



EUROPEAN COMMISSION
RESEARCH DG HUMAN RESOURCES
AND MOBILITY

RTN Mid-Term Activity Report

Project No.: 503369

Project Acronym: QUEST FOR UNIFICATION

Project Full Name: THE QUEST FOR UNIFICATION : THEORY
CONFRONTS EXPERIMENT

Marie Curie Actions

RTN Mid-Term Activity Report

Period covered: from 01/10/2004 to 30/09/2006

Start date of project: 01/10/2004

Project coordinator name:

Prof. IGNATIOS ANTONIADIS

Project coordinator organisation name:

ECOLE POLYTECHNIQUE

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Marie Curie Actions

RTN Mid-Term Activity Report

GENERAL INFORMATION

Project No.:	503369
Project acronym:	QUEST FOR UNIFICATION
Project full name:	THE QUEST FOR UNIFICATION : THEORY CONFRONTS EXPERIMENT
Period number:	1st
Period covered - start date:	01/10/2004
Period covered - end date:	30/09/2006
Project start date:	01/10/2004
Project duration [months]:	48
Project coordinator name:	Prof. IGNATIOS ANTONIADIS
Project coordinator organisation name:	ECOLE POLYTECHNIQUE
Date of submission:	06/11/2006

SUMMARY OF THE RECRUITMENT SINCE THE START OF THE PROJECT

Contractor: ECOLE POLYTECHNIQUE

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Francesco Nitti	ER (4-10 years)	IT-Italy	No	Male	01/09/2005	31/08/2006	12
Pablo Camara	ER (4-10 years)	ES-Spain	No	Male	01/09/2006	31/08/2008	1
Arunansu Sil	ER (4-10 years)	IN-India	No	Male	01/10/2006	31/05/2007	0

Contractor: COMMISSARIAT A L'ENERGIE ATOMIQUE

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Arunansu Sil	ER (4-10 years)	IN-India	No	Male	01/06/2007	30/09/2008	0

Contractor: RHEINISCHE FRIEDRICH-WILHELMS-UNIVERSITAET BONN

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Andrei Micu	ER (4-10 years)	RO-Romania	Yes	Male	01/10/2005	30/09/2008	12

Contractor: ARISTOTLE UNIVERSITY OF THESSALONIKI

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Iain Nicholas Richard Peddie	ER (4-10 years)	UK-United Kingdom	No	Male	06/09/2005	05/09/2007	13

Contractor: ISTITUTO NAZIONALE DI FISICA NUCLEARE

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Vyacheslav Rychkov	ER (4-10 years)	RU-Russian Federation	No	Male	01/09/2005	31/08/2007	13
Olga Mena Requejo	ER (4-10 years)	ES-Spain	No	Female	01/10/2006	30/09/2008	0

Contractor: SCUOLA INTERNAZIONALE SUPERIORE DI STUDI AVANZATI

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Nicolas Moeller	ER (4-10 years)	DE-Germany	No	Male	01/10/2005	30/09/2007	12

Contractor: ISTITUTO SUPERIOR TECNICO

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Maria Amparo Tortola	ER (4-10 years)	ES-Spain	Yes	Female	01/02/2006	31/01/2008	8

Contractor: UNIVERSIDAD AUTONOMA DE MADRID

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Stefan Antusch	ER (4-10 years)	DE-Germany	No	Male	01/09/2005	31/08/2007	13

Contractor: UNIVERSITAT DE VALENCIA

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Satoru Utsunomiya	ER (4-10 years)	JP-Japan	No	Male	01/10/2006	30/09/2008	0

Contractor: THE CHANCELLOR, MASTERS AND SCHOLARS OF THE UNIVERSITY OF OXFORD

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Gianmassimo Tasinato	ER (4-10 years)	IT-Italy	No	Male	01/09/2005	31/08/2007	13
Andreas Athenodorou	ESR (<4 years)	CY-Cyprus	No	Male	01/10/2005	30/09/2008	12

Contractor: UNIWERSYTET WARSZAWSKI

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Kin-ya Oda	ER (4-10 years)	JP-Japan	No	Male	01/10/2005	31/03/2006	6
Oliver Eyton-Williams	ER (4-10 years)	UK-United Kingdom	No	Male	16/05/2006	15/11/2006	4.5

Contractor: EUROPEAN ORGANIZATION FOR NUCLEAR RESEARCH

Name of the Researcher (as stated at time of selection)	Type	Origin		Gender	Start date of recruitment	End date of recruitment	No. of full-time equivalent months
		Country	LFR				
Cedric Delaunay	ESR (<4 years)	FR-France	No	Male	01/12/2006	28/02/2007	0

SUMMARY OF THE MAJOR PROJECT ACHIEVEMENTS SINCE THE START OF THE PROJECT

Describe what you would consider to be the most outstanding or more particularly significant outcome of the work performed during the period covered by this report, in terms of scientific/technological results, research training methodologies, opening up of career opportunities to researchers, international networking of the concerned scientific community, etc.

GENERAL PROGRESS AND COMPARISON WITH THE WORK PROGRAMME

According to the Joint Work Plan, the research objectives of the network are falling into six general categories:

- (a) The origin of mass; quark, charged lepton and neutrino masses and mixing.
- (b) Supersymmetric phenomenology.
- (c) Particle astrophysics and cosmology.
- (d) String phenomenology.
- (e) Extra dimensions, Kaluza Klein phenomenology and gravity modifications.
- (f) Dualities and non-perturbative effects.

Progress has been made in essentially all the main directions of our work plan. The scientific highlights in the above six research topics are described in a separate document. It follows that our network made significant progress in all these objectives which are still relevant and achievable. In particular, as can be seen from the publication list, the network during the first two years of the contract produced 215 joint publications (involved at least two different nodes) that have received already about 3000 citations.

The network research activity during the first two years of the contract in the various nodes is summarized in Table 1 of the document with the tables, to be compared with the corresponding table of the Distribution of Tasks in the Work Programme. The differences are denoted by the symbol 'star' (* where it was y in the Work Programme, and y* for a new entry). As it can be seen from the table, there was no essential difference in the distribution of tasks planned in the Work Programme. There have been though some small deviations, in connection to recent developments. In particular, it appears that there was somewhat less activity than expected on physics from extra dimensions (task e), while there was more research effort by several network nodes on supersymmetry and string related phenomenology and fermion masses (tasks b, d and a).

The main topics of activity where breakthroughs were obtained are (i) split supersymmetry, (ii) models of fermion masses and neutrino oscillations based on non-abelian discrete symmetries, (iii) methods for computing non-gaussianity in primordial fluctuations, (iv) flux compactifications for moduli stabilization and supersymmetry breaking, (v) naturalness and electroweak precision tests, (vi) methods of supersymmetry breaking mediation, (vii) holographic description of QCD, (viii) tachyon condensation.

The list of milestones, according to the Work Programme, is (in parenthesis we indicate the distribution of the milestones within the six main research objectives):

- Milestone 1: Higgs phenomenology (a, b, d, e).
Milestone 2: Study of models of flavor, describing quark and lepton masses and mixing (a, d).
Milestone 3: Study of CP violation in K and B physics in extensions of the Standard Model(a, b).
Milestone 4: Experimental tests of supersymmetry (b).
Milestone 5: Models of neutrino masses and mixing and prospects for neutrino long baseline and factory experiments (a).
Milestone 6: Supersymmetry breaking and mediation mechanisms (b, d, e).
Milestone 7: Comparison with observations of the predictions of inflationary models (b, c, d, e).
Milestone 8: Models of baryogenesis and leptogenesis (b, c, d, e).
Milestone 9: Brane cosmology (c, e).
Milestone 10: Brane construction of the Standard Model (d).
Milestone 11: Study of moduli stabilization from non-trivial fluxes (d, f).
Milestone 12: Systematic construction of unification models (b, d, e, f).

Milestone 13: Gravitational phenomena in brane constructions (d, e).

Milestone 14: Non-perturbative string dynamics and AdS/CFT correspondence (f).

The present status compared to the expected schedule to accomplish these milestones in terms of numbers of years elapsed from the start of the network contract is described in Table~2 of the document with the tables. As seen by the table, there was decisive progress towards all Milestones of the Work Programme. In particular, Milestones 3, 7 and 11 were achieved according to the schedule. Also, Milestones 14 and 6 were achieved much earlier than expected (3rd and 4th year, respectively). Moreover, Milestone 2, 5 and 12 were also achieved, according to the schedule, while decisive progress was made towards Milestone 9 whose completion is expected for next year. On the other hand, significant progress was made towards the remaining Milestones of the Work Programme: Milestone 1 (from Palaiseau, Saclay, INFN, Oxford, CERN), Milestone 8 (from Saclay, Greece, INFN, Trieste, Oxford), Milestone 13 (from Palaiseau, Saclay, Greece, Oxford, CERN), Milestone 4 (from Greece, Lisbon, Valencia, Oxford, Warsaw, CERN), and Milestone 10 from Palaiseau, Bonn, Oxford, Madrid, CERN).

There were several secondments of senior and young researchers from one node to another. Those funded by the network were more than 200 and are displayed in Table 3 of the document with the tables. The numbers stand for different short visits with duration from a few days to a month and the arrow indicates the direction of the secondment. Important outreach activity was done in the greek node.

Scientific prizes:

- Gabriele Veneziano (CERN node): University of Berne Albert Einstein Medal (2006)
- Giovanni Villadoro (Rome/INFN node): "INFN Sergio Fubini Prize 2006" for the best Ph.D. theses in theoretical physics. His work, under the supervision of Fabio Zwirner, was part of the network activities.
- Sergio Ferrara (CERN node): Danni Heinemann Prize of the American Physical Society for the discovery of Supergravity.
- Jose Valle (Valencia node): Humboldt award.
- Gustavo C. Branco (Lisbon node): Humboldt Fellowship (1/10/2005 to 28/2/2006).

TRAINING

According to the Work Plan, most of the young researchers were employed during the second year of the contract but were selected in the first year. All vacancies were published in the Web (on the home page of the network, as well as of the local institutes, and in the Web site of CORDIS) and were announced to the main institutions active in our research field, world-wide. All available standards were used, as well as modern electronic means: Robot Jobmenu, High Energy Physics Information Center (HEPIC), Physics Jobs, TIPTOP and CERN. In addition, the announcements were sent to many institutions in Europe and to special mailing lists of senior people who sent suggestions for candidates. A large number of applications was received, varying between 50 and 100 per node with vacancy. The selection procedure was made locally and was based mainly on scientific excellency on the main research topics of the network.

Up to now, the network employed 15 young researchers (14 ER and one ESR). Nine of them started their employment early Fall 05: Francesco Nitti (ER in Ecole Polytechnique/Palaiseau from September 05), Iain Peddie (ER in Thessaloniki/Greece from September 05), Vyacheslav Rychkov (ER in Pisa/INFN from September 05), Stefan Antusch (ER in Madrid from September 05), Gianmassimo Tasinato (ER in Oxford from September 05), Andrei Micu (ER in Bonn from October 05), Nicolas Moeller (ER in SISSA/Trieste from October 05), Kin-ya Oda (ER in Warsaw from October 05), Andreas Athenodorou (ESR in Oxford from October 05). Two started in the middle of the academic year 05-06: Maria Amparo Tortola (ER in Lisbon from February 06) and Oliver Eyton-Williams (ER in Warsaw from May 06), while four more started this Fall: Pablo Camara (ER in Ecole Polytechnique/Palaiseau from September 06), Arunasu Sil (ER partly in Ecole Polytechnique/Palaiseau and partly in Saclay from October 06), Olga Mena Requejo (ER in INFN/Rome from October 06), Satoru Utsunomiya (ER in Valencia from October 06).

Their expected employment is two years, except for A. Micu and the ESR A. Athenodorou who are

expected to stay three years. On the other hand, F. Nitti was paid one year and then was moved on different funds but remains member of the coordinating node. Moreover, K. Oda stayed only six months in Warsaw and then moved back to Japan in a longer term position. He was replaced by O. Eyton-Williams who will be paid from the contract for the remaining six months (until 15.11.06), and then will remain in Warsaw node on different funds. Finally, S. Utsunomiya had to postpone the last moment his starting date in Valencia by 15 days due to an urgent medical operation. Thus, at this moment, the network is already engaged to fill 335.5 person months, out of a total of 348 of the Work Plan, which corresponds to 96.4%. In the remaining two years, there is only one vacancy of 12 months to fill in Madrid for the fourth year of the contract, with a selection that will take place early 2007.

The majority of the selected ER's (9/15) were previously in institutes related to (other) network nodes, either as students or as postdocs (P. Camara in Madrid, A. Micu in Hamburg/Sussex, I. Peddie in Southampton, O. Mena in Madrid, M. Tortola in Valencia, S. Antusch in Southampton, K. Oda in Bonn, G. Tasinato in SISSA/Bonn and O. Eyton-Williams in Southampton). Moreover, the US team has hired a post-doctoral fellow, Michele Pappucci, who was a graduate student at the INFN/Pisa node, leading to considerable interchange between members of these nodes. Up to now, four of the twelve your researchers employed by the network came from a country "outside" EU (V. Rychkov, K. Oda, A. Sil, S. Utsunomiya) corresponding to about 23% of the engaged amount of person months. Finally, the female percentage is rather small, about 14% of person months.

Compared to the initial planing, apart from minor modifications in the expected starting dates of the appointment contracts (in four nodes by one month earlier and in two by a few months later), the main difference is that in three nodes (Saclay, Greece and Valencia) the employment was delayed by a year. These changes are not significant for the Work Plan but, on the contrary, made the employment rate of young researchers more balanced over the remaining years of the contract. There are two more modifications of the recruitment plan of the network:

- (i) A slight redistribution of months between the two french nodes mainly for complementarity of training for the recruited ER (string theory and phenomenology) but also for financial reasons. A. Sil started his appointment in October 06 in Ecole Polytechnique for 8 months on fixed stipend and then will move to Saclay for the remaining 16 months. During his stay in EP, he has also an office in Saclay where is expected to spend a maximum of 30% of his time.
- (ii) In order to use the leftover of funds resulting mainly from the marital status of the recruited researchers (single versus married as expected), a certain number of students will be exchanged among different nodes as ESRs. One of them is already included in the employment forecast of CERN node for three months (Cedric Delaunay from Saclay).

The young researchers have been very well integrated into the research programme of the network. They had beneficial interactions with the other postdocs and students, and they participated actively in the scientific activity of their host institutes. Furthermore, they have been encouraged to travel and get contacts with other network nodes and establish collaborations. They also attended and presented their work to major network meetings, as well as to international conferences and workshops related to the network research activity. They enlarged considerably their expertise and acquired complementary skills: presentation skills, computer skills, and knowledge of the language of the host country. Many of them were also in charge of research seminars organization and acquired organizational as well as teaching skills. All Career Development Plans were established on time and have been followed closely during the year.

Following the Work Programme of the contract, training of young researchers had two components:

(a) Individual training through:

- a1. Active participation in the joint research programme, that led in particular to 14 publications up to now. Eleven of them were in collaboration with senior and other members of the host institutes, while 5 were joint involving at least two different network nodes.
- a2. Frequent exchanges among participating nodes and extended stays outside their home institutes.
- a3. Special training measures of every host institute.

(b) Common training through:

- b1. Active participation in the network meetings.
- b2. Participation in European and other International Schools.

CERN played a special role in these training activities, and for establishing close connection and

communication among the network members. The ER and ESR mobility activity is summarized below (the duration of visits is usually one week, unless otherwise indicated):

Francesco Nitti (ER, Ecole Polytechnique/Palaiseau)

- 2 conferences (2 invited talks), 1 school
- Visits: CERN (March 06, July 06), Warsaw (April 06)
- String seminar organizer

Andrei Micu (ER, Bonn)

- 4 conferences (3 invited talks), 1 school
- Visits: Hamburg (January 06), Durham and Sussex (February 06, talk), Oxford (March 06)
- Visits outside the network: Utrecht (September 06, seminar)
- Theoretical physics seminar organizer

Iain Peddie (ER, Thessaloniki/Greece)

- 2 conferences (1 invited talk), 2 schools

Vyacheslav Rychkov (ER, Pisa/INFN)

- 7 conferences (3 invited talks), 3 schools (1 invited lectures)
- Visits: INFN/Rome (April 06, talk), ICTP/Trieste (May 06, talk), INFN/Gran Sasso (July 06), CERN (1-31 August 06)
- Visits outside the network: Universities of SUNY Stony Brook, New York, Maryland, Pennsylvania (US, November 05, talks)

Nicolas Moeller (ER, SISSA/Trieste)

- 1 conference (1 invited talk)

Mariam Tortola (ER, Lisbon)

- 2 conferences (2 invited talks)
- Visits: Valencia (April 06, September 06)

Stefan Antusch (ER, Madrid)

- 7 conferences (7 invited talks)
- Visits: CERN (February 06, June 06)

Gianmassimo Tasinato (ER, Oxford)

- 6 conferences (2 invited talks), 1 school
- Visits: Durham (January 06, seminar), Bonn (April 06, talk), Sussex (May 06, talk)
- Seminars: Oxford, Cambridge (May 06)
- Research seminar organizer
- Teaching in the graduate programme

Andreas Athenodorou (ESR, Oxford)

- 2 conferences

Kin-ya Oda (ER, Warsaw)

- 2 conferences (1 invited talk)

Oliver Eyton-Williams (ER, Warsaw)

- Visits: CERN (two weeks in June 06, September 06)

Details of training of A. Athenodorou (ESR in Oxford):

He attended an intensive series of lectures and associated problem classes designed to prepare him for his first research project, which involved full time study for his first nine months at Oxford. The lectures were supplemented by his attendance at the British Universities summer school in particle physics in August, this year held in Edinburgh. In addition to the formal research training he has worked closely with his supervisor on his first research project and is expected the work will be written up in a research paper soon. At the end of his first year, he had to pass an examination in order to proceed to his second year of study which will be devoted almost full time to research. The

examination required a presentation of his research work and showed a good general knowledge of his field of research, and a very good general performance.

MANAGEMENT

The recruitment strategy of the network was very effective and successful both for ER and ESR. As mentioned in the training part of the report, the vacant positions were widely publicized and there was an open competition at international level. We received several hundreds of applications distributed equally between member (and associated) states of the EU and third countries from all over the world. applications from women for ER was adequately large. Although decisions were based mainly on scientific criteria, gender issues and promotion of the exchange between nodes were taken into account. Two female scientists were hired as ERs for two years each (M. Tortola in Lisbon and O. Mena in INFN/Rome).

The overall efficiency of the external communication was excellent, as well as in decisions making of the Network and the communication among the nodes of the network and the coordinating team. The network web site is well kept and regularly updated. During the first two years of the contract, it received about 3500 hits. A special role in the management was played by the network meetings that are reported in a separate list. In addition to the scientific programme, there were regular administrative meetings of the steering committee to follow up the network activities and discuss organisation and management matters. Such meetings took place five times until now during the main network meetings (at CERN on 07.12.04, in Trieste on 25.05.05, in Corfu on 13.09.05, in Madrid on 12.12.05, and in Paris on 31.05.06).

DISSEMINATION OF RESULTS OF THE PROJECT

Participation in conferences and other scientific events

Type of Event	Active participation			Passive participation
	Oral	Poster	Of which were invited presentations	
Conferences	217	0	217	53
Workshops	138	0	138	59
Other Scientific Meetings	85	0	85	47

Publications

Type of Publication	Total	Of which involved recruited researchers	Of which joint publications involving at least 2 network contractors	Of which invited
Peer Reviewed - Articles in Journals	448	6	129	0
Peer Reviewed - Chapters in Books	4	0	0	0
Peer Reviewed - Articles in Conference Proceedings	126	2	27	126
Peer Reviewed - Books and Monographs	0	0	0	0
Non-Peer Reviewed	0	0	0	0
Submitted	202	6	59	0
Manuscripts in preparation	0	0	0	0

List of joint publications

see document attached

Patents

Number of patents granted:

0

Number of patents pending:

0

MAJOR PROBLEMS/DIFFICULTIES

Please specify any major problems/difficulties you may have encountered until now or may anticipate in the near future, and suggest possible remedial actions at network and/or commission level.

As mentioned above, there are three modifications of the recruitment plan of the network, requiring an appropriate redistribution of funds between participants:

(i) A slight redistribution of months between the two french nodes (Ecole Polytechnique and Saclay) mainly for complementarity of training for the recruited ER (string theory and phenomenology) but also for financial reasons. A. Sil started his appointment in October 06 in EP for 8 months on fixed stipend and then will move to Saclay for the remaining 16 months. During his stay in EP, he has also an office in Saclay where is expected to spend a maximum of 30\% of his time. This implies that there will be a corresponding redistribution of funds (8 person months of stipend will be transferred from Saclay to the Coordinating node).

(ii) In order to use the leftover of funds resulting mainly from the marital status of the recruited researchers (single versus married as expected), a certain number of students will be exchanged among different nodes as ESRs. A first estimate allows the hiring of three students for three months each, which is the minimum stay required as ESR. One of them is already included in the employment forecast of CERN node (Cedric Delaunay from Saclay), while the other two are expected to be hired during the 4th year of the contract. In the meantime, a precise computation of the leftover will be done.

(iii) Because of the delay of the starting date of S. Utsunomiya, as explained previously, Valencia will provide 23.5 ER person months instead of 24 expected in the original plan.

Attachments	NetworkMeetingsMT.pdf, JointPubsMT.pdf, TablesMT.pdf, highlightsMT.pdf
Name	
Date	
Signature	