

**STEFAN FRONTIER CONFERENCES**  
**(Frontier Science Research Conferences Worldwide)**  
**15th Anniversary, 1989-2004 / FSRC editors.**

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**Note:** **This is an abridged version of the above title.**

## 1. Introduction

In the last few years, a number of Frontier Science Research Conferences (FSRC) have been held in La Jolla, Calif., dealing with various subfields in science and technology: Laser-Matter-Interaction-2004,-2005, High Energy Density Plasma Physics-2003 (See Section 3), Luminescent Materials-2002[1], Carbon and Carbide Materials-2002, Silicon Materials-2001[2], Optical Fibers-2001[3], and Chaos and Transport in Fluids and Plasmas-2002 (See Section 4), among others. The Laser-Matter-Interaction-2004,-2005 and the High-Energy-Density-Plasma Physics-2003 were organized within the conference series on Science and Technology of Energy Sources, which started with the FSRC on Inertial Confinement Thermonuclear Fusion[4]. The FSRC on Chaos and Transport in Fluids and Plasmas was held within the series on Plasma Science and Technology[5,6] and the FSRCs on materials research within the conference series on Materials Science and Technology[7-9].

The FSRC's final goal is publication <sup>A</sup> of submitted edited materials within various FSRC book series so that they can be used by a broader scientific

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<sup>A</sup> The reports from the FSRC meetings are published in several book series: Stefan University Press Series on Research Trends in Physics ISSN: 1543-4036 (formerly published by the American Institute of Physics as Research Trends in Physics Series founded by V. Stefan), S-U-Press Series on Frontiers in Interdisciplinary Physics, ISSN: 1543-7329, S-U-Press Series on Frontiers in Biomedical Science and Technology, ISSN:1541-8766, S-U-Press Series on Laser Medicine ISSN:1522-6352, and S-U-Press Series on Frontiers in Genomic Medicine, ISSN.1541-4728 The FSRC books are micro reviews of research activity in a last 2-3 years, or more, of a particular research group, including a future plans for research They also reflect on larger questions, problems, and

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community at present and in years to come as a quality research document. Overall, approximately fifty FSRC books/bulletins have been published since 1989. As to the publishing and making research results known to larger audience, Einstein says [10]:

*"The progress of science presupposes the possibility of unrestricted communication of all results and judgments—freedom of expression and instruction in all realms of intellectual endeavor. The freedom of communication is indispensable for development and extension of scientific knowledge. Such an ideal must be sought unremittingly if scientific thought, and philosophical and creative thinking in general, are to be advanced as far as possible."*

In the following, some reviews of recent conferences are given, as well as a brief account of some seed activities of the FSRC since 1989.

## **2. FSRC: Brief Information**

Frontier Science Research Conferences-FSRC [11] was founded in 1989 in La Jolla, California. It was initiated by a two-day meeting on Beat Wave Driven Free Electron Lasers. The meeting was intense in its exchange of ideas, comments, critique of research results; in a word, it was highly fruitful.

The conference participants suggested that this type of scientific meeting should be organized for other, much larger research communities, whereby the participants are basically invited speakers—similar to initial Solvay Conferences [12] held in 1910s and 1920s. The FSRC provide free exchange of ideas and opinions on research, whereby critical comments could be made without the inhibitions that are often present at larger meetings.

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trends within particular research subfield. The FSRC abstracts are published in the Books of Abstracts—Bulletin of the Stefan University, Series II, ISSN: 1098-1632. The FSRC tutorial manuscripts, invited tutorial lectures, are published in the Stefan University Graduate Courses Series, ISSN 1543-558X.

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The FSRC is operated by the La Jolla International School of Science jointly with the Institute for Advanced Physics Studies, La Jolla, California, divisions of the Stefan University<sup>B</sup>. The goal is to promote some of the most prominent achievements in various research areas as seen by the members of particular scientific communities and to diffuse that knowledge worldwide in the form of the published material: edited bulletins, edited books, reference brochures, tutorial booklets, as well as media interviews and public lectures. Of ultimate importance

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<sup>B</sup>The FSRC are small, select scientific meetings bringing together representatives in a particular research field from all major research centers worldwide, as identified by the members of the Advisory Board. The FSRC are essentially meetings of invited speakers as opposed to meetings whereby several invited speakers talk to a larger audience. Larger audience is welcome by the FSRC, albeit not important for a successful work of the meetings. The members of the FSRC Advisory Board are selected in a cumulative manner. At the beginning, a few members are suggested by the Scientific Advisory Board of the La Jolla International School of Science and The Institute for Advanced Physics Studies who, in turn, suggest other members, and so forth. The cumulative list of advisors, including advisors from previous meetings, covers the whole subfield and includes researchers worldwide. The members of the advisory board identify "hot" topics, research centers worldwide involved in a particular research, and suggest potential invited speakers. The invitations-to-give-a-talk are sent to research leaders, their collaborators and Ph.D. students. In some cases, for the purpose of covering as many as possible research centers worldwide and to give a broader picture of research activities, the invitations are extended to researchers of lesser renown and from less active research centers. Each nominated invited speaker is entitled to suggest other potential speaker(s). In addition, any researcher interested in giving a talk at the FSRC may contact directly any member of the Advisory Board for nomination. The FSRC scientific program, in a sense, is built up by all participants. Accordingly, the process is quite long; usually the final program is available a month prior to the Conference date. The participation of PhD students is highly encouraged. This is very important aspect of the FSRC as a forum whereby young scientists can get exposure and a strong impulse for further research.

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is the quality of published books rather than urgency in publishing of "yet another proceeding," which, later on, nobody needs.

Since 1989 many conferences have been organized in various FSRC conference series: plasma science and technology, biomedical science and technology, materials science and technology, laser medicine, environmental science and technology, science and technology of energy sources, interdisciplinary physics, research trends in physics. Overall, researchers from thirty-five countries from all continents have contributed to FSRC events since 1989.

**3. Science and Technology of Energy Sources—Thermonuclear Fusion  
Devices, Radiation Generators, Particle Accelerators**

Recently, the following conferences have been organized in the series on Science and Technology of Energy Sources: the Laser-Matter-Interaction-2000, -2004, -2005, and the High Energy Density-Plasma-Physics-2003. A wide range of topics was addressed: X-ray Protein Crystallography, Kinetic Theory of Laser Matter Interaction, Petawatt Laser Pulses in Plasmas, Inertial Confinement Fusion, Implosion Physics, Relativistic Electrons in Super Dense Plasmas, Suprathermal Electrons, Accelerated Ions, Atomic Physics of Laser Plasmas, and more [15]. The study of laser-matter interaction has been one of the most rapidly evolving fields in physics during recent years.

One of the main factors in this development was the invention, at the beginning of the 1990s, of the "Chirped Pulse Amplification" (CPA) technology, which has allowed the generation of high-intensity very short pulses—in the picosecond and femtosecond pulse length range.

In his review of the FSRC book [15], D. Batani (University of Milano, Milano, Italy) states:

*"... this book is a valuable up-to-date research reference which may be useful for active researchers in the field as well as for graduate and advanced undergraduate students."*

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The very first conference organized within this series was, as previously mentioned, on Beat Wave Driven Free Electron Lasers<sup>C</sup> (see [17]) in the summer 1989. Later, conferences on Inertial Confinement<sup>D</sup> Fusion [4] and Tokamak fusion [13] were organized, as well as conferences on coherent radiation generation<sup>E</sup> and plasma particle acceleration [14]. The material is published in the book series "*Research Trends in Physics*."<sup>F</sup>

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<sup>C</sup> A novel method, proposed by V. Stefan, for generation of ultra short wavelength radiation was discussed. The method is based on stimulated Raman backscattering of a beat laser driver on Doppler-shifted Electron Bernstein modes excited on relativistic electron beams.

<sup>D</sup> The book [4] was reviewed by R. Kidder, Lawrence Livermore National Laboratory, Livermore, CA., in Nuclear Fusion. Vol. 34.No.2 (1994 ) p.313. He states: The papers are generally of high quality and cover a broad spectrum of topics concerned with laser driven, light ion driven and heavy ion driven fusion. I particularly enjoyed R. R. Johnson's paper Target development and laser fusion experiments, which gives a fascinating account of the clever techniques that have been developed to fabricate laser fusion targets; and T. W. Johnston's paper Challenges to our understanding of the scattering instabilities of laser fusion, a model of clarity and wit.

<sup>E</sup>The review of the book [14] is written by Nizar Ebrahim of AECL Research, Chalk River, Canada in Physics in Canada Vol.49,No5, p393;November 1993 (La Physique au Canada, Novembre,1993 ) Ebrahim says the book is " excellent volume which documents the latest thinking and future trends in research." He further comments: "The topics covered in these essays are free electron lasers, microwave generators, relativistic beam physics, radiation and energy physics, as well as accelerators and synchrotron radiation physics. From the material presented in this volume, it is clear that the goal set by the symposium in this volume was met. The symposium brought together some of the most prominent researchers from around the world. Their discussions indicate the status of some of the areas covered and the future trend in these fields. The interdisciplinary nature of the material will make this book valuable to both veteran researchers and those new to the field."

<sup>F</sup>Contributors in the series—all of whom appear by invitations—are advised to go beyond the narrow particulars of their work and to reflect on larger questions, problems, and trends. Some papers are written in the form of monographs defining the current status in a

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In his review in *Nuclear Fusion* Vol. 38 No. 3 1996, of the FSRC book [13], P. Rutherford of Princeton University, Princeton, N.J., writes:

*"This book provides a valuable perspective on ideas for improving the tokamak... The Tokamak has been by far the most successful magnetic confinement concept for the realization of fusion conditions. Already, significant amounts of fusion power have been produced for periods of the order of a second from deuterium-tritium (DT) plasma in a tokamak. Extrapolations from today's experimental results to the requirements for achieving ignited burn, for example, in the International Thermonuclear Experimental Reactor (ITER), can be made with justifiable confidence.... At the same time, recent conceptual studies of DT tokamak reactors have indicated that substantial improvements in conventional tokamaks will be needed before a fusion power plant based on the tokamak will be commercially attractive. Moreover, the tokamak would seem to suffer from too low a plasma beta value to make it suitable for an advanced fuel fusion reactor."*

#### 4. Plasma Science and Technology

Recently two conferences were organized within this series: FSRC-Chaotic-Dynamics-and-Transport in Fluids and Plasmas-2000 and Chaos and Transport in Fluids and Plasmas-2002. [6b] A number of topics were discussed: Selected Topics in Dynamics of Molecular Chains, From Steady Wave to Turbulence, Random Walk Behavior of Comet Evolution, Scaling Symmetry, Universalities and Phenomena of Equal Topological Entropy in One-Dimensional Maps, and more. In particular, the impressive results from Chinese research centers were presented at these conferences.

The very first conference dealing with Chaos Theory and related topics was organized in 1991 with the FSRC book [6] as its outgrowth.

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subfield. Brief reports are also included for the purpose of giving a more complete account of the research worldwide. The material contained in the volumes is accessible to graduate and advanced undergraduate students. The resulting volumes document the latest research achievements in physics for the international community.

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The book was reviewed by M. V. Osipenko, [Uspekhi Fizicheskikh Nauk 164(7) 781-782 (1994) Physics-Uspekhi 37(7) 711-712(1994)], who stated:

*"The editor in chief of this volume is Ilya Prigogine<sup>G</sup>, a Nobel Prize laureate. He has been largely responsible for the inclusion of a paradigm of the modern scientific knowledge of the concepts of 'self-organization' or 'order out of chaos.'*

*These concepts have been embodied in his work on thermodynamics of non-equilibrium systems, which is applicable even to such exotic issues as street traffic, stability of insect populations, and development of ordered biological structures, including cancer cells. Reading of this monograph creates an impression that chaos is simply an external manifestation of latent order. In scientific language the concepts of 'order' and 'chaos' can be regarded as complementary (in the sense given by Bohr<sup>H</sup>) methods of describing our self-organizing world."*

The FSRC-Nonlinear and Relativistic Effects in Plasmas (February 1990<sup>I</sup>) were one of the first organized in the Plasma Science and Technology series.

In his review, [Uspekhi Fizicheskikh Nauk: Physics-Uspekhi 35(10) 902 (1993)], V. I. Petviashvili (Kurchatov Institute, Moscow, Russia) writes:

*"This book is a collection of reports presented at the eponymous conference held in San Diego in 1990. The conference set an ambitious goal: to gather the most outstanding American specialists<sup>7</sup> on the practical problems of nonlinear and relativistic effects in plasma.... The goal set by the conference organizers, the*

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<sup>G</sup> Ilya Prigogine (1927 – 2003), a Belgian physicist.

<sup>H</sup> Niels Bohr (1885 – 1962), a Danish physicist.

<sup>I</sup> The Advisory Board consisted of such prominent plasma physicists as D. Baldwin, A. Bers, R. Davidson, A. Hasegawa, N. A. Krall, M. N. Rosenbluth, A. Sessler, and T. H. Stix, among others. V. Stefan was the Conference Chair. One of the aspects of this conference was a promotion of a cross pollinating effect: the methods developed in one research area applied in other research areas.

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*creation of a contact between experienced and young specialists, was obviously met. This collection is undoubtedly of interest to scientists of all ages and skills."*

The series of conferences on Space Plasma Physics and Plasma Astrophysics [18] covered a wide range of issues. Leading figures in the field met to discuss topics that included Chaotic Phenomena in Space Plasma, Ionospheric and Alfvén Waves, Plasma Instabilities and Turbulence, and Collisionless Shock Waves. The FSRC was greatly helped in the organization of these meetings by H. O. G. Alfvén<sup>J</sup>, C. H. Kennel, and R. Z. Sagdeev, among others.

The FSRC book by R. Z. Sagdeev et. al. [18] is reviewed by P. K. Browning in *Plasma Physics and Controlled Fusion*, 36, No. 1, January 1994, p. 170, who said:

*"The book makes interesting reading, to dip into and learn something about the huge variety of nonlinear effects in space plasma physics. Laboratory plasma physicists will be impressed to discover how well space plasmas can be diagnosed, and may find many interesting parallels with nonlinear phenomena observed in laboratory plasmas."*

## **5. Materials Science and Technology; Nanoscience and Technology**

The FSRC-Luminescent-Materials-2002 (January 28-30, 2002, in La Jolla, Calif.) [1] was organized within the series on Materials Science and Technology. The advantages of material science and fundamental physics were demonstrated by various techniques and with different organic, inorganic, and hybrid substances. Some theoretical approaches were demonstrated in connection with luminescent properties of systems. Many other aspects of luminescent materials were presented at this FSRC, such as new materials for medical applications, doped insulators, electron processes in doped insulators, and application of surface plasmon excitation, among others. Overall, approximately twenty

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<sup>J</sup> H. O. G. Alfvén (1908 – 1995), a Swedish physicist, shared the 1970 Nobel Prize for physics with Louis Néel.



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presentations by scientists worldwide covered practically all 'hot' areas in the modern luminescence.

A. Vitukhnovsky (P. N. Lebedev Institute of Physics, Russian Academy of Sciences, Moscow, Russia) reports:

*"In general a strong focus has been given to inorganic (L. Carlos, A. Ivanov, K. Hino) and organic nanostructures (P. Reineker, A. Vitukhnovsky). Two presentations were dealing with organic nanoobjects - dendrimers. Dendrimers are new class of engineered macromolecules showing a branching pattern on a nanometer scale. Reineker with co-authors focused on optical absorption and energy transfer of dendrimers taking into account vibrational degrees of freedom. A few reports in the book[1a].(E. Antic-Fidancev, P. Dorenbos, A. Florez, D. Jaque, and M. Morita) were devoted to high luminescent materials based on lanthanides.*

*The Lead-Halide compounds were studied by M. Iwanaga, T. Kobayashi, M. Watanabe, and T. Hayashi. T. Kushida and M. Tanaka dealt with nanocrystals doped with impurity ions. Quantum dots were discussed by F. Minami, T. Kuroda, and Y. Mitsumori, and by A. L. Ivanov."*

Three conferences dealing with crystal growth and epitaxy were organized during the period 1999–2001; some of the material is published in [16].

In his review of the FSRC books [16], V. V. Osiko, General Physics Institute, Russian Academy of Sciences, Moscow, Russia, writes:

*"The papers constituting 'Crystal and Epitaxial Growth' volumes are of a high scientific and technological standard, so that it is hoped that these two books will be very helpful for all chemists and physicists, both young researchers and experienced specialists working in crystal and epitaxial film growth."*

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A number of other conferences within the series on Materials Science and Technology were organized in the period 1993–2003<sup>K</sup> (see for example, [7-9]). In particular, impressive research achievements from various Japanese research centers have been reported at these conferences.

The Nanophotonics volume [1c] covers research in nanophotonics worldwide. The applied nature of the presented papers and their cross-disciplinary character make this volume a most valuable resource to research scientists in this subfield. The volume documents the latest research results by prominent scientists from around the world covering a wide range of topics: 1-D molecular excitons, optical spectroscopy, semiconductor nanostructures, thermoelastic waves, disordered materials, optical oxide materials, double quantum dots, optical materials, photolithography, solid state ultraviolet lasers, and more.

## **6. Life Science and Technology; Environmental Science and Technology**

The Life Science and Technology series was initiated with conferences organized in 1994: Physics of the Origin of Life, Physics of DNA, Medical Physics, and Biophysics [19]. The FSRC Advisory Boards for this series of conferences included, among others: G. Arrhenius, M. Brunori, R. Callender, I. Giaever<sup>L</sup>, V. I. Goldansky, H. Frauenfelder, A. Salam<sup>M</sup>, T. Spiro, M. Tamura, and V. E. Zuev.

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<sup>K</sup>A number of prominent researchers worldwide contributed to these conferences. The conference on Semiconductor Science and Technology--1998, had on Advisory Board four Nobel Prize winners: N.G.Basov (in 1964,with A.M.Prokhorov and C.Townes), L.Esaki (in 1973,with B.D. Josephson and I.Giaever), K.von Klitzing (in 1985), and Z.Alferov (in 2000,with H. Kroemer and J. S. Kilby).

<sup>L</sup>I. Giaever (b. 1929), a Norwegian physicist, the 1973 Nobel Prize winner for physics with B. Josephson and L. Esaki.

<sup>M</sup>A. Salam (1926 – 1996), a Pakistani physicist, the 1979 Nobel Prize winner for physics with S. Weinberg and S. Glashow.

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Within the origin of life physics, the following topics were addressed: Concentration and Organization of Precursors at Inorganic Interlayers and Interfaces, Prebiotic Chirality and Life, Symmetry Breaking and the Origin of Life, The Origin-of-Life Problem and the Proteinoid Theory, and more. The Physics of DNA covered Liquid Crystals and Liquid-Crystalline Dispersions of Circular DNA, Observation and Manipulation of Single DNA Molecules using Optical Tweezers and Fluorescence Microscopy, and Vibrational Spectroscopy of Ligand--DNA Interactions, among other topics. The Biophysics conference addressed Probing the Fast Events of Protein Folding/Unfolding, Theory of the Stark Effect in Protein Systems Containing an Electron Donor-Acceptor Couple, Statistical Mechanics Applied to Bond Disruption, Cooperative Melting, Energy Use in Biomolecules, and other topics.

The FSRC Laser Medicine and Laser Biophysics-1999 was held in La Jolla, Calif.[19d] Topics discussed included: Relationship Between Laser Irradiation of the Primary Auditory Neurons and Degeneration of Their Receptor Cells in Cultures of the Mouse Cochlea, The Chorioallantoic Membrane of the Chick Embryo—An in Vivo Model System for Laser Therapy (or Photodynamic Therapy), Suppression of Hematogenous Spread Using Photodynamic Therapy (PDT), Medical Application of Ultrashort Pulse Lasers, All-Fiber-Optics Waveguide Delivery System for Laser Medicine, In Vivo Tissue Spectroscopy Using Diffusely Scattered Femtosecond White Light, Laser Treatment of Benign Prostate Disease, and others.

The Biomedicine [19c] volume covers research in laser medicine and laser biophysics worldwide. The latest research results by prominent researchers from around the world are presented, covering a range of topics that include photodynamic therapy, laser-neuron interaction, tissue spectroscopy, laser therapy, brain tumor treatment, burnt skin treatment, protein dynamics, and nerve cells. This book is intended for graduate and advanced undergraduate students, and by faculty and research staff as an advanced research reference.

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The FSRC Aerosols-1999 was held within the series on Environmental Science and Technology [20a]. The following topics were discussed: The Diffusion Cloud Chamber Unraveling the Mystery, Aerosol Nucleation Studies in a Laminar Flow Tube Reactor, Fundamental Problems of Atmospheric Optics, Dynamical Nucleation Theory, Small Angle Neutron Scattering from Nanodroplets Aerosols: Theory and Experiment, The Kinetic Pathway in Binary Nucleation,

Application of Resonance Based Light Scattering Techniques for Investigation of Physical and Chemical Process in Aerosol Droplets, Condensation of Supersaturated Vapors on well-defined Ions: A New Technique for Ion-Induced Nucleation, Dynamical Nucleation Theory: Application to Small Water Clusters, Aerosol Nucleation Studies in a

Laminar Flow Tube Reactor, and Fundamental Problems of Aerosol Optics including Optical Sounding of Aerosol.

The seed conference in the Environmental Science and Technology series was held in 1993, and the resulting material is published in four volumes [20b]. Topics covered include Industrial Ecology, Pollution, Hazardous Waste, Environmental Biophysics, Environmental Optics, Soil Physics, Water, Soil-Atmosphere-Hydrosphere Interaction, Earthquake Physics, Climate, Greenhouse Gases, Ozone Layer, Aerosols, and Environmental Plasma Physics.

### 7. Special Events

The "Achievements in Physics" conference honoring K. A. Brueckner, the founder of the Physics Department at the University of California, San Diego (UCSD), was held in early 1991.<sup>N</sup> A banquet was held at La Valencia Hotel in La Jolla, Calif.; Roger Revelle<sup>O</sup>, who founded the San Diego campus of the

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<sup>N</sup> Invited speakers included: M. Gell-Mann (Awarded the 1969 Nobel Prize for Physics), R. Dashen, R. Kidder, D. Pines, R. Revelle, M. N. Rosenbluth, K. Watson, and J. A. Wheeler.

<sup>O</sup> R. Revelle (1909 – 1991) was described by the *New York Times* as "one of the world's most articulate spokesmen for science" and "an early predictor of global warming."

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University of California in the early 1960s, gave a speech about the history of the Physics Department and UCSD in general, saluting Brueckner's achievements as a physicist and an organizer. Brueckner, a pioneer in inertial confinement fusion research<sup>10</sup>, made various outstanding contributions in elementary particle physics, many-body theory, nuclear physics, theory of crystals and liquids, hydrodynamics, plasma theory, and nonlinear dynamics. Brueckner received the Dannie Heineman Prize for Mathematical Physics in 1963. He is a member of the National Academy of Sciences of the United States.

In May of 1992, V. F. Weisskopf<sup>P</sup> visited the Institute for Advanced Physics Studies (which later became a division of the Stefan University). At that time the idea was developed that *Festschrift* [21] be published by the American Institute of Physics in celebration of his lifetime achievements.<sup>Q</sup> Among the many breakthroughs his research has yielded have been the theory of the widths of energy levels of the electron, the "Clouded Crystal Ball" model of nuclear structure, and the "MIT Bag" model of hadronic matter. For his contributions to physics, Weisskopf has been awarded the Max Planck Medal, the J. Robert Oppenheimer Medal, and the Karl Taylor Compton Award. Throughout his life he made a great effort to improve relations between scientific communities

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<sup>P</sup> V. F. Weisskopf (1908 – 2002), an American physicist.

<sup>Q</sup> This collection of essays by scientists from around the world honors Victor Frederick Weisskopf one of the true luminaries of twentieth-century physics. The essays in this book, by some of the world's leading physicists, including seven Nobel Prize winners, address topics ranging from Weisskopf's contributions to theoretical physics to more intimate views of his role as teacher, friend, and humanist. Contributors include: Hans A. Bethe, Hendrick B.G. Casimir, Georges Charpak, Sidney D. Drell, Evgenii L. Feinberg, Herman Feshbach, Jerome I. Friedman and Henry W. Kendall, Murray Gell-Mann, Kurt Gottfried, J. David Jackson, Maurice Jacob, Francis E. Low, Ove Nathan, Norman F. Ramsey, V. Stefan, Walter Thirring, and Charles H. Townes.

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worldwide<sup>R</sup>, and particularly between American and Russian scientists. In May 1932, Weisskopf lectured at the Physical-Technical Institute in Kharkov, where he developed a close relationship with Lev Landau<sup>S</sup> and later on with many leading Russian scientists including Andrei Sakharov<sup>T</sup>. In 1956, Weisskopf obtained permission to invite six Russian scientists, including Lev Landau, to attend the Sixth Rochester Conference. Only V. I. Veksler, M. A. Markov, and V. P. Silin attended. This was the first time in well over a decade that Russian scientists were allowed to visit the United States.

A. M. Prokhorov<sup>U</sup> and N. G. Basov<sup>V</sup>, Nobel Prize winners in physics in 1964 with C. Townes, were Science Advisors of the Institute for Advanced Physics Studies (IAPS) from 1992. They also helped with the organization of many FSRC events on Materials Science and Energy Sources Science. Z. I. Alferov<sup>W</sup> along with N. N. Ledentsov, both from A. F. Ioffe Physico-Technical Institute, St. Petersburg, Russia, served on the Advisory Board for Semiconductor Science and Technology-1988, among others.

B. B. Kadomtsev<sup>X</sup> was one of the ultimate authorities in plasma physics and Tokamak thermonuclear fusion research. He was elected to the Russian Academy of Sciences as a Corresponding Member of the Division of Physical-Mathematical Sciences in 1962 and as Academician of the Division of General Physics and Astronomy in 1970. Kadomtsev was a Science Advisor for the Institute for Advanced Physics Studies (a division of the Stefan University) from 1992-1998.

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<sup>R</sup>An honorary member of a number of Academies worldwide, he was a president of the American Physical Society in 1960, and the president of the American Academy of Arts and Sciences in the period: 1976-1979.

<sup>S</sup> Lev Landau

<sup>T</sup> Andrei Sakharov (1921 – 1989), a Russian physicist.

<sup>U</sup> A. M. Prokhorov (1916-2002), a Russian physicist.

<sup>V</sup> N. G. Basov (1922-2001), a Russian physicist.

<sup>W</sup> Z. I. Alferov, a Russian physicist, the 2000 Nobel Prize winner for physics with H. Kroemer and J. S. Kilby.

<sup>X</sup> B. B. Kadomtsev (1928-1998), a Russian physicist.

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He visited La Jolla, Calif., in 1992 as a member of the Advisory Board for the FSRC-Tokamak-Fusion-1992[13] and in 1994 as a guest of the IAPS.

Kadomtsev helped organize many FSRC meetings on Energy Sources Science and Plasma Science. The last time V. Stefan talked to Boris Borisovich was in May 1998 (via telephone), at a time when the world plasma science community was saddened by his health condition. He said to Stefan, with dignity so typical for him: "Sasha, my health is not improving." ("Sasha, zdorovie ne uluchaetsa"). He was posthumously awarded the James Clerk Maxwell Prize for Plasma Physics by the American Physical Society in 1998.

### **8. New FSRC Trends—Laser Neurophysics, Genomic Physics, and Genomic Medicine**

In preparation are conferences on Laser Neurophysics<sup>Y</sup>. Research in Laser-Neuron Interaction may lead to discoveries of mechanisms of brain functioning as well as to discoveries of laser-based treatments for many neurological diseases such as Alzheimer's, Parkinson's, and others.

A series of FSRC meetings are in preparation to address Genomic Medicine and Pharmacogenomics under the auspices of the American Society for Genomic Medicine<sup>Z</sup>. Those conferences will bring together luminaries from industry and academia worldwide.

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<sup>Y</sup>Stefan University Institute for Neurophysical Studies, a California nonprofit corporation, is founded in 1994 to facilitate and promote research in Laser-Neuron Interaction.

<sup>Z</sup>The American Society for Genomic Medicine, a California nonprofit corporation is founded in 1999 (V. Stefan, founding president) with the goal to promote and diffuse the knowledge in Genomic Medicine, Pharmacogenomics, and Genomics related disciplines worldwide.

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Genomic medicine deals with the application of knowledge on human genome to medical practice. The genome is a complete set of DNA for a particular organism. DNA-deoxyribonucleic acid-is made up of four chemicals called bases, abbreviated as A, T, C, and G. The human genome has approximately 3 billion pairs of bases.

The United States Human Genome Project formally began in 1990 under the coordination of the U.S. Department of Energy (DoE) and the National Institutes of Health (NIH). The major goals set were to identify all of the approximately 30,000 genes in human DNA and to determine the sequences of the 3 billion DNA base pairs that constitute the human genome. The recent completion of the draft sequence [22,23] has increased interest in its application to the field of medicine [24-26]. In 1999 the American Society for Genomic Medicine<sup>15</sup> was founded with the goal of promoting research in genomic medicine and to facilitate public awareness of the benefits it may bring to the human race. The details of the working draft DNA sequence was published in February 2001 by the Human Genome Project and Celera Genomics, Inc. The first panoramic view of the human genetic landscape has revealed a wealth of information presently under study [22, 23].

The successes of the Human Genome Project enable researchers to identify errors in genes that cause or contribute to disease. All diseases have a genetic component, whether inherited or resulting from the body's response to environmental stresses such as viruses or toxins. A number of genes associated with breast cancer, muscle disease, deafness, and blindness have been identified.

The explorations [26] into the nature of human genome represent a major challenge extending far into the twenty-first century. These explorations will shed light on the role of faulty genes in disease causation. With this knowledge, commercial efforts are shifting away from diagnostics and toward developing a new generation of therapeutics based on genes. Drug designs—pharmacogenomics are being revolutionized. Researchers are now creating new classes of medicines based on information on gene sequence and protein structure function rather than the traditional trial-and-error method. Drugs targeted to specific sites in the body promise to have fewer side effects than many of today's



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medicines. Laser-guided drug-delivery techniques have a high potential in targeting drugs to specific sites in the body.

One of the greatest impacts of research in Genomics<sup>17</sup> may prove to be an entirely new approach to biomedical research. In the past, researchers studied one or a few genes at a time. With whole-genome sequences they can approach problems systematically and on a large scale. Presently, all the genes in a genome can be studied, as well as how tens of thousands of genes and proteins work together via networks to orchestrate the physics of life.

In Conclusion:

\* Medicine has now entered a new age whereby the patient's genome will be of utmost importance for optimal health care, preventive, therapeutic, diagnostic, and clinical, giving rise to Genomic Medicine.

\* Many problems in Genomic Medicine will be treated as subfield of physics, biophysics, chemical physics, and other physics-related disciplines.

\* A new field of physics is emerging: **Genomic Physics**.

\* **Laser Neurophysics** may bring revolutionary discoveries, foundations for the physics of the brain and the physics of consciousness.

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