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RESEARCH PROPOSAL

Dutch Russian Research
Cooperation 2004

1	**Please select the scientific field:**	Interdisciplinary Mathematics

2	**Please state the title of your project:**	*Geometry and Singularity Theory in Mathematical Physics*

PERSONALIA OF APPLICANTS

Please complete these fields for the Dutch Project leader (applicant):

3	**Name and title(s):**	**Prof.Dr. Dirk Siersma**	male

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Please complete these fields for the Russian co-leader (co-applicant):

5	**Name and title(s):**	**Prof.Dr. Sergey Natanzon**	male

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Date ----------------------------

Date ---------------------------------

Signature Dutch applicant **Signature Russian co-applicant**

PROJECT CONTENT

7 Please insert the estimated duration and the start date of the project:

36 Months 01 07 04 Start Date

8 Please give a summary of your project in terms of its content and goals:

(max. 500 words, plus keywords):

Mathematics and theoretical physics (in particular, quantum and string theories) traditionally have a lot of connections and influence each other. This connections work in two sides. Mathematics is the main tool in theoretical physics. On the other side quantum and string theories produce new concepts and problems which become subjects of mathematical research. Most important and interesting results are obtained at the edge between these fields.

The main aim of the Project is to develop interdisciplinary connections between geometry and singularity theory on one side and quantum field theory on the other. It consists of several adjoint themes, connected with quantum field theory: string theory, WDVV equations, Frobenius manifolds, Gromov-Witten invariants, mirror symmetry, integrable systems, Whitham hierarchies, Seiberg-Witten theory, matrix models, quantum topological invariants of knots and 3D-, 4D-manifolds, modern problems of theory of singularity and symplectic geometry.

The goal of the project is to clarify connections between these theories and to use these connections for progress in them.

The project includes, in particular,

- study of topology of moduli spaces of complex and real algebraic curves, corresponding Hurwitz spaces and their applications to quantum invariants of manifolds,
- development of tools for computing Gromov-Witten invariants of complex manifolds based on singularity theory,
- study of various spaces of mappings and their quantum invariats such as Vassiliev invariants of knots, 4-invariants of graphs, finite order invariants of complex mappings,
- mirror symmetry for Fano manifolds and especially 3D- and 4D- Fano manifolds,
- applications of integrable systems KP/Toda/Calogero and Whitham type to study of important problems of mathematical physics: Seiberg-Witten theory, Dijkgraaf-Vafa theory, Landau-Ginzburg models, matrix models etc,
- D-branes theory and associated deformations of open-closed topological field theory, Landau-Ginzburg models with boundaries, noncommutative Frobenius manifolds.

Keywords:

quantum field theory, string theory, WDVV equations, Frobenius manifolds, mirror symmetry, integrable systems, Seiberg-Witten theory, matrix models, quantum topological invariants of knots and 3D-, 4D- manifolds, singularity theory, symplectic geometry

9 Please describe briefly (by name) how young scientists will be involved in this project and what will be their role:

Young scientists will work on majority problems of the Project. There will be established regular contacts between young scientist from the both sides and also between them and senior researchers. At least one visit to the counterpart country is planned for each Russian young scientist and for majority of Dutch ones. Main tasks of young researchers will be connected with the following problems.

Alexandrov Alexander: study of matrix models as one of the basic physical systems connected with integrable and topological structures, in particular, study of the Dijkgraaf-Vafa type matrix model solutions.

Amburg Natalia: combinatorics in graph theory and corresponding Riemann surfaces as one of the main objects emerging within the integral context in physical theories, their applications to matrix models.

Vasiliev Dmitry: WDVV equations and related problems, study of topological structures in physical models basically related to the WDVV equations.

Shadrin Sergey: study of different theories of quantization (genus expansion) of Frobenius manifolds and related algebraic structures, in particular, a definition of BV-infinity and WDVV-infinity; related questions in the intersection theory of the moduli space of curves like new topological recursion relation, the structure of the tautological ring, and so on.

Pushkar Petr: symplectic and contact topology, theory of Legendrian knots related to the theory of wave propagation, construction of Legendrian knots invariants connected with differential graded algebras and Morse theory.

Karpenkov Oleg: classification of faces of multidimensional continued fractions; development of new algorithms to construct such fractions; study of Frobenius matrix solvability (and the connection with Thue equations).

Chulkov Sergey: problem of convergence of formal solutions of a system of nonlinear PDE, generalization to systems of PDE depending on infinite set of variables, applications to some problems of mathematical physics involving systems of PDE depending on infinite set of variables; combinatorial properties of integer lattices and their applications in algebraic geometry, theory of PDE and topology.

10 **Please give a brief description of the previous research cooperation between your institutions.** Mention some recent joint publications:

Russian and Dutch schools in Mathematical Physics and, in particular, participants of the proposal have long history of contacts and worked under big influence of each other. Majority of the mathematical part of the Russian side emerged from the school of V.I.Arnold known for its interest in physical applications. Pioneer works of Arnold had big influence on researches of D.Siersma, J.Steenbrink, E.Looijenga et al. In the other direction results of Dutch researchers, such as mentioned above, R.Dijkgraaf, E. and H. Verlinde and others, were used and developed by Russian ones. This collaboration took place, in particular, in the framework of the NWO-RFBR grant 047.008.005 and a number of INTAS grants coordinated by Prof. Dirk Siersma. In the framework of these grants there were obtained a number of important new results. Collaboration of Russian and Dutch researchers in applications to mathematical physics got a big impetus during the spring school on Frobenius manifolds and the corresponding conference "Frobenius manifolds in Mathematical Physics" which took place in May 2002 at the University of Twente (Enschede, Netherlands) in May 2002. A number of Russian participants of the Proposal (both from mathematical and physical sides, e.g., S. Natanzon, S. Shadrin, O. Karpenkov, A. Losev, A. Marshakov) took part in these events and established useful scientific contacts with Dutch participants of the Proposal.

11 **Describe the state-of-the-art in the research field in the Russian federation and in the Netherlands:**

Russia and the Netherlands are among leaders in modern mathematical physics and mathematics, connected with it. There positions are especially strong in quantum fields and string theories, geometry and singularity theory.

In the Netherland these themes are elaborated, in particular, by

R. Dijkgraaf (quantum string theory, matrix moduls, moduli spaces),
E. Verlinde (quantum algebras, integrable systems),
D. Siersma (theory of singularities and its applications),
E. Looijenga (moduli spaces),
J. Steenbrink (algebraic geometry and theory of singularities),

J. Stienstra (arithmetic algebraic geometry, hypergeometric systems, K-theory),
G. Heckman (Representation theory, Symplectic geometry, Integrable systems),
J. van de Leur (infinite dimensional Lie algebras, integrable systems).
In Russia they are elaborated, in particular, by
A. Morozov (string theory, integrable systems, conformal field theory),
A. Mironov (quantum field theory, string theory, conformal field theories, classical and quantum integrable systems),
A.Losev (string theory, topological theories),
S.Natanzon (string theory, integrable systems, moduli spaces),
S.Gusein-Zade (topology and algebraic geometry of singularities),
S.Lando(moduli spaces, singularity theory, combinatorics),
V.Vassiliev (topology, singularity theory, integral geometry, complexity theory, combinatorics, algebraic geometery),
M.Kazarian (differential geometry, topology, characteristic classes, singularity theory),
Vik.Kulikov (algebraic and symplectic geometry).

12 **Discuss the content of your project:**

- What is the problem definition or central hypothesis of your project?

The project deals with integrable and topological properties in various physical models. The circle of ideas connecting these could be divided into two groups: the first one concentrates around interrelations between different integrable and topological properties of the models. Our standpoint is that the key object for understanding these interrelations is Whitham integrability. However, the notion of Whitham integrability is not enough developed, at the moment, in order to observe the interrelations in full.

The second group of ideas is more concentrated on topological properties of the physical models. Here we propose to study such mathematical structures as homotopical algebra as a prototype of universal degrees of freedom. We are going to look at homotopical theories as a proper enlargement of the string theory approach to quantum field theory.

We propose to deal with integrable and topological theories in different branches of modern theoretical and mathematical physics. During recent decades there has been accumulated huge exeprimental material on structures of these kind revealed in different physical frameworks. Now one should make a next step, that is search for an understanding and building a concept that could deal with a whole picture where various integrable and topological structures revealed would naturally emerge within same context and would interrelate.

These mentioned structures, first of all, include different kinds of integrability. Indeed, it was realized in the mid-seventies that generating functions for correlators in many physical systems are nothing but τ-functions of integrale hierarchies (for instance, KP/Toda hierarchy). The list of examples starts from statistical mechanics models (correlators in Ising models, non-linear Schrodinger system etc) and ranges up to matrix models and string theory (2d gravity coupled to conformal matter).

In fact, matrix models provides one with a reference example for the phenomenon, since they are, on one hand, easy to calculate and, on the other hand, shows up practically all non-trivial and essential features celebrated by more involved physical theories.

The second kind of integrability that also typically emerges within different physical contexts is Whitham integrability. This kind of integrable systems is naturally associated with slow dynamics on moduli spaces of solutions to standard integrable systems. Therefore, there is an intrinsic connection between Whitham and standard integrable hierarchies. However, this connection is not really understood yet.

Within the project we are planning to continue our search for the understanding dealing with concrete systems showing up both standard integrable and Whitham properties. Examples of such systems are numerous, however, the most clever example seems to be supersymmetric gauge theories that, in the low energy limit, are exactly solved. Another suitable example would be the matrix models again. However, the situation is even more plausible: the low energy behaviour of supersymmetric theories turns out to be most effectively described in terms of matrix integrals. This means one gets a variety of

tools at once to study the integrable systems and Whitham hierarchies and their interrelations. Therefore, we are going within our part of the project to concentrate on such physical theories as supersymmetric gauge theories at low energies and matrix models.
More concretely, the low energy limit of N=2 supersymmetric gauge theories called Seiberg-Witten theory manifests a more complicated pattern of integrability. Namely, the physical variables that describes vacua of the theory (vacuum expectation values of scalars) are associated with the action-angle variables of an integrable system (of Toda/Calogero type) with finite number degrees of freedom (equal to rank of the gauge group). This is the standard integrable system. As for Whitham integrability, logarithm of the corresponding τ-function (called prepotential) gives rise to the low-energy effective action in the gauge theory (as a function of vacuum expectation values). In order to get deeper connections with Whitham structures, one needs to look not just at the effective action, but at the correlation functions or different operators of topological type.
Further dealing with supersymmetric gauge theories, one is naturally led to consider N=1 supersymmetric gauge theories. The extremal values of the superpotential in these theories (obtained from an N=2 SUSY gauge Seiberg-Witten theory via breaking of one of the supersymmetries by monopole condensation and generating a non-perturbative superpotential) turn out to be described by a prepotential of some Seiberg-Witten type theory (F.Cachazo, K.Intrilligaotr, C.Vafa). Therefore, the whole machinery of Seiberg-Witten theory is applicable in this case too. Moreover, R.Dijkgraaf and C.Vafa have associated the corresponding prepotential with logaritm of the partition function of the Hermitean one-matrix model in the leading order in the size M of the matrix.
This leading order of the matrix model is described by the Whitham hierarchy. This should not come as a surprise, since typically partition functions of matrix models are τ-functions of integrable hierarchies of the KP/Toda type. In the simplest large M (planar) limit, the matrix model partition function becomes the τ-function of the dispersionless KP/Toda hierarchy. This is the simplest example of Whitham hierarchy.
However, one may ask for other solutions to matrix models. An important class of solutions studied by R.Dijkgraaf and C.Vafa is called multi-cut or multi-support solutions. These solutions are associated with a family of Riemann surfaces and form a basis in the space of all matrix model solutions. They are distinguished by their ``isomonodromic" properties (that is, switching on higher matrix model couplings/1/M-corrections does not change the family of Riemann surfaces, their moduli being functions of these couplings). This property is in charge of the fact that partition functions of these solutions are τ-functions of Whitham hierarchy (prepotential of the corresponding Seiberg-Witten-like system). Moreover, these solutions {\it do have} integral representation.
Now one should note that this is typical that integrable properties of systems under study typically turns out to be accompanied with some specific topological features. The latter have different manifestations depending on concrete physical context. This is either an infinite set of constraints that is satisfied by the partition function of a theory (this is the case in matrix models, and where the infinite set of constraints forms a Borel subalgebra of the W- or Virasoro algebra and is nothing but Ward identities=Schwinger-Dyson equations in physical terms) or another set of equations, the so called Witten-Dijkgraaf-Verlinde-Verlinde (or associativity) equations (which are typically satisfied by the prepotentials, say, of Seiberg-Witten theory). These latter have a lot of mathematical background behind them (which is called Frobenius manifolds, this is to be a point of separate studies within the whole project, in particular, by other teams).
Let us note that these topological properties in different theories come along with their integrable features and look closely related. However, any direct connections have not been established so far. Therefore, our main goal to establish such connections. Here we should stress again that the models proposed for investigations, that is, supersymmetric gauge theories and matrix models celebrate {\it all} of the integrable and topological properties listed above and, moreover, some relations between them could be traced out. We propose, using these concrete physical systems to deal with interrelations between (listed) integrable and topological structures within a generic framework.
Our reference physical examples so far have been borrowed from quantum field theory. An alternative step towards exploring topological sturctures would be to study the topological theories that basically come from string theory. These studies, although being oriented to looking at new mathematical physics

structures, could ultimately lead to constructing new physical theories. This is exactly what we are going to do within the project: to use completely topological terms in order to develop string theory examples. As an example, let us say that recent developments in M-theory inevitably lead to the conclusion that we do not understand its underlying degrees of freedom. It is clear that these degrees are not strings since they are absent in the 11-dimensional phase of the theory. Therefore, we have to admit that the search for fundamental degrees of freedom is still open and try to find something as elegant as strings but more universal.

In particular, we are ready to replace local observables by special (point-like) objects and study a homotopy counterpart of quantum field theory. What we propose is not that far from the standard string theory as it sounds. Really, bosonic string theory may be considered as a version of the homotopic theory based on the Lie algebra complex (for the algebra of diffeomorphysms of the 1-dimensional manifold, interval or loop) taking values in the module of functions on the space of intervals or loops. The type B theory is really a homotopical theory for the $\bar{\partial}$ complex and should be treated along the standard homotopical algebra of algebraic geometry. Moreover, even superstring theory in the Berkovits formulation in the limit of infinite tension can be considered as a homotopical theory. Actually, it turns out that the open sector, i.e. the fields of supersimmetric Yang Mills theory in the BV formulation have a representation as higher torsion between two sheaves on the manifold of spinors (one of them has a support at zero and another is the sheaf of functions on the manifold of pure spinors).

To complete the description, Berkovits claimed that even linearized 11-dimensional supergravity has such a representation. All this indicates that it is quite reasonable to look at homotopical theories as a proper enlargement of the string theory approach to quantum field theory.

With these questions there is connected the theory of noncommutative extension of topological field theories. Standard topological field theories deal with compact oriented manifolds without boundary. Two dimensional topological field theories are in one-to-one correspondence with Frobenius algebras. At the same time some analogs of classical topological field theories for all orientable and nonorientable surfaces and surfaces with boundary (Klein topological field theory) appear in string and brane theories, G-flux and K-theories, WZW, and CS theories. Recently it was found (Alekseevskii and Natanzon) that this topological field theories are in one-to-one correspondence with some noncommutative analogs of Frobenius algebras: structure algebras. One of part of the project consists of different application of Klein topological field theories and structure algebras.

The mirror problem also makes up a part of the project. Mirror symmetry for Fano manifolds, that is, manifolds such that the line bundle of homomorphic differential forms has negative curvature. The simplest examples of Fano manifolds are projective space P^n and hypersurfaces of low degree $d\geq n$ in P^n. Mirror symmetry is best known in the context of Calabi-Yau manifolds, that is, manifolds such that the line bundle of holomorphic differential forms has zero curvature. The simple example is a nonsingular hypersurface of degree $n+1$ in P^n. A well-known version of mirror symmetry identifies the variation of Hodge structure of a family of K\"ahler Calabi-Yau manifolds with the differential equation satisfied by the Gromov--Witten potential of the mirror dual symplectic Calabi--Yau manifold. Recently Golyshev has shown that mirror symmetry applies to Fano threefolds, thereby widening the class of Fano manifolds for which mirror symmetry is known to exist and precise mirror symmetry conjecture for those Fano manifolds. We will concentrate on two conjectures, the Crystalline conjecture and the Hypergeometric pullback conjecture, with the aim of generalising the theory to higher dimensional nonsingular Fano manifolds of rank 1. Applications to Fano 4-folds will be of particular interest.

Finite order invariants of mappings were introduced by Vassiliev about fifteen years ago, and this notion changed dramatically the general point of view, in particular in knot theory. It happened that all the so-called polynomial invariants of knots, including those inspired by physical investigation, can be expressed in terms of finite order invariants. Finite order invariants can be described in purely combinatorial terms. Although both the invariants themselves and their combinatorial description have been thoroughly studied since their invention, a lot of important questions remain open.

Our approach is planned to be based on the description of finite order invariants in terms of so-called chord diagrams. To a chord diagram, a graph can be associated, called the intersection graph of the diagram. A rich family of graph invariants (called 4-invariants) produces finite order invariants of knots. Many important graph invariants fall in this class. On the other hand, there is a hope that graph invariants admit a simpler effective description than invariants of chord diagrams, and understanding this description would provide a more clear insight in the finite order invariants. In particular, one could expect that enumeration of 4-invariants would provide efficient lower bounds for the finite invariants.

Most of the known algorithms for construction combinatorial Polyak-Viro type formulae for finite order invariants use geometric constructions with knots and links. In opposite to this approach we look for such algorithms that are based on combinatorics and linear algebra only. These algorithms are based on the study of the intersection graph of the chord diagram. The obstructions to existence of integer-valued combinatorial formulae will be computed (the rational formulae always exists due to Gussarov's theorem). The problem of computation of such obstructions is closely related to the classification problem of plane curves.

The notion of chord diagram can be generalised to that of framed chord diagram, which fits for description of finite order invariants of curves on surfaces. Framed chord diagrams admit a natural complexification: the complex analog of a framed chord diagram is a framed knot in the 3-sphere (or, more generally, in an arbitrary 3-manifold). One can hope that these complexified chord diagrams can help to understand the topology of 3- and 4-manifolds. However, it remains unclear which aspects of this topology can be covered by these complexified chord diagrams and what are the corresponding spaces of mappings.

In the area of local singularity theory the study will concentrate in the classification of special types of Lagrange and Legendre singularities. Namely, the contact type of Lagrange or Legendre submanifolds with the fibers of coisotropic fibrations. The points of the base corresponding to non-transversal contact for a simple stable singularity in this problem is determined by an appropriate crystallographic Coxeter group. Another related problem is the classification of simple families of matrix singularities. These singularities are related to the special pairs of Weyl reflection groups. The properties of their bifurcation diagrams are of the particular interest.

During the last decades, a new kind of invariants of Lagrange manifolds has been introduced. These invariants are so-called Gromov-Witten invariants, and they play an important role both in pure mathematics and in theoretical physics, namely, in quantum field theories and string theories. Essentially, Gromov-Witten invariants count mappings of two-dimensional manifolds to manifolds of arbitrary dimensions, satisfying some restrictions. These restrictions are either of symplectic (on "Gromov's side") or complex-geometric (on "Witten's side") nature. The group is planning to concentrate on the complex algebro-geometric point of view. One of the goal of the project is to develop a tool for computing Gromov-Witten invariants of complex manifolds based on singularity theory.

- Discuss your method of approach:

Integrable and topological properties in the string theory and quantum field theory will be studied with the help of general methods of integrable systems, matrix integrals, dynamics on moduli spaces, theory of Frobenius manifolds, homotopical algebra of algebraic geometry, and methods of supersymmetric gauge theories. Noncommutative extension of topological field theories will be studied with the help of methods of algebraic geometry, integrable systems, and symplectic topology. The mirrow problem, theory of finite order invariants and problems of local singularity theory will be studied by methods of algebraic geometry, general methods of singularity theory and algebraic topology, algebras of chord diagrams. The study of Gromov-Witten invariants from the viewpoint of the singularity theory will use local and global singularity theory, geometric properties and compactifications of moduli spaces of algebraic mappings of curves, expressions for cohomology classes dual to subvarieties in the moduli spaces of stable maps formed by mappings with prescribed singularities in terms of some "basic" classes belonging to a relatively small finite set.

- What are the objectives of the project?
The main objectives of the project are:
- Development of the notion of Whitham integrability which makes clear the interrelations between integrable and topological properties become clear.
- Construction of a homotopical algebra as a prototype of universal degrees of freedom in string theory.
- Study of loop finiteness, construction of field theory and interaction for supergravity theory in homological formulation.
- Construction of new invariants Turaev-Reshetikhin's type for 3-dimention manifolds.
- Reduction of some known mathematical structures (Hurwitz numbers, $2D$ Yang-Mills theory, etc) to Klein topological field theories and thus to structure algebras.
- Investigation of deformation of Klein topological field theories and structure algebras.
- Construction of effective algorithms for computation of finite order invariants.
- Structure analysis of 4-invariant of graphs.
- Enumerative aspects of 4-invariants of graphs.
- Possible extensions of the notion of finite order invariants to complex mappings.
- Study of appropriate spaces of mappings and establishing their relationship with properties of complexified chord diagrams.
- Classification of special types of Lagrange and Legendre singularities, namely, the contact type of Lagrange or Legendre submanifolds with the fibers of coisotropic fibrations.
- Study of properties of bifurcation diagrams corresponding to simple families of matrix singularities.
- To develop the relative version of Thom's theory.
- To extend Thom's theory to the case including general mappings admitting nonisolated singularities of prescribed type.
- To apply the extended Thom's theory to sample calculations of Gromov--Witten invariants (especially, in the case of one-dimensional target).
- To investigate the relationship between the results of the calculations of Gromov--Witten invariants and field theories.
- To investigate differential equations which satisfy the Crystalline or Hypergeometric pullback Conjectures, and the relation of these differential equations to singularity theory.

13 **Describe the division of tasks between the Dutch and the Russian researchers, include an estimate of working hours:**

Dutch Research tasks:

Dutch research teams contribute with their knowledge on string theory, mirror symmetry, integrable systems, D-branes, conformal field theories, singularity theory (including non-isolated singularities), representation theory, crystalline or hypergeometric pullback Conjectures, arrangement spaces, etc. We don't distinguish too much in tasks between teams since we want to integrate the efforts. Influx of new postdocs in the future also will influence the dutch contribution. The research related to the project can be estimated as 10 person-year.

Russian Research tasks:

Russian research teams mostly will study interrelations between integrable and topological properties in the string theory and quantum field theory, low energy limit of N=2 supersymmetric gauge theories (Seiberg-Witten theory), integrable systems of Toda/Calogero type, homotopical algebra as a prototype of universal degrees of freedom in string theory, field theory and interaction for supergravity theory in homological formulation, noncommutative extension of topological field theories, the mirrow problem, theory of finite order invariants, problems of local singularity theory, Gromov-Witten invariants from the viewpoint of the singularity theory. Except group leaders, key researchers and young scientists (see personalia below) there will participate Yu.Chekanov, G.Iluta, V.Karpushkin, B.Kazarnovskii, I.Bogaevskii, V.Sedyh, Valentin Kulikov, V.Golyshev, A.Merkov, S.Duzhin, V.Zakalukin, A.Davudov. The amount of time necessary for the research can be estimated as 25 person-year.

14 **Describe the significance and innovative aspects of the project:**

The aim of the project is to develop interdisciplinary researches inbetween quantum field and string theories on one side and geometry and singularity theory on the other. The project consists of investigation of modern models of mathematical physics such as: quantum string theory, matrix models, D-branes, Landau-Ginzburg models, supersymmetric gauge theory and other; development of classical and modern mathematical theories: moduli spaces of complex and real algebraic curves , Hurwitz spaces, integrable systems, commutative and noncommutative Frobenius manifolds, symplectic geometry and theory of singularities etc.

15 **Describe the expected results of the project (e.g. anticipated publications):**

The expected results are:
- Construction of new invariants Turaev-Reshetikhin's type for 3-dimention manifolds.
- Reduction of some known mathematical structures (Hurwitz numbers, $2D$ Yang-Mills theory, etc) to Klein topological field theories and thus to structure algebras.
- Investigation of deformation of Klein topological field theories and structure algebras.
- Construction of effective algorithms for computation of finite order invariants.
- Structure analysis of 4-invariant of graphs.
- Enumerative aspects of 4-invariants of graphs.
- Possible extensions of the notion of finite order invariants to complex mappings.
- Study of appropriate spaces of mappings and establishing their relationship with properties of complexified chord diagrams.
- Classification of special types of Lagrange and Legendre singularities, namely, the contact type of Lagrange or Legendre submanifolds with the fibers of coisotropic fibrations.
- Study of properties of bifurcation diagrams corresponding to simple families of matrix singularities.
- To develop the relative version of Thom's theory.
- To extend Thom's theory to the case including general mappings admitting nonisolated singularities of prescribed type.
- To apply the extended Thom's theory to sample calculations of Gromov--Witten invariants (especially, in the case of one-dimensional target).
- To investigate the relationship between the results of the calculations of Gromov--Witten invariants and field theories.

There are previewed a number of publications in international and Russian journals, including joint ones.

16 **Describe possible future application results:**

The results will be used in mathematics and quantum field and string theories.

PERSONALIA CONTINUED

17 **Please provide names and contact information of the Russian participating researchers per institute**

Institute 1

Institute name nr.1: **Institute of Theoretical and Experimental Physics, Moscow**

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Institute 2

Institute name nr.2: **Independent University of Moscow**

Group Leader: **Natanzon Sergey Mironovich** male

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Institute 4

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18 **Please give the names and contact information of the participating Dutch researchers per institute**

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Tel: +31 253 3731 / Tel: +31 253 3833
looijeng@math.uu.nl
stien@math.uu.nl / vdleur@math.uu.nl

Young scientists institute nr.1:

Marius Crainic	male	Age: 31
Balasz Szendroi	male	Age: 30
Sergei Anisov | Rogier Swierstra	male	Age: 32 / 24
Alex Boer | Quintero Velez, Alexander	male	Age: 24 / 28

Telephone and e-mail addresses:
tel: +31 30 253 1429, +31 30 253 1186, +31 30 253 1496, +31 30 2531530, +31 30 2531530
crainic@math.uu.nl, szendroi@math.uu.nl, anisov@math.uu.nl, swierstr@math.uu.nl, boer@math.uu.nl

Institute 2

Institute name nr.2: **Inst Theor Fysica UvA | Nr 3: Math Inst Radboud Univ Nijmegen**
Group Leader: **Dijkgraaf, Robbert | Steenbrink, Joseph** male
Institute Address, Telephone/Fax Number and e-mail address:
Due to lack of space in the electronic form we list instiues 2 and 3 here parallel

Nr 2: Institute for Theoretical Physics	Nr 3: Radboud Universiteit
University of Amsterdam	Mathematisch Instituut
Valckenierstraat 65	Toernooiveld 1
1018 XE Amsterdam Nederland	6525 ED Nijmegen Nederland
tel: +31-20-525 5745;	Tel: 024-3652986
fax: +31-20-525 5778	Fax: 024-3652140
email: rhd@science.uva.nl	email: steenbri@math.ru.nl

Key Researchers institute nr.2 (no more than 2):

Verlinde, Erik	**Gert Heckman**	male
Boer, Jan de		male

Telephone and e-mail addresses:
+31 20 525 7314, +31 20 525 5769, | 024-3652986
erikv@science.uva.nl, jdeboer@science.uva.nl | heckman@math.ru.nl

Young scientists institute nr.2:

B. Fiol	**Tommasi Orsola**	male	Age: 30 / 30
A. Sinkovics	**Grooten Martijn**	male	Age: 30 / 26
L. Hollands (female)	**Reuvers Erik**	male	Age: 24 / 27
M. Temurhan	**Gorinov Alexei**	male	Age: 27 / 28

Telephone and e-mail addresses:
tel.: +31 20 525 5738, +31 20 525 7308, +31 20 525 5920,
+31-24-3652863, +31-24-3652863, +31-24-3653334. +31 20 525 5920.
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O.Tommasi@math.ru.nl, M.Grooten@math.ru.nl, E.Reuvers@math.ru.nl

RESUMES OF RUSSIAN PARTNERS

19 **Please give short resumes of the Russian group leaders:**

Group leader 1:
Morozov Alexei Yurievich
Date and place of birth: November 02, 1961, Moscow, USSR
Nationality: Russia
Title: PhD, 1986 in Institute of Theoretical and Experimental Physics;
DrSc, 1991 in Institute of Theoretical and Experimental Physics
Education: Graduated from Moscow Physical Technical Institute in 1984
Affiliations: 1984 - present - Institute of Theoretical and Experimental Physics, Moscow; at present - Head of Laboratory
Area of expertise: string theory, integrable systems, conformal field theory
Publications: 150 publications

Group leader 2:
Natanzon Sergey Mironovich
Date and place of birth: October 18, 1948, Moscow, Russia
Nationality: Russia.
Education: Undergraduate: Moscow State University, Faculty of Mechanics Mathematics, 1966-1971
Postgraduate: Central Economical-Mathematical Institute, 1971-1974
Scientific degrees: PhD - 1982, Institute of Mathematics of SO AS USSR;
Dr.Sc.- 2000, Steklov Institute of Mathematics of AS Russia.
Professional experience:
1991 - present time: Mathematics College, Independent University, professor,
1999 - present time: Moscow State University, Moscow, Russia, leading scientific researcher.
2001 - present time: Institute Theoretical and Experimental Physics, Moscow, Russia, leading scientific researcher.
1975 - 1999, Central Research Institute of geodesy, airsurvey and cartography, Moscow, Russia leading scientific researcher,.
Main fields of scientific interest: Moduli of complex and real algebraic curves and its superanalogs; Frobenius manifolds; integrable systems, quantum field theory, string theory.
Publications: more than 80 papers.

Group leader 3:
Vassiliev Victor Anatolievich
Date and place of birth: April 10, 1956, Russia
Nationality: Russia
Education: Undergraduate: Moscow State University, Dept. of mechanics and mathematics, 1973 - 1978
Postgraduate: Dept. of mechanics and mthematics 1978-1981.
Professional Experience:
1991 - present time: Independent University of Moscow, professor
1995 -present time : Steklov Math. Inst. of Russian Ac. Sci., Dept. of Geometry and Topology, Principal researcher
1991-1995: Research Institute of System Studies of RAS, Leading researcher

1989-1990:	Institute of Applied Math. of RAS, Senior Researcher
1987-1989:	Institute of Statistical Information, Senior Researcher
1981-1987:	Institute of Documents and Archives, Senior Researcher
Scientific degrees:	PhD - 1982, Moscow State University;
	DrSc - 1992, Steklov Math. Institute

Main fields of the scientific interest: Topology, Singularity Theory, Integral Geometry,
Complexity Theory, Combinatorics, Algebraic Geomtery

Number of publications: 115

Group leader 4:

20 **Please give short resumes of the Russian key researchers:**

Key researcher 1:

Mironov Andrei Dmitrievich

Date and place of birth: August 17, 1961, Moscow, USSR

Nationality: Russia

Title: PhD, 1990 in Lebedev Physical Institute;
Doctor of Physics and Mathematics, 1997 in Lebedev Physical Institute

Education: Graduated from Moscow State University (Physics Department) in 1984

Affiliations:

1984 - present - Lebedev Physical Institute, Moscow; at present - Head Scientist

1994 - present - Institute of Theoretical and Experimental Physics, Moscow;
at present - Head Scientist

Area of expertise: quantum field theory, string theory, conformal field theories,
classical and quantum integrable systems

Publications: around 100 publications

Key researcher 2:

Losev Andrei Semenovich

Date and place of birth: July, 03, 1963, Moscow, USSR

Nationality: Russia

Title: PhD, 1989 in Institute of Theoretical and Experimental Physics

Education: Graduated from Moscow Physical Technical Institute in 1986

Affiliations: 1986 - present - Institute of Theoretical and Experimental Physics,
Moscow; at present - Senior Researcher

Area of expertise: string theory, topological theories

Publications: 40 publications

Key researcher 3:

Gusein-Zade Sabir Medzhidovich

Date and place of birth: 29.07.1950, Moscow, Russia.

Nationality: Russia.

Education: Undergraduate: Moscow State University, Faculty of Mechanics and Mathematics, 1966-1971.
Postgraduate: Moscow State University, Faculty of Mechanics and Mathematics, 1971-1974.

Professional Experience:

1996 - present time: Moscow State University, Faculty of Mechanics and Mathematics,
Dept. of Higher Geometry and Topology, Professor.

1991 - present time: Independent University of Moscow, Mathematics Colledge, Professor.

1974 - 1996: Moscow State University, Faculty of Geography,
Junior, Senior, Leading Researcher.
Scientific degrees: PhD - 1975, Moscow State University;
DrSc - 1991, Moscow State University.
Main fields of the scientific interest: topology and algebraic geometry of singularities.
Number of publications: 135 (approx. 70 in pure mathematics,
approx. 65 in applied mathematics)

Key researcher 4:
Lando Sergei Konstantinovich
Date and place of birth: July 9, 1955, Perm, Russia
Nationality: Russia
Education: Undergraduate: Moscow State University, Dept. of Mathematics, 1972 - 1977
Postgraduate: Moscow State University, Dept. of Mathematics, 1981 - 1984
Professional Experience:
1991 - present: Independent University of Moscow, professor
1996 - present: Institute for System Research RAS, Senior Researcher
1990 - 1996: Insitute of New Technologies, Leading Researcher
1984 - 1990: Program Systems Institute USSR AS, Junior Researcher,
Senior Researcher, Head of Laboratory, Leading Researcher
1977 - 1981: Institute of Controlling Machines and Systems, Perm
Scientific degrees: PhD - 1986, Moscow State University;
Main fields of the scientific interest: algebraic geometry, singularity theory, combinatorics
Number of publications: about 40

Key researcher 5:
Kazarian Maxim Eduardovich
Date and place of birth: 11.04.1965, Moscow, Russia
Nationality: Russia
Education: Undergraduate: Moscow Aviation Institute, Faculty of Applied Mathematics, 1982 - 1988
Postgraduate: Steklov Math Inst RAS, 1988-1991
Professional Experience:
1996 - present time: Independent Moscow University, Math College, Professor.
2000 - present time: Steklov Math. Inst. RAS, Senior Research Fellow
Scientific degrees: PhD - 1993, Steklov Math. Inst. RAS;
DrSc - 2003, Steklov Math. Inst. RAS.
Main fields of the scientific interest: differential geometry, topology, characteristic classes,
singularity theory
Number of publications: 22

Key researcher 6:
Kulikov Viktor Stepanovich
Date and place of birth: 13 April, 1952, Moscow, URSS
Nationality: Russian
Education: Graduated: Mekh-Mat faculty of Moscow State University, 1974.
Postgraduate: Department of Algebra of Steklov (1974-1977)
Mathematical Institute of Acad. of Sciences SSSR
Professional Experience:
1977-1980. Assistent of Professor. Chair of Mathematics of Moscow Institute of Railroad

Engineers (MIIT).
1980-1997. Professor. Chair of Applied Mathematics II of MIIT.
1998-1999. Professor, Head of Chair of Applied Mathematics II of Moscow State University of Transport Communications (MIIT).
1997 - present time: Leading Researcher of Department of Algebra of Steklov Mathematical Institute.
Scientific degrees: Ph.D. - 1978, Steklov Mathematical Institute RAS
PhSc. - 1992, Steklov Mathematical Institute RAS.
Main fields of the scientific interest: Algebraic and symplectic geometry
Number of publications: 45

Key researcher 7:

Key researcher 8:

21 **Please give short resumes of the young scientists (include learning/working experience)**

Young scientist 1:
Alexandrov Alexander Sergeevich
Date and place of Birth: October, 4, 1979, Protva, Kaluga reg., USSR
Nationality: Russia
Education: Graduated from Moscow Physical Technical Institute in 2002;
2002 - present - PhD student in Institute of Theoretical and Experimental Physics and in Moscow Physical Technical Institute
Research interests: String theory, topological theories and matrix models
Publications: 7 publications

Young scientist 2:
Amburg Natalia Yakovlevna
Date and place of Birth: December, 22, 1975, Kemerovo, USSR
Nationality: Russia
Title: PhD, 2004 in Moscow State University
Education: Graduated from Moscow State University (Department of Mathematics and Mechanics), 1998
Affiliations: 2000 - present - Institute of Theoretical and Experimental Physics, Moscow; at present - Scientific Researcher
Research interests: Combinatorics, Theory of Belyi Pairs, Graph Theory, Grothendieck's dessins d'enfant theory and Strebel Differentials
Publications: 5 publications

Young scientist 3:
Vasiliev Dmitry Viktorovich
Date and place of Birth: May, 03, 1979, Kirov, USSR
Nationality: Russia
Education: Graduated from Moscow Physical Technical Institute in 2002;
2002 - present - PhD student in Institute of Theoretical and Experimental Physics and in Moscow Physical Technical Institute

Research interests: SUSY gauge theories, integrable systems, topological theories, matrix models
Publications: 3 publications

Young scientist 4:
Shadrin Sergei
Date and place of birth: July 20, 1980, Moscow, Russia
Nationality: Russia
Education: Undergraduate: Independent Univ. of Moscow,
Department of Mathematics, 1997-2002
and Moscow State University, Department of Mathematics,
1997-2002
Postgraduate: Independent Univeristy of Moscow,
Department of Mathematics, 2001- now
Moscow State University, Department of Mathematics, 2002 - now
and Stockholm University, Department of Mathematics,
2003-2004 (part-time)
Professional Experience:
1998 - now, Moscow State 57 School, teacher of mathematics (part-time).
2004 - now, Stockholm University, Department of Mathematics, research fellow (part-time).
Scientific degrees: PhD - 2004, Stockholm University.
Main fields of the scientific interest: mathematical physics, algebraic geometry
Number of publications: 9

Young scientist 5:
Pushkar Petr Evgen'evich
Date and place of birth: February 14, 1972, Moscow, Russia
Nationality: Russia
Education:
Undergraduate: Moscow State University, Mechmat, 1989 - 1994
Postgraduate: Moscow State University, Mechmat, 1994 - 1998
Professional Experience:
1998 - 2000, 2002 - 2003: Independent University of Moscow, Assistant Professor
2000 - 2002: University of Toronto, Faculty of Arts and Science, Postdoctoral fellowship
2003 - present time: Moscow State University, Faculty of mechanics and mathematics, Postdoctoral fellowship.
Scientific degree: PhD - 1998, Moscow State University
Main fields of the scientific interest: symplectic geometry, Morse theory, contact topology.
Number of publications: 11
Office address:
Vorobevy gory
Moscow State University
Faculty of mechanics and mathematics
Dept. of higher geometry and topology
Moscow, 119992, Russia
Tel./FAX: +7 095 9393798
Private address:
2V-92, Simpheropolskii b-r, Moscow, Russia, 113149
Tel.: +7 095 3102172
e.mail: pushkar@mccme.ru

Young scientist 6:
Karpenkov Oleg Nikolaevich
Date and place of birth: 14.01.1980
Nationality: Russia
Education: Undergraduate: Moscow State University,
Faculty of Mechanics and Mathematics, 1997 - 2002;
Postgraduate:
Faculty of Mechanics and Mathematics, 2002-present time
Professional Experience: No
Scientific degrees: No
Main fields of the scientific interest: Number theory; Knot Theory; Topology; Singularity theory.
Number of publications: 5.

Young scientist 7:
Chulkov Sergey Pavlovich
Date and place of birth: 25 September, 1980
Nationality: Russian
Education: Undergraduate: Moscow Lomonosov State University,
Faculty of Mathematics and Mechanics, 1997 - 2002;
Postgraduate:
1) Moscow Lomonosov State University, Faculty of Mathematics and Mechanics, 2002 - present time;
2) Independent University of Moscow, 2002 - present time;
3) University of Stockholm, Department of mathematics, 2004 - present time.

Professional Experience:
2002 - present time, Independent University of Moscow, teaching assistant.
Scientific degrees: none.
Main fields of the scientific interest: Geometry and topology, theory of PDE²s, algebraic geometry, singularity theory.
Number of publications: 3.

Young scientist 8:

FINANCIAL SCHEME

22 **Please list in detail the anticipated equipment costs:**

Equipment or consumable	Amount	Price per unit	Russian Group	Dutch group	Subtotal
Total					

23 **Please lists in detail the travel and subsistence costs:**

Visit	Name of traveller	Duration	Subsistence costs	Travel costs	Russian group	Dutch group	Subtotal
1	A. Morozov, S. Natanzon, V. Vassiliev.	3 times 1 month each	6 000	1 350	7.350		7 350
2	A. Mironov, A. Losev, S. Gusein-Zade, S. Lando, M. Kazarian, Vik. Kulikov, V. Golyshev.	7 times 1 month each	14 000	3 150	17.150		17 150
3	A. Alexandrov, N. Amburg, D. Vasiliev, S. Shadrin, P. Pushkar, O. Karpenkov, S.Shadrin.	7 times 2-4 weeks each	7 000	2 800	9.800		9 800
4	D. Siersma,	2 times 1-2 weeks each	3 000	1 200		4.200	4 200
5	R. Dijkgraaf, E. Looijenga, J. Steenbrink.	3 times 1-3 weeks each	4 500	1 800		6.300	6 300
6	J. Stienstra	1 month	2 000	600		2.600	2 600
7	M. Crainic, S. Anisov, R. Swierstra, A. Sinkovics A.Gorinov.	5 times 2-3 weeks each	5 000	2 500		7.500	7 500
8	Other senior researchers	5-6 times 1-3 weeks each	7 500	3 000		10.500	10 500
9	Other younger researchers	5-7 times 2-3 weeks each	6 000	2 800		8.800	8 800
10							
11							
12							
13							
14							
15							
16							
Total					**34.300**	**39.900**	**74 200**

24 **Please give a short comment on the anticipated visits mentioned in question 23:**

The list of visits is very tentative. It is difficult to predict in advance which visits will be more useful for working out the project research. It is possible that some visits will be substituted by travels of other participants of the project, such as Yu. Chekanov, Val. Kulikov, V. Zakalukin, A. Davydov etc. Some visits are not specified.

Please note that conference visits outside the Netherlands or the Russian Federation have to be specified within the budget for travel and subsistence.

25 **Please list the anticipated individual grants with respect to Russian scientists:**

	Name	Hours spend on the project per month	Monthly Fee	Months	Subtotal
Group leaders					
1	A. Morozov	40	400	14	5 600
2	S. Natanzon	40	400	21	8 400
3	V. Vassiliev	40	400	21	8 400
4		40			
Key researchers					
1	A. Mironov	40	300	14	4 200
2	A. Losev	40	300	14	4 200
3	S. Gusein-Zade	40	300	21	6 300
4	S. Lando	40	300	21	6 300
5	M. Kazarian	40	300	21	6 300
6	Vik. Kulikov	40	300	21	6 300
7					
8					
Young scientists					
1	A. Alexandrov	40	200	12	2400
2	N. Amburg	40	200	12	2400
3	D. Vasiliev	40	200	12	2400
4	S. Shadrin	40	200	12	2400
5	P. Pushkar	40	200	12	2400
6	O. Karpenkov	40	200	12	2400
7	S. Chulkov	40	200	12	2400
8					
Total					**72 800**

26 **Please summarize all the costs allocated to young scientists:**

Type of Cost	Russian group	Dutch group	Subtotal
Travel and subsistence	9 800	16 300	26 100
Individual grants	16 800		16 800
Total	**26 600**	**16 300**	**42 900**

27 **Give an overview of the total project costs:**

	Russian group	Dutch group	Subtotal
Equipment & Consumables			
Travel & Subsistence	34300	39900	74200
Individual grants	72800	Cannot be declared	72800
Overhead (max 2% of the budget)	Cannot be declared	3000	3000
Total	107100	42900	150000

OTHER RELEVANT INFORMATION

28 **If you have any other relevant information on your project, you can enter it here:**

FINALLY, WE ASK YOU IF YOU COULD GIVE US THE NAMES AND ADRESSES OF TWO DUTCH SCIENTISTS THAT ARE ABLE TO EVALUATE YOUR PROPOSAL AND ARE IN NO WAY INVOLVED IN THE PROJECT.

SCIENTIST NR. 1: PROF. DR. DUCO VAN STRATEN
JOHANNES-GUTENBERG-UNIVERSITAET MAINZ
FB 17 MATHEMATIK
55099 MAINZ
GERMANY
STRATEN@MATHEMATIK.UNI-MAINZ.DE

SCIENTIST NR. 2: PROF. DR. KLAAS LANDSMAN
RADBOUD UNIVERSITEIT
MATHEMATISCH INSTITUUT
TOERNOOIVELD 1
6525 ED NIJMEGEN
NEDERLAND
LANDSMAN@MATH.RU.NL

THANK YOU FOR COMPLETING THIS FORM

Contact information and address

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2509 AC The Hague
The Netherlands

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fax: + 31 70 3472623

e-mail: blokhuis@nwo.nl

RFBR Russian Foundation for Basic Research
International Relations Department
Mr. Vladimir Kovalev
32a Leninsky prospect
Moscow 119991
The Russian Federation

e-mail: kovalev@rfbr.ru

Dutch – Russian Scientific Cooperation 2004-2005
Manual for Full Research Proposal (FRP)

This form is a protected document. It means that you can not change the lay-out of the document and text input is restricted to a certain amount of characters and designated sections
Note: Use the Tab-key or Up and Down arrow keys to move through the document.

The questions

Question 1

With this question you are asked to assign your project to one of the scientific priority areas. Projects that cannot be assigned to these areas are not eligible for participation. You can select a priority area by clicking on the box and you will see a drop-down menu appear. From this menu you can select the appropriate scientific field by clicking on it.

Humanities:	**Cultural Heritage**
Exact sciences:	**Interdisciplinary Mathematics**
Earth and Life sciences:	**Geo-biology including Evolutionary Ecology and Evolutionary Change**

After having selected your scientific field you can enter into the next question by pressing the TAB key or the Arrow-Down key.

We are aware of the fact that some projects may be of a multi-disciplinary nature and that it is sometimes more appropriate to assign the project to two priority areas. In this case, we ask you to assign the project to the priority area that fits your project the best or to submit your project also under the other relevant priority areas.

Question 2

Here you can insert the title of your project under which it will be registered. There is a maximum input on this field of 200 characters, about 30 words. So be sure to choose a brief and clear title for your project. Use the TAB or Arrow key to continue.

Question 3,4, 5 and 6

For communications purposes, please give the names of two principal participators who will represent the Dutch and Russian research group. All letters or correspondence in the framework of the Dutch - Russian scientific co-operation will be directed to the Dutch principal scientist. Please add all the necessary address information. You can move around the various fields by using the TAB or Arrow keys.

Question 7

The maximum duration for a project in this framework is 36 months. The NWO support cannot start before the grants have been awarded.

Question 8

There is a maximum input on this field of 3200 characters, about 500 words. If you reach the maximum, you will not be able to add characters or you are about to type outside the area of the box and the input will not be printed. So please use the space inside the field box efficiently.

Question 9

The involvement of young Russian scientists into the project is one of the administrative requirements within Dutch-Russian scientific programme.

Question 10

One of the administrative criteria is that the project is by preference a continuation of an existing scientific co-operation. Please, describe in this section, if any, how the previous co-operation took form and mention some recent joint results.

Question 11

This question is self-explanatory.

Question 12, 13, 14, 15 and 16

These questions deal with the content of your proposal.

Question 17

Please, provide contact address/telephone and/or e-mail per proposed Russian candidate

Question 18

Please, provide contact address/telephone and/or e-mail per proposed Dutch candidate

Question 19, 20 and 21

Please, provide short Curriculum Vitae of proposed Russian candidates. Please include for the young scientists their working/learning experience.

Question 22-27

These questions aim to get an insight into the allocation of a grant by the applicants. The tables are divided into 4 different cost types (in Euro):

1. Equipment and consumables. The purchase of small equipment and consumables is allowed if those are essential for the execution of the project. Specify for Russian and Dutch group.
2. Travel and subsistence – e.g. the amount of the grant that will be spend on travel and subsistence in the framework of the project. Specify for Russian and Dutch group.
3. Individual grants – e.g. the amount of individual grants to be declared (for Russian group).
   Note: Salary costs for or appointments of Dutch participants cannot be subsidised from this grant.
4. Young scientists (YS). In this programme, the involvement of young Russian scientists (< 35 years) is greatly valued. In particular this group should be given opportunities to participate in the co-operation and get training abroad. Please specify the part of the grant that will be allocated specifically to young Russian scientists.
5. Overhead. The overhead costs are reimbursed to a maximum of 2% of the total budget (maximum €3.000). These are only for the Dutch group, to compensate for the financial administration.

Please fill in the fields of the table while taking the following into consideration: a research project has a maximum budget of € 150.000. A typical project has the following budget:

Per project	**Max. € 150.000**
Equipment and consumables	60.000
Travel and subsistence (includes YS)	40.000
Individual grants (in RF includes YS)	47.000
Overhead (max. 2% = 3.000 in NL)	3.000
	€ 150.000

Division of funds	
Dutch team(s) (NL)	Approximately 35% of the grant
Russian team(s) (RF)	Approximately 50% of the grant
Young scientists (YS RF)	Approximately 15% of the grant
The research teams can propose a different division of funds if they consider this necessary and beneficial for the proper execution of the project.	

Individual grants for Russian researchers (standard amounts per month in €)			
Per project (in RF)	**Russian institute**		
Team leader	Max.	1	€ 400
Key researcher (senior)	Max.	2	€ 300
Young scientist (PhD or post-doc)	Max.	3	€ 200
Per Russian participating institute one group leader and up to two key researchers may receive individual grants. The research teams can propose different grant amounts (no more than the above mentioned maximum amounts in €) if they consider this necessary and beneficial for the proper execution of the project.			

Travel and subsistence for Russian researchers during their visit to the Netherlands (to be reimbursed on the basis of real costs) in €. Please note: the month tariff in the Netherlands includes the individual grant.	
Day tariff	€ 125
Month tariff for senior researchers	€ 2000 (includes € 400 or € 300 individual grant in the RF)
Month tariff for young scientists	€ 1250 (includes € 200 individual grant in the RF)

Travel and subsistence for Dutch researchers during their visit to Russia (to be reimbursed on the basis of real costs) in €	
Day tariff 80% UN DSA:	Moscow € 200; St. Petersburg € 300, other € 100
Month tariff for senior researchers	€ 2000
Month tariff for young scientists	€ 1250

Question 28

Question 28 enables you to add any information that you feel is relevant for the evaluation of your project.

The deadline for submitting the Full Research Proposal electronically (IRIS at NWO) is
31st of October 2004.

Contact information and addresses:

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International Relations Department
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The Russian Federation

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