EU-network ForcesUniverse

Main parts of the contract

Part A: CONTRACT DETAILS AND OBJECTIVES

1: Full Title: Constituents, Fundamental Forces and Symmetries of the Universe
Short Title: ForcesUniverse

2: Proposal Number: FP6-005104
Contract Number: MRTN-CT-2004-005104

3: Beginn/Duration of the project: 1. November 2004/48 months

4: Contractors and scientists in charge

The Co-ordinator

1. Ludwig-Maximilians-Universität München [LMU-München], D. Lüst

Other contractors

2. Max-Planck-Institute for Gravitational Physics [MPG], S. Theisen
3. Universidad de Barcelona [UB], J. Gomis,
4. Consejo Superior de Investigaciones Cientificas [CSIC], C. Gomez
5. Institudes des Hautes Etudes [IHES], N. Nekrasov
6. Ecole Normale Sup. Paris [CNRS], C. Kounnas
7. Nordisk Institut for Teoretisk Fysik [NORDITA], P. Di Vecchia
8. Trinity College Dublin [TCD], S. Shatashvili
9. Instituto Nazionale di Fisica Nucleare Frascati [INFN], F. Palumbo
10. Universita degli Studi di Torino [UNITO], P. Fre
11. Katholieke Universiteit Leuven [KULeuven], A. Van Proeyen
12. Imperial College of Science [Imperial], K. Stelle
13. Universite de Neuchatel [UniNE], J.-P. Derendinger
14. University of Patras [UPAT], I. Bakas
15. Institut for Nuclear Research and Nuclear Energy of the Bulgarian Academy of Sciences [INRNE], I. Todorov
16. Universiteit Utrecht [UU], B. de Wit
17. Universität Bonn [Uni Bonn], H.-P. Nilles
18. University of Iceland [Iceland], L. Thorlacius

19. Padova University [Uni Padova], M. Tonin
20. Universita de Milano-Biccocca [UNIMIB], L. Girardello
21. Vrije Universiteit Brussel [VUB], A. Sevrin
22. University Edinburgh [UEDIN], J.Figueroa-O'Farill
23. ETH-Zürich [ETH Zürich], M. Gaberdiel
24. University of Craiova [UCV], C. Bizdadea
25. Groningen University [RUG], E. Bergshoeff

Other institutes will also contribute to the project:

1. University of Valencia [UV] together with UB
2. Universidad De Santiago de Compostela [USC] together with CSIC
3. Universidad de Oviedo [UO] together with CSIC
4. Ecole Polytechnique [EP] together with IHES
5. Service de Physique Théorique CEA/Saclay [SPhT] together with CRNS
6. Napoli University [NAP] together with INFN
7. Torino Politecnico [TOPO] together with UNITO
8. University of Allesandria [AL] together with UNITO
9. National Technical University of Athens [NTUA] together with UPAT
10. SISSA in Trieste [SISSA] together with Uni Padova
11. Università di Milano (Milano I) [UMI] together with UNIMIB
12. Université Libre de Bruxelles [ULB] together with VUB

In accordance with Annex III.2.2i, and as for secondments to other contractors, it will be ensured that appointed ESRs/ERs will spend substantial part of their appointment in the project at the contractor node. Moreover, it will be ensured that these asscociate groups will not benefit from direct network funding, in particular from overhead.

Part B: IMPLEMENTATION

1. Description of the joint Research/Training Project

1.1 Research

(a) Work plan

The joint work programme will span the following range of topics:

(i) Basic constituents: Strings & Branes

It will be the goal of this topic to extend the non-Abelian Dirac-Born-Infeld effective action of D-branes, which is so far known up to fourth order in the string slope parameter α', to higher orders, or to get a complete closed expression for the non-Abelian Born-Infeld action, which is also relevant to extra dimensional scenarios and brane world models as well. The boundary-state approach will be applied to D-brane configurations not yet considered in this context, such as intersecting branes in type I strings, with and without supersymmetry, wrapped branes, rigid branes at orbifold singularities etc.

Furthermore tachyon condensation with D-branes will be investigated, which involves an infinite number of string excitations. Furthermore to study the relation between string symmetries and tachyon condensation is one of the scientific goals. In addition, the end-result of this process will be discussed for general configurations like intersecting D-branes. Moreover the time-dependent decay processes of D-branes will be investigated in detail, where the tachyon plays the role of time. The relation of tachyon condensation to space-like brane configurations, to subcritical Liouville string theory with open strings and also to matrix models will be a further point of study. Finally, the tachyon condensation process will be considered in the context of brane phenomenology, such as the Higgs effect intersecting brane-world models or in the context of supersymmetry breaking.

(ii) Symmetries: supersymmetry, duality symmetry & infinite dimensional algebras

One of the scientific goals for this topic will be to consider the plethora of higher-spin fields present in string theory, and which become massless in the limit of slope parameter $\alpha' \to \infty$. In this way a handle on the high energy stringy symmetry group, especially the duality symmetries and other infinite dimensional symmetries, which organize the spectrum and the interactions in a very non-trivial way, will be obtained. The construction of the effective action for the higher spin field will be performed by some contractors. Furthermore, infinite dimensional string symmetries and duality symmetries, which also play an important role in the tachyon condensation process involving an infinite number of string states, will be investigated. This will also include the discussion of closed string tachyon condensation, which induces a 'decay' of the space-time geometry itself. Furthermore the discussion about non-commutative space time geometry will be extended, which is a symmetry typically occurring in string theory with B-field background fields.

(iii) Gauge theories and (super)gravity: several correspondences

It is one of the scientific goals of this topic to further establish the gauge theory/gravity correspondence for non-conformal and/or non-supersymmetric gauge theories, which should correspond to various deformations of the original anti-de Sitter backgrounds. One problem, which will be investigated, is how to include matter fields into the AdS/CFT correspondence by considering wrapped or intersecting brane configurations. In this way, non-perturbative results

on chiral symmetry breaking in a QCD-like theory from the dual gravitational theory will be obtained. It is planned to extend the quantum mechanical description of BMN gauge theory to further classes of operators, such as operators containing fermions, field strengths or covariant derivatives. Furthermore, theories with reduced supersymmetry and without conformal invariance should be analyzed.

Another manifestation of the open/closed string correspondence, which will be explored, is given by the topological large N transition in type II strings on (non-compact) Calabi-Yau spaces. Since this has led to the observation that the superpotential of certain $\mathcal{N} = 1$ supersymmetric gauge theories can be computed from a particular large N-matrix model, and since it has been found for N=2 susy gauge theories that the prepotential is given by the discrete version of the large N matrix model, it is planned to establish the direct link between these two statements, as well as their dual closed string explanation.

(iv) Compactifications: brane world models and connection to the standard model

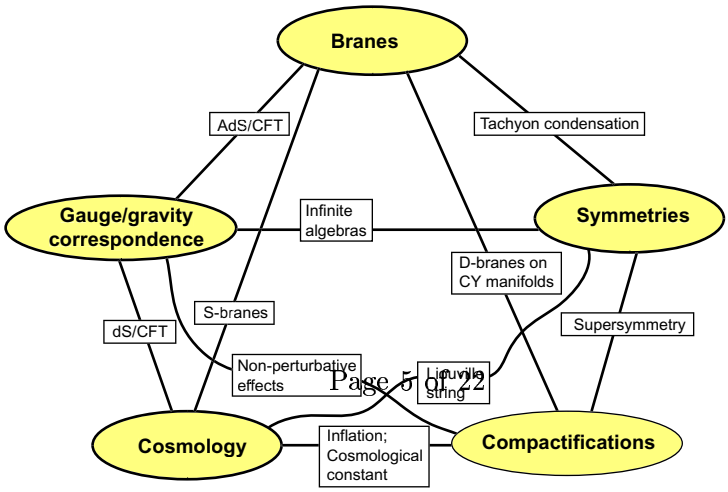
It is one of the main goals of this topic to make progress in deriving the Standard Model from string compactifications and to eventually confront the new theories with future experiments (LHC, TESLA, Tevatron), where the search for supersymmetric particles, rare decays, flavor changing neutral currents, the search for extra dimensions and gauge coupling unifications will be central topics. In particular, brane-world models with D-branes wrapped on Calabi-Yau homology cycles will be investigated in every detail, as they have turned out to have very attractive phenomenological features, since chiral fermions are located at the brane intersections. Problems in this class of string vacua that are planned to be investigated include the derivation of the effective action of the massless modes, the derivation of the MSSM, the issue of supersymmetry breaking, mass generation and the possibility of large extra dimensions.

Furthermore the discussion of (warped) compactifications with background fluxes through Calabi-Yau cycles will be an important scientific goal of the project. It is planned to systematically explore compactifications with background fluxes also in the presence of additional D-branes, their relation to non Calabi-Yau backgrounds, and their M-theory embedding via manifolds with G_2 structure.

(v) The early universe: supergravity, string and brane cosmology

It will be one of the important goals of this topic to study time-dependent backgrounds in string theory, cosmological (inflationary) backgrounds and de Sitter vacua with cosmological constant. The consortium will also confront the theoretical investigations with the new astrophysical experiments (such as Virgo or the ESA mission Planck) that are expected to produce refined results on the history of the early universe.

All five topics are intertwined with each other. In order to make the flow between the different topics more transparent, the main common links are shown in the following flow diagram:



The distribution of the five scientific topics to the various contractors can be structured as follows:

	Strings/branes	Gauge/gravity	Symmetries	Compactifications	Cosmology
LMU-München		x		x	x
MPG			x		x
UB	x		x		x
CSIC	x	x		x	
IHES		x		x	x
CNRS	x		x	x	x
NORDITA	x	x	x		x
TCD		x	x		
INFN	x	x		x	
UNITO	x	x		x	x
KULeuven		x	x		x
Imperial	x	x	x		x
UniNE	x	x	x		
UPAT		x	x	x	x
INRNE	x	x	x		
UU	x	x			x
Uni Bonn				x	x
Iceland	x				x
Uni Padova	x	x	x		
UNIMIB		x	x		
VUB	x		x		
UEDIN	x	x	x		
ETH Zürich	x	x			x
UCV		x			
RUG	x				x

(b) Deliverables and milestones

In the following, the deliverables and the milestones for the five main research objectives as well as the tentative time schedule is indicated. These deliverables and milestones will be reviewed in detail at least at the mid-term review and new ones defined, if necessary, in light of developments made.

1. *Strings and branes:*

   1a) **Non-Abelian D-brane action:** It will be important to know the higher derivative terms in the effective Non-Abelian gauge action on the world volume of a stack of N D-branes. The non-Abelian D-brane action will be important for the formulation of the effective action of realistic brane world models.

   1b) **String/string duality and string states:** The derivation of the non-Abelian D-brane action will also be relevant for checking the string/string duality symmetry between the type I string with open strings ending on D-branes, and the heterotic string with only closed strings. In addition, in order to check string/string duality symmetries, the study of the properties of higher string states is important also in view of possible large radius compactifications.

   1c) **Derivation of tachyon condensation for various D-brane configurations:** This

is important for phenomenological problems like the Higgs effect as well as for time dependent, cosmological problems.

1d) **D-branes in non-trivial backgrounds:** This is important for D-branes wrapped around cycles of internal spaces and D-branes in time dependent backgrounds.

2. *Gauge theory/gravity correspondences*

2a) **Generalizing the AdS/CFT correspondence:** This will involve the extension of the AdS/CFT correspondence for general gauge groups as well as gauge groups with matter.

2b) **The AdS/CFT correspondence in the plane wave limit:** This will involve the study of new large N limits in gauge theories, as well as an extension of the description of BMN operators.

2c) **Geometric transitions, confinement and matrix models:** The geometric transitions from branes to fluxes on Calabi-Yau space will be explored which are related to the confinement mechanism in the corresponding gauge theory. The corresponding matrix model picture needs further better understanding and verifications.

2d) **Holography for de-Sitter spaces:** This is important for the understanding of the dS/CFT correspondence and also for cosmological solutions in string theory.

3. *Underlying symmetries*

3a) **Derivation of higher spin actions and their symmetries:** This is crucial for the understanding of infinite dimensional symmetries in string and M-theory related to higher spin fields in the limit $\alpha' \to \infty$.

3b) **Space-time symmetries and decay processes of space-time:** This is important to understand the role of space-time in string theory and will also play a role in string cosmology. In string theory the decay of space-time is related to the condensation of a closed string tachyon mode.

4. *Compactifications and the connection to the standard model*

4a) **Derivation of the MSSM from brane worlds and flux compactifications:** It will be important to demonstrate that the minimal supersymmetric Standard Model, or mild extensions of it, can be derived from string theory via brane or flux compactifications.

4b) **Derivation of the low-energy effective action from brane worlds and flux compactifications:** This will involve the computation of the effective superpotential, the gauge kinetic terms and the Kähler potential, which is important for the Yukawa couplings, gauge coupling unifications etc. The knowledge of the low-energy effective action will be the basis for comparing brane world models with the future experimental results.

4c) **Supersymmetry breaking in brane world models and flux compactifications:** This will involve the study of various supersymmetry breaking mechanisms like by fluxes, gaugino condensation and the Scherk-Schwarz mechanism. The computation of the associated soft-SUSY breaking parameters will be also performed.

5. *String and Brane cosmology:*

   5a) **Obtaining inflation from string compactifications:** This involves the study of vacua where moduli are stabilized from induced potentials. A realistic setup which will produce naturally early time inflation (and/or late time acceleration) will be studied.

   5b) **The study of time-dependent solutions in string/M- theory and the effective supergravity:** This is an important task that addresses more conceptual problems in cosmology like the resolution of initial singularities and the nature of the correct formulation of the cosmological evolution problem.

   5c) **The study of (string) cosmology in the context of brane-worlds:** New cosmological processes are possible in this context as energy can be either on the brane, or in the bulk, always affecting the cosmological evolution. Moreover, the exchange of energy between brane and bulk may provide strong constraints on model building as well as interesting new realizations of cosmological acceleration.

With present knowledge results on these milestones are expected to be obtained in the following time schedule:

12 months	24 months	36 months	48 months
1a), 1d), 2a), 2b) 5a)	1c), 2c), 2d), 3a), 4a) 5b)	1c), 3b), 5b), 5c)	1b), 4b), 4c), 5c)

1.2 Training and Transfer of Knowledge (ToK)

The network as a whole undertakes to provide a minimum of 444 person-months of Early Stage and Experienced Researchers whose appointment will be financed by the contract. Quantitative progress on this, with reference to the table contained in Part C and in conformance with relevant contractual provisions, will be regularly monitored at the consortium level.

(a) Objectives

It is the aim of the project to provide the appointed ESRs/ERs a stimulating and active research and training environment. The training/ToK program addresses both the appointed ERs and ESRs. There will be both individual and common components in the training/ToK program. It is expected that the individual training and common program will be equally important for the scientific education of the appointed ESRs/ERs.

The training/ToK programme will provide the specific knowledge necessary in the field of theoretical particle physics, such as quantum field theory, string theory, cosmology, mathematical physics and their relations to phenomenology. In this way the training and the transfer of knowledge activities of the appointed ESRs/ERs will definitely assist them in their future academic careers in science and research.

The training/ToK programme will also provide many skills which are important for non academic careers, since some of the appointed ESRs/ERs may eventually decide to continue their career outside the specific field of theoretical physics. In this context, the training will provide skills in communication, presentation, analyzing problems from a broader perspective, i.e. problem solving techniques, modeling management, international experience, collaborations with different teams and different styles of work etc. In particular the interdisciplinarity of the project will help the researchers to realize common structures and connections between different fields of work.

Finally, the European aspect of the training/ToK programme will play an important role. The network will give the opportunity to compete with the centers of excellence in the US and other countries, and hence will largely contribute to the visibility of European basic research all over the world.

(b) Integration and Career Development Plans

Each contractor has well-developed administrative procedures to aid the appointed ESRs/ERs, as well as for any dependents moving with them, with regard to housing, salary/taxation issues, and the bureaucracy associated with EU-funded positions. The network will nominate a contact person for the appointed ESRs/ERs who will advise and support them in issues of the future career (Career Development Plan), in practical matters relating to their mobility and other administrative network problems.

A Career Development Plan (CDP) will be drawn up for each researcher within approximately two months of taking up the position. In order to be actively involved in drawing up the plan it is important that the appointed ESRs/ERs has a good overview of the whole of the project activities and research programme before this happens. The Career Development Plan will be updated annually and collected centrally by the Training Co-ordinator (UNIMIB) at the time of the compilation of the Annual Report.

The Career Development Plan will identify individualized training/ToK objectives, taking into account the specific needs of the ESRs or ERs. These individualized objectives will naturally

include the scientific activities of the researcher, but will also address the possibility for local training in management skills (enrolment in courses on project management, involvement in research policy of the Consortium), educational skills (involvement in the supervision of junior students), presentation skills (specific training in writing scientific papers and proposals, as well as making oral presentations), and language skills. Also, a plan will be made at this point for visits/secondments to other Contractors that the appointed ESRs/ERs will be expected to undertake.

The precise details of each researcher's secondment programme (for both ESRs and ERs) will be discussed with the researcher in question directly following her/his recruitment (in the context of the researcher's Career Development Plan) and by the project Management Board (in consultation with the Training Co-ordinator).

In the case of an ER, the Career Development Plan will be used to assess the implementation of the knowledge transfer aspects that the employment of this researcher is expected to facilitate. The Career Development Plan is re-assessed every 12 months.

In the case of researchers whose employment ends within 18 months from the time that the Career Development Plan is formulated, the practical implementation of their career development after the termination of their employment will be an important aspect of the Plan.

(d) Training programme

The training program will consist of the following building blocks:

(i) Individual training within the research groups

(ii) Individual visits

(iii) The annual network conference

The annual network conference is one of the main research and training events of the network, where most of the appointed ESRs/ERs, as well as most of the senior scientists, come together for one week. This workshop will usually be hosted by one of the contractors and normally takes place during the autumn, although this is not necessarily required. The midterm meeting will be combined with one of the network conferences. The conference program is planned to contain several, typically five or six, lectures by senior scientists on research topics which are of general interest and reflect the current status of the field. The lectures will always be complemented by discussion sessions where the appointed ESRs/ERs are encouraged to ask also basic questions concerning the lectures. The coordinators of the working groups should influence the selection of the topics and the speakers of these general conference lectures. In addition the workshop will also consist of a number of seminars where mostly the appointed ESRs/ERs have the occasion to present their own scientific results. It is expected that the annual workshops will attract around 150 participants. Finally, the main administrative meeting of the contact persons of all teams will be held during the network conferences.

(iv) The annual network school

The school is mainly intended for all appointed ESRs/ERs of the network and focuses on topics that are at the moment particularly important to the aims of the network. Its purpose is to quickly bring the appointed ESRs/ERs up to a level where they can actively contribute to the research program of the network. The school should provide a close contact between the lecturers and the students, leaving also a lot of time for discussions, both on an individual level and also in special discussion sessions. Again, it will be one of the duties of the working group coordinators

to contribute to the organization of the network schools. A typical school of the network will attract around 150-200 students. Researchers from less favored regions, new member states and from the candidate associate states will be allowed to participate free of inscription fee to all our network schools and workshops.

(v) Working groups and mini workshops

The creation of five Working Groups is an important element which will ensure that the training/ToK elements of the joint programme of work will be intimately tied to the overall schedule and the above described **deliverables** and **milestones** of the project. The co-ordinators of the Working Groups will organize smaller meetings and lecture series. All members of the consortium may participate in these mini workshops and schools which will concentrate on some specific topics, if considered relevant to their training/ToK activities. In this way the Working Groups provide a link between the individual and the common training/ToK program, stimulating the exchange of ideas and collaborations among the appointed ESRs/ERs in particular in order to strengthen the overall unity and coherence of the consortium with respect to research and training/ToK.

(e) ToK programme

The transfer of knowledge will be of mutual benefit for all contractors of the consortium, as the research in the field of unified theories needs a lot of knowledge not only of the subjects directly related to field theory and string theory, but also needs intersectorial education, e.g. in mathematical theories and cosmology. Also the fragmentation of research will be overcome by the consortium. The interchange of methods used to obtain similar goals will be also very fruitful. This transfer of knowledge will occur among the different contractors by the mutual visit of the senior researchers, as well as by the appointed ERs in particular.

Secondly, the workshops and lecture series on specific topics will ensure that there will be interaction and collaboration among the different nodes.

Finally during the annual network workshop the appointed ESRs/ERs will get the opportunity to present their results to the other members of the consortium. During this workshop a lot of time will be devoted to discussion sessions where open problems can be clarified, and new suggestions for future research directions will be outlined. The transfer of knowledge will be critically reviewed in any meeting of the contact persons such that suggestions for possible improvement can be implemented in a short time.

Intense exchange of knowledge is expected to occur between the contractors listed in the following topics:
Strings/Branes: UB, CSIC, CNRS, NORDITA, INFN, UNITO, Imperial, UniNE, INRNE, UU, Iceland, Uni Padova, VUB, ETH Zürich and RUG;
Gauge/Gravity correspondence: LMU-München, CSIC, IHES, NORDITA, TCD, INFN, UNITO, KULeuven, Imperial, UNINe, UPAT, INRNE, UU, Uni Padova, UNIMIB, UEDIN, ETH Zürich and UCV;
Underlying symmetries: MPG, UB, CNRS, NORDITA, TCD, KULeuven, Imperial, UNINe, UPAT, INRNE, Uni Padova, UNIMIB, VUB and UEDIN;
Compactifications and model building: LMU-München, CSIC, IHES, CNRS, INFN, UNITO, UPAT and Uni-Bonn;
Cosmology: LMU-München, MPG, UB, IHES, CNRS, NORDITA, UNITO, KULeuven, Imperial, UPAT, UU, Uni-Bonn, Iceland, ETH Zürich and RUG.

(f) Complementary Skills

The training programme will also provide many other skills such as training in communication, presentation, public outreach and analyzing problems from a broader perspective, i.e. problem solving techniques, modelling management, international experience, collaborations with different teams and different styles of work. In particular the interdisciplinarity of the project will help researchers to realize common structures and connections between different fields of work. Such intellectual independence will benefit the appointed ESRs/ERs in whatever career path they choose to follow, inside as well as outside academia.

2. Management

(a) Management structure

Specifically the management structure is as follows:

(i) Coordinator [LMU-München]: will represent the consortium as a whole to the outside and is the relevant contact person to the EC. The coordinator supervises the general functioning of the network.

(ii) Deputy coordinator [VUB]: will assist the coordinator in all relevant issues given previously.

(iii) Executive Board: All *scientists in charge* of the contractors and supporting teams are members of the Executive Board. It should meet at least twice every year (during the school and during the workshop) to discuss the proposals of the coordinator. The Executive Board decides upon the recruitment of appointed ESRs/ERs. It will also decide about the scientific content of the common meetings of the network and can propose new initiatives. The Executive Board can be supported and advised by other scientists of the network. There will be a representative of the appointed ESRs/ERs, who will represent the appointed ESRs/ERs in the executive board and workshop/school organization committees.

(iv) Secretaries: Several secretaries will be nominated, who will be concerned with some central organizational problems of the network. They will also communicate between the coordinator and the Executive Board during the entire year. Therefore they will be very important for the smooth management of the network. There will be secretaries in the following fields:

(1.) Outreach [Imperial]: This person is responsible for the public relations affairs, such as communication of results to the public, public talks etc.

(2.) Training of the appointed ESRs/ERs and schools [UNIMIB]: This person is responsible for the training programme and the organization of schools.

(3.) Workshops and research issues [IHES]: This person will supervise and coordinate the research efforts of the network. This person will also assist the local organizers of the workshops and will be consulted by the five scientists who will organize the working groups.

(4.) Recruitment and contact person for the appointed ESRs/ERs [KULeuven]: This person will supervise the recruitment of the appointed ESRs/ERs and will also be the contact person for the appointed ESRs/ERs concerning network questions. This person will also be attentive to the opportunities of women in the recruitment process.

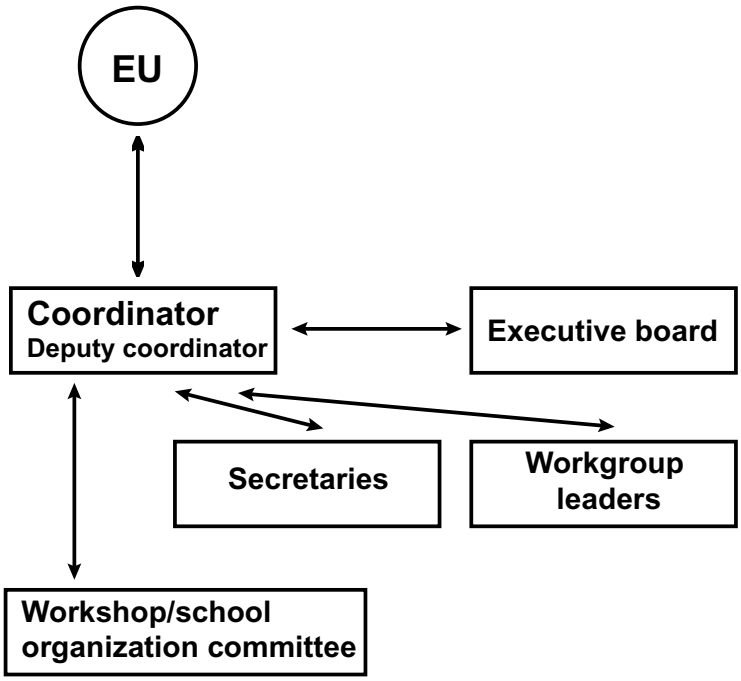
(5.) Maintenance of the Web-page [UNITO]: This person will maintain the web-page, which includes the on-line applications of the ESRs/ERs.

(v) Working group leaders: There will be the creation of five working groups around each of the five main research topics of this proposal. These working groups, each led by a senior scientist, will meet on a more frequent time-scale thereby enhancing the possibilities for scientific collaborations. The functioning of the working groups will be evaluated on a six monthly basis (at the occasion of the school and the workshop). The work group leaders will assist the executive board and the Specialists in all scientific issues, and they will also organize the working groups. They will be assisted by the appointed ESRs/ERs who will be asked to write reports on the

research and training progress and the foreseen activities. The nomination of the work group leaders will be done after the beginning of the network.

(vi) Workshop/School organization committees: These committees consist of scientists of the network, including the local organizers plus organizers of the previous meetings in order to ensure that past experience is suitably taken into account.

The whole management structure is summarized in the following diagram:



(b) Network communication

Several mechanisms (daily exchange via e-mail, schools, workshops, lecture series, working groups, visits/secondments, ...) are foreseen in order to ensure a smooth collaboration between contractors and to ensure the successful implementation of the project, in particular the training/ToK aspects.

Dedicated webpages devoted to scientific discussions, electronically advertising open positions, fully automated application procedures, making recorded seminars and lecture series (or at least copies of overheads) available on-line, the use of electronic archives (such as hep-th) for rapid communication of scientific results, ... all contribute to the creation of a virtual environment which greatly enhances the networking and scientific capabilities of the consortium.

(c) Collaboration/integration policy

At an individual level, the network greatly facilitates the mobility of collaborations between different nodes. Indeed, frequent visits of both junior and senior scientists to other nodes provide a powerful mechanism for collaborative research efforts. The working groups, each led by a senior scientist, will meet on a frequent time-scale thereby enhancing the possibilities for scientific collaborations. The workshops and schools will be widely attended by all members of the

network, and ample time for discussion is foreseen so that numerous collaborations originate at the school or at the workshop.

(d) Recruitment strategy

All open positions will be announced and published on the home Web page of the project and also on the Researchers Mobility Portal (http://europa.eu.int/eracareers). Furthermore, announcements will be sent to the main institutes in Europe and overseas in order for them to advertise vacancies to their researchers at these institutes.

The announcements for positions, usually starting at the beginning of the academic year in the autumn, will appear during the autumn of the previous year; interested researchers should then apply online on the Web site of the network, ensuring that at least three recommendation letters from senior people are also sent. The selection of candidates will usually take place during January by a Selection Panel, which consists of the contact persons from each contractor.

The Selection Committee will also consider the exchange of researchers among the contractors. For example, researchers having just finished their doctoral degree, may have the opportunity to have their first Experienced Researcher position at another contractor. However, preference in the selection of candidates will not be given in order to ensure a fair, open and transparent recruitment procedure in accordance with Annex III.3.4b) of the contract.

The consortium will ensure that any difficulties that might occur in the recruitment of ESRs/ERs will be effectively solved by re-balancing between the contractors, i.e. should one contractor have temporary problems in filling its positions, then another contractor can hire in substitution. Such re-balancing will only be done after first consulting and agreeing with the Commission.

The main selection criteria will be based on scientific qualifications, as well as the other criteria given in Annex III.3.4b) of the contract. Originality and independence will also be qualities sought from applicants and women will be strongly encouraged to apply in order to try to increase the number of women researchers in this field of research.

Applications coming from researchers based in Third Countries (e.g. South America, Japan, India, Korea, the United States) will be possible and also encouraged. It is expected that this will enhance the scientific quality of the project. However it will be ensured during the common selection meeting that the number of appointed ESRs/ERs will be kept within the 30% of total person-months limit.

(e) Equal opportunity policy

It is hoped to increase the number of women researchers in theoretical high energy physics, primarily in the appointment of Early Stage Researchers. Applicants from female ERs will, of course, also be welcomed. By acting at this earlier stage in research careers in particular, the aim would be to stimulate women to be involved in this area of research, continuing also in their future appointments. The secretary for recruitment of researchers will have to make sure, as a matter of priority, that women should be encouraged to join the project in this way.

In addition the consortium, based on the support of the local institutions, aims to provide childcare facilities and flexible working hours for researchers (male and female).

(f) Dissemination

The dissemination of the results, obtained by the senior researchers and the appointed

ESRs/ERs of the network to the scientific community will be realized first by publications in journals on high energy physics and mathematical physics (Physics Letters B, Nuclear Physics B, JHEP, Physics Review, Fortschritte der Physik, Communications in Mathematical Physics, ..). As a first step in publishing procedure the obtained results, the scientific papers will be available to the public by putting them on the well-known Los-Alamos e-print archives at xxx.lanl.gov.

All members of the consortium, particularly the appointed ESRs/ERs will be encouraged to present their results on international workshops and conferences, and publish them in the proceedings of these events. In addition all talks at the annual network conferences and network schools will be published in special proceedings.

In addition it is planned to highlight outstanding scientific results of the network on the network webpages. In addition the network webpage will aim to explain the main objectives and results also to non-specialist readers.

Finally serious efforts will be undertaken concerning public outreach, i.e. the dissemination of the network results to the public via public talks, by approaching newspapers etc.

(g) Financial management – Budget

The essential parts of the budget are:

(A) Monthly living allowance

This is the monthly salary of the young researcher. The yearly rate for the Early Stage Researchers (ESR=PhD students) is 30.550,- Euro (N^1_{ESR}) if hired by a contract or 15.275,- Euro (N^2_{ESR}) for researchers receiving a stipend. It is assumed in the budget that all the ESR's except for Sofia and Craiova will get a stipend. The yearly rate for the Experienced Researchers (ER=postdoc) is 47.000,- Euro (N^1_{ER}) if hired by a contract or 23.500,- Euro (N^2_{ER}) for researchers receiving a stipend. It is assumed in the budget that all the ER's will get a contract. Note that the living allowance is subject to the country dependend correction coefficient c_i.

Researchers will be officially only employed by the main contracting nodes. The number of ER months for every node is m_i, the number of ESR months for every node is $\tilde{m}_i$. Therefore the researcher budget will only appear at the main nodes, and the postdoc/PhD distribution among the main contractor and the subcontractor(s) should be discussed inside the main node. So, in conclusion, the (A)-part of the budget for every contrcating node is computed vy the following formula:

$$A_i = c_i(N^1_{ER} \times \frac{m_i}{12} + N^{1,2}_{ESR} \times \frac{\tilde{m}_i}{12}) \tag{1}$$

(B) Travel allowance

The travel allowance for a period of 12 months is based on the direct distance between the place of origin and the host institution of the researcher. It varies between 500,- and 1000,- Euro per yar.

(C) Mobility allowance

The mobility allowance is foreseen to cover additional expenses as relocation, family charges, language course etc. Is is 800,- Euro per month for a married researcher and 500,- Euro per month for an unmarried researcher. Furthemore it is subject to the country dependend correction coefficient c.

(D) Carrer exploratory allowance

This is 2000,- Euro per fellow, but only for fellows selected for stays of at least one year.

(E) Contribution to the participation expenses of the researchers

These are the expenses for the participating of the ESR/ER to the research and training activities (workshop, school, visits). It is 4.800,- Euro per researcher per year. Note, in the previous network this was part of the networking budegt.

The sum of items (A) – (E) is the part of the budget for young researchers. It makes about 67 % of the total budget.

(F) Contribution to the training and transfer of knowledge programme

This is the part of the budget for networking expenses. It is based on the size of the groups and also on the participation in the previous network activities where to every group i a label p_i is assigned , which goes from 1 to 3. So a group with the label p_i will get the fraction $p_i/72$ of this part of budget:

$$F_i = F' \times \frac{p_i}{72}. \tag{2}$$

(One yearly unit corresponds to 1.900 Euro.) Note that also the supporting teams (subcontractors) participate from this part of the budget. Furthermore note that the F-part for Munich contains an additional sum of 81.223,16 Euro for common activites (workshops, schools), i.e. $F' = F - 81.223,16$ Euro.

(G) Management

These are the expenses for the audit certifications, namely 2000,- Euro for every contracting node. In addition it contains 5000,- Euro for Padova/Trieste for organzing the school in 2005, as well as 60.000,- Euro for Munich for hiring a part time secretary.

(H) Overhead

These are 10% of the direct costs for each contracting mode, i.e. the sum (A+B+C+D+E+F)/10.

All this leads to the following budget distribution:

	p_i^j	$m_i/\tilde{m}_i$	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	Total
1. Munich	3	24/0	97.582	1.000	19.92,60	2.000	9.600	104.023,16	62.000	23.412,44	319.537,20
2. Potsdam	3	0/0						22.800	2.000	2.280	27.080
3.1 Barcelona	2	12/0	44.039	800	8.995,20	2.000	4.800	15.200	2.000	8343,42	86.177,62
3.2 Valencia	1							7.600			7.600
4.1 Madrid	2	0/12	14.312,68	800	7308,60	2.000	4.800	15.200	2.000	5.202,13	51.63,41
4.2 Santiago/Oviedo	1							7.600			7.600
5.1 Bures IHES	2	24/0	98.418	1.000	20.102,40	2.000	9.600	15.200	2.000	16.152,04	164.472,44
5.2 Ecole Pol.	2							15.200			15.200
6.1 Paris ENS	3	0/0						22.800	2.000	3.800	28.600
6.2 Saclay	2							15.200			15.200
7. Copenhagen	3	24/0	121.354	1.400	24.787,20	2.000	9.600	22.800	2.000	18.194,12	202.135,31
8. Dublin	2	0/12	16.527,55	800	8.439,60	2.000	4.800	15.200	2000	4.776,72	54.543,87
9.1 Frascati	2	12/12	61.839,08	1.000	17.278,20	4.000	9.600	15.200	2.000	12.411,73	123.329,01
9.2 Napoli	2							15.200			15.200
10.1 Torino	3	24/0	93.342	1.000	19.065,60	2.000	9.600	22.800	2.000	16.300,76	166.108,36
10.2 T-Polytechn.	1							7.600			7.600
10.3 Alessandria	1							7.600			7.600
1. Leuven	3	24/0	94.000	1.000	19.200	2.000	9.600	22.800	2.000	14.860	165.460
12. London	3	24/0	105.750	1.000	21.600	2.000	9.600	22.800	2.000	16.275	181.025
13. Neuchatel	2	18/0	78.984	1.000	17.971,20	2.000	7.200	15.200	2.000	13.175,52	146.930,72
14.1 Patras	2	12/12	54.552,90	2.000	15.242,40	4.000	9.600	15.200	2.000	10.89,53	113.414,83
14.2 Athens	1							7.600			7.600
15. Sofia	2	0/24	44.053,10	2.000	11.247,60	2.000	9.600	15.200	2.000	8.410,08	94.510,78
16.1 Utrecht	3	24/0	97.666	1.000	19.948,80	2.000	9.600	22.800	2.000	15.301,48	170.316,28
17. Bonn	3	12/0	48.786	500	9.964,80	2.000	4.800	22.800	2.000	8.885,08	99.735,88
18. Reikjavik	1	0/12	15.275	1.000	7.800	2.000	4.800	7.600	2.000	3.847,50	44.322,50
19.1 Padova	2	24/0	93.342	1.000	19.065,60	2.000	9.600	15.200	6.000	15.540,76	161.748,36
19.2 Trieste	2							15.200			15.200
20.1 Milano-Bic.	2	24/0	93.342	1.000	19.065,60	2.000	9.600	15.200	2.000	15.540,76	157.748,36
20.2 Milano I	2							15.200			15.200
21.1 Bruss. VUB	2	12/12	62.275	1.000	17.400	4.000	9.600	15.200	2.000	12.467,50	123.942,50
21.2 Bruss. ULB	2							15.200			15.200
22. Edinburgh	1	0/12	17.184,38	700	8.775	2.000	4.800	7.600	2.000	4.105,94	47.165,32
23. Zürich	1	0/18	28.594,80	1.000	14.601,60	2.000	7.200	7.600	2.000	6099,64	89.00,04
24. Craiova	1	0/12	16.833,05	1.000	4.297,80	2.000	4.800	7.600	2.000	3.653,09	42.38,94
25. Groningen	2	12/0	48.833	500	9.974,40	2.000	4.800	15.200	2.000	8130,74	91.438,14
Totals	72	306/138	1.455.875,53	23.900	342.061,20	52.000	17.600	628.423,16	114.000	267.985,98	3.061.845,87

The first payment will cover 80% of a period of 18 months and will consist of an amount 525.146,- Euro.

3. Indicators of Progress and Success

3.1 Quantitative indicators of progress and success to be used in monitor the project

3.1.1 Research Activities

In reporting on the progress with the implementation of its research programme the network will provide information and data on the following:

- Individual and joint publications, directly related to the network undertaken within the contract (number, authors, title)
- Invitation of network researchers to conferences, workshops and schools within the contract (number, title of events, dates, places) – contributions to conference proceedings
- Organisation of workshops and schools within the contract (number, title of events, dates, places)
- specialist exchange among network teams (number, who, where, date, nature)
- scientific awards and prizes obtained from work related to the contract (number, details)

3.1.2 Training/Transfer of Knowledge (ToK) Activities

In reporting on the progress with the implementation of its training and ToK Plan programme the network will provide information and data on the following:

- the rate of recruitment of ESR and ER for each participant and for the network as a whole (ration person-months filled/offered)
- the nature and justification for adjustments, if any, to the original overall number of person-months of ESR and ER as well as to the breakdown of this overall number among the participants
- the time and duration of each individual appointment
- the number, names and level of involvement of senior researchers directly related with the tutoring/supervision of the recruited ESR or ER, at each participant
- the number of ESR that are expected to present their PhD thesis and when
- the number and place of short visits either within or outside the network
- number of visits of the ESR and ER to their home scientific community
- attendance at networks meetings by the ESR and ER (number, names, place, date)
- participation in and presentation to workshops and conferences by ESR and ER (number, names, place, date)
- organization of training events: schools, network conferences, workgroup meetings, mini-workshops, lecture series (number, attendees, names, place, date)

- number of internal training tutorials
- events, meetings organized by the ESR or ER themselves

3.2 Qualitative indicators of progress and success to be used in monitor the project

3.2.1 Research Activities

In reporting on the progress with the implementation of its research programme the network will provide information and data on the following:

- general progress with research activities at individual, participant team and network level
- highlights on more particularly innovative developments (novel concepts, approaches, methods)
- citation index for individual and joint publications directly related to work undertaken within the contract
- expected scientific breakthroughs
- overall progress and possible problems encountered with individual work packages and/or network-wide research activities
- nature and justification for adjustments, if any, to the original work plan and/or time table
- progress on cross interaction among disciplines represented within the network
- progress on cross interaction between academic partners
- highlights on wider social components of the network, such as public outreach activities
- highlights on the scientific community recognition of the network research contribution (awards, invitation to conferences, ...)

3.2.2 Training/Transfer of Knowledge (ToK) Activities

In reporting on the progress with the implementation of its training and ToK Plan programme the network will provide information and data on the following:

- general progress with training and ToK activities programmed at individual, participant team and network level (type of guidance, supervision, coaching and mentoring in place to support ESR and ER)
- highlights on the development of more particularly innovative approaches to training and ToK (e.g. specific training packages of network-wide relevance)
- highlights on the exploitation of the "complementarities" between network participants with respect to training and ToK
- the nature and justification for adjustments, if any, to the original training/TOk plan and/or time table (e.g. opportunities for new collaborations regarding training activities)

- career development plans as elaborated by the ESR and ER involved in the project
- career development opportunities/prospects for the ESR and ER involved in the project
- achievements regarding the acquisition of complementary skills such as communication, language skills, computer skills, project management, ethics, team building, etc.
- level of satisfaction of the trainees (e.g. as expressed in response to questionnaires)

3.2.3 Management

In reporting on the progress with its management the network will provide information and data on the following:

- effectiveness of the "internal" communication and decision making between the co-ordinator, team leaders, supervisors, down to ESR and ER, including feedback processes
- effectiveness of the communication between the network and the Commission Services (frequency, efficiency, timely feedbacks), particularly regarding the conformance with contractual provisions and the implementation of contingency plans where needed
- network self-assessment through benchmarking activities (exchange of best practices among participants and/or development of ad hoc performance indicators regarding cost managements, staff selection, measurement of research/training outputs, appointed ESRs/ERs involvement, etc
- overall quality and efficiency of the "external" communication strategy of the network (Cordis; personal, team and network web sites updates; newsletters, etc)
- effectiveness of recruitment strategy of the networks teams of equal opportunities (including gender balance) and open competition at international level
- development of any specific planning and management tool(s) and databases