Report to the 1999 General Assembly for 1996-99 Officers 1996-1999:

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The General Aims of the Commission on Statistical Physics (C3) are:

To promote the exchange of information and views among the members of the international scientific community in the general field of Statistical Physics including: statistical and thermodynamic methods concerning the static and dynamic properties of mesoscopic and macroscopic states of matter;

applications of statistical physics to related fields such as non-linear dynamics, turbulence, chemical kinetics, polymers, colloids, liquid crystals, non-crystalline solids, heterogeneous media, neural networks and computational physics.

To recommend for Union sponsorship international conferences which qualify for support under Union regulations.

To select winners of the Boltzmann medal.

1. ACTIVITIES

From 1996 to March 1999, C3 only sponsored the 20th International Conference on Statistical Physics, STATPHYS 20, in Paris from July 20 to 24, 1998. STATPHYS 20 took

place in the Conference Center of UNESCO, the United Nations Educational Scientific and Cultural Organization, except on Wednesday, July 22, where special sessions were presented in the Grand Amphitheatre of the Sorbonne, Paris-University. STATPHYS 20 welcomed around 1800 participants from 60 countries, an exceptionally high figure to be compared with a usual number of 700 - 1 (Xiamen 1995: 700, Berlin 1992: 1100, Rio de Janeiro 1989: xxx, Boston 1986 : 0. Previous figures were smaller). Simultaneous translation in French was made at UNESCO in the main lecture room (room I). Twelve plenary lectures and three special sessions were presented at UNESCO and at the Sorbonne, respectively. Besides these activities, the Conference was organized around 12 scientific themes. They range from the most theoretical or mathematical ones to recently developed or more applied topics, and to other domains such as Biology (theme 11) or Economy/Finance (theme 12) where methods of Statistical Physics have proved useful. Each theme included at least one session with 3 or 4 invited 30 minute talks, one or several specialized sessions of 15 minute contributions and one poster session. The total number of oral presentations was 250 and there were 1400 posters. The proceedings of STATPHYS 20 will be published as a special issue of Physica A in the spring of 1999.

The winners of the 1998 Boltzmann medal were Professors E. Lieb (Princeton University, USA) and B. Widom (Cornell University, USA). The citations are as follows:

Lieb: For his outstanding mathematical investigations of fundamental problems in classical and quantum statistical physics, including exact solutions of a wide range of models with important applications.

Widom: For his illumination studies of the statistical mechanics of fluids and fluid mixtures and their interfacial properties, especially his clear and general formulations of scaling hypotheses for the equation of state and surface tensions of fluids near critical points.

The 21st International Conference on Statistical Physics, STATPHYS 21, will be held in Mexico City, Mexico, in the summer of 2001.

2. NEW DEVELOPMENTS

Bose-Einstein Condensation:

The condensation of identical bosons at low temperatures was predicted by S. Bose and A. Einstein in 1925. As suggested by F. London in the thirties this phenomenon is responsible for the superfluidity of He4, but its effects are masked by interatomic interactions in the liquid state. Thanks to the development of laser cooling technology, Bose-Einstein condensation was first observed in a dilute gaseous system, consisting of a cold cloud of rubidium atoms, in 1995. In 1998, a team at MIT made a single condensate from million hydrogen atoms.

Nonequilibrium Statistical Mechanics:

One important development which has taken place recently in statistical mechanics concerns nonequilibrium. Specifically the role and importance of chaotic microscopic dynamics have come to be better understood, due to the work of a number of authors. Among the basic ideas involved are that of "Gaussian Thermostat" (W. Hoover, D.J. Evans), and the use of "Sinai-Ruelle-Bowen" (SRB) states. Important results include the Gallavotti-Cohen Fluctuation Theorem and the Dettmann-Morriss Pairing Theorem.

Self-organized Criticality:

The idea of self-organized criticality was introduced into statistical physics in 1987. In recent years, many exact results on sand pile models of self-organized criticality were obtained.

Disordered quantum systems:

A renormalization group method to study a random quantum spin chain was proposed in 1979. In recent years, this method has been extended to study disordered quantum systems in higher dimensions and interesting phase diagrams have been obtained.

Novel Applications of Statistical Physics:

During the last few years, statistical physics has become even more interdisciplinary than before. There are novel applications of methods and ideas of statistical physics to interesting problems in biology and economics, e.g. universal scaling laws in biology, collective motion of birds, metastable states in traffic flow, scaling laws in finance, etc. There are also various attempts to understand the protein folding problem.

Computer-Aided Statistical Physics:

Numerical methods, such as Monte Carlo and molecular dynamics simulations, were developed in the early 1950's. With the development of high-speed computers these have become increasingly important tools in statistical physics. In recent years, novel methods to carry out Monte Carlo simulations and to analyze Monte Carlo data have been developed, whereby researchers can obtain accurate and interesting results, Examples are critical points and exponents as well as universal finite-size scaling functions for percolation and spin models. As the computing power of personal computers has increased it has become possible for scientists in developing countries to make more and more significant contributions to computational statistical physics.

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