlinear processes to obtain uv is fully supported by basic theory. The theoretical introduction to frequency doubling and tripling, phase matching and the optics of relevant crystals is of interest not just for uv generation, but more generally. The theoretical discussion continues into important practical limitations such as saturation and incomplete phase matching. This discussion is followed by an enumeration of recent experimental results.

P. F. Moulton describes the use of transition metals and rare earths in crystals such as sapphire, ruby, alexandrite, emerald and gadolinium gallium garnet. This article takes the reader through the physical background of ions in crystals to an understanding of the performance of specific lasers. Moulton has spent considerable time studying these systems and includes previously unpublished data. A minor criticism is the difficulty in understanding that alexandrite and emerald lasers both use Cr ions—a fact missing from the tables and hidden in the text.

The survey of methods to obtain supernarrow optical resonances by V. P. Chebotayev includes saturated absorption, two-photon resonances and the methods of separated fields. Laser lines are now so narrow that one can investigate new effects caused by particle collisions, finite transit time, recoil and particle flight in the resonance. This paper suffers from stilted English, but the physics is superb. It is a welcome addition to the handbook to have a paper from the Soviet Union, complete with Russian references.

Laser photochemical and thermal processing for microlithography is described briefly by J. T. Yardley. Finally, an extended article by N. C. Luhmann Jr and W. A. Peebles on laser diagnostics of plasmas includes an important but esoteric description of laser interferometry, polarimetry, Thompson scattering and fluorescence spectroscopy as applied to plasma research. I wonder if this specialized application is of sufficiently general interest to fill almost 200 pages of a handbook. Two articles, one on far-infrared lasers and one on light scattering processes in plasmas, might have been of greater value.

In conclusion, these handbooks are a valuable resource for the quantum electronics community. They are strongly recommended for every library and research group. I look forward to additional volumes in the series.

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Elements of Quantum Mechanics of Infinite Systems

Franco Strocchi
World Scientific, Singapore (Teaneck, N. J.), 1985. 179 pp. $33.00 hc ISBN 9971-978-91-1; $21.00 pb ISBN 9971-978-92-X

There is a dramatic difference between the quantum mechanical behaviors of a finite system and of an asymptotically infinite system. The difference appears in such behaviors as collective phenomena and symmetry breaking that play a crucial role in theoretical physics and have no counterpart in the quantum mechanics of finite systems. Historically many have viewed these phenomena as the origin of numerous difficulties in infinite systems. But nowadays these difficulties emerge as the basis for welcome structures that yield a deep physical understanding of QM_∞.

Franco Strocchi treats some archetypical structures from QM_∞ in his book of lecture notes and gives an introduction to these structures. He brings them to life in an exact, "nonperturbative" way by means of diverse archetypical examples from QM_∞. These examples constitute the basis of our quantum mechanical understanding of the central features of condensed matter and elementary-particle physics. They range from photon emission by an accelerated classical charge to the Heisenberg ferromagnet. In between, one finds nucleons interacting with a meson field, an electron interacting with a phonon field in a metal or a polar crystal, many electrons in a metal, a dilute Bose gas and the Bardeen–Cooper–Schrieffer model of superconductivity.

These examples drive home by increments the central feature of QM_∞: The quantum states of a system decompose into unitarily distinct representation spaces. This beautiful common denominator unites the examples and elevates QM_∞ above the quantum mechanics of finite systems. Structurally, ordinary QM is much simpler than QM_∞ because of a famous theorem by John von Neumann from some 57 years ago (*Math. Ann.* **104**, 570, 1931): For a finite system all quantum representations of p's and q's are unitarily equivalent. Quantum mechanical descriptions of a given physical system thus reduce to the status that different coordinates have in relativity. They are all equivalent.

In QM_∞, however, different inequivalent representations give rise to different physical pictures. Besides the "dynamical problem," often involving an evolution equation, there is also problem of determining an appropriate representation. Failure to recognize this has often frustrated many workers in the past. In desperation they have passed the blame to QM_∞, asserting that it is beset by various "catastrophes," "difficulties" and "malignancies."

There are several ways of distinguishing different representation spaces. What in various contexts one might call the "condensed," "false," "physical," "Rindler" or "Minkowski" vacuum, the author simply calls a "reference" or "ground" state. It uniquely labels the representation space. Such a labeling is already implicit in von Neumann's theorem.

Similarly, quasiparticles, "Rindler" particles, bogolons, magnons, holes, Goldstone bosons and so on, Strocchi simply calls "elementary excitations" or "modifications" of a given reference state.

If I had to single out the most striking concept in Strocchi's book, then I would pick what he calls a "Haag charge" (after R. Haag, who in *Nuovo Cimento* **25**, 287 [1962], introduced it into condensed matter physics). This object together with the idea of a "ground state" must rank among the most important concepts in QM_∞. Both of them serve as identifying labels of a given representation space of quantum states. The latter highlights the microscopic (elementary particle) aspects of QM_∞ while the Haag charge focuses itself on the macroscopic (condensed matter) aspects. It is analogous to the angular momentum operator for the hydrogen atom or to the three-dimensional oscillator in ordinary quantum mechanics: It commutes with all relevant quantum operators, it is a physically significant multiple of the identity on each irreducible representation space, and it hence makes an exact solution of the quantum mechanical problem possible. In fact, following Haag, Strocchi illustrates the usefulness of Haag charges by solving exactly the models for superfluidity and superconductivity.

Furthermore these "charges" evidently establish a link between the representation problem and the dynamical problem of a broken-symmetry system. They must play a very fundamental role in QM_∞, at least in phenomena where an order parameter emerges when a continuous symmetry is broken. Thus, the Haag charges can refer to:

▷ the number concentration of a superfluid condensate

▷ the gap parameter of a superconductor

▷ the magnetization of a Heisenberg ferromagnet.

Common to these as well as all the rest of Strocchi's archetypes is the fact that translation symmetry does not get broken. Strocchi considers only those representation spaces of a given system on which parallel-translational symmetry can be implemented by unitary transformations. Thus he excludes the example of an acceleration-partitioned relativistic system (William G. Unruh, *Phys. Rev. D* **14**, 870, 1976). This system has the peculiar property that the Minkowski vacuum has a finite temperature T with the well-known Davies–Unruh value $(1/k)(\hbar/2\pi)(a/g)$, where a is the acceleration. Furthermore the ground state of this system breaks the translation symmetry and has the macroscopic attributes of liquid light, that is, of photons in the configuration of a superfluid.

One cautionary remark: Strocchi puts great technical demands on his readers, with no qualms about condensing nontrivial calculations or demonstrations. This should not deter an active reader. The inclusion of such calculations would only detract from learning through Strocchi's illustrative examples the central structures of QM_∞.

I found these notes extremely rewarding because not only did they enlarge my physics horizon, but they did so where it counts.

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BOOK NOTE

The Beginnings of the Nobel Institution: The Science Prizes, 1901–1915

Elisabeth Crawford
Cambridge U. P., New York, 1987 [1984]. 281 pp.
$39.50 hc ISBN 0-521-26584-3;
$16.95 pb ISBN 0-521-34747-5

The Nobel Population 1901–1937: A Census of the Nominators and Nominees for the Prizes in Physics and Chemistry

Elisabeth Crawford, J. L. Heilbron and Rebecca Ullrich
Univ. of Calif., Berkeley, 1987. 337 pp. $20.00 pb
ISBN 0-918102-15-4

Recently reissued in paperback, *The Beginnings of the Nobel Institution* traces the background of the Nobel Prize and its early years. Elisabeth Crawford discusses how the vague last wishes of Alfred Nobel, the inventor of dynamite, were implemented in setting up a large fund, "the interest on which shall be annually distributed in the form of prizes to those who, during the *preceding* year, shall have conferred the greatest benefit on mankind" (emphasis added). The author focuses on the physics and chemistry prizes awarded annually by the Royal Swedish Academy of Sciences. A major factor in the selection of the prizewinners before World War I was the experimentalist bias in the composition of the Nobel Prize commit-