ESI

The Erwin Schrödinger International Institute for Mathematical Physics

Scientific Report for the year 1993

ESI–Report 1993

ERWIN SCHRÖDINGER INTERNATIONAL INSTITUTE OF MATHEMATICAL PHYSICS, REPORT FOR THE YEAR 1993

ESI, Pasteurgasse 6/7, A-1090 Wien, Austria

February 14, 1994

Table of contents

Short overview

Two dimensional quantum field theory. The amount of 1.1 Mio. S. was spent, a workshop with 120 participants was held, 22 preprints were written.

Schrödinger Operators. The amount of 1.1 Mio. S. was spent, a workshop was held, 14 preprints were contributed.

Differential Geometry. The amount of 1.5 Mio. S. was spent, visitors supported from abroad contributed the equivalence of further 0.5 Mio. S. 41 preprints were contributed.

Visitors outside of programs. The amount of 0.4 Mio. S. was spent, 3 preprints were written.

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Erwin Schrödinger Institute opened

Established in January 1993, the official opening of the International Erwin Schrödinger Institute for Mathematical Physics (ESI) took place in April of that year, with the Austrian Minister for Science and Research, Vice Chancellor Dr. E. Busek performing the opening ceremony. The institute is housed in 3 flats near the Institutes of Mathematics and of Theoretical Physics of the University, in Pasteurgasse 4/7, 6/7, and 6/11, 1090 Wien, with premises encompassing $420m^2$. The first flat is just below the last residence of Erwin Schrödinger in Vienna. ESI was founded with the hope of achieving the following.

1. To provide continuing financial support combined with invitations to leading experts in the international scientific community, therefore providing an ideal centre of excellence in the heart of Europe, nurturing the exchange and development of ideas not only in the international arena but also on the home front with its affiliations with Austrian universities.

2. Though intellectually evenly matched with their western colleagues (also in Chess), scientists from the former Eastern Bloc countries, though well advanced and independent in theoretical studies, were then faced with shortages of scientific and practical resources and facilities resulting in the current massive migratory 'brain drain' to the West, from which the U.S.A. seems to be profiting the most. With the help of long and short term grants, ESI hopes to if not stop, then at least stem this migration, enabling scientists to remain firstly in Europe and hopefully, more importantly, in their own countries.

The scientific administration is run under the auspices of the International Scientific Administration Committee, comprising members from 11 states, who elect the directorship of ESI (at present W. Thirring, scientific director, P. Michor, acting director), initiate and supervise the scientific programmes and issue the long term invitations. ESI operates on a project and invitation basis with leading experts invited to the institute to continue and expand their research activities.

To date around 120 foreign scientists have visited ESI, contributing to (at time of writing) 76 preprints, many of which have been accepted for publication in top international scientific journals. Four specialized congresses have already been organized and held by ESI therefore producing and maintaining its own high standards of excellence.

Though a private organisation, the Society for the International Erwin Schrödinger Institute is subsidised by the Austrian Ministry for Science and Research, with its annual budget currently standing at 10 million Austrian Schillings, with further contributions from the Istituto Nazionale di Fisica Nucleare in Italy, the ETH in Zürich, the NSF in the U.S.A. and other scientific organisations.

The statutes of the society allow also for supporting members providing sponsorship for research, and donations to the society are, under Austrian law, tax-deductible. Organisations or persons wishing to support our institute in any way are asked to contact the administration director Mario Springnagel, ESI, Pasteurgasse 6/7, A-1090 Vienna, Tel. 3172047. For enquiries of a more scientific nature, please contact P. Michor at the insitute.

The Erwin Schrödinger Institute An Austrian Initiative for East-West-Collaboration

Walter Thirring

Contribution to the OECD-Seminars
"East-West-Mobility of Scientists and Engineers"

The downfall of communism in the eastern European countries confronts the scientific community with a solidarity problem of unprecedented scale. Whereas these governments has ruined their countries economically, ecologically and politically they had highly developed some fields like sports, musics or science. Their scientific institutes had far more staff than their western analogues and in natural sciences scientific qualification was useful for employment even without political engagement. The only handicap for the scientific development was the restricted exchange with foreign scientists because foreign travel needed some party protection. As a consequence, in some new scientific developments eastern researches were absent and conversely

some progress made by eastern scientists was scarcely appreciated in the west.

Today the new governments find that they need all the scarce resources for improving the living conditions and science cannot be supported on such a scale. Thus they have the choice either to effectively reduce the salaries of the scientists by a good fraction or to lay off this fraction of the number of scientists. Both alternatives have grave consequences. Since the living conditions were never very splendid a sizeable reduction comes close to the limit of starvation and the scientists are practically forced to seek employment elsewhere. On the other hand, since the number of excellent people is big, a reduction of positions means that some people of high scientific merit have to be fired. This has actually happened, for instance in eastern Germany, and had morally a very bad effect. Together with the living conditions also the conditions for work deteriorate since, for instance, the money for buying the scientific literature and other research needs is running low. Based on these facts I put forward the following three theses:

(1) In natural sciences the eastern countries do not so much face a problem of reconstruction but of preservation.
(2) These countries should not be deprived of their most qualified people lest they might fall back to the level of third world countries. After the last war Europe was materially destroyed but its recovery was effective only since qualified people were available.
(3) The western European countries should provide eastern scientists part time positions with adequate salaries and working conditions so that they can survive the coming difficult years. It would be a pity if this intellectual capital gets lost for Europe or may even be misused by other dictorial regimes.

The arguments put forward above were warmly approved by scientific circles. In addition, the Austrian government was susceptible to them and in a rather short time for this very purpose an international institute for mathematical physics was founded. It is named after the great Austrian scientist Erwin Schrödinger and is located in the house where he lived for his last years.

Reasons for the Foundation of ESI. The years 1989 and 1990 have seen revolutionary changes in Middle and Eastern Europe: After years of severe restrictions the original cultural, geographical, and political bonds between these countries and Western countries have reasserted themselves. The economic recovery is slow and painful, and a huge brain drain is taking the best scientists out of these countries; they are looking for acceptable working and living conditions. Due to its vast resources and the flexibility of its academic institutions the USA is the main beneficiary of this scientific migration. In view of the economic and political unification of Europe one should try to keep some of the best scientists in Europe and even in Middle Europe. ESI will try to do just that.

Some of the main scientific and cultural developments of this century have their origins in Middle and Eastern Europe: 12 tone music (Schoenberg, Berg, Webern), psycho analysis (Freud, Reich), literature (Musil, Roth, Schnitzler), philosophy (Wittgenstein), quantum mechanics (Schroedinger, Pauli), functional analysis (Hahn, Banach), homotopy theory (Cech, Hurewicz), measure theory (Radon, Nikodym). The political change and the fall of establishments in the wake of World War I was a very fertile ground for new ideas in science and art. This could happen again, and ESI could provide a focal point for similar developments in mathematical physics.

How would such an institute fit into the scientific landscape of Middle and Eastern Europe? The former communist countries suffer from severe economic problems. They have to decrease the sizes of their academic institutions and to rebuild parts of them (law, philosophy, economics). They are quickly loosing some of their best scientists, who are mainly attracted by the much better working conditions elsewhere. For theoretical sciences, these conditions are mainly possibilities of contact with collegues and good libraries. ESI can meet some of these demands and may help to retain some of the best minds in Europe.

The role of theoretical research institutes in the scientific life should not be underestimated: On the one hand they are a focal point or center for contact at highest levels of research for the scientists of a country. But they are also an aim for young talented scientists of the nation: they know where to apply to for temporary positions, where to look for help and opportunities. The flexible structure of such an institute makes it possible for a gifted researcher to start a

career in science, which otherwise depends upon the availability of open positions, overcoming the envy of established professors, and so on. In the long run the level of the whole scientific production in Mathematics and Theoretical Physics will rise.

Why exactly Mathematical Physics? There is no such institute anywhere. It blends very well with some of the best scientific traditions of Middle Europe. Mathematical Physics is very much alive just now. Three of the four Fields medals in Kyoto 1990 were given to Mathematical Physicists.

To guarantee the international character and the highest scientific level it was thought that an international advisory committee composed of leading scientists in this field should guide the activities of the institute. Fortunately indeed several eminent scientists were willing to serve and thus the institute has the following international advisory committee:

P. Budinich (SISSA, Trieste)
A. Connes (IHES, Bures-sur-Yvette)
V. Drinfeld (Academy of Sciences, Kharkov)
L.D. Faddeev (Steklov Mathematical Institute, St. Petersburg)
J. Fröhlich (ETH Zürich)
A. Galindo (Universidad Complutense, Madrid)
E. Lieb (Princeton, USA)
G. Marmo (Universitá di Napoli)
P. Michor (Universität Wien)
H. Narnhofer (Universität Wien)
W. Reiter (Bundesministerium für Wissenschaft und Forschung)
V. Souček (Charles University, Prague)
W. Thirring (Universität Wien)
I.T. Todorov (Academy of Sciences, Sofia)
A. Trautman (University of Warsaw)
A.M. Vinogradov (University of Moscow)
J. Wess (Universität München)

Many activities of the institute so far (workshops and conferences) had a very favourable response by the scientific community and have helped eastern researchers to take part in the mobility which western scientists have enjoyed so far.

ACTIVITIES IN 1993

Two dimensional quantum field theory

H. Grosse

In this program a very lively development set in and is still going on. This was reflected in a large number of seminars (two to three per week), which were presented at ESI. In addition, discussions were numerous and very involved. Almost thirty papers were started and completed within this activity at ESI. They would not have been possible without the opportunity for the physicists from various countries to get together. Various discussions with the other groups at ESI have not only been appreciated, but led even to a number of common papers. Numbers to which we refer in the following short descriptions, refer to ESI preprints (1-76) which already exist, or to the list of forthcoming papers. We can divide these descriptions into three main subjects:

1. Integrable Models, Lattice Spin Models and Magnetic Field Models.
Integrable Models can be obtained through solutions of the Yang- Baxter relation. An infinite number of conserved quantities show up, and the transfer matrix can be diagonalized with the help of the algebraic Bethe Ansatz. This way it is possible to study the phase diagram of the model. All three contributions from Borovick [12,13,66], are of this type. In [12], vertex models defined on two layers which interact with each other are treated; in [13] and [66] integrable multicomponent models are dealt with. In Pasquier's paper [24], a Calogero-Sutherland model

with spin is treated. Properties like degeneracies of the spectrum have been derived from a solution of the Yang-Baxter relation and from the underlying Yangian symmetry. In my own work with Raschhofer [26], we treated an $SU(3)$ type XXZ model which is integrable too; we were able to obtain the finite size corrections and determined the conformal charge which turned out to depend on the interaction. Although the 1-dimensional Hubbard model is integrable also, it is the 2-dimensional one which is the favourite model to explain super conductivity, which up until now has only been analyzed through approximate methods. A careful self-consistant mean field type analysis of the appearance of antiferromagnetic, ferromagnetic as well as superconducting phases, is given in the papers [31, 77], by Popov. Van Hove points play an essential role thereby.

In a common work with Popov [57], we found a way to relate the partition function of general spin systems to partition functions of fermion systems. For the latter, standard expansion methods can be applied. Spectra of Magnetic field problems are of interest, due to our interest in the quantum Hall effect. How the degenerate spectra of Landau levels split under the influence of nonconstant magnetic fields as well as under the influence of scalar potentials is analyzed in a common work together with Stubbe [71].

2. Models of Quantum Field Theory-External Field Problems. One of my own interests concerns cocycles which occur as central extensions of current algebra and the Virasoro algebra. They can be studied in external field problems within quasi-free second quantization. Together with Maderner and Reitberger, [8], we formulated these Schwinger terms as cyclic cocycles, respectively characters of a 2-summable Fredholm module. General states have been treated, and especially the independence of these cocycles on temperature has been formulated. We studied, in addition, anomalies between generators of translation and time evolution, within spin models for Kink-like states [22]. We compare our way of implementing the generators in finite temperature states to another method, which allows us to obtain temperature dependent anomalies. A further way to define symmetry generators for noncyclic states, together with a summary of the various approaches is given in [59]. Together with Maderner, we analyzed the classical origin of the fermionic Schwinger term in [58]. It turned out that the comomentum mapping is not a homomorphism of Lie algebras, and the algebra of charges can be recovered in an entirely classical context of smooth functions on the Grassmanian.

3. Algebraic Theories.

Chern-Simons Model. In discussions with Alekseev and Schomerus, we made attempts to obtain a lattice model which enjoys as a gauge symmetry, a quantum group. We therefore studied a lattice version of the Chern-Simons model. What results is a mathematically precise quantization of the Hamiltonian Chern-Simons model. We constructed the algebra of observables and formulated the model such that the lattice version already reproduces the results of the continuum model exactly.

Conformal Field Theory. This lively expanding subject was well represented by the Bulgarian group. Their method of obtaining local extensions of the chiral algebra of observables for conformal invariant models led to Stanev's publication [19]. He constructs all such extensions with the help of polynomial solutions of the Knizhnik-Zamolodchikov equation for SU_3 current algebra at level k. Discussions at ESI, between the Bulgarian and the Hamburg group, led to the understanding that there exist local extensions of the algebra of observables, which do not belong to the class considered by Doplicher-Haag-Roberts. A summary of 'What we are learning from 2-dimensional conformal models?' is given by Todorov in his Beer Sheva Workshop contribution [52].

Noncommutative Manifolds. In my own attempts to relate models of QFT to noncommutative geometry, we studied, together with Prešnajder, the noncommutative analogs of homogeneous spaces using coherent states [23]. A one parameter family of algebras is obtained, which yields in the commutative limit the algebra of functions over a standard manifold. We apply this procedure to the Fuzzy sphere and to the Fuzzy hyperboloid. In a further contribution, we formulate the noncommutative analog of the Dirac operator on these algebras and find its spectra. This allows us to describe the analogs of the Thirring model in this noncommutative lattice.

Quantum Groups. Quantum Groups are, in a way, the central algebraic structure, which came out from studies of integrable models. This was also reflected in a number of seminars dealing with this new algebraic concept and also in a number of contributions.

Hadjiivanov studied the q-deformation of Bose parastatistics [20], and obtained a deformation of the algebra of para Bose-oscillators. The dynamics of a point particle moving on a 3-sphere was considered by Stanev and Todorov in [34]. They used an R-matrix which depends on a time parameter. It led to interesting discussions with the Hamburg group and might lead to a new concept: quasi Yang-Baxter equation for an R-matrix depending on a spectral parameter. Together with Prešnajder [45], we considered the classification of unitary representations of the q-oscillator algebra and showed the connection to explicitly known realizations.

The duality between deformations of the algebra of functions over a group to the deformations of the universal enveloping algebra of the Lie algebra, is worked out for Z_2-graded Hopf algebras by Pittner [69]. In the classical limit an interesting algebraic structure results.

Rehren worked out possible values which the index of subfactors can take in, [14].

Poisson Structures. Perelomov [17] joined visitors from the mathematics programme (Grabowski and Marmo), and worked out a classification of all possible Poisson structures in low dimensions.

The publication [33], by Alekseev and Todorov would not have been possible without the opportunity to combine the experience of Fadeev's group in St. Petersburg on quadratic brackets and Lie-Poisson groups, with the experience of the group in Sofia on matching the monodromy of chiral sector solutions of the Knizhnik-Zamolodchikov equation with a certain quantum group monodromy.

In summarizing, I may conclude, that we had very fruitful discussions, seminars and colloquiums during the project on 'two-dimensional Quantum Field Theory' at ESI. As a result I obtained, for example, a large number of applications for a post doc. position. There was a great interest to continue this programme in 1994 and for this purpose, up to ten visitors will join ESI in March and April 1994.

I. Todorov, Inst. f. Nucl. Research, Sofia, Bulgaria 15.2.-15.5.
V.N. Popov, Steklov Math. Inst., St. Petersburg, Russia 1.4.–30.6.
A.E. Borovick, Kharkov, Ukraine, 1.3.-31.3.
A. Perelomov, Univ. Bonn, 1.3.-15.3.
A. Alekseev, Dep. of Math. Physics St. Petersburg, Russia, 1.3.-30.6.
V. Schomerus, Univ. Hamburg, 1.3.-31.8.
L. Hadjiivanov, Inst. f. Nucl. Research, Sofia, Bulgaria, 15.2.-15.5.
V. Stanev, Inst. f. Nucl. Research, Sofia, Bulgaria, 15.2.-15.5.
K. Gawedzi, IHES Bures-sur-Yvette, 1.3.–31.3.
G. Mack, Univ. Hamburg, 3.5.–28.5.
K.H. Rehren, Univ. Hamburg, 1.3.–31.3.
K. Fredenhagen, Univ. Hamburg 15.2.–10.3.
V. Pasquier, Saclay, Paris, 1.3.–31.3.
P. Presnajder, Univ. Bratislava 1.6.–31.6.
Short invitations:
M. Havlicek, Prag,
V. Rittenberg, Universitaet Bonn,
J. Madore, Orsay, Paris,
R. Flume, Universität Bonn
G. Sotkov, Sofia
A. Schnizer, Tokyo
F. Nill, Berlin
W. Weich, Munich, Germany, July 7, 1993.

Workshop: Two dimensional quantum field theory. March 8–12, 1993.

Monday	Tuesday	Wednesday	Thursday	Friday
Conf. QFT	Conf. QFT	short contrib.	Int. Mod.	noncomm. DG
Todorov	Marchetti	CQFT-Anyons	Pasquier	Fröhlich
Nahm	Fredenhagen	and	Mussardo	Dubois-Violette

Schomerus	Rehren	Integrable mod.	Faddeev	Madore
Gravity	Conf. QFT	short contrib.	CS and top.QFT	
Jackiw	Onofri	quantum groups	Karowski	
Prešnajder	Alekseev	and	Itzykson	
Kummer	Seiler	gravity	Gawedski	

Schrödinger Operators

T. Hofmann-Ostenhof

For over 65 years quantum mechanics and hence the Schrödinger equation has played a central rôle in the description and understanding of nature, in particular atoms and molecules. The questions raised and the answers given by quantum mechanics has led to many far reaching new developments not only in physics, but also in chemistry, mathematics and even philosophy.

There has always been a strong mutual influence between quantum mechanics and mathematics. Quantum mechanics prompted, even as early as in the 1930's, the development of some new areas in mathematics like the functional analysis of unbounded operators, and influenced with its new problems, many other fields of mathematics (representation theory, C^* algebras etc). On the other hand, new developments in various fields in mathematics (e.g. partial differntial equations, stochastic processes, pseudo differential operators etc), have played, and still play an increasingly important rôle in the progress in quantum physics, and especially in the investigation of the Schrödinger equation, leading us to a better understanding of this important part of physics.

The Schrödinger equation is a partial differential equation. The central objects one deals with are called 'Schrödinger operators'. Ever since the end of the 1960's, 'Schrödinger operators' is a very active field in mathematical physics and mathematics, with many probing results, and, naturally enough, still many open, challenging problems.

The programme 'Schrödinger operators' was devoted to such problems. It started in spring and culminated at the beginning of December in a workshop with about 50 participants. Approximately 25 scientists visited the ESI during the year. 25 seminar talks and 37 talks at the workshop were given. The list of the talks, visitors etc. can be found below.

Up to now, 14 papers have been written (see in addition the list of ESI preprints), and about 10 are to be expected in the next few months. The research activities were devoted to the spectral theory of elliptic operators [27,29,43,62,64,67,71,74,75], to scattering theory [60,63], and to properties of the solutions of Schrödinger equations [35,36]. Schrödinger operators with magnetic fields were investigated very intensively and very successfully [27,67,71,74,75 and some work in preparation]. The analysis of Schrödinger operators with magnetic fields poses many new, physically important and challenging problems. Collaborations on such problems have been started and will be continued in the near future at ESI. Also other questions concerning the spectral theory of Schrödinger operators and scattering theory, as well as the Schrödinger equation considered as a partial differential equation, led to collaborations which will eventually be continued at ESI. The seminar talks were especially helpful in starting the exchange of ideas and discussions between the visiting scientists and some Austrian colleagues, but in particular between scientists from former Eastern Bloc countries and scientists from the West.

Naturally, a programme of this size cannot cover the enormously rich field of Schrödinger operators, and therefore has to focus around some specific problems. But the talks given at the workshop documented very well the progress made in other fields related to Schrödinger operators - in spectral geometry, microlocal analysis, time dependent problems etc. Within the next few weeks a collection of abstracts of the talks given at the workshop will be available.

Finally, I should like to mention that the accomodation for the scientists, their salaries, and the sometimes difficult visa problems, was handled smoothly and efficiently by Mr. Springnagel, and the handwritten manuscripts were brought into their final form competently by Miss Haffner. My wife, Maria Hoffmann-Ostenhof helped me enormously with the scientific preparation of the workshop, while Mrs. Kroll took responsibility for a good deal of the organization of this conference, with Mr. Stöltzner also helping whenever possible. Most of the visiting scientists and myself made complete use of the PC facilities provided at ESI for writing papers,

and especially for electronic mail which, thanks to the unstinting efforts and advice of Dr.
Cap and Dipl.Ing. Schichl, never caused problems. Last but not least, I would like to mention
that the good working atmosphere which also led to many interesting contacts with scientists
participating in other programmes, has been nourished by the cooperative efforts of Professor
Michor, Professor Thirring and other Viennese colleagues. All these individuals I want to thank
heartily.

Visitors 1993.

Bach, Volker, TU Berlin, 11.10.-24.10.93

Combes, Jean Michel, University of Toulon, 22.11.-16.12.93

Derezinski, Jan, University of Warsaw, 22.9.-21.12.93

Erdös, Laszlo, Princeton University, 28.11.-18.12.93

Exner, Pavel, Nuclear Institute Prague, 18.10-12.12.93

Gerard, Christian, Ecole Polytechnique Palaiseau, 18.10.-29.10.93

Graf, Gian Michele, ETH Zürich, 11.10.-22.10.93

Harrell, Evans, University of Atlanta, 22.11.-17.12.93

Hempel, Rainer, University of Alabama, 4.12.-18.12.93

Herbst, Ira, University of Virginia, 1.6.-30.06.93

Hislop, Peter, University of Kentucky, 07.12.-20.12.93

Ivrii, Victor, University of Toronto, short visitor (December'93)

Kalf, Hubert, University of Munich, 26.09.-10.10.93

Karner, G. University of Virginia, short visit (June'93)

Korotyaev, Evgeni, Electrotechnical University of St. Petersburg, short visitor (Decem-
ber'93)

Loss, Michael, Georgia Technical School of Mathematics, 20.09.-20.12.93

Nadirashvili, Nicolai, University of Moscow, 01.03.-13.07.93

Nenciu, Gheorghe, University of Bucharest, 01.10.-31.12.93

Pavlov, Boris, University of St. Petersburg, 31.10.-19.12.93

Siedentop Heinz, University of Trondheim, 19.06.-02.07.93, 01.12.-16.12.93

I.M. Sigal, University of Toronto, January'93 (short visitor)

Skriganov, Maxim, University of St. Petersburg, 05.12.-19.12.93

Sobolev, Alexander, University of Nantes, 30.11.-12.12.93

Stubbe, Joachim, CERN Geneva, 11.10.-29.10.93

Thaller, Bernd, University of Graz, 11.11.-13.12.93

Vugalter, Simeon, Radiophysik Institute, Nishni Nogorod, 19.10.-19.12.93

Yafaev, Dimitri, University of Rennes, 30.09.-30.10.93, 29.11.-19.12.93

Zhislin, Gregory, Radiophysik Institute, Nishni Nogorod, 15.11.-15.12.93

Talks held at the Workshop on Schrödinger Operators.

M. S. Birman (St. Petersburg) A perturbation of a periodic Schrödinger operator by a
modulated decaying potential

M. Bordoni (Rome) A method to compare operators. Applications to Schrödinger and
Dirac operators

Y. Colin de Verdiere (Grenoble) Semi-classical analysis of tunneling and graph's embed-
ding into surfaces

J. M. Combes (Toulon) Positive commutators and perturbation of the singular spectrum

M. Combescure (Paris) Localization versus diffusion for 'kicked' quantum systems

M. Demuth (Potsdam) Trace class criteria in stochastic spectral analysis

J. Derezinski (Warsaw) Long-range scattering theory for time-dependent potentials

P. Exner (Prague) Wannier-Stark ladder with unusual spectral properties

L. Erdoes (Princeton) Magnetic Lieb-Thirring inequalities

G. Goldstein (Baton Rouge) Spin polarized Thomas-Fermi theory with the Fermi-Amaldi
correction

J. Goldstein (Baton Rouge) Obstacle scattering for elastic waves

E. Harrell (Atlanta) Some bounds on eigenvalues and spectral gaps of Schrödinger and
Laplace operators

B. Helffer (Paris) On the Schrödinger equation in large dimensions

R. Hempel (Birmingham, USA) Strong magnetic fields, Dirichlet boundaries, and spectral gaps

A. Hinz (Munich) Selfadjointness of Schrödinger operators

P. Hislop (Lexington, USA) Localization for the scalar wave and Maxwell equations in random medias

M. Hoffmann-Ostenhof (Vienna) Regularity properties of the zero set of solutions to Schrödinger equations

V. Ivrii (Toronto) Accurate spectral asymptotics for operators with singularities and the Scott correction term

G. E. Karadzhov (Sofia) Spectral asymptotics for some Schrödinger opertors and applications

E. Korotyaev (St. Petersburg) The effective masses and conformal mapping

Y. Kuperin (St. Petersburg) Adiabatic Faddeev equations for three-body quantum scattering

M. Loss (Atlanta) Fluxes, Laplacians and Kasteleyn's theorem

A. Martinez (Paris) Non-linear Stark effect and molecular localization

E. Mitidieri (Trieste) Weakly coupled elliptic systems and positivity

G. Nenciu (Bucharest) Perturbation theory for time dependent Hamiltonians

H. Neidhardt (Berlin) On the Spectra of self adjoint extensions

B. Pavlov (St. Petersburg) Harmonic analysis on Riemann surfaces and the Lax-Philipps theory for lattices

D. Robert (Nantes) Statistics of level spacings and distributions of matrix elements for chaotic systems

R. Seiler (Berlin) Charge transport and the index of projectors

H. Siedentop (Oslo) Electronic densities of large atoms near the nucleus

M. Skriganov (St. Petersburg) Anomalies in spectral asymptotics

A. V. Sobolev (Nantes) The precise asymptotics for the discrete spectrum of the Schrödinger operator with Coulomb singularities in a homogeneous magnetic field

J. Stubbe (Geneva) A sum rule for the Schrödinger equation and applications

S. Vugal'ter (Nizhni Novgorod) Limits on stabiltity of positive molecular ions in a homogeneous magnetic field

D. Yafaev (Rennes) Eigenfunctions of the continuous spectrum for the N-particle Schrödinger operator

G. Zhislin (Nizhni Novgorod) On the localization of the essential spectrum of N-particle Hamiltonians with magnetic field

Amongst the participants of the conference not contributuing a talk were: B. Baumgartner (Vienna), P. Clement (Delft), M. Daumer (Munich), H. Grosse (Vienna), H. Kalf (Munich), P. Michor (Vienna), H. Narnhofer (Vienna), Walter Thirring (Vienna), and a few other Austrian colleagues.

Differential geometry

Peter W. Michor

The field of differential geometry has a long tradition of mutual scientific exchange with theoretical physics, and this exchange is even growing in importance now. Thus it fits well into ESI as a mathematical program.

By happy coincidence some very active groups found together, a lot of discussion also with members of other programs took place, and many beautiful results were published in the preprint series of ESI.

The following topics were worked on:

(1) Classical mechanics: here G. Marmo coordinated the discussion, G. Vilasi, G. Landi, J. Grabowski, D. Alekseevski, A. Perelomov (from 2-dim. QF program), T. Ratiu, I. Vaisman, A. Vinogradov and others contributed. Preprints 2, 5, 16, 17, 26, 28, 40, 46, 49, 66, 70, 72, 73 belong to this field.

(2) Geometry of nonlinear partial differential equations: A. Vinogradov coordinated this activity, A. Vinogradov, V. Lychagin, I. S. Krashilchik, V. V. Sokolov, V. N. Chetverikov. Preprints 9, 46, 47, 48, 51, 53, 54, 55, 61, 73.

(3) Infinite dimensional differential geometry: Here a topical series of lectures by D. Burghelea on Waldhausen algebraic K-theory and cohomomology of diffeomorphism groups was held in July. Preprints 4, 11, 26, 41.

(4) Riemannian differential geometry and related material: Here D. Alekseevski was most active, preprints 7, 11, 21, 30, 32, 38, 39, 65, 70.

(5) Spectral theory on manifolds. Here was some collaboration with the program on Schrödinger operators. D. Burghelea, L. Friedlander, F. Kamber, were active here, preprints 37, 44, 65.

The following 40 ESI Preprints were produced by the visitors and collaborators of this program: 1, 2, 4, 5, 6, 7, 9, 10, 11, 15, 16, 17, 21, 26, 28, 30, 32, 37, 38, 39, 40, 41, 44, 46, 47, 48, 49, 50, 51, 53, 54, 55, 56, 61, 65, 66, 68, 70, 72, 73

Finally I want to thank all who have contributed to the success of ESI in 1993, to the nice athmosphere, and for a lot of work in the administration and at the computer system: Andreas Cap, Harald Grosse, Elisabeth Haffner, Thomas and Maria Hoffmann-Ostenhof, Hedwig Kroll, Hermann Schichl, Mario Springnagel, Michael Stöltzner, Walter Thirring.

List of visiting scientists.

D. Alekseevki, Center 'Sophus Lie', Krasnokazarmennaya 6, 111250 Moscow, USSR; January 18 -July 10,

Bogdan Bucicovschi, Dept. of Mathematics, Ohio State University, Columbus OH 43210, USA, supported by NSF, USA, July 14–July 31, 1993

D. Burghelea, Dept. of Mathematics, Ohio State University, Columbus OH 43210, USA, June 14 – August 14, 1993.

A. Cap, Institut f'ur Mathematik der Universität Wien, whole year, computer support and scientific collaboration.

Pierre Cartier, Institut des Hautes Études Scientifiques, 35, Route de Chartres, F-91440 Bures-sur-Yvettes, Frankreich 10 days, April 14–24.

Vladimir N. Chetverikov, ul. Ryleeva 6, korp. 1, Apt. 19, 121019 Moscow, Russland, September

L. Friedlander, Univ. of Arizona, USA, July 5 – July 31, 1993.

Thomas Friedrich, Fachbereich Mathematik, Humboldt Universit"at, PF 1297, D-10099 Berlin, June 19–25, 1993.

Olga Gil-Medrano, Universidad de Valencia, Dpto. de Geometria y Topologia, 46100 Burjassot, Spain; March 15–20, supported by Spain.

Janusz Grabowski, Institute of Mathematics, Warsaw University, ul. Banacha, P-02-097 Warszawa, Polen, 4 months, February 15 – July 14.

Dmitri Gurevich, MPI Bonn, Moscow, April 4–9.

Franz Kamber, Department of Mathematics, University of Illinois at Urbana-Champaign, 1409 W. Green Street, Urbana IL 61801, USA; Salierstrasse 4, D-8000, Muenchen 90, Deutschland, July

Max Karoubi UFR de Mathematiques, Université de Paris VII, 2, Place Jussieu, F-75251 Paris, Frankreich; April 21–24.

I. S. Krashilchik, 1st Tversloy-Yamskoy per. 14, Apt. 45, 125047 Moscow B-279, Russland; September – October 1993

Gianni Landi, SISSA, Strada Costiera 11, I-34014 Trieste, January 17 – July 17, supported by Italy.

Fedele Lizzi, Universitá di Napoli, Dipartimento di Fisica, April 4 – May 7, supported by Italy.

M. Losik, ul. Chapaeva 28, kv. 8, 410056 Saratov, Russia; June – July

V. Lychagin, Center 'Sophus Lie', Krasnokazarmennaya 6, 111250 Moscow, USSR; September – October 1993

M. Markl, Mathematical Institute, Czech Academy of Sciences, Žitná 25, CZ-115 67 Praha, June 11 – July 6, 1993.

G. Marmo, Dipartimento di Fisica, Universita di Napoli , Mostra d'Oltremare, Pad. 19-20, I-80125 Napoli, Italy; January 17 - May 20.

Giovanna Mendella, Dipartimento di Fisica, Universita di Napoli, Mostra d'Oltremare, Pad. 19-20, I-80125 Napoli, Italy; February 20–24; supported by Italy.

Giuseppe Morandi, Universitá di Bologna, Dipartimento di Fisica, 46 via Irnerio, I-40126 Italy; February 5–12; supported by Italy

A. L. Oniscik: Kolomenskaja nab. 10-153, 115 142 Moscow, Russland, January 10–April 10,

Emanuela Nicorestianu, Technical University Bucarest; May 20 – June 20; supported by an Austrian scholarship.

I. Penkov, Dept. of Mathematics, University of California, Riverside, CA 92521, September– October.

T. Ratiu, Dept. of Mathematics, University of California, Santa Cruz CA 95064, USA; ratiu@cats.ucsc.edu, June 21 – July 24

S. M. Salamon, Mathematical Institute, University of Oxford, 24–29 St. Giles, Oxford, UK; June 20–27, 1993.

Gaetano Scarpetta, Universitá di Salerno, Dipartimento di Fisica, I-84081 Baronissi - Salerno, Italy; March 7– 13, supported by Italy.

Herman Schichl, Institut f'ur Mathematik der Universität Wien, whole year, computer support and scientific collaboration.

Rudolf Schmid, Dept. of Mathematics, Emory University, Atlanta, GA-30322, USA, June 24–July 23, 1993.

Steven Shnider, Bar-Ilan University, Israel, June 24–30, supported by Israel

V. V. Sokolov, September – October 1993

Giovanni Sparano, Dipartimento di Fisica, Universita di Napoli, Mostra d'Oltremare, Pad. 19-20, I-80125 Napoli, Italy; February 24 – March 16; supported by Italy.

Andrea Spiro, Universitá di Ancona, Facoltá di Ingeneria, vial delle Brecce Bianche, Ancona, Italy; April 4 – 9; supported by Italy.

Wlodizimierz Tulczyjew, Universitá di Camerino, via Faverino, 26, I-62032 Camerino, Italy; April 13 – 20; supported by Italy.

I. Vaisman, Department of Mathematics, Department of Mathematics, University of Haifa, Mount Carmel, Haifa 31999, Israel July 20 – September 15

J. Vanžura, Mathematical Institute, branch Brno, Czechoslovak Academy of Sciences, Mendlovo nám. 12A, CS-60300 BRNO, Tschechoslowakei 1 month, September

Gaetano Vilasi, Universitá di Salerno, Dipartimento di Fisica, I-84081 Baronissi - Salerno, Italy; January 18 – February 14 and March 7 – April 7; supported by Italy.

A. Vinogradov, Dipartimento di Matematica, Universitá di Salerno, Italien; private: vl. Republica 72, I-50019 Sesto Fiorentino (FI), Italien; Universitá di Salerno, Italy, Jan. 18 – March 19, and July 15– October 15

Patrizia Vitale, Dipartimento di Fisica, Universita di Napoli , Mostra d'Oltremare, Pad. 19-20, I-80125 Napoli, Italy; April 18 – May 7; supported by Italy.

Cornelia Vizman, University of Timişoara, Bul. V. Parvan 4, R-1900 Timişoara, Rumänien,

May 20 – December 20; supported by an Austrian scholarship.

Visitors outside of specific activities

P. Bizon, Institute of Physics, Jagiellonian University Krackov, Poland, October 1, 1992 — September 30, 1993.

N. P. Ilieva-Litova, Institute of Nuclear Research and Nuclear Energy, 72, Tsagiradsko chaussee, 1784 Sofia, Bulgaria, February 1–28, 1993.

List of Preprints

1. V. A. Bunegina, A. L. Onishchik, *Two Families of Flag Supermanifolds*, to appear, Diff. Geom. Appl. (1994), 30 pages.
2. G. Landi, G. Marmo, G. Vilasi, *An algebraic Approach to Integrability*, Preprint ESI **2** (1993), 16 pages.
3. Peter C. Aichelburg, Piotr Bizon, *Magnetically Charged Black Holes and Their Stability*, Preprint ESI **3** (1993), 18 pages.
4. Peter W. Michor, *Radon transform and curvature*, to appear, Proceeding of the conference 75 years of Radon transform, (S. Gindikin, P. Michor, eds.), International Press, Hongkong, 1994, pp. 3 pages.
5. Janusz Grabowski, *Isomorphisms of the Jacobi and Poisson Brackets*, Preprint ESI **5** (1993), 5 pages.
6. A. Cap, P. W. Michor, H. Schichl, *A Quantum Group like Structure on non Commutative 2-Tori*, Letter Math. Physics **28** (1993), 251–255.
7. D. V. Alekseevsky, Peter W. Michor, *Differential geometry of $\mathfrak{g}$-manifolds I. $\mathfrak{g}$-manifolds of constant rank and their characteristic classes*, Preprint ESI **7** (1993), 32 pages.
8. H. Grosse, W. Maderner, C. Reitberger, *Cyclic Cohomology for Massive 1+1d-Fermions and Virasoro Algebras*, Preprint ESI **8** (1993), 11 pages.
9. A. M. Vinogradov, *From Symmetries of Partial Differential Equations towards the Secondary ('Quantized') Calculus*, To appear, J. Geom Physics, 65 pages.
10. A. L. Onishchik, *On the Rigidity of Supergrassmannians*, Annals of Global Analysis and Geometry **11** (1993), 361–372.
11. O. Gil-Medrano, P. W. Michor, *Pseudoriemannian Metrics on Spaces of Almost Hermitian Structures*, to appear under the title 'Geodesics on Spaces of Almost Hermitian Structures', Israel J. Math., 12 pages.
12. A. Borovick, S. Kulinich, V. Popkov, Yu. Strzhemechny, *A new class of completely solvable bi-Plane 2d Vertex Models*, Preprint ESI **12** (1993), 36 pages.
13. A. Akhiezer, A. Borovick, V. Popkov, *Exactly solvable system of coupled nonlinear Schrödinger equations*, Preprint ESI **13** (1993), 8 pages.
14. Karl-Henning Rehren, *On the Range of the Index of Subfactors*, Preprint ESI **14** (1993), 9 pages.
15. Pierre Cartier, *Construction Combinatoire des Invariants de Vassiliev – Kontsevich des Nœds*, To appear, Comptes Rendus Acad. Sci., Paris (1993), 10 pages.
16. Janusz Grabowski, *Poisson Lie groups and their relation to quantum groups*, Preprint ESI **16** (1993), 9 pages.
17. J. Grabowski, G. Marmo, A. M. Perelomov, *Poisson structures: towards a classification*, to appear, Modern Physics Letters A **8** (1993), 1719–1733.
18. P. Bizon, *Saddle points of stringy actions*, Preprint ESI **18** (1993), 10 pages.
19. Yassen S. Stanev, *Classification of the local extensions of the chiral observable algebra in $SU(3)$ WZNW models*, Preprint ESI **19** (1993), 18 pages.
20. Ludmil K. Hadjiivanov, *Quantum deformation of Bose parastatistics*, Preprint ESI **20** (1993), 20 pages.
21. A. Alekseevsky, D. Alekseevsky, *Asystatic G-manifolds*, to appear, Proceedings of the conference on Differential Geometry and Topology, Alghero (F. Tricerri, ed.), 1993, pp. 21 pages.
22. Maderner, Grosse, Reitberger, *On spin chains, charges, and anomalies*, to appear in Journal of Physics A: Mathematics, Preprint ESI **22** (1993), 9 pages.
23. Grosse, Presnajder, *The Construction of Non-Commutative Manifolds Using Coherent States*, to appear, Letters of Math. Physics **28** (1993), 239–250.
24. D. Bernard, M. Gaudin, F. D. M. Haldane, V. Pasquier, *Yang-Baxter equations in long range interacting systems*, Preprint ESI **24** (1993), 23 pages.
25. H. Grosse, E. Raschhofer, *Bethe-Ansatz Solution of a Modified SU(3)-XXZ–Model*, Preprint ESI **25** (1993), 17 pages.
26. J. Grabowski, *A Poisson-Lie group Structure on the Diffeomorphism Group of a Circle*, Preprint ESI **26** (1993), 7 pages.

27. R. Hempel, J. Laitenberger, *Schrödinger operators with strong local magnetic perturbations: existence of eigenvalues in gaps of the essential spectrum*, to appear, Proceedings of the conference: Mathematical results in quantum mechanics, Blossin 1993, Series: Operator theory: advances and applications, Birkhäuser, 1993, pp. 6 pages.

28. J. Grabowski, G. Landi, G. Marmo, G. Vilasi, *Generalized Reduction Procedure: Symplectic and Poisson Formalism*, Fortschritte der Physik/Progress in Physics **42** (1994), 39 pages.

29. Nikolai S. Nadirashvili, *Raleigh's conjecture on the principal frequency of the clamped plate*, Preprint ESI **29** (1993), 11 pages.

30. D.V. Alekseevsky, M.M. Graev, *Twistors and Cartan Connections*, Preprint ESI **30** (1993), 14 pages.

31. V. N. Popov, *Magnetic and Superconductive States in the Repulsive Hubbard Model*, Preprint ESI **31** (1993), 18 pages.

32. D. Burghelea, C. Constantinescu, *Cutting and Glueing Back along a Closed Simple Curve on a Riemann Surface*, Preprint ESI **32** (1993), 20 pages.

33. A. Yu. Alekseev, I. T. Todorov, *Quadratic brackets from symplectic forms*, Preprint ESI **33** (1993), 16 pages.

34. P. Furlan, Y. S. Stanev, I. T. Todorov, *Exchange relations and correlation functions for a quantum particle on the SU_2-group manifold*, Preprint ESI **34** (1993), 15 pages.

35. M. Hoffmann-Ostenhof, T. Hoffmann-Ostenhof, H. Stremnitzer, *Local properties of Coulombic wave functions*, to appear, Comm. Math. Physics, 33 pages.

36. M. Hoffmann-Ostenhof, T. Hoffmann-Ostenhof, N. Nadirashvili, *Regularity of the nodal sets of solutions to Schrödinger equations*, to appear, Proceedings of the conference: Mathematical results in quantum mechanics, Blossin 1993, Series: Operator theory: advances and applications, Birkhäuser, 1993, pp. 7 pages.

37. J. F. Glazebrook F. W. Kamber, *Secondary invariants and chiral anomalies of basic Dirac families*, to appear in, Diff. Geom. Appl. (1993), 14 pages.

38. Mark Losik, *Categorical differential geometry*, Preprint ESI **38** (1993), 16 pages.

39. D. V. Alekseevsky, P. W. Michor, *Differential geometry of Cartan connections*, Preprint ESI **39** (1993), 23 pages.

40. G. Landi, G. Marmo, G. Vilasi, *Recursion Operators: Meaning and Existence for Completely Integrable Systems*, Preprint ESI **40** (1993), 10 pages.

41. Rudolf Schmid, *A solution of the BRST Consistency Condition and g–symplectic orbits*, Preprint ESI **41** (1993), 11 pages.

42. Heinz Siedentop, *Bound for the atomic ground state density at the nucleus*, Preprint ESI **42** (1993), 6 pages.

43. R. Hempel, J. Voigt, *The spectrum of Schrödinger operators in $L_p(R^d)$ and $C_0(R^d)$*, Preprint ESI **43** (1993), 11 pages.

44. D. Burghelea, L. Friedlander, T. Kappler, *Asymptotic Expansion of the Witten deformation of the analytic torsion*, Preprint ESI **44** (1993), 38 pages.

45. H. Grosse, P. Prešnajder, M. Chaichian,, *Unitary Realizations of the q-Oszillator Algebra*, Preprint ESI **45** (1993), 11 pages.

46. F. Lizzi, G. Marmo, G. Sparano, A. M. Vinogradov, *Eikonal type equations for geometric singularities of solutions in field theory*, Preprint ESI **46** (1993), 27 pages.

47. I. S. Krasil'shchik, *Lie algebra structures for symmetries of differential equations possessing recursion operators*, Preprint ESI **47** (1993), 14 pages.

48. I. S. Krasil'shchik, *An algebraic model for characteristics of differential equations*, Preprint ESI **48** (1993), 15 pages.

49. Izu Vaisman, *Second order hamiltonian vector fields on tangent bundles*, Preprint ESI **49** (1993), 18 pages.

50. Ivan Penkov and Vera Serganova, *Generic Irreducible Representations of Finite-Dimensional Lie Superalgebras*, Preprint ESI **50** (1993), 30 pages.

51. V.Lychagin, *Quantizations of braided differential operators*, Preprint ESI **51** (1993), 11 pages.

52. I. T. Todorov, *What are we learning from 2-dimensional conformal models?*, Preprint ESI **52** (1993), 21 pages.

53. I. Z. Golubchik, V. V. Sokolov, S. I. Svinolupov, *A new class of nonassociative algebras and a generalized factorization method*, Preprint ESI **53** (1993), 11 pages.

54. A. V. Bocharov, V. V. Sokolov, S. I. Svinolupov, *On Some Equivalence Problems for Differential Equations*, Preprint ESI **54** (1993), 12 pages.

55. V. N. Chetverikov, *Invertible linear differential operators on two-dimensional manifolds*, Preprint ESI **55**, 16 pages.

56. Andreas Cap, Jan Slovak, *On multilinear operators commuting with Lie derivatives*, Preprint ESI **56**, 29 pages.

57. H. Grosse, V. N. Popov, *On the relation between spin systems and fermion systems*, Preprint ESI **57** (1993), 6 pages.

58. Harald Grosse, Walter Maderner, *On the classical origin of the fermionic Schwinger term*, Preprint ESI **58** (1993), 6 pages.

59. Harald Grosse, Walter Maderner, Christian Reitberger, *Can anomalies melt?*, Preprint ESI **59** (1993), 14 pages.

60. J. Dereziński, C. Gerard, *Chapter 3: Quantum time dependent 2-body Hamiltonians*, Preprint ESI **60** (1993), 85 pages.

61. V. Lychagin, *Braidings and Quantizations over bialgebras*, Preprint ESI **61** (1993), 23 pages.

62. B. Thaller, *A criterion for essential self-adjointness*, Preprint ESI **62** (1993), 11 pages.

63. D. Yafaev, *Eigenfunctions of the continuous spectrum for the N-particle Schrödinger operator*, Preprint ESI **63** (1993), 27 pages.

64. P. Kargaev, E. Korotyaev, *Effective masses and conformal mappings*, Preprint ESI **64** (1993), 32 pages.

65. Ronald G. Douglas, James F. Glazebrook, Franz W. Kamber, Guoliang Yu, *Index formulas for geometric Dirac operators in Riemannian Foliations*, Preprint ESI **65** (1993), 28 pages.

66. Andrei Borowick, Gaetano Vilasi, *Invariant endomorphism and complete integrability of a dissipative multicomponent Burgers model*, Preprint ESI **66** (1993), 11 pages.

67. S. Vugalter, *Limits on stability of positive molecular ions in a homogeneous magnetic field*, Preprint ESI **67** (1993), 23 pages.

68. Martin Markl, Steve Shnider, *Drinfel'd algebra deformations and the associahedra*, Preprint ESI **68** (1994), 6 pages.

69. L. Pittner, P. Uray, *Duals of quasitriangular $\mathbb{Z}_2$-graded Hopf algebras and the classical limit*, Preprint ESI **69** (1994), 24 pages.

70. Michel Dubois-Violette, Peter W. Michor, *A common generalization of the Frölicher-Nijenhuis bracket and the Schouten bracket for symmetric multi vector fields*, Preprint ESI **70** (1994), 15 pages.

71. H. Grosse, J. Stubbe, *Splitting of Landau levels in the presence of external potentials*, CERNTH. 7143/94, Preprint ESI **71** (1994), 9 pages.

72. D. V. Alekseevsky, J. Grabowski, G. Marmo, P. W. Michor, *Poisson structures on the cotangent bundle of a Lie group or a principal bundle and their reductions*, Preprint ESI **72** (1994), 21 pages.

73. Anthony Bloch, P.S.Krishnaprasad, Jerrold E. Marsden, Tudor S. Ratiu, *The Euler-Poincaré Equations and Double Bracket Dissipation*, Preprint ESI **73** (1994), 45 pages.

74. Rainer Hempel, Ira Herbst, *Strong magnetic fields, Dirichlet boundaries, and spectral gaps*, Preprint ESI **74** (1994), 28 pages.

75. László Erdős, *Magnetic Lieb-Thirring inequalities*, Preprint ESI **75** (1994), 41 pages.

76. S. Twareque Ali, Amine M. El Gradechi, Gérard G. Emch, *Modular algebras in geometric quantization*, Preprint ESI **76** (1994).

77. C. Malyshev, V. N. Popov, *Three-band Hubbard model and high temperature superconductivity*, Preprint ESI **77** (1994), 29 pages.

ESI-Colloquium

We organized the ESI-colloquium in a large lecture room at the University, usually Tuesday 16.00–17.00, where talks of introductory nature for a wide audience were offered to the scientific

community of Vienna.

> Giuseppe Marmo (Naples University): Surprises in Classical Dynamics. 23.3.1993.

> Pierre Cartier (CNRS and IHES, France): From Feynman Diagrams to the Classification of Knots: A Tale About the Use of Physics in Pure Mathematics. 20.4.1993.

> G. Mack (Hamburg University): Quantum Group Symmetry in Quantum Mechanics. 4.5.1993.

> Klaus Schmidt (University of Warwick): Mahler Measure and Entropy. 18.5.1993.

> Walter Thirring (Vienna University and ESI): Quantum Ergodic Theory. 25.5.1993.

> Simon Salamon (Oxford University): A Report on Quaternionic and Hypercomplex Manifolds. 22.6.1993

> Ivan Penkov (University of California) Generic representations of Lie superalgebras 5.10.1993

> Michael Loss (Georgia Institute of Technology) Minimization of Conformally Invariant Functionals 12.10.1993

> Sir Herman Bondi (Cambridge University) Conservation Theorems in General Relativity 15.10.1993

> Jan Derezinski (University of Warsaw) Asymptotic Completeness of N - body Long - range Systems 19.10.1993

> Bernd Thaller (University of Graz) Some Remarks on the Essential Selfadjointness of Dirac Operators 23.11.1993

> Evans M. Harrell (Georgia Technical University) Geometric Bounds on Eigenvalues 30.11.1993

List of Seminars

A.P. Isaev (JINR, Dubna): Covariant Quantum Algebras for Quantum Groups. 10.3.1992.

Dan Voiculescu (Berkeley, Bures–sur–Yvette): Perturbation of Operators and Entropy. 5.3.1992.

D. Buchholz (University of Hamburg): Vom Vakuum zum Gibbs Ensemble - Ausgewählte Kapitel aus der relativistischen lokalen Quantenfeldtheorie 6.,8.,13.10.

Elliot Lieb (Princeton University, Schrödinger–Gastprofessur 1992): Large Atoms in Strong Magnetic Field. 3.11.1992.

Elliot Lieb (Princeton University, Schrödinger–Gastprofessur 1992): Sharp Hypercontractivity Bounds for Fermi Fields. 5.11.1992.

Elliot Lieb (Princeton University, Schrödinger–Gastprofessur 1992): Maximizers of Gaussian Kernels and Fourier Transform 11.11.1992.

Giuseppe Marmo (Naples University): Algebraic Differential Calculus: Gauge Theories. 27.11.1992.

G. Nemciu (Bucharest, Lausanne): Adiabatic Perturbation Theory and Applications. 27.11.1992.

V.F. Weisskopf (MIT Cambridge): Warum sind die Berge so hoch, die Tropfen so klein und die Wasserwellen so lang ?. 9.12.1992.

N. Ilieva (Bulgarian Academy of Sciences): Superfield Wave Function of $N = 4$, $d = 2$ Superparticle. 11.12.1992.

Peter Gilkey (University of Oregon): Heat Content Asymptotics. 14.12.1992.

I. Sigal (Toronto University): Periodic Solutions of Non–Linear Schrödinger and Wave Equations. 12.1.1993.

A. Oniščik (Jaroslavl): Superhomogenous Spaces. 20.1.1993.

Giuseppe Marmo (Naples University): Dynamical Systems: Symmetries, Reduction, and Complete Integrability. 21.1.1993.

Gianni Landi (Trieste University): Lagrangian Supermechanics. 25.1.1993.

Dmitrij Alekseevskij (Moscow): Cohomogeneity two Riemannian Manifolds. 26.1.1993.

Gaetano Vilasi (Salerno University): Some open problems in completely integrable field theories. 27.1.1993.

Alexandr Vinogradov (Moscow and Firenze): Geometry of Non–Linear Partial Differential Equations. 28.1.1993.

Dmitrij Alekseevskij (Moscow): Twistor Spaces and G–strutures. 29.1.1993.

Middle European Seminar on Differential Geometry: Miniworkshop together with guests from Brno Lectures by Kollar, Slovak, and Vanzura. 29.1.1993.

A. Cap and P. Michor (Vienna University): A Quantum Group like Structure on the Non–commutative Torus. 3.2.1993.

Heide Narnhofer (Vienna University): On the Non-commutative torus. 4.2.1993.

Klaus Fredenhagen (Hamburg University): Conformal Field Theory and the Theory of Superselection Sectors: Results and Problems. 19.2.1993.

Ivan Todorov (Academy of Sciences, Sofia): $T^*(SU_2)$ Revisited. 23.2.1993.

L. Hadjiivanov (Academy of Sciences, Sofia): Quantum Groups and Quantum Oscillators. 24.2.1993.

Y. Stanev (Academy of Sciences, Sofia): Polynomial Solutions of the Knizhnik-Zamolodchikov Equations. 25.2.1993.

Klaus Fredenhagen (Hamburg University): Global Observables in Local Quantum Field Theory. 26.2.1993.

Ivan Todorov (Academy of Sciences, Sofia): Introduction to Conformal Quantum Field Theory. 1.3.1993.

K.–H. Rehren (Hamburg University): Klein Transformations and the Gauge Principle. 3.3.1993.

Roman Jackiw (MIT Cambridge): Gauge Theory and Linear Gravity (Schrödinger–Gastprofessur 1993). 2.,3.,5.3.1993.

Gregory Chaitin (IBM Research Division, New York): The Berry Paradox. 10.3.1993.

So–Young Pi (Boston University): Inflation and COBE Data. 15.3.1993.

Roman Jackiw (MIT Cambridge): Time Travel ?. 15.3.1993.

A. Perelomov (Moscow): On the Completeness of Subsystems of Coherent States: The Problems of E. Schrödinger and of J. von Neumann. 17.3.1993.

N. Nadirashvili (Moscow): On the Littlewood Conjecture for the Mean Value Property 18.3.1993 (Keyword: Harmonic Functions).

A. Schnizer (RIMS Kyoto): Roots of Unity: Representations of Quantum Groups. 19.3.1993.

Discussion moderated by Giuseppe Marmo on Geometrical : Methods in Classical Dynamics (continued for several weeks during the stay of G. Marmo). 22.3.1993.

N. Nadirashvili (Moscow): On the Rayleigh Isoperimetric Conjecture. 23.3.1993.

K. Gawedzki (IHES Bures–sur–Yvette): Lattice Kac-Moody Algebras. 25.3.1993.

Janusz Grabowski (Warsaw University): Poisson Structures and Deformation Quantization. 25.3.1993.

V. Pasquier (Saclay): Quantization of Toda–Lattices. 26.3.1993.

A. E. Borovick (Kharkov): A New Class of Completely Solvable Bi–Plane 2 D Vertex Models. 29.3.1993.

A. Perelomov (Moscow): The Projection Method for Integration of the Equations of Motion: Classical Mechanics – Quantum Mechanics. 2.4.1993.

A. Yu. Alekseev (St. Petersburg): Symplectic Structures associated to Lie–Poisson Groups. 5.4.1993.

Dmitrij Gurevič (Bonn and Moscow): The Poisson bracket associated with R–matrices and their quantization. 6.4.1993.

Andrea Spiro (Ancona University): Curvature homogeneous Riemannian manifolds. 7.4.1993.

A. Perelomov (Moscow): Partition functions for string theory with small genus. 16.4.1993.

Y. Stanev (Academy of Sciences, Sofia): Expansions of the Observable Algebra for SU(3) WZNW – Models. 21.4.1993.

Institute for Mathematics- Colloquium, together with ESI P. Cartier (CNRS and IHES, France): Combinatorial Construction of Vassiliev–Kontsevich Invariants of Knots. 21.4.1993.

Max Karoubi (University of Paris VII): Non–Commutative Differential Forms and Topology. 22.4.1993.

Institute for Mathematics- Colloquium, together with ESI P. Cartier (CNRS and IHES, France): Combinatorial Construction of Vassiliev–Kontsevich Invariants of Knots II. 23.4.1993.

G. Sotkov (Academy of Sciences, Sofia, and Montpellier University): Infinite Symmetries of 2 D Integrable Models: Off–Critical W–Infinity, Virasoro, Kac–Moody, ... 28.4.1993.

V. N. Popov (Steklov Institute, St. Petersburg): Magnetic and Superconducting States in the Repulsive Hubbard Model. 30.4.1993.

M. Havlíček (Technical University, Prague): Irreducible Representations of $U_q(gl(n,\mathcal{C}))$. 5.5.1993.

Rainer Hempel (Munich University): Spectral Properties of Neumann Laplacians. 6.5.1993.

A. Yu. Alekseev (St. Petersburg): The Symplectic Structure of the Chern–Simons Theory. 10.5.1993.

A. Yu. Alekseev (St. Petersburg): Quadratic Brackets from Symplectic Forms. 11.5.1993.

Heide Narnhofer (Vienna University): Entropy Density in Relativistic Quantum Mechanics. 11.5.1993.

R. Flume (Bonn University): Convergent Perturbation Series Around D=2 Rational Conformal Field Theories. 12.5.1993.

G. Mack (Hamburg University): Quantum Field Planes. 14.5.1993.

V. Rittenberg (Bonn University): Reaction – Diffusion Processes and Quantum Groups. 24.5.1993.

Piotr Bizon (Cracow University): Regular Solutions in Einstein – Yang–Mills and Related Topics. 2.6.1993.

Andreas Cap (Vienna University): An Introduction to K-Theory. 7.,8.,9.6.1993.

Rainer Hempel (Munich University): Eigenvalue Problems in Solid State Physics. 8.6.1993.

I. Herbst (University of Virginia): Perturbation Theory for the Decay Rate of the Schrödinger Equation. 15.6.1993.

Mark Losik (Saratov University): Characteristic Classes of Transformation Groups. 17.6.1993.

Dan Burghelea (Ohio State University): From Elementary Linear Algebra, via K–Theory to Geometric Topology and Physics An Overview and four topical lectures. 17., 18., 22., 24., 25.6.1993.

Heinz Siedentop (Oslo University) Generalizations of the Kustaanheimo - Stiefel Transform. 23.6.1993

Thomas Friedrich (Humboldt University) On Twistor - Spinors 24.6.1993

Steve Schnider (University of Bar Ilan) Drinfeld Algebras via Deformation Theory 28.6.1993

ESI - Colloquium Tudor Ratiu (University of California) Geometric Mathods in the Stability of Relative Equilibria 29.6.1993

G. Karner (University of Virginia) Dynamics of the Quantum Standard Map 29.6.1993

Florian Nill (FU Berlin) Hopf Quantum Spin Chains 2.7.1993

Wolfgang Weich (University of Munich) $SU_q(3)$ - Symmetric Quantum Mechanics 5.7.1993

Seminars on Differential Geometry 12th-16th July T. Ratiu (University of California) The Toda - Lattice and Brockett's Equations 12.7.1993 An Infinite Dimensional Convexity Result 13.7.1993

R. Schmid (Emory University) BRST - Symmetries 14.7.1993

M. Losik (Saratov University) A Generalization of Manifolds and its Characteristic Classes 15.7.1993

Bogdan Bucicovschi (Ohio State University) The Zeta - function without Hard Analysis 16.7.1993

Seminars on Differential Geometry 19th-22nd July
L. Friedlander (University of Arizona) The Zeta - Function for Elliptic Operators and Non-commutative Residue 19-21.7.1993

Franz Kamber (University of Illinois) Index Formulas for Dirac Operators in Riemannian Foliations 22.7.1993

Seminars on Differential Geometry 2nd-6th August Izu Vaismann (University of Haifa) On the Lichnerowicz-Poisson cohomology 3.8.1993

Dan Burghelea (Ohio State University) Torsion in Geometry and Topology 4-6.8.1993

V. Chetverikov (Moscow University) Invertible Linear Differential Operators on Two dimensional Manifolds 9.9.1993

Alexander Dynin (Ohio State University) Variations on the theme of Feynman path integrals 17.9.1993

V. Lychagin (Moscow University) Differential operators and quantizations in braided tensor categories 27-28.9.1993

I. Krashilshchik (Moscow University) Graded differential equations and their recursion operators 29-30.9.1993

Hubert Kalf (University of Munich) The Expansion of a Function in Sherical Harmonics 7.10.1993

V. V. Sokolov (Ufa center of Russian Academy of Sciences) Non associative algebras and integrable equations 12.10.1993

Gian-Michele Graf (ETH Zürich) Anderson Localization and the Space-Time Characteristic of Continuum States 14.10.1993

Michal Marvan (University of Opava) On zero curvature representations of partial differential equations - a new algorithm 20.10.1993

D. Kölzow (University of Erlangen) Fraktale in der Analysis 21.10.1993

Volker Bach (TU Berlin) The Ground State Energy of Large Atoms and Molecules 21.10.1993

D. Yafaev (University of Rennes) The Scattering Matrix for the N-particle Schrödinger Operators 22.10.1993

D. Horn (University of Tel-Aviv) Neural Modeling of Cognitive Functions 25.10.1993

A. Vinogradov (University of Salerno) Realization of the standard bracket operations in secondary (quantized) calculus 27.10.1993

Joachim Stubbe (Theory Division, CERN) Spacing of Energy Levels for Schrödinger Operators with Magnetic Fields 28.10.1993

Franco Ferrari (University of Munich) On the Abelian Gauge Field Theories on Riemann Surfaces 3.11.1993

Jiři Vanžura (Czech Academy of Sciences) Algebras of differentiable functions 4.11.1993

Maria Hoffmann-Ostenhof (University of Vienna) Regularity of Nodal Sets of Solutions of the Schrödinger Equation 4.11.1993

Pavel Exner (University of Prague) Stark Ladder without Absolutely Continuous Spectrum 5.11.1993

Gheorghe Nenciu (University of Bucharest) Semi-classical S-matrix for One-dimensional N-state Systems 12.11.1993

Simeon Vugal'ter (University of St. Petersburg & Nizhnii Novgorod) Finiteness of Discrete Spectrum for 3-particle Systems with Short-range Interaction 16.11.1993

Wofgang Ruppert (University for Bodenkultur, Vienna) Das Dividierbarkeitsproblem für Unterhalbgruppen von Lie-Gruppen 17-18.11.1993

G. Zhislin (Nizhnii Novgorod) The Extremal Properties of Two-particle Systems with Magnetic Fields 26.11.1993

Jan Slovak (Masaryk University) Invariant operators on conformal Riemannian manifolds 1.12.1993

A. P. Karataschov (University of Moscow) Self organizing neural networks 17.1.1994

E. Karataschova (Shirshov Institute, Moscow) Non-linear wave interactions in bounded regions 18.1.1994

Jaroslaw Piasecki (Institute of Theoretical Physics, Warsaw) Aggregation of Mass by Inelastic Collisions 27.1.1994

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