

ERASMUS MUNDUS JOINT DOCTORATE PROGRAMME APPLICATION FORM INTERNATIONAL RELATIVISTIC ASTROPHYSICS DOCTORATE PROGRAM IRAP PHD





Je, soussigné(e) Albert MAROUANI, Président de l'Université de Nice Sophia-Antipolis certifie que le diplôme de doctorat délivré par mon établissement à tous les étudiants Erasmus Mundus (européens et pays tiers) à l'issue du cursus conjoint Erasmus Mundus dont le titre suit :

International Relativistic Astrophysics Doctorate Program

Sera :

un diplôme conjoint (un seul document/diplôme avec logos et emblèmes de tous les partenaires, signé par les présidents de tous les établissements impliqués dans le consortium) dont le titre suit:

Doctorat en Astrophysique Relativiste

Ce diplôme conjoint <u>s'adosse</u> à notre diplôme national de doctorat indiqué cidessous:

Diplôme National de Doctorat en Astrophysique Relativiste Adopté par le Conseil Scientifique de l'Université du 26 avril 2002

Fait à Nice..... le 2 juillet 2009.....









Modèle-type - Effacer ou Ajouter toute mention nécessaire

Je, soussigné Gilbert Angénieux, Président de l'Université de Savoie

Certifie que le diplôme de doctorat délivré par mon établissement à tous les étudiants Erasmus Mundus (européens et pays tiers) à l'issue du cursus conjoint Erasmus Mundus dont le titre suit :

International Relativistic Astrophysics Doctorate Program

Sera :

> un diplôme conjoint (un seul document/diplôme avec logos et emblèmes de tous les partenaires, signé par les présidents de tous les établissements impliqués dans le consortium) dont le titre suit:

Doctorat en Astrophysique Relativiste

Ce diplôme conjoint s'adosse à notre diplôme national habilité comme doctorat (ou diplôme donnant grade de doctorat) indiqué ci-dessous:

le Diplôme National de Doctorat : Physique Théorique.

Fait à Chambéry, le 02 Juillet 2009

Signature du Président de l' Université de Savoie Et cachet de l'établissement

Pour le Président et par délégation, le Vice-Président du Conseil Scientifique LUC FRAPPAT







Reference Number To be filled in by the Agency

APPLICATION FORM

PROGRAMME	ERASMUS MUNDUS 2009-2013
Call for Proposals Detailed information on the application procedure and the implementing rules of the Action is available in the <u>Erasmus Mundus</u> <u>2009-2013 Programme Guide</u>	EAC / 04 / 2009
Action	Action 1 – Joint Programmes
Sub-Action Applicants wishing to apply to both sub-actions, must submit two separate applications	EMJD - Joint Doctorate Programme
Application Deadline	30 April 2009 (as per postmark) For EMJDs , the electronic version of the summary sheet (annex 3) should be sent by email to the address below by 31 March 2009
Project Title	International Relativistic Astrophysics Doctorate Program
Project Acronym	IRAP PhD
Application Language	English

By the deadline of 30 April 2009:

The signed original of the application (together with the relevant annexes) and 2 copies thereof must be sent in the same envelope to:

Education, Audiovisual and Culture Executive Agency Unit P4 (BOUR 00/38) Avenue de Bourget, 1 B-1140 Evere (Brussels)

An electronic version of the application must be sent to the following email address:

EACEA-EM2-A1@ec.europa.eu

Paper and electronic copies of the application must be sent to the <u>National Structures</u> in the countries of each of the European participating institutions (not applicable to associated members and third country institutions)

Présidence et services Centraux

Le Président

Affaire suivie par :

Caty CONRAUX Chef de Cabinet

Tél. : 04 92 07 66 06 Fax : 04 92 07 66 00 cabinet@unice.fr

N/REF AM/CC N° 2009-223 Université Nice sophia antipolis

April 30,2009

To whom it may concern,

The University of Nice-Sophia Antipolis (UNS) will actively participate in the joint programme "Erasmus Mundus Joint Doctorate (EMJD) in Relativistic Astrophysics" as the Coordinating Organisation. Thanks to many Ph.D., I am aware that UNS is involved in its application.

The Doctoral School "Sciences Fondamentales et Appliquées" (ED.SFA: Fundamental and Applied Sciences), ED364, has had a wide experience in cosupervision of Ph.D. thesis since its beginning in 2000. Since then, a total of 38 Ph.D. thesis under co-direction, based either in the Partner Institution or directly inhouse, have been engaged. Of these, 21 are active, meaning that the international engagement is alive and growing steadily. Because of the ED.SFA's geographical location, Italy has always been a strong partner with 11 Ph.D. thesis already defended and 9 underway. As part of the French requirements for a Ph.D., a variety of courses are offered divided in 3 different groups: general background, specialty courses and professional courses. The former aim at broadening the knowledge of our students and are directly organized by the ED.SFA, whereas for specialty courses, UNS supports Summer Schools and similar initiatives. For professional courses, the "College des Etudes Doctorales" (Federation of the Doctoral Schools of the UNS) has developed a very strong offer with the help of professionals who typically intervene in the private sector with a similar offer.

The University of Nice-Sophia Antipolis will be engaged in providing all necessary support for this joint programme.

Sincerely yours,

Pr Albert MAROUANI 7.7.199 President of UNS University

GRAND CHÂTEAU 28 AV VALROSE • BP 2135 06103 NICE CEDEX 2

PART A: Identification of the applicant and other participating organisations								
Parts A and B must be filled in separately for each organisation involved in the project (including associated members). The application must be accompanied by copies of letters from the legal authority of each participating organisation confirming their support to the joint programme and their agreement with the submitted application (<i>not necessary for associated members</i>)								
		A. 1 ORGANISA				/		
Role in the co (leave the releva	onsortium nt role only)	 Applicant / Coordinating Organisation Partner Organisation Associated member 						
Official name organisation: If applicable, orga in latin characters	of the anisation's name s	UNIVERSITE DE NICE SOPHIA ANTIPOLIS						
Acronym:		UNS						
N° of the Eras Education Ins	mus University Char titutions only	rter (if applicable), for Eur	opean ⊦	lighe	er 2	8502		
Department, i	f applicable:	Présidence						
Official Addre	SS	Grand Château 28 avenue Valrose, BP 2135						
Postal Code:		06103 Town: NICE						
Region:		Country: FRANCE						
Internet addre	ess:	http:// portail.unice.fr						
Telephone 1:	+33492076460	Telephone 2:			Fax		+33492076510	
I	Name of the person entitle	A.2. LEGAL REPRES ed to legally commit the organis	SENTAT	IVE the co	ordinatii	ng organ	nisation	only)
Last Name:	Mr	MAROUANI		Fir	First Name:		ALB	ERT
Function:		PRESIDENT						
Address (Only address above):	if different from official							
	A.: (respons	3. CONTACT PERSON / able for the management of the	COORE project in	DINA the o	TOR rganisat	ion)		
Last Name:	Mr	COULLET		Fir	st Narr	ne:	PIEF	RRE
Function:		Professor of Physics						
@ : Pierre.CC	OULLET@unice.fr	Telephone: +33492076	6460	Fa	x numt	ber	+	33492076510
Address (Only address above):	if different from official	Présidence, Grand Ch BP 2135 F-06103 Nice	nâteau 2 e Cedex	8 av 2	enue V	alrose/		

PART B: Description of the Organisation				
B.1. NATURE OF THE ORGANISATION				
Status: (leave only the relevant status)	Public Private (an organisation which has received over 50 % of its annual <i>i</i> two years, or which is controlled by public bodies or their rep	revenues from public sources over the preceding resentatives can be declared as "public")		
Type of organisation: (leave only the relevant type(s))	 X Higher Education Institution HE research centre/organisation Private research centre/organisation Public research centre/organisation (not HE) Graduate/Doctoral School Public authority (local) Public authority (national) Public authority (regional) Chamber of commerce / crafts 	 Chamber of industry Enterprise large (> 500 employees) SME Professional associations Social partners (trade unions, etc) Assoc. of professors and researchers Assoc. of Universities / Research centres Other (please specify under B.2) 		

B.2.1 OKI OSE AND ACTIVITY OF THE OKGANISATION

Please provide a short presentation of your organisation in relation with the activities covered by the project and more particularly concerning its postgraduate (masters/doctorate level) and international cooperation activities (max. 20 lines).

-The University of Nice Sophia Antipolis is a young and dynamic French University with a complete cursus of possibilies:medicine, science, law, art and litterature. Nice is equiped with the second international french airport after Paris and the city is situated on on the head of mediteranean sea. This will facilitated the connection with other Institutions. The University is part of the recent french governement PRES (Pole de Recherche et d'Enseignement Superieur), called euromediteranean PRES for the specific relations with Italy and the countries in the border of the mediteranean sea. The University will benefit of the dynamism of the local region PACA which has invest a lot in new technology and space science. The technopol of Sophia Antipolis and Thales Alenia are examples. The university hosts the academic base of the present doctorate. It benefits from the presence of the astrophysics reserach institute of Observatoire de la Côte d'Azur involved in relativistic and non-photonic astrophysics: gravitational waves experiement, spatial mission like GAIA, best measurement of the earth-moon distance at Calern site, experiements in Antartic and for the european Very Large Telescope in Chile. With Nice University, the first european doctorate in Relativistic Astrophysics was born in 2002: the IRAP PhD program. Since 2002, 18 doctorates were form inside the international collaboration with Roma, Ferrara, Zurich, Berlin and Chambery.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

The Doctoral School "Sciences Fondamentales et Appliquees" (ED.SFA: Fundamental and Applied Sciences), ED364, has had a wide experience in cosupervision of Ph.D. thesis since its beginning in 2000. Since then, a total of 38 Ph.D. thesis under co-direction, based either in the Partner Institution or directly in-house, have been started. Of these, 21 are active, sign that the international engagement in alive and growing steadily. Because of the ED.SFA's geographical location, Italy has always

been a strong partner with 11 Ph.D. theses already defended and 9 underway.

As part of the French requirements for a Ph.D., a variety of courses are offered divided in three different groups: general background, specialty courses and professional courses. The former are aimed at broadening the knowledge of our students and are directly organized by the ED.SFA, while for the specialty courses we participate in supporting Summer Schools and similar initiatives. For the professional courses, the "College des Etudes Doctorales" (Federation of the Doctoral Schools of the Universite de Nice-Sophia Antipolis) has developed a very strong offer with the helpof professionals who typically intervene in the private sector with a similar offer.

B.3 OTHER COMMUNITY GRANTS (for the applicant organisation <u>only</u>)				
Projects related to the application (i.e. development/implementation of joint study programmes and/or management of scholarship schemes) and for which the applicant organisation has received financial support from the European Community during the last financial year.				
Programme or funding scheme	ID / Contract number	Project Title		
See Annexe 1				

PART C: Description of the Joint Programme

C.1.a For EMMCs ONLY

The full programme covers study months (excluding any academic break of one month or more) and ECTS credits (or equivalent; if another system is used, please specify under the relevant award criteria)

The joint programme will start in (month) of year "n" and will end in (month) of year "n + "; the end of the programme includes the graduation ceremony and communication of final results to the students; the end date cannot be later than October of "year n+1" – for one year EMMCs - or "year n+2" – for 2 years EMMCs - following the beginning of the programme.

Is the proposal a continuation of an existing EMMC:

• An EMMC? ; if yes, please specify hereafter the EMMC original title and acronym:

During their EMMC period, the students will study in <u>at least</u> different partner organisations.

Not counting the first "home university", the minimal mobility for each student will be months (corresponding to ECTS credits or equivalent)

C.1.b For EMJDs ONLY

The joint programme will be mainly laboratory based

(If the proposal is selected, the confirmation of laboratory or non laboratory based research will be applied individually to each fellowship candidate proposed by the consortium)

If applicable, the joint programme training / teaching period will last 36

(specify months, days, hours and/or ECTS credits).

Is the EMJD directly linked to:

- an EMMC? No; if yes, please specify hereafter the EMMC title and acronym:
- a Marie Curie Initial Training Network (ITN)?No; if yes, please specify hereafter the ITN title, name of the contracting organisation and agreement number

During their EMJD period, the candidates will visit <u>at least</u> 05 different partner organisations.

Not counting the first "home university", the minimal mobility for each doctoral candidate will be 07 months.

C.2. NUMBER OF STUDENTS / DOCTORAL CANDIDATES PLANNED TO BE <u>ENROLLED</u> IN THE FIRST EDITION OF THE JOINT PROGRAMME (applies to all students/doctoral candidate, with or without EM scholarship/fellowship)

Third Country Students / 9 doctoral candidates:	EU Students / doctoral 3 candidates:	
C.3 STUDY AREA / DOCTORAL RESEARCH DISCIPLINE		
Main Area (see annex 2 for List of thematic study fields).	13.07	
(if not listed please specify hereafter)		
Second Area (see annex 2 for List of thematic study fiel	ds): 13.02	
(if not listed please specify hereafter)		
Third Area (see annex 2 for List of thematic study fields)	2 13 . 05	
(if not listed please specify hereafter)		

C.4 STUDENT / DOCTORATE CANDIDATE PARTICIPATION COSTS IN THE JOINT PROGRAMME

Please indicate the estimated student/doctorate candidate participation costs in the joint programme during the first edition of the programme (these will be the costs advertised on the joint programme website in case of approval). Please refer to sections 4.4 (for EMMCs) or 5.5 (for EMJD) of the Programme Guide for the programme's maximum contribution to these costs

Participation costs for a Third-Country student/doctorate candidate (in euros)21600 /3 yearsParticipation costs for a European student/doctorate candidate (in euros)21600 /3 years

C.5 SUMMARY DESCRIPTION OF THE JOINT PROGRAMME

(max. 400 words)

Please provide a summary description of your joint programme covering aspects such as its objectives and main characteristics (content/research area, type of organisations and countries involved, duration, mobility options available for students/doctoral candidates, language(s), type of degrees awarded and any other information considered relevant for the description of the course/programme)

If your application is successful, this summary will be used as the official description of the Masters course/doctorate programme. It will be part of your grant agreement and published on the internet. You are therefore kindly requested to formulate it clearly and carefully and to provide this summary in English, French or German.

Following the successful scientific space missions by the European Space Agency (ESA) and the European Southern Observatory (ESO) in Chile, as well as the high-energy particle activities at CERN in Genève, we have created a Ph.D. program dedicated to the formation of scientists in the field of relativistic astrophysics. The students of such a program will lead the theoretical developments of one of the most active fields of research, based on the above observational and experimental facilities. This program needs expertise in the most advanced topics of mathematical and theoretical physics, and in relativistic field theories. It requires the ability to model the observational data received from the above facilities, as well as all the basic knowledge in astronomy, astrophysics and cosmology. This activity is necessarily international, no single university can cover the broad expertises. From this, the proposed program of the IRAP Ph.D., in one of the youngest and most dynamical French universities, pole of research and teaching in the Euro-Mediterranean region (PRES): the University of Nice. It benefits from the presence of the astrophysics research institute of Observatoire de la Côte d'Azur involved in relativistic and non-photonic astrophysics. The participation of the Freie Universitaet Berlin and of the Einstein Institute in Potsdam offers the possibility of teaching in relativistic field theories at the highest level. The University of Savoy offers the link to the particle physics at CERN. The activities at the University of Rome, at Stockholm University and at ICRANet offer teaching programs in all the fields of relativistic astrophysics, including cosmology, the physics of gravitational collapse, gamma-ray bursts, and black hole physics. Finally, the University of Ferrara will be present with lectures and researches in the topics they have pioneered such as x-ray astrophysics and observational cosmology. Through ICRANet the extra-European connections with Brazil, China and India will be guaranteed: in China, with the Shanghai Observatory of the Chinese Academy of Science, studying the formation and evolution of large-scale structure and galaxies; in India, with the Indian Centre for Space Physics (ICSP), renowned for its research on compact objects as well as on solar physics and astrochemistry; in Brazil, with ICRA-BR at CBPF, where a successful program of research and teaching in relativistic astrophysics has been established in recent years.

PART D: Technical Capacity

Consortium experience in the area of joint programmes and the specific study/research field of the project

 Provide a list of projects/activities implemented by the consortium organisations in relation with the proposal (title, duration, funding programme, partners involved, etc.)

Provide (in annex to the application) the CVs of the main actors (/team leaders) in the consortium participating organisations
 Every institution participating the consortium is recognised as having given contributions in research as well as in teaching PhD programs. Particularly relevant has been the creation since 2002 of the IRAP PhD program which has been the first PhD jointly recognized by the presidents and by the rectors of the following six universities:
 ETH Zurich, Freie Universität Berlin, Università di Ferrara, Università di Roma "La Sapienza", Université de Nice Sophia Antipolis, Université de Savoie. 34 students coming from all over the world have already been enrolled, 29 with fellowship given by the participating universities. Since 2005 the creation of ICRANet, the first

international organization dedicated to the study of relativistic astrophysics, has fostered these activities. All the above organizations, with the only exception of ETH Zurich, are participating to the present proposal.

PART E: Implementation of the Joint Programme

Provide a detailed answer to each of the specific questions listed under annex 1 and corresponding to the following award criteria:

EMMC		EMJD	
A.1) Course content	(25%)	B.1) Academic and research quality	(20%)
A.2) Course integration	(25%)	B.2) Partnership experience and composition	(20%)
A.3) Course Management, visibility and		B.3) European integration and functioning of th	е
sustainability measure	(20%)	programme	(20%)
A.4) Students' services and Facilities	(15%)	B.4) Provisions for EMJD candidates and	
		fellowship holders	(20%)
A.5) Quality Assurance and evaluation	(15%)	B.5) Programme Management and	
		Quality Assurance	(20%)
Answers must be provided in a separated	docume	ent, respecting the numbering of the questions a	nd in
15 to 20 pages maximum (annexes not inc	cluded)		

INTERNATIONAL RELATIVISTIC ASTROPHYSICS PHD

B.I Academic and research quality (20% of the max. score) Under this criterion applicants should specify/describe/justify,

B.I.I the needs analysis (including in socio-economic terms) of the joint programme taking into account the current state of the art in science and technology terms;

Why a Ph.D. program in relativistic astrophysics? The enormous conceptual revolution introduced by Albert Einstein with general relativity in 1916 was followed by meagre experimental verification and observational evidences extremely hard to be objectively assessed. In 1939 two extremely important contributions were made by Robert Oppenheimer and his students: the concept of massive neutron cores and the concept of continuous gravitational contraction following the process of gravitational collapse.

General relativity was also plagued by the enormous mathematical difficulty in solving the fundamental field equations. By 1955, the year of the death of Albert Einstein, only very few mathematicians were interested in general relativity and the physics community regarded with disdain all the attempts by Albert Einstein to unify the basic interactions.

Epochal changes start to occur with the discovery of quasars and especially by the discovery of an exact solution of the Einstein equations for a rotating object by Roy Kerr [Physical Review Letters, 11 (1963) 237]. Enormous momentum was gained by the discovery of the pulsar NP0532 in the Crab nebula, clearly pointing to the existence of the neutron stars postulated by Robert Oppenheimer and to the confirmation of the proposal by Baade and Zwicky [Physical Review, 46 (1934) 76] that both supernovae and cosmic rays originate from the process of collapse leading to the formation of a neutron star. Further momentum was gained by the work "Introducing the Black Hole" [Ruffini and Wheeler, Physics Today, January 1971, just reprinted in the April 2009 issue of Physics Today]. The introduction by Riccardo Giacconi of x-ray astronomy led to the discovery of a black hole in our galaxy [Riccardo Giacconi, Nobel lecture, 2002]. These events, and the discovery of gravitational waves by Joe Taylor in a binary pulsar, signed the clear becoming of maturity of the field of relativistic astrophysics: Einstein's theory, far from being a field of interest for a small number of mathematicians, had become the central theoretical framework for new chapters of astrophysics.

All these discoveries, with the sole exception of the introduction of Einstein's Theory in Germany, were actually achieved in the United States of America. Three of the participants to these discoveries are among the proponents of the present Ph.D. proposal: Riccardo Giacconi, Roy Kerr and Remo Ruffini. In the last 30 years, Europe has made enormous technological and instrumental progress with a very successful pan-European collaboration. The European Space Agency (ESA) has launched a total of 17 scientific satellites. This opens a new era for a continued story of Europe in space. The European Center for Nuclear Research (CERN) in Genève is leading the international scene of particle physics. The European Southern Observatory (ESO) has built the largest optical telescope in the world in Chile. These tremendous experimental and observational facilities give a new opportunity to approach some of the most profound issues in relativistic astrophysics. Such topics as the origin of the universe, the end of the life of the stars, a new understanding of the fundamental physical laws of the universe can now be addressed, but a new theoretical culture is needed. The new graduate students should master the mathematical aspects of the field theories. They should be at ease with the basic

understanding of the ultrarelativistic quantum phenomena. They should as well know the basic concepts of classical astronomy and astrophysics. In 2005 a new international organization dedicated to the theoretical aspects of relativistic astrophysics has been founded. Together with the University of Arizona, the University of Stanford and the International Centre for Relativistic Astrophysics (ICRA), the States of the Republic of Armenia, the Federal Republic of Brazil, the Republic of Italy and the Vatican are the founding members of ICRANet. As a first step of such an organization, the International Relativistic Astrophysics Ph.D. program has been established, founded by ETH Zurich, Freie Universität Berlin, Institut des Hautes Etudes Scientifiques, Observatoire de la Côte d'Azur, Università di Ferrara, Università di Roma "La Sapienza", Université de Nice Sophia Antipolis, Université de Savoie.

The present proposal is aimed at fostering this activity and extending this European collaboration to new European institutions such as the Albert Einstein Institute in Potsdam and Stockholm University and Tartu Observatory. In addition, it is planning to fortify the connections to three leading institutions in Brazil, China and India, who are collaborating successfully with ICRANet.

B.1.2 the objectives of the EMJD (including in terms of inter/multi-disciplinary, intersectorial and/or newly emerging fields);

The EMID intend to create the condition of high level education in Astrophysics in Europe to create a new generation of leading scientists in Europe. No single university in Europe today has the expertise required by the formation of such a new generation of scientists by itself. For this reason we have identified universities which offers a very great complementarity and selected as coordinator one of the youngest and most dynamical French universities: the University of Nice Sophia Antipolis. The University of Rome participates as well, with its large faculty, operating in many of these fields of research with its great tradition since the days of Tullio Levi Civita in the Mathematics department and Enrico Fermi in the Physics Department. The University of Ferrara, one of the oldest universities in Italy, where Nicolaus Copernicus was a student, and also one of the most dynamical ones in recent achievements in x-ray astronomy, is also participating to this project. The University of Savoie, one of the newest universities created to keep contacts with the particle physics activities developed at CERN, also participates. The Freie Universitaet Berlin also participates, where new theoretical approaches have been applied, ranging from the study of particle physics to solid state physics to economics. Also participating is Stockholm University, where novel interests in general relativity and in relativistic phenomena of gamma-ray bursts are reaching new important results. To these academic institutions, three research institutions are added: the Albert Einstein Institute in Potsdam, where some of the most profound implications of symmetries of the Einstein field equations are explored, with the goal of reaching a new unification of physical interactions; the Observatorie de la Cote d'Azur, where many topics of classical astronomy as well as new astrophysical space missions and non-photonic astronomy are being developed; Tartu Observatory where Prof. Einasto and his group have lead the study of the large scale structures of the Universe and finally ICRANet in Pescara, where some of the new theoretical approach on quantum field theory and general relativity are being developed and confronted with experts worldwide in an intense series of meetings and scientific encounters. The Faculty, made by Professors of these institutions, is in charge to follow the students in their three year cycle doctorate.

Particularly important are the researches in our partner centers in Brazil, China and India, where emerging new field of researches are occurring and a great opportunity of exchange between local and European scientists is going to be created both in teaching and in research.

Each student admitted to the Ph.D. will be part of a team inside a laboratory of our organization. Each

year they will have the opportunity to visit the other laboratories of the consortium and to learn new languages.

B.1.3 the joint programme's contribution to European education, research, excellence and competitiveness and its added value compared with existing programmes at national and international level

The aim of our Ph.D. program is to bring in direct contact some of the leading scientists in the world working in general relativity and in quantum field theory with the students. In addition to the theoretical centers, we associate experimental and observational centers. This will give to the Ph.D. students a complete education in theoretical relativistic astrophysics and also an experience on how to manage a specific astrophysical mission. In this sense, just to mention a few:

Felix Aharonian, from the Max Planck Institute and ICRANet, will deliver lectures on high energy gamma-ray sources from the HESS telescope;

Vladimir Belinski will deliver lectures on the classical BKL approach to the cosmological singularity;

Sandip Chakrabarti from the Indian Center of Space Physics will report on his classical work on accretion on black holes and neutron stars, as well as on a totally new field of exobiology;

Pascal Chardonnet will give lectures on particle physics applied to astrophysics;

Thibault Damour, member of Academie des Sciences and permanent professor at Institut des Hautes Etudes Scientifiques at Bures sur Yvette, will give a series of lectures on general relativity and gravitational waves emission process;

Jaan Einasto, one of the founders of the study of the large scale structure of the universe, will introduce his recent understanding of the cellular structure of the universe;

Filippo Frontera, the principal investigator of the BeppoSAX satellite, the satellite who revolutionized the gamma ray bursts physics, will share his unique experience to our PhD students;

Riccardo Giacconi, Nobel laureate 2002, will deliver lectures on the future missions to study x-ray clusters;

Roy Kerr will deliver lectures on the mathematical structure which have led to the discovery of the Kerr solution; it is appropriate here to remember that, with more than 2 millions of citations in the citation index, Roy Kerr is one of the most quoted scientists in the world;

Hagen Kleinert will present his unified approach to relativistic field theory, spanning from astrophysics to solid state physics, particle physics and financial markets;

Hermann Nicolai will present some developments on the classical BKL model, and its generalization toward process of unification in physical theories;

Mario Novello will bring his experience in teaching cosmology;

José Pacheco will give lectures on extragalactic astrophysics;

Remo Ruffini will give lectures on black holes and fundamental physics.

In addition to that, the Observatorie de la Cote d'Azur, with two permanent scientists and more than one hundred engineers and technicians involved in astronomy, astrophysics and geophysics, will give to the students a great opportunity to be in touch with the very important missions of ESO such as VLT and VLTI, the geodesical laser ranging activity to the moon and satellites, the present and future ESA missions like CoRoT and GAIA. These projects cross-benefit from other research areas like plasma physics (MHD), leading edge R&D for top-level instrumentation (interferometry, space-time metrology, optics and laser technology among others) and basic research in applied mathematics, physics and signal processing. The Observatory is already collaborating with major European and other non-European organizations as, for instance ESA, ESO, NASA, Polar Institutes, EGU and has developed a long tradition of forming graduate young students from all continents.

Each annual batch of students are part of an academic year of our Ph.D. each cycle during 3 years. Every year, all the students of a batch will be grouped in some of the organization partners to follow the lectures mentioned above in period of one month each. These sessions are a unique occasion to create a spirit of school inside our Ph.D. even if our students will be all over the institutions for their respective research. In this way they are part of a group and the Organization coordinator is in charge of supervising all the mobility of professors and students. During these month sessions, each student will present his personal research to the faculty and to the other students of the group. This is also the occasion to discuss together to our organization and have the feedback of our students.

All these opportunities are clearly added values compared with existing programs at national and international levels.

B.1.4 the scientific quality of the education, training and research programme, including its originality and innovative aspects notably as regards research methodologies and approaches (incl. training activities in core and transferable skills, articulation between education / training activities and the research part, participation of industry/public sector, etc.);

To educate students in the techniques of research we do systematically train students in the nature and organization of scientific projects. The future scientists have to assume leadership role in new investigations in astronomy and astrophysics.

New ideas are the key to moving science forward. Productive astronomers have the ability to envision and recognize the best ideas and they effectively implement research strategies to tackle them. However, designing, managing, and bringing a scientific project to completion requires more than original scientific thinking. It also requires project management skills which are well understood but are not currently taught in PhD programs.

Some of our graduate students will become scientists working for businesses, government agencies. In all the real world setting, the project management and leadership stills are paramount. We intend also adopt a pragmatic approach on education and train astronomers and astrophysicists for a wide range of career paths.

We have the chance in our organization to have a leading observatory in Europe: Observatoire de la Cote d'Azur. This institution is in contact also with the European Southern Observatory where the biggest telescope (VLT) and projects in astronomy (ALMA) are built. They have a great experience in managing projects. We want to develop competence in leadership and project management through one month stage of our PhD student in Observatoire de la Cote d'Azur (see annexe 4).

The Observatory will actively contribute to different areas of the EMJD training courses in the following areas: planetary science, including extra-solar planets, extragalactic astronomy and data analysis related to observational astrophysics. In addition an important number of senior scientists are willing to supervise or co-supervise Ph.D. level young scientists with the perspective to develop new international collaborative projects both in observational and theoretical fields. Indeed the institute will offer its major facilities (instruments, computing clusters, etc..) to support such educational and research programs. The Observatory has also a regional well established tradition of collaboration with local industries Thalès Alenia Space Cannes, SESO among others.

Every scientist who has undertaken a sponsored research project has experienced administrative and leadership tasks, such as planning budgeting, fundraising, distributing tasks, motivating and coordinating staff, and writing reports. This session at the Observatory could be the occasion for the student to approach: project management (experimental and theoretical), proposal writing as an example of project and presentation skills as an example of winning support for an idea.

B.1.5 the extent to which the programme includes inter-sector and inter-organisation collaboration and mobility (such as placements) to better address societal and economical needs and the graduates' employability issue;

In add to the theoretical formation, we need to take account in our PhD formation that the careers of scientists have changed. There is not only academia. Many of the future European space program will be collaboration with different partners and the size will be ever more demanding. We will prepare the future scientists in Europe to this reality.

B.1.6 the nature and quality of the expected innovative educational, scientific and technological outcomes, including in terms of skills and competences acquired; included in our organization institutions partners of these emergent countries.

By this innovative education proposal of the EMJD we expect the students to reach an unprecedented maturity: they will be exposed to some of the most outstanding teachers at international level; they will reach scientific competence in a variety of fields, all necessary in order to become autonomous in their scientific judgment; they will be acquainted with the most advanced technological developments; at the same time they will have a vast knowledge through their mobility program within other European institutions; finally they will be introduced to three of the most prestigious and advanced centers of researches in the fast moving developing world in Brazil, China and India.

B.2 Partnership experience and composition (20% of the max. score) Under this criterion applicants should specify/describe/justify,

B.2.1 the partners' (understood as both the institutions and the key academic, research and administrative staff) recognised capacity, expertise and experience to achieve the EMJD objectives;

All the institutions in the proposed EMJD have a great experience in international collaboration both with visiting professors, post-doctoral researchers and training Ph.D. students. All of our Partners have enrolled Ph.D. students inside their laboratories in various aspects of astrophysics. In addition, all the previous members of the IRAP-PhD program have successfully enrolled 34 graduate students over a period of 7 years, and they have delivered to them a common Ph.D. degree recognized by all the rectors or presidents of the participating universities.

The European universities of Berlin, Ferrara, Roma, Nice, Savoie and Stockholm have also the needed structures to organize courses at Ph.D. level through numerous qualified professors. In addition the non European partners will give expertises in their topics and could host Ph.D. students through mobility.

The High Energy Astrophysical Group of Ferrara University, developing Beppo-SAX satellite, have obtained the Bruno Rossi Prize in 1998 of the American Astronomical Society and the Descartes Prize of European Committee in 2002 for their contribution in solving a mystery of gamma ray bursts. Nice is the coordinating organization and we will use the "savoir faire" of the "Ecole Doctorale" in term of logistic and administrative experience on the management of Ph.D. students. We will enroll a secretary in charge of following all the activity of the Eramus Mundus in Relativistic Astrophysics. She/ He will be based in an office of Ecole Doctorale of Nice University. On this way, the secretary could benefit of the experience of all the others collaborators of this School to administer our Ph.D. students. She/He will in charge of following the administrative activities of our Erasmus Mundus in collaboration with all the services of Nice University. It is appropriate to mention that the Municipality of Nice has recently granted to ICRANet for 30 years the use of the prestigious Villa Ratti as a seat for its activities in Nice, a few hundred meters away from the University. Villa Ratti, as soon as it will be restored, will be the main location of coordination for the entire EMJD program (see annexe 8).

B.2.2 the diversity (in terms of countries / regions, types of organisation, etc.) and complementarity (in terms of education, training, research or dissemination/valorisation activities) of the consortium members:

The Ph.D. students will have the great opportunity to use the different geographical locations of the participating institutions, ranging from the Southern Europe (Italy) all the way to the Northern countries (Sweden, Estonia), with the participation of leading institutions in France and Germany. They will have also the possibility to interface in these Countries with academic institutions such as the universities of Berlin, Ferrara, Nice, Rome, Savoie and Stockholm, and with research institutions such as the Albert Einstein Institute in Potsdam, the Nice Observatory, the Tartu Observatory, and ICRANet. The complementarity of these two participating groups is also represented by the "bridges" created by the cooperation agreements already signed between the parts. As an example, we enclose the agreement signed between ICRANet and the Physics Department of the University of Rome and the one signed between ICRANet and the University of Nice (see annexe 9). These agreements, already implemented, are essential in creating opportunities for scientists of the research institutes to give

lectures in the universities within the Ph.D. program, and vice versa for the faculty of the universities to have a sabbatical leave for research in the research institutions.

The partner "Observatoire de la Cote d'Azur" has indeed such an agreement with the University of Nice, and it will provide lectures on Planetology, Extragalactic Astronomy and Data Analysis during the first year of our Ph.D. program. These courses will be organized one month in Nice Observatory. Analogous programs of one month length will be organized for the first year students at the University of Rome, with lectures on relativistic astrophysics, and for an additional month at the University of Berlin on quantum field theory and cosmology. In addition, weekly training in local language will be done in each institutions.

The second year students will receive training on project management and courses both at the Nice Observatory and at the University of Ferrara on Planetology. The Physics Department of Ferrara University has a long experience in X and gamma ray observations. Prof. Filippo Frontera who was the Pl of BeppoSAX will propose theoretical studies of compact sources and GRBs, as well as a direct contact with experimental research activities in space missions.

Students will have also the opportunity, in the second year, to spend one month in Stockholm University for lectures on general relativity and gravitational collapse. Particularly important are going to be the lectures in local languages and the weekly courses during all the three years. The official language of the present EMJD program is English, but the acquisition of at least one additional European language (French, Germany, Italian, or Swedish) is highly recommended.

Particularly noteworthy are the dissemination/valorization activities of the consortium, especially in Brazil, China and India. Particularly important are, in this respect, the encouraged publications on international refereed journals of research papers by the students and the active participation and presentation of work in all the major international meetings in Europe, Americas, and Asia.

B.2.3 the partnership track records in terms of networking and cooperation activities (through their joint involvement in EU/International research and/or education projects); if relevant, the added value of third-country organisations to the EMJD objectives and content;

There is a long tradition in astronomy of International collaboration all around the world. Our Ph.D. student will strongly participate of this reality. We have chosen three third-countries in our program. They represent the emergent countries with a great potential of development in science. Our attention toward these activities is well represented by the activities organized by ICRANet with the participation of students and faculty of the IRAP-PhD in 2009. Such activities will be fostered within the EMJD program in the future. We just mention the Second Kolkata conference on observational evidence for black holes in the universe (10-15 February 2008) and the Satellite meeting on black holes, neutron stars and gamma-ray bursts (16-17 February 2008) organized by our Indian partner in the present EMJD program ICSP (see annexe 10). The proceedings have just been published by the American Institute of Physics in the volume 1053 of the AIP Conference Proceedings Series. With Brazil, we recall the very successful activities organizing every two years the Brazilian School on Cosmology and Gravitation together with our Brazilian partner in the present EMJD program ICRA-BR, whose proceedings have been published by the American Institute of Physics in volumes 910 and 782 of the AIP Conference Proceedings Series (see annexe 11). Particularly relevant in this year of astronomy 2009, the celebration organized by ICRANet, an official institutional member of the celebration organized by Unesco and United Nation, of the 90th anniversary of the light deflection by the gravitational field of the Sun made in Sobral. This international conference will take place from the 26rd to the 29th of May (see annexe 12). We mention again for the year of astronomy 2009 the first international Xu Guangqi - Galileo meeting in Shanghai from 26th to 30th October 2009, coorganized by ICRANet and our Chinese partner in present EMJD program (see annexe 13). We finally mention also the first opening to the Austral-Asia scientific community with the meeting organized in Christchurch, New Zealand, from 16th to 18th December 2009.

B.2.4 the extent to which the partner teams demonstrate a high level of internationalisation (international staff, international activities, etc.);

A great attention to international collaboration is well rooted in our program. We promote sabbatical leaves of scientists from the Americas and Asian countries at ICRANet. Currently, graduate students from Belarus, Brazil, China are participating to our IRAP-PhD program. Among the many organized international meetings, there are the Italo-Korean meetings, organized every two years alternatively in Italy and in Korea, the Italo-Chinese meetings, held yearly at ICRANet, and the Stueckelberg meetings on the fundamental aspects of field theory, also held yearly at ICRANet. Particularly, we recall the major event which has been started 30 years ago by Abdus Salam and Remo Ruffini, the Marcel Grossman meetings on relativistic astrophysics, which have characterized the birth and followed the developments of relativistic astrophysics. These meetings occurs every three years and they have been held in Australia, Brazil, China, Israel, Italy, Japan, United States, and in this year 2009, in celebration of the International year of astronomy, in Paris in June (see annexe 14).

B.2.5 the role and appropriateness of the professional (/economic/scientific/cultural) sector participation in terms of activities and responsibilities, and the way this participation is formalised in specific arrangements and agreements covering issues such as co-funding, co-supervision, intellectual property rights, publishing possibilities, quality assurance, etc.

In astrophysical research there is a natural link between industry and research. The University of Ferrara has been a strong partner with industries in the aerospace sector, and so has been the Observatoire de la Cote d'Azur with a long tradition of collaboration with industries such as Aerospatiale and Thales. Similar activities have been promoted by the Tartu Observatory. All these experiences will be transmitted to our students.

In addition, we recall the agreements between CNRS and industrial partner to finance grant for Ph.D. student on specific research in developing prototype. We will also encourage some Ph.D. students to obtain a job in industry, related to the development done during their Ph.D. theses. This will be a powerful instrument, not only to have optimal economical reward but also to reinforce a virtuous contact between the world of research and the industrial reality. We would like also to mention a different aspect which is crucial. At ICRANet, electronic editing coupled with some of the leading publishing companies has been established. The students will participate to this activity and, again, be encouraged to have position in this very crucial field of "virtuous" collaboration with the industrial world in the publishing arena. All this is of course crucial not only for the scientific and economic aspects, but also for the broader cultural activities. It is important to stress, especially, in this respect the Marcel Grossman meeting in Paris, which will be held under the official heading of Unesco. Major publishing company have asked to be present and to put their stands at this event, which will become an emblem as well for our present EMJD program.

We will propose to have three members of our Quality Board designated by CERN, ESA and ESO.

B.3 European integration and functioning of the programme (20% of the max. score) Under this criterion applicants should specify/describe/justify,

B.3.1 the extent to which the EMJD programme is organised in a structured and integrated way ; exploiting current good-practices in terms of doctoral/ graduate/research schools or co-tutelle arrangements; providing a strong research environment capable to enhance excellence and international collaboration; ensuring full recognition - through ECTS or other built-in mechanisms - for all the training and research activities performed by the candidates;

Our proposition of EMJD programme is based on the 7 years experience of working together on a PhD programme in Relativistic Astrophysics. Our experience started with a common international agreement (see annexe 7) between Institutions. This agreement establish the role of the Faculty, a group of professor and senior researcher of all the Institution. This Faculty is the analogous of the French term "Ecole Doctorale". In the present application we propose to generalize this Faculty to all the partners of our Organization. This structure in term of Faculty is adapted to the diversity in terms of regions and institution types (both universities and research centers).

The Faculty is in charged of recruitment, selection criteria and supervision of all the Ph.D. students. Each student has, in addition of her/his Ph.D. director, a member of the Faculty which correspond to her/his tutor. The Faculty defines the courses of each year to be followed by the students. We have established a code for the Ph.D. student, which generalized the French "Chartre des theses" including all the duty and the law of the student. The Faculty organized meeting twice a year in the Coordinating Organization, first in order to select the Ph.D. student and second to follow the development of research of each student (see the rules of the IRAP PhD in the annexe 3).

Each year the students must follow training and learning activities for three months. These activities are developed in the annexe 4. In addition, in each place where the students are they follow local language lessons. We thought that for their future career it is important to give a solid background to our Ph.D. students in addition to their Ph.D. diploma. This is the reason why the third year is totally dedicated to the preparation of the thesis in the laboratories and in the universities in contact with major technological, scientific, editorial, processes. Only when all these procedures will be accomplished, the students will be able to submit the final discussion of the thesis.

B.3.2 the relevance and appropriate organisation of the mandatory mobility periods of the candidates in the participating institutions;

Clearly the mobility periods are of crucial relevance in our program: three months in the first year and three months in the second year. Equally important are the efforts to make all Ph.D. students fluent in English (mandatory) and in one additional European language. Each Ph.D: student will follow language courses every week. There is a well established procedure for this in all the participating institutions. For Italian at the universities of Ferrara and Rome, for French at the universities of Nice and Savoie, for Germany at the university of Berlin and we understand the same program is being started for us for Swedish a Stockholm university. Of course, this will be in parallel to the scientific activities which have been highlighted in the lectures proposed.

The last Ph.D. year will be also the occasion to chose a lab inside our network to spend one month without the supervisor. This will give to the student the occasion to present her/his results to other people and to finish the writing of her/his Ph.D. thesis in a different environment.

In addition to all this, every year the Faculty will have the opportunity to participate to the yearly meeting of the ICRANet scientific committee, actually chaired by Riccardo Giacconi (Nobel laureate 2002). This will give the opportunity to each student to outline her/his research activities and the progresses toward obtaining the final Ph.D. degree.

B.3.3 the common standards and mechanisms developed by the consortium for the application, selection, admission and examination of doctoral candidates (European and Third-Country), in order to ensure recruiting the best candidates; the extent to which these mechanisms are transparent, fair and objective; the provisions to take into account the equity issues, exploring alternative ways of recruitment and considering the LLL requirements;

Our experience of IRAP-PhD program tells us that we must rely on external advise and on reference letters by distinguished scientists who have been in contact with the candidate. In the case of IRAP-PhD program we have organized the selection as follow. Each year we have prepare a poster distributed in 2500 copies all over the world through universities and research centers. Associated with this call, we prepare an internet site: <u>http://www.icra.it/IRAPPhD/2008/Welcome.htm</u>. All information about our doctorate is presented including application and fellowship. The candidate fill in an application form online and requests the recommendation letters of at least two eminent scientists acquainted with her/his work.

At the end of the call, we send all the application form to the faculty members and then we start the selection by discussion via email. After a first selection made on basic criteria related to the relevance of the curriculum, we fix a date for a meeting of the faculty, where all the candidatures will be discussed. In addition to the examination of the reference letters, we proceed to have additional opinions by e-mails and by phone from eminent scientists. In necessary, in some cases we invite the candidate to give a seminar in one of the participating institutions or, alternatively, to participate to one of the international meetings we organize, for a direct interview. The final decision is taken by the Faculty. There is also the possibility to admit some students without fellowship, if the presence of satisfactory external financial resources is verified.

In this spirit, we will use our past experience. In add of this method, we have prepare a document in order to select candidates. This document is in annexe 1. This application form will be available for download on the internet site we will prepare. Among the requirements, there is a good level in English. These criteria are written in our application form.

B.3.4 the quality of the joint mechanisms envisaged to ensure a high quality supervision and monitoring of the candidate activities;

In supplement of the application form for the PhD, we have prepare a "Charter of Thesis" which is kind of student code of duties and rights. This document, once the student will be enrolled, must be signed by himself and his supervisor. In add of his supervisor, each student has a tutor inside the Faculty. In this sense, if the student have some difficulty with his supervisor, he could discuss them with the tutor.

Each year, all the students will present their research to the faculty, which will verify as well the satisfactory accomplishment of following the mandatory courses. The Faculty will recommend the continuation of the Ph.D. activities or, if necessary, the deepening of special scientific topics of learning.

B.3.5 the appropriateness of the joint assessment procedures (including the exams for the taught part and the assessment and defence of the thesis) to ensure the highest quality of the outcomes; if relevant, the extent to which assessment committees include external representation chosen at international level and/or non academic experts; the extent to which assessment criteria include compulsory publication requirements and/or an evaluation of the potential contribution of the candidate's work to innovation.

Our aim is to contribute to the excellence in Europe in Astrophysical Research and Education. Each of our students should be familiar with the fundamentals of mathematical physics, theoretical physics, as well as astrophysics. This is why we have prepared this seminar week to be sure that every Ph.D. cycle will be able to deal with all aspects of theoretical astrophysics without hesitation. In addition to the teaching and learning procedures, it will be held a weekly seminar, electronically broadcasted among the participating institutions of the EMJD program. Such seminars can be delivered by students, to verify their ability to approach a wide class of astrophysical problems without hesitations. This correspond to an ongoing procedure to verify the thought part of the learning procedure.

For the final exam, the Ph.D. thesis defense is held in the host institution. The examination committee for each student is formed by the tutor, four professors of the Member institutions and an expert from a university or research center from a country different from the one of the host institution. The examination committee is appointed by the Faculty. The judgment of the examination committee is transmitted to the rector, the president or the director of the host institution. In case of positive judgment, the candidate receives the Ph.D. degree from all the Member institutions.

B.3.6 the kind and nature of the degree(s) awarded and and, if applicable, the measure taken or envisaged by the consortium to deliver a fully accredited and recognised joint degree;

Our IRAP-PhD program has a joint Ph.D. diploma. We expect also in the present EMJD the Stockholm University to join and sign such an agreement. Therefore we are planning for a joint Ph.D. diploma

B.4 Provisions for EMJD candidates and fellowship holders (20% of the max. score) Under this criterion applicants should specify/describe/justify,

B.4.1 the information and promotion strategy envisaged by the consortium to reach out potentially interested candidates and more particularly from third-countries;

We shall follow for information and promotion strategy the well verified and successful procedure adopted for the IRAP-PhD already mentioned above. This will include electronic mailing announcements to organizations usually addressing this problem in relativity, in the astroparticle physics and in the astrophysics community. In addition, we will send worldwide 2500 copies of our posters. This will include, in addition to the scientific and university communities, also the Consulates of the European countries all over the world. Of course, one of the major and most successful approach to contact young candidates, is to invite their participation to scientific events organized by all the Member institutions. We will make sure that, in each one these event, the EMJD program will be well advertised and present

B.4.2 the quality and nature of the services provided by the consortium to host doctoral candidates (housing facilities, coaching, language courses, activities aiming at social integration, assistance with visas and social insurance); the extent to which specific services are available for grantees with a family or with special needs

We have analyzed in which why the social insurance could be better for the all the student of our Ph.D.. The best way is to make an administrative registration of all of them in Nice University coordinator partner. In such a way, the student of our program of any nationality could be part of French "securite sociale" for 205 euro per year. With this he will acquire a European social security card. We have study in detail the way to have a better insurance. It exists two pack for students under 28. The European pack with a prize of 207 euros per year covers them all over in Europe. The world pack is the complementary for the rest of the world and it cost 400 euros.

The Universities of our network will provide house facilities for their Erasmus Mundus Ph.D. students. During mobility of the Ph.D. students, the lodging will be provide by the institutions in charge of the courses. The travel expenses of the mobility period is also take account as presented in the annexe 6. This is part of our expenses for the program.

The language courses are also paid, where needed, by the network for each students as well as specialty and professional courses.

Since the Ph.D. student will be enrolled under 3 years contracts, we will need scientific visa. The secretary in Nice in charge of our program will provide the help in following the administrative procedure with the candidates and with the French Consulates in the world. She could also use the experience on this point from the Ecole Doctorale and Service des Relations Internationales.

B.4.3 the way the linguistic aspects of candidates' mobility have been addressed (e.g. training facilities, mentorship, local language learning, etc.) and the specific language policy in place in the joint programme (e.g. integration, availability, costs coverage, recognition of the language courses in the joint programme); the way the consortium intends to meet the objective to offer candidates the possibility to use at least two different European language

Each student will be required to be fluent in English, since this is the official language of our doctorate. Where necessary, specific courses will be organized with high priority. In addition, in each institution where the Ph.D. thesis is prepared, the students will follow local language lessons. At the completion of her/his Ph.D. program, each student must be fluent in an European language in addition to English.

B.4.4 the extent to which administrative arrangements are foreseen to address the candidates' rights (including health care, social security and pension rights) and the extent to which employment contracts are used to appoint the candidates;

The student will benefit of a contract with the university of Nice for a period of 3 years. This contract will detail the social security and pension rights.

B.4.5 the relevance of the measures taken to deliver the fellowship scheme, and in particular for the distribution of grantees between institutions and the financial management of fellowships;

For the financial balance, we have prepare a table in order to precise the charge related to the mobility, the courses and the local expense of the institutions.

B.4.6 the measures taken by the consortium to ensure the candidate's career prospects and to monitor his/her career development once graduated;

The future career of the Ph.D. students is part of our engagement. In fact in the Charter of Thesis we have a part related to the post-thesis period where we will follow his activities and help him through associations like Bernard Gregory.

In addition the University organizes every year a special week in order to discover the industry. We will associate our PhD students to these activities.

The continuous contacts between our former IRAP-PhD and the graduate school has been well established and successful. Former students are invited to give lectures during the following years of their graduation in our weekly seminars, in order to make the students and the Faculty acquainted with their successful path in science, or in the industrial world, or in the publishing activities. These experiences have been extremely important for the morale of the students and for the Faculty. We

plan to continue them in the EMJD program.

B.4.7 the nature and comprehensiveness of the Doctoral Candidate Agreement defining the joint course implementation rules and mechanisms as well as the mutual rights, obligations and responsibilities of the two parties for what concerns the academic, research, administrative and financial aspects of the candidate's participation in the joint programme; the extent to which the consortium adheres to and implements the European Charter for Researchers and the Code of Good Conduct for the Recruitment of Researchers;

For this part we have the Charter of Thesis which precise the mutual rights and obligations. It is in annexe 3. It is a document signed by the student and by his supervisor.

B.5 Programme Management and Quality Assurance (20% of the max. score) Under this criterion applicants should specify/describe/justify,

B.5.1 the quality of the organisational arrangements and cooperation mechanisms within the consortium (degree of institutionalisation, financial and human resources allocated to the programme, existence of management and supervision board, clearly defined and active role of all partners, established feed-back system, existence of detailed partnership agreements covering the academic, scientific and administrative aspects of the Programme, etc.) and the specific role played by each of its members.

For the reasons already mentioned, we have centered our Ph.D. program at the University of Nice. The central location, the excellent transportation facilities, including an international airport, the electronic communication backbones, the attention of the Municipality and all local Institutions to these activities are reasons to be confident in a successful outcome. The main supporting structure for the previous Ph.D. program, the IRAP-PhD, has been ICRANet, which is linked to the University of Nice by an already mentioned cooperation agreement. ICRANet, as well as all the previous IRAP-PhD partners are all participating in the EMJD program. These institutions will participate actively with financial and human resources also by providing a full time secretary detached in Nice for this EMID. She/He will be in contact with the staff of the other organizations and her/his role will be to synchronize the cooperation around our EMID within the framework of each administrative constrains of the partner organizations. She/He will be using all the experience of the services of Nice University such as Relations Internationales, Agent Comptable, Ecole Doctorale acting for the benefit of the EMJD program. The other partner institutions will naturally collaborate with the secretary. One of the first missions of the Faculty, before the selection of the candidates, will be to organize such a local cooperation with the EMID, in order to have a harmoniously collaboration between countries of different administrative rules and the local structure at the University of Nice. This process is essential in order to work with efficiency and maximizing positively all the national and international connections.

In summary, our administrative structure is centered around an administrative manager in Nice which is in direct collaboration with other secretarial and administrative branches in Nice as well as in each participating institution. The Faculty, which has already a long experience of positive collaboration together within the IRAP-PhD, will be certainly able to fulfill this task.

B.5.2 The way participations costs in the joint programme have been calculated; if differences exist between Third-Country and European candidates, the reasons for such differences; in which way will these costs will be distributed among the participating institutions;

Astrophysics is an observational science and so we have naturally a laboratory based EMJD. We don't want to have segregation between students and so will propose a unique participation coast of 600 euro per month. This money will the consortium to prepare the mobility periods and the high level formation as explained in annexes 4,5 and 6.

B.5.3 the consortium development and sustainability plan designed to ensure the proper implementation and continuity of the joint programme beyond Community funding (including implementation timeline, enrolment projections, mid and long term potential benefits for the institutions involved, etc.); the way this plan involves not only the consortium members but also other public and/or private organisations in the countries concerned (and in particular associated members);

As already mentioned, our IRAP-PhD program has been operative since 2002, and it has seen the participation of 8 new graduate students registering every year and reaching a joint degree. The aim now is threefold:

I) to keep this program going, enlarging its participation to the new entrance of the Albert Einstein Institute in Postdam and of the Stockholm University;

2) to double in three years the number of students, thanks to the EMJD program;

3) the expand our activities both toward other European countries and toward our partners in Brazil, China, India.

If this program will be successful, we are confident that a new standard of young scientists will be created and will be strongly requested for future works in European institutions as well as in the partner institutions abroad. We are thinking to create a precious "scientific reservoir" of high level young scientists which will have a tremendous impact in the further developments of scientific and industrial activities in Europe but will be especially meaningful also in the three extra European countries participating with us. Prof. Chakrabarti in his form, stresses the crucial role his Center may play in the scientific development in South-East Asia countries. Prof. Jing Yipeng well represent a successful story of our many activities in China. With a scientific base developed in Italy, he has created the most successful activity on relativistic astrophysics in China. Finally, the recent entrance of Brazil into ICRANet gives the great opportunity to new agreements of ICRANet with local Governments and scientific institutions in Brazil to open three additional Centers devote to relativistic astrophysics in addition to the one in Rio.

For all this, the role of EMJD at this moment is crucial and essential. If this possibility will be granted, scientific activities with a new imprint of European activities will be known internationally, fostering very successful and similar positive examples in the past history of science.

B.5.4 the nature of the internal evaluation (by the institutions themselves, through candidates/ scholars feed-back systems, etc.) and external quality assessment (by e.g. national, international or professional bodies) envisaged;

We think to implement the internal evaluation and external quality assessment by co-opting three experts from Europe, one from ESA, one from ESO and one from CERN. Three additional experts will be co-opted from the third countries partner in our EMJD program. We also plan to have consistent and monitoring support from the scientific and visitor committees of the four research institutions which are partner in the present proposal: the Albert Einstein Institute in Potsdam, ICRANet, the Observatoire de la Cote d'Azur and the Tartu Observatory.

B.5.5 the extent to which complementary funding possibilities have been explored and secured, in particular to provide additional (full or partial) fellowships to doctoral additional candidates and, if applicable, to top up the difference between the fixed programme contribution to the candidates participation costs and the actual cost for the consortium

All the institutions already participating in the IRAP-PhD will secure the funding of the fellowships of their program joining the ones guaranteed by the possible funding of the EMJD program. In such a merging, we are sure to reach the goal we have established in the previous point and so reaching the long term potential benefit for all the involved institutions.

B.5.6 the way the consortium intends to address issues such as gender balance and the access to the programme by candidates with special needs.

We have long experience in this respect. The IRAP-PhD has seen the participation of an equal number of male and female students, with two of the women coming from Lebanon and Pakistan. In addition, one of the success story of the ICRANet activities in Rome has been the one to guarantee the teaching and research activities of a visually impaired theoretical physicists who has been successful in advising a large number of students in the IRAP-PhD program.

The joint programme will result in the award of

a joint degree

PART F: Degree(s) awarded

To be filled in for each dearee awarding organisation

		-	1	
		Type	Reco	gnition status ¹
e awarding ition	Official name of the degree in national language (and in English)	 Part of double degrees Part of multiple degrees Joint degree 	Already recognised?	Expected recognition date <u>OR</u> validity end date (/ next review date)
Antipolis	Docteur de Recherche en Astrophysique Relativiste (PhD in Relativistic Astrophysical)	a joint degree	No	2010
	Docteur de Recherche en Physique Theorique (PhD in Theoretical Physics)	a joint degree	No	2010
apienza	Dottore di Ricerca in Astrofisica Relativistica (PhD in Relativistic Astrophysics)	a joint degree	No	2010
	Dottore di Ricerca in Fisica (PhD in Physics)	a joint degree	No	2010
	Filosofie doktorsexamen (Doctor of Philosophy Degree)	a joint degree	No	2010
i	Doktor rer.nat. (PhD in Natural Things)	a joint degree	No	2010

Check list and Declaration of Honour by legal representative of applicant organisation

To be completed by the person legally authorised to sign on behalf of the applicant organisation, as defined in Part A.2 of the application form.

he application is completed in full. All questions have been answered.	Ó
ach page has been numbered.	内
he application has been typewritten or word-processed.	[]
opies of letters from the appropriate authorities of each institution participating in the Masters Course and Joint rogramme, confirming their agreement with the application as submitted are attached.	
ne original application has been signed by the legal representative of the co-ordinating institution and stamped. (Please one that scanned coloured copy of the signed application is not accepted as original)	Ŀ
ne original application and 2 copies thereof are being sent to the address indicated on page 1 of the application form rexpress mail, in the same envelope and before the closing date.	Ċ)
ne original application is being sent to the e-mail address indicated on page 1 of the application form by e-mail.	L
aper and electronic copies of this application are being sent to the National Structures in the countries of each of the propean participating institutions before the closing date.	Ú

the undersigned, certify that all information contained in the Erasmus Mundus 2009-2013 Action - Joint programme application named iroject title" International Relativistic Astrophysics Doctorate Program, including the description of the project, is correct to the best of y knowledge and that I am aware of the content of the annexes to the application form.

confirm that my institution/organisation has the financial and operational capacity to carry out the proposed project.

ake note that under the provisions of the Financial Regulation applicable to the general budget of the European Communities, grants⁽²⁾ ay not be awarded to applicants who are in any of the following situations:

are bankrupt or being wound up, are having their affairs administered by the courts, have entered into an arrangement with creditors, ave suspended business activities, are the subject of proceedings concerning those matters, or are in any analogous situation arising om a similar procedure provided for in national legislation or regulations;

have been convicted of an offence concerning their professional conduct by a judgment which has the force of res judicata;

have been guilty of grave professional misconduct proven by any means which the contracting authority can justify;

have not fulfilled obligations relating to the payment of social security contributions or the payment of taxes in accordance with the gal provisions of the country in which they are established or with those of the country of the contracting authority or those of the puntry where the contract is to be performed;

have been the subject of a judgment which has the force of *res judicata* for fraud, corruption, involvement in a criminal organisation any other illegal activity detrimental to the Communities' financial interests;

following another procurement procedure or grant award procedure financed by the Community budget, have been declared to be in rious breach of contract for failure to comply with their contractual obligations;

in their grant application, are subject to a conflict of interest;

in their grant application, are guilty of misrepresentation in supplying the information required by the contracting authority as a indition of participation in the grant award procedure, or fail to supply this information.

confirm that neither I nor the institution for which I am acting as legal representative are in any of the situations described above, and at I am aware that the penalties set out in the Financial Regulation may be applied in the case of a false declaration.

the event that my application is successful, I am aware that the Education, Audiovisual and Culture Executive Agency / European ommission will publish on its website or in any other appropriate medium the name and address of the beneficiary of the grant, the bject of the project, the future grant awards;

leclare that the organisation I represent is (please tick as appropriate):

Albert MAROUANI

a public body $(^3)$

a private body which has financial and operational capacity to carry out the proposed action or work programme and is able to provide a Bank Guarantee for the amount of the 1st (and 2nd, if applicable) pre-financing payment(s), should the Education, Audiovisual and Culture Executive Agency request so.

signing this application form, I accept all the conditions set out in the Erasmus Mundus 2009-2013 Programme Guide and the Call for oposals EAC/04/2009, including the general conditions published on the Education, Audiovisual and Culture Executive Agency's bsite. I also declare that all the partners participating in this project have agreed with the content of the application and have confirmed ir intention to carry out the tasks described accordingly.

one at: ignature: <u>Présid</u> ent de l'Université ame and position in ca pitals: <u>Crésid</u> ent de l'Université	Date $29/34/2009$ (day/month/year) Stamp of the applicant organisation
	5/ 1



Council Regulation (EC, Euratom) No 1605/2002 (OJ L 248 of 16.09.2002), amended by Regulations (EC, Euratom) No 1995/2003 (OJ L 390 of 30.12.2006) and (EC) No 1525/2007 (OJ L 343 of 27.12.2007). These can be consulted in the Official Journal online at: <u>http://europa.eu.int/eur-lex/ack/en/index.htm</u>. For the Erasmus Mundus Programme, considered to be public bodies are all higher education institutions specified by Member States (participating countries), and all institutions or organisations which have received over 50 % of their annual revenues from public sources over the last two years, or which are controlled by public bodies or their representatives.

Der Kanzler

Berlin

Kaiserswerther Str. 16-18 14195 Berlin Germany

Telefon: +49 30 838-53443 Fax: +49 30 838-53448 E-Mail: Claudia.Christmann@fu-berlin.de Internet: www.fu-berlin.de

Bearb.-Zeichen: VI C DMV 7 Bearbeiter: Ms. Christmann

27. April 2009

To whom it may concern,

Freie Universität Berlin, - Der Kanzler -

Kaiserswerther Str. 16-18, 14195 Berlin

The Physics Department of the Freie Universitaet Berlin will actively participate in the European Programme Erasmus Mundus Joint Doctorate (EMJD) in Relativistic Astrophysics as a European Institution Partner.

Freie Universität

The research and education required by the joint programme will be carried out within the Doctorate Program in Physics led by Prof. Dr. Dr. h.c. mult. Hagen Kleinert. The research activity of the Doctorate students of this program will be carried out in the Physics Department. The Freie Universitaet Berlin welcomes this initiative which will link its Physics Department to a large number of prestigous international research centers.

For the institution (applicant legal entity)

Peter Lange Director of Administration and Finance Email: Claudia.christmann@fu-berlin.de

FREIE UNIVERSITÄT BERLIN DAS PRÄSIDIUM

Abt.: VI – Drittmittelverwaltung DMV Kaiserswerthe: Str. 16-18, 14195 Berlin Dienstgebäude: Rudeloffweg 25-27
		A. 1	ORGANI	SATION	I			•		
Role in th		Applicant / Applicant /	Coordinat	ing Orgi 🛋 /	anisa	ition	nemb	er		
Official na organisati	ame of the on:	Freie Universität Berlin								
Acronym:		FUB								
N° of the I Higher Ed	Erasmus University (lucation Institutions c	Charter (if applionnly	cable), for	Europe	an	28 E	8233- UC-1	IC-1-2	2002-1-FR Erasmus-	
Departme	ent, if applicable:	Institut für Th	neoretische	e Physik	(
Official Ac	ddress	Arnimallee 14								
Postal Co	de:	14195		Town	:	Berlin	erlin			
Region:				Count	ry:	Germany				
Internet a	ddress:	http://www.ph	ysik.fu-ber	lin.de						
Telephon	e 1:		Telephor	ne 2:			Fax			
	Name of the person en	A.2. LEG	AL REPRE	ESENT/	ATIV for the	E coordina	ating or	rganisat	tion only)	
Last Name:	Mr, Ms	Lenzen			Fir	irst Name:			er	
Function:		PRESIDENT								
Address (Only if different from official address above):										
	(respc	A.3. CONTACT	PERSON pagement of t	l / COO he projec	RDIN t in the	IATOR e organis	ation)			
Last Name:	Mr, Ms	Kleinert F			Ha Fir	igen st Nam	e:			
Function:		Professor of	Theoretica	l Physic	cs		1			
@:kleinert@	physik.fu-berlin.de	Telephone: -	+49308385	53034	Fax nui 083	x mber:+4 856510	193			

PART B: Description of the Organisation							
	B.1. NATURE OF THE ORGANISATION						
Status: (leave only the relevant status)	Public Private (an organisation which has received over 50 % of its annual r two years, or which is controlled by public bodies or their repr	revenues from public sources over the preceding resentatives can be declared as "public")					
Type of organisation: (leave only the relevant type(s))	 X Higher Education Institution HE research centre/organisation Private research centre/organisation Public research centre/organisation (not HE) Graduate/Doctoral School Public authority (local) Public authority (national) Public authority (regional) Chamber of commerce / crafts 	 Chamber of industry Enterprise large (> 500 employees) SME Professional associations Social partners (trade unions, etc) Assoc. of professors and researchers Assoc. of Universities / Research centres Other (please specify under B.2) 					
	B.2. PURPOSE AND ACTIVITY OF THE ORGAN	JISATION					

The research group at the Freie Universität Berlin is internationally known for its research and teaching in quantum field theory with applications to a wide range of physical phenomena. The group uses the modern techniques of functional integration and develops analytic as well as numeric approximation procedures, extending and improving greatly seminal work which the contact person did in collaboration with the late American physicist and Nobel Laureate Richard Feynman. The range of applications includes nuclear physics, quark physics, solid state physics, liquid crystal physics, string theory, and financial markets.

Within the project which may run under the title « From the Nuclei to the Stars », the process of pair creation in strong electric and gravitational fields plays an essential role. The star formation will modelled by an extension of the Oppenheimer-Volkoff model of gas stars by including nuclear forces so that the star appears as a natural continuation of nuclei beyond the instability region of superheavy nuclei. In a first stage, the theory will have the following key ingredients: 1.) Fermi seas of neutrons, protons, and electrons whose Fermi levels account for the weak transitions between these particles. 2.) The electric field to account for the Coulomb energy. 3.) A scalar field, an omega field, and a rho field to account for the strong nuclear forces so that small lumps of nucleons form proper nuclei whose masses satisfy the Bethe-Weizsäcker mass formula. 4.) The metric of general relativity and an Einstein-Hilbert action to take care of the proper gravitational forces. Therein, the theory of spontaneous symmetry-breaking transitions is important since the nucleon mass will be different inside and outside the nuclear matter. At higher pressures, the nuclear matter will become quark matter and will therefore be described by a chirally-symmetric effective Lagrangian of the type that the contact person derived from quark theories by Hadronization in the seventies.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

The Berlin group will contribute to the project courses in quantum field theory taylored to the application in astrophysics. In particular, the field-theoretic formulation of the extension of nuclear physics to stellar physics will be formulated in a consistent field-theoretic way with a special emphasis on the theory of critical phenomena. To this end the theory of phase transitions in condensed matter physics will be taught in such a way that the students can apply it to nuclear matter physics. In order to exercise the students in phase transitions that can be compared with experimental results at all stages, they will be taught the instructive example of the theory and experiments of Bose-Einstein condensation in both magnetic traps and optical lattices. Particular attention will be paid to train the students in delivering well-understandable presentations of their results.

MAX-PLANCK-INSTITUT FÜR GRAVITATIONSPHYSIK (ALBERT-EINSTEIN-INSTITUT)



MPI für Gravitationsphysik, 14424 Potsdam, Germany

Prof. Pierre Coullet
Université de Nice Sophia Antipolis
Présidence (Dossier Erasmus Mundus)
Grand Château
28 avenue Valrose
BP 2135
F-06103 Nice Cedex 2
FRANCE

 Prof. Dr. Hermann Nicolai

 Tel.:
 +49 (331) 567-7216

 Fax:
 +49 (331) 567-7297

 E-Mail:
 hermann.nicolai@aei.mpg.de

 http://www.aei.mpg.de

April 29, 2009

Letter of intent

The Albert Einstein Institute will actively participate in the joint programme « Erasmus Mundus Joint Doctorate (EMJD) in Relativistic Astrophysics » as an European Institution Partner.

The research and education required will be carried out by the Department of Quantum Gravity and Unified Theories led by myself. The Albert Einstein Institute will provide all necessary support for this joint programme.

Sincerely yours,

H Nicola

Prof. Hermann Nicolai Director

	A. 1 ORGANISATION								
Role in th	e consortium	🔹 App	licant / Coordinat	ing (Organi	isation	, i		
(leave the re	elevant role only)	🌒 Pa	rtner Organisation		🛎 Ase	sociate	ed me	ember	f
Official na organisati	ame of the ion:	Max Pla	nck Institute for Gravi	tation	al Phys	ics (Alb	ert Ein	istein Ir	nstitute) – Potsdam
If applicable, name in latin	organisation's characters								
Acronym:	Acronym: AEI – Potsdam								
N° of the Higher Ec	Erasmus University (lucation Institutions o	Charter only	(if applicable), for	Euro	opean				
Departme	ent, if applicable:						•		
Official A	ddress	Am Mi	ihlenberg 1						
Postal Co	ode:	14476		То	wn:	G	GOLM		
Region:		GERMAN Country:			ANY				
Internet a	ddress:	ldress: http://www.aei.mpg.de							
Telephon	e 1:+49-331-567-0-		Telephone 2:		Fax n	numbe	r:	+49- 7297	-331-567 - 7 / 7298 / 7699
	Name of the person en	A. titled to le	2. LEGAL REPRI gally commit the orga	E SE I nisatio	NTAT on (for t	IVE the coor	rdinatiı	ng orga	anisation only)
Last Name:	Mr	NICC	LAI		First Name:				HERMANN
Function:		Director of Quantum Gravity Division							
Address (official addr	Only if different from ess above):								
	(respo	A.3. CO	NTACT PERSON	I / C the pr	OORE	DINAT the org	OR Ianisat	ion)	
Last Name:	Mr	NICOLAI			1	First N	lame	:	HERMANN
Function:		Direc	tor of Quantum G	ravit	y Divis	sion			
@ : hermann.	: Telephone: rmann.nicolai@aei.mpg.de +49 (331) 567				F	=ax nu	Imbei	r	+49 (331) 567-7297
Address (official addr	Only if different from ess above):				<u> </u>				

	PART B: Description of the Organisation						
	B.1. NATURE OF THE ORGANISATION						
Status: (leave only the relevant status)	É Public É Private (an organisation which has received over 50 % of its annual r two years, or which is controlled by public bodies or their repr	revenues from public sources over the preceding resentatives can be declared as "public")					
Type of organisation: (leave only the relevant type(s))	 X Higher Education Institution X HE research centre/organisation Private research centre/organisation Public research centre/organisation (not HE) Graduate/Doctoral School Public authority (local) Public authority (national) Public authority (regional) Chamber of commerce / crafts 	 Chamber of industry Enterprise large (> 500 employees) SME Professional associations Social partners (trade unions, etc) Assoc. of professors and researchers Assoc. of Universities / Research centres Other (please specify under B.2) 					
	B.2.PURPOSE AND ACTIVITY OF THE ORGAN	IISATION					

During the last years, significant progress has been achieved in the development and generalization of the BKL (Belinski, Khalatnikov, Lifshitz) Theory of cosmological singularity. Since the behaviour of the universe at the initial stage of its evolution determines essentially also the late aspects of cosmology, such a topic is a must for a complete scientific program of research and teaching in Relativistic Astrophysics. Since the year 2000, a series of works have developed a new effective description of the BKL theory using the notion of the so-called "Cosmological Billiard". This research began in France at the Institut Hautes Etudes Scientifiques (IHES) lead by Thibault Damour, at the University of Bruxelles lead by Marc Henneaux, and in Germany here at the Albert Einstein Institute Potsdam under Hermann Nicolai. This work has lead to the discovery of very interesting hidden symmetries describable by an infinite-dimensional hyperbolic Lie Algebras of the type discovered forty years ago by V. Kac and Moody. The results can lead to modifications in the standard Big Bang Theory as well as to new approach of unification of fundamental interactions. Aspects connected to Quantum Field theory will be developed in contact with the Freie Universitaet of Berlin. The astrophysical aspects will be discussed with all the partners of the IRAP PhD program. The graduate students will be able to follow courses delivered by the Faculty of the Einstein Institute in the IRAPPhD and do their research works in any of the participating institutions including the Einstein Institute in Potsdam.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

Do research on Cosmology close to the initial singularity including: 1) rigorous mathematical analysis of the appearance of the asymptotic billiard structure, 2) construction of the integrable supersymmetric models in the vicinity of the singularity, 3) clarification of the integrability of the equation of motion of the theory with clarification of the role of the Kac Moody symmetry



Università degli Studi di Ferrara

RIPARTIZIONE DIDATTICA E SERVIZI AGLI STUDENTI

Ufficio Mobilità Internazionale e Studenti Stranieri



Ferrara April 15th, 2009

To whom it may concern,

The Physics Department of the University of Ferrara will actively participate in the joint programme "Erasmus Mundus Joint Doctorate (EMJD) in Relativistic Astrophysics" as a European Institution Partner.

I am aware of its application.

The research and education required by the joint programme will be carried out within the Doctorate Program in Physics, curriculum of Astrophysics, led by Prof. Filippo Frontera. The research activity of the Doctorate students of this program will be carried out in Physics Department. The University of Ferrara will provide all the necessary support for this joint programme.

Sincerely yours,

Prof. Patrizio Bianchi RECTOR

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PART 4	PART A: Identification of the applicant and other participating organisations								
Parts A and E members). Th participatin	Parts A and B must be filled in separately for each organisation involved in the project (including associated members). The application must be accompanied by copies of letters from the legal authority of each participating organisation confirming their support to the joint programme and their agreement with the submitted application (not necessary for associated members).					luding associated authority of each reement with the			
A. 1 ORGANISATION									
Role in the cc (leave the releva	onsortium ant role only)	Applicant /Partner Or	 Applicant / Coordinating Organisation Partner Organisation Associated member 						
Official name of the organisation:									
in latin characters	anisation's name s								
Acronym:		UNIFE							
N° of the Eras Education Ins	smus University Char stitutions only	rter (if applicabl	le), for Eur	opean ŀ	Highe	۶r L E	JNIFE Erasmu	IT 29 JS- EL	176-IC-1-2007-1-IT JC-1
Department, if applicable: Physics Department									
Official Addre	ess	Via Saragat, 1	I						
Postal Code:		44100 Town: FERRARA							
Region:		ITALIA IT4 Country:							
Internet addre	ess:	http:// www.ur	nife.it/						
Telephone 1:	+39-0532-974211		Telephor	ne 2:		Fax			+39-0532-974210
	Name of the person entitle	A.2. LEGAL	_ REPRES it the organis	ENTAT	TIVE the cc	ordinati	ng orgar	nisatior	n only)
Last Name:	Mr, Ms	BIANCHI			Fir	st Nan	ne:	PAT	RIZIO
Function:		RECTOR							
Address (Only address above):	[,] if different from official	Via Savonarc	ola 9, 4410)0 FERF	RARA	4			
	A.: (respons	3. CONTACT F sable for the manag	PERSON /	COORI project ir	DINA n the o	TOR organisat	tion)		
Last Name:	Mr, Ms	FRONTERA			Fir	st Nan	ne:	FILI	PPO
Function:	<u></u>	Full Professo	or of Gener	al Phys	ics				
@ : frontera@	⊉fe.infn.it	Telephone: -	+390532-9	74254	Fa	ax num	ber	+	+39-0532-974210
Address (Only if different from official address above): For phone: Poologic Prazor Fax number							L		

PART B: Description of the Organisation						
B.1. NATURE OF THE ORGANISATION						
Status: (leave only the relevant status)	Public Private (an organisation which has received over 50 % of its annual re- two years, or which is controlled by public bodies or their repr	evenues from public sources over the preceding esentatives can be declared as "public")				
Type of organisation: (leave only the relevant type(s))	 X Higher Education Institution HE research centre/organisation Private research centre/organisation Public research centre/organisation (not HE) Graduate/Doctoral School Public authority (local) Public authority (national) Public authority (regional) Chamber of commerce / crafts 	 Chamber of industry Enterprise large (> 500 employees) SME Professional associations Social partners (trade unions, etc) Assoc. of professors and researchers Assoc. of Universities / Research centres Other (please specify under B.2) 				
	B.2.PURPOSE AND ACTIVITY OF THE ORGAN	ISATION				

The University of Ferrara is one of the oldest in Italy. It was founded in 1391. It includes many faculties: Law, Humanities, Economics, Medicine and Surgery, Pharmacy, Architecture, Engineering, Mathematical, Physical and Natural Sciences. Many courses are offered by the last Faculty, among which those for a first level graduation in Physics and Astrophysics and a higher level graduation in Physics, with several curricula, inclusive of Astrophysics. At the highest level, the University of Ferrara has set up the Institute for Higher Studies, IUSS - Ferrara 1391, that offers Doctorate courses to Italian and international students through a proper selection. One of them is the Doctoral Program in Physics, with several curricula, among which Astrophysics. Enrolled students of this Curriculum can also be admitted to the International Relativistic Astrophysics PhD (IRAPP) program. The main reference structure for PhD students in Physics is the Physics Department, that performs research activity in different fields, from nuclear and subnuclear physics to solid state physics, physics of atmosphere, astroparticles and high energy astrophysics. PhD students of the astrophysics curriculum mainly join the High Energy Astrophysics Group, that since many years is involved, through national and international collaborations, in experimental and observational X-/gamma-ray astronomy programmes. Among these, it merits to mention the PI-ship of the high energy instrument PDS and the Gamma Ray Burst Monitor (GRBM) aboard the BeppoSAX satellite, through which we have solved a thirty year mystery, that of the Gamma Ray Burst (GRB) sites, though the discovery of their afterglow. For this discovery we have obtained the Bruno Rossi Prize 1998 of the American Astronomical Society and the Descartes Prize 2002 of the European Committee. The current research activity, with national and international collaborations, mainly concerns studies of GRBs and compact objects in binary systems, and the development of Laue lens telescopes for soft gamma-ray astronomy.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

The University of Ferrara will contribute to the International Relativistic Astrophysics Doctorate Program through formation of the enrolled Doctorate students of the proposing institutions in the following fields:

a) observational studies of compact sources (mainly neutron stars and black holes) in binary systems, through data analysis of X-/gamma-ray observations obtained with currently operative missions or past missions (e.g., BeppoSAX);
b) Observational studies of Gamma Ray Bursts thorough systematic analysis of GRBs data archive and/or new GRB detections. c) Theoretical studies of compact sources and GRBs, through development of analytical or Monte Carlo models. d) Experimental research activity. This include participation to feasibility studies of new mission, development of Laue lens telescopes for gamma-astronomy.



Indian Centre for Space Physics

43 Garia Station Road, Kolkata - 700 084 PHONE: +91-(0) 33-2436 6003, 2462-2153 FAX: +91-(0) 33- 2436 6003, 2462-2153; EMAIL:root@csp.res.in

TO WHOMSOEVER IT MAY CONCERN

Date: April 23rd, 2009

Sub: <u>Pledging our support to the joint programme</u>

This is to confirm that Indian Centre for Space Physics wishes to join in the team of ERASMUS MUNDUS and is submitting the application to this effect. We are fully committed to support such a programme and carry out our obligations to the best of our abilities.

stren

Prof. B.B. Bhattacharyya, President, Governing Body of ICSP

President Indian Centre for Space Physics

A. 1 ORGANISATION									
Role in the con (leave the relevant	sortium trole only)	Applicant / Coordinating Organisation Partner Organisation Associated member							
Official name o organisation:	f the	Indian Cen	tre for S	Space	e Phy	sics			
If applicable, orgar in latin characters	nisation's name								
Acronym:	Acronym: ICSP								
N° of the Erasn Education Instit	rter (if applicabl	e), for Eur	opean	Highe	er				
Department, if	applicable:								
Official Address	S	43 Chalantika,	, Garia Sta	ation R	load,				
Postal Code:		700084		Tow	n:	Kolka	Kolkata		
Region:				In Country:		India	dia		
Internet addres	S:	http://csp.res.i	n				T		
Telephone 1: +	913324366003		Telephor	ne 2:			Fax	+913324622153 ext.28	
Na	ame of the person entitl	A.2. LEGAL ed to legally commi	t the organis	SENTA	TIVE	oordinatii	ng organ	nisation only)	
Last Name:	Mr.	Bhattacharyy	а	First Na			ame: Bimalendu		
Function:		PRESIDENT	, Governin	ig Bod	у				
Address (Only if address above):	different from official								
	A. (respons			COOF project	RDINA	TOR organisat	ion)		
Last Name:	Mr	Chakrabarti			Fir	st Nam	ne:	Sandip	
Function:	Senior Profes	ssor and Ir	n Char	ge, Ac	ademi	c Affair	'S		
@ : sandip@cs	sp.res.in	Telephone: +	-91990312	20700	Fa	x numt	ber	+913324622153 ext.28	
Address (Only if address above):	different from official				1				

	PART B: Description of the Organisation					
	B.1. NATURE OF THE ORGANISATION					
Status: (leave only the relevant status)	Public Private (an organisation which has received over 50 % of its annual retwo years, or which is controlled by public bodies or their representation	evenues from public sources over the preceding esentatives can be declared as "public")				
Type of organisation: (leave only the relevant type(s))	 X Higher Education Institution □ HE research centre/organisation 					

B.2.PURPOSE AND ACTIVITY OF THE ORGANISATION

Please provide a short presentation of your organisation in relation with the activities covered by the project and more particularly concerning its postgraduate (masters/doctorate level) and international cooperation activities (max. 20 lines).

Indian Centre for Space Physics (ICSP) is mainly engaged in research activities is various branches of astrophysics, astronomy and space science. The research topics range from relativistic astrophysics around compact objects, theoretical and observational studies (through satellite data analysis) of activities around compact objects, solar science through satellite observations, payload developments for satellites, developments of detectors for space applications, astro-chemistry, very low frequency (VLF) studies of ionospheres for possible correlations with seismic activities etc. ICSP recently participated in three payload developments for Indo-Russian satellite CORONAS-PHOTON. It is collaborating with Stanford University in VLF projects. International Centre for Theoretical Physics (ICTP) supports ICSP through ICTP fellowships to train Ph.D. students from developing worlds. It is recognized by Calcutta University. ICSP students receive Ph.D. degree from Calcutta or Jadavpur Universities.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

ICSP is strategically located in a position surrounded by a large number of developing nations such as Nepal, China, Bhutan Srilanka, Thiland, Bangladesh, Indonesia and other southeast asian countries. It is therefore of great advantage to have a centre here so that young students from these developing nations may be trained in modern aspects of relativistic astrophysics, data analysis of various satellites, instrumentations etc. The institute is strong in theoretical aspects and students of varied interests may be catered. It can identify bright students from south and southeast asia and can recommend them to European counterparts for further higher studies if needed. Being itself in a developing nation, the cost of training would be lesser compared to European nations. Thus ICSP can contribute in a major way to have a healthy community of research workers in the relevant fields at a lesser cost.



International Center for Relativistic Astrophysics Network

1) Pescara, 29/04/2009 1) Prot. n. 592

Subject: Letter of Endorsement - ERASMUS MUNDUS ACTION 1 B APPLICATION

I undersigned Remo Ruffini, confirm that ICRANet fully undertakes to coordinate the Erasmus Mundus Action 1 B Doctoral Program: IRAP Ph.D. International Relativistic Astrophysics Ph. D. Program.

ICRANet will undertake to contribute to the joint-Ph.D. program curriculum design, teaching and research. Moreover ICRANet will facilitate the practical placement of staff and students in its facilities.

I have read and approved the content of the proposal submitted to the Agency. I undertake to comply with the principles of good partnership practice

Ruff-

Prof. Remo Ruffini Director of ICRANet

P.le della Repubblica, 10 - 65100 Pescara - Ttaly - CF: 91080720682 Phone:+39.085.23054200 Fax: +39.085.4219252 Email: Director@icranet.org - Secretariat@icranet.org Http://www.icranet.org

A. 1 ORGANISATION									
Role in the co (leave the releva	onsortium nt role only)	Partner Organisation							
Official name organisation:	International Center for Relativistic Astrophysics Network								
If applicable, orgain latin characters	anisation's name s								
Acronym:		ICRANet							
N° of the Eras Education Ins	smus University Cha titutions only	rter (if applicabl	e), for Eur	opean	Highe	r			
Department, i	if applicable:								
Official Addre	SS	at ICRANet, P	iazza della	a Repu	bblica	, 10			
Postal Code:		65122		Towr	ו:	PES	CARA		
Region:		ABRUZZO Country: ITALIA							
Internet addre	ess:	http:// www.icranet.org/							
Telephone 1:	+39-085-23054		Telephor	ne 2:			Fax		+39-085-4219252
	Name of the person entitl	A.2. LEGAL REPRESENTATIN			TIVE r the co	IVE the coordinating organisati			n only)
Last Name:	Prof.	RUFFINI			First Name:			REN	МО
Function:		DIRECTOR							
Address (Only address above):	if different from official								
	A. (respons	3. CONTACT P sable for the manag	PERSON / ement of the	COOR project i	DINA in the o	TOR rganisa	tion)		
Last Name:	RUFFINI			Fire	st Nan	ne:	REM	10	
Function:		Director of IC "Sapienza" –	RANet and Rome	d Chair	of Th	eoreth	nical Pl	hysics	s at University
@ : frontera@)fe.infn.it	Telephone: -	+39-085-23	3054	Fa	x num	ber	+39-	-085-4219252
Address (Only address above):	if different from official								

	PART B: Description of the Organisation						
B.1. NATURE OF THE ORGANISATION							
Status: (leave only the relevant status)	X Public (an organisation which has received over 50 % of its annual revenues from public sources over the preceding two years, or which is controlled by public bodies or their representatives can be declared as "public")						
Type of organisation: X Higher Education Institution (leave only the relevant type(s)) X No-profit International research centre/organisation X Assoc. of Universities / Research centres							
B.2.PURPOSE AND ACTIVITY OF THE ORGANISATION							

ICRANet, the International Centers for Relativistic Astrophysics Network, is an International Organization doing theoretical Research on Relativistic Astrophysics, whose Members States are Armenia, Brazil, Italy, The Vatican as well as the University of Stanford, the University of Arizona, and ICRA. The seat is located in Pescara (Italy). In addition to the Board chaired by the Chinese astrophysicist Fang Li-Zhi and the Director Remo Ruffini, there is a Scientific Committee chaired by the Nobel Laureate Riccardo Giacconi, with Members including distinguished Astronomers and Space Scientists such as Felix Aharonian, David Arnett, João Braga and Bill Stoeger. Faculty Members include Vladimir Belinski, the co-author of the famous BKL theory of the primordial Universe, and Roy Kerr, author of the famous Black Hole Kerr solution, and in part time Thibault Damour from the IHES in Paris. The ICRANet is co-sponsoring the IRAP Ph.D. program, as well as an intense series of meetings including the Italian-Korean meeting on Relativistic Astrophysics which is held every two years alternatively in Italy and Korea, the Italian-Chinese meeting held every year in Italy, the newly created Xu Guangqi meeting, the Brazilian School on Cosmology. A major activity of ICRANet is the organization of the Marcel Grossmann Meetings, held every three years in selected Countries all over the world with publication of 3 volumes of proceedings and assembling up to 1000 scientists.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

Particularly relevant is the commitment of ICRANet to the graduate students, postdoc programs, visiting scientists and scientific meetings. It is important to mention a vigorous program of scientific exchange, as well as a vast series of publications in scientific journals and of textbooks in English, Italian, Chinese, Korean etc...Topics of Research include Early Cosmology, the Physics and Astrophysics of Neutron Stars and Black Holes, structure formation in Cosmology, exact solutions of the Einstein-Maxwell equations, Gamma Ray Bursts, Binary X Ray sources, Pulsars and Galactic Halos.



Bd de l'Observatoire BP 4229 06 304 Nice cedex 4 France

To Whom it May Concern

Our institute, Observatoire de la Côte d'Azur (OCA) agrees to participate as a partner in the project Erasmus Mundus, aiming to support the academic activities of the International Relativistic Astrophysics school, particularly in the fields of Planetary Science, including extra-solar planets, Extragalactic Astrophysics and Data Analysis.

OCA will also offer to students of this school the access to its facilities as laboratories, computating services and Library.

Farrokh VAKILI Director OCA Nice April 28th 2009

IRAP 28/4/2009

PART A: Identification of the applicant and other participating organisations								
Parts A and B must be filled in separately for each organisation involved in the project (including associated members). The application must be accompanied by copies of letters from the legal authority of each participating organisation confirming their support to the joint programme and their agreement with the submitted application (<i>not necessary for associated members</i>)							luding associated authority of each reement with the	
A. 1 ORGANISATION								
Role in the consortium (leave the relevant role only)	Applicant /Partner Or	 Applicant / Coordinating Organisation Partner Organisation Associated member 						
Official name of the organisation: If applicable, organisation's name in latin characters	Observatoi	Observatoire de la Côte d'Azur						
Acronym:	OCA							
N° of the Erasmus University Ch Education Institutions only	arter (if applicabl	e), for Eur	opean	Highe	r			
Department, if applicable:								
Official Address	Boulevard de	Boulevard de l'Observatoire						
Postal Code:	06304 Tov			1:	Nice			
Region:	Alpes Maritim	ies	Coun	itry:	Franc	e		
Internet address:	http:// www.oc	za.eu						1
Telephone 1: +33492003001		Telephor	1e 2:			Fax		
Name of the person ent	A.2. LEGAL	. REPRES	ENTA	FIVE r the co	ordinatin	g organ	isatior	n only)
Last Name:	Vakili			Fir	st Nam	e:	Farr	okh
Function:	Director							
Address (Only if different from official address above):								
(respo	A.3. CONTACT P nsable for the manag	'ERSON / gement of the	COOR	DINA n the o	TOR rganisatio	on)		
Last Name:	de Freitas Pacheco José First Name:			é 				
Function:	Astronomer							
@ : pacheco@oca.eu	Telephone: +	+33492003	3182	Fa	x numt	ber		
Address (Only if different from official address above):								

PART B: Description of the Organisation							
B.1. NATURE OF THE ORGANISATION							
Status: (leave only the relevant status)	Public Private (an organisation which has received over 50 % of its annual revenues from public sources over the preceding two years, or which is controlled by public bodies or their representatives can be declared as "public")						
Type of organisation: (leave only the relevant type(s))	Type of organisation: X Higher Education Institution (leave only the relevant type(s)) Image: Description of the problem						
	B.2.PURPOSE AND ACTIVITY OF THE ORGANISATION						

Observatoire de la Côte d'Azur (OCA) is a multi-disciplinary research institute with 200 permanent scientists and more than 100 engineers and technicians involved in Astronomy, Astrophysics and Geophysics academic research based on major ground-based instruments: e.g. VLT and VLTI at ESO, the VIRGO gravitational antenna in Italy, Geodesical Laser Ranging (Moon and satellites) and more generally in ESA present and future space missions like CoRoT and GAIA. These projects cross-benefit from other research areas like plasma physics (MHD), leading edge R&D for top-level instrumentation (interferometry, space-time metrology, optics and laser technology among others) and basic research in applied mathematics, physics and signal processing.

OCA is already collaborating with major european and other non-european organisations as, for instance ESA, ESO, NASA, Polar Institutes, EGU and has developped a long tradition of forming graduate young students from all continents. It is worth to remind that OCA has been a founder member of IRAP so that our institute will naturally contribute to the present Erasmus Mundus extension.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

OCA intends to actively contribute to different areas of IRAP training courses in relation OCA expertise in the followings in particular: planetary science, including extra-solar planets, extragalactic astronomy and data analysis related to observational astrophysics. In addition an important number of OCA senior scientists are willing to supervise or co-supervise PhD level young scientists with the perspective to develop new international collaborative projects both in observational and theoretical fields. Indeed the institute will offer its major facilities (instruments, computing clusters, etc..) to support such educational and research programs. OCA has also a regional well established tradition of collaboration with local industries Thalès Alenia Space Cannes, SESO among others.



CBPF Centro Brasileiro de Pesquisas Físicas

Ministério da Ciência e Tecnologia



April 23, 2009

To whom which may concern

The Brazilian Center of Physics Research (CBPF), will actively participate in the joint programme "Erasmus Mundus Joint Doctorate (EMJD) in Relativistic Astrophysics" as a non-European Institution Partner. The research and education required by the joint program will be carried out by Insituto de Cosmologia, Relatividade e Astrofísica (ICRA-Br) led by Prof. Mario Novello. CBPF will provide all necessary support for this joint programme.

RICARDO M. O. GALVÃO Diretor do CBPF PO 829/08 PO 407/06

Ricardo Galvão Diretor Centro Brasileiro de Pesquisas Fisicas

Rua Dr. Xavier Sigaud, 150 - Rio de Janeiro, RJ CEP: 22290-180 - Brasil Tel. (55 21) 2141-7100 - Fax: (55 21) 2141-7400 - http://www.cbpf.br

A. 1 ORGANISATION										
Role in the consortium (leave the relevant role only) É Applicant / Coordinating Organisation É Partner Organisation É Partner Organisation					memb	er				
Official name of the organisation:		Centro Brasileiro de Pesquisas Fisicas								
If applicable, orgatin latin characters	anisation's name S									
Acronym:		CBPF								
N° of the Erasmus University Char Education Institutions only		ter (if applicable), for European Higher 28233-IC-1-2002-1-FR Erasmu EUC-1						2002-1-FR Erasmus-		
Department, i	if applicable:	Instituto de Co	osmologia	Relativ	/idade	Astro	ofisica (ICRA	-Br)	
Official Addre	SS	150, Rua Dr. >	Kavier Siga	aud		-				
Postal Code:		22290-180		Towi	า:	Rio de Jan		ieiro		
Region:		Count			ntry:	ry:				
Internet address:		http:// www.cbpf.br					Γ			
Telephone 1: 5521214171 99		Telepho		ne 2:			Fax		552121417266	
	Name of the person entitl	A.2. LEGAL led to legally commi	. REPRES	SENTA	TIVE	oordina	ting orga	nisatior	n only)	
Last Name:	Mr, Ms	GALVÃO			Fir	First Name:			ARDO	
Function:		Director								
Address (Only if different from official address above):										
	A. (respons	3. CONTACT P sable for the manag	PERSON / ement of the	COOF project	RDINA in the o	TOR organisa	ation)			
Last Name: Mr, Ms		NOVELLO			MARIO First Name:					
Function:		Professor of Physics						r		
@ : novello@lcbpf.br		Telephone: 5521214171 99			Fa	Fax number 552121417266			121417266	
Address (Only if different from official address above):										

PART B: Description of the Organisation							
B.1. NATURE OF THE ORGANISATION							
Status: (leave only the relevant status) (leave only the relevant status) (an organisation which has received over 50 % of its annual revenues from public sources over the preceding two years, or which is controlled by public bodies or their representatives can be declared as "public")							
Type of organisation: X Higher Education Institution Image: Chamber of industry Type of organisation: Private research centre/organisation Image: Chamber of industry Image: Private research centre/organisation Private research centre/organisation Image: Chamber of industry Image: Private research centre/organisation Public research centre/organisation Image: Chamber of industry Image: Private research centre/organisation Public research centre/organisation Image: Chamber of industry Image: Private research centre/organisation Public research centre/organisation Image: Chamber of industry Image: Private research centre/organisation Public research centre/organisation Image: Chamber of industry Image: Private research centre/organisation Public research centre/organisation Image: Chamber of industry Image: Private research centre/organisation Public research centre/organisation Image: Chamber of industry Image: Public authority (local) Public authority (regional) Image: Chamber of commerce / crafts Image: Chamber of commerce / crafts Image: Public authority (regional) Image: Chamber of commerce / crafts Image: Chamber of commerce / crafts Image: Chamber of commerce / crafts Image: Public authority (regional) Image: Chamber of commerc							
B.2. PURPOSE AND ACTIVITY OF THE ORGANISATION							

The Institute of Cosmology, Relativity and Astrophysics (ICRA-Br) is an organization linked to the Brazilian Center for Physics Research of Brazilian Ministry of Science and Technology. It consists of 10 permanent positions for scientists, 3 Administration Staff, 6 position for Visiting Professors, 14 PhD Students and 2 Pos-Doctoral associates. The main lines of research includes: Cosmological effects of non-linear electrodynamics; Analog Models; Structure Formation in Singular and Bouncing Universe; Field theory in Curved Space-Times.

The Institute of Cosmology, Relativity and Astrophysics is responsible for representing CBPF in the coordination promoted by the Institute, as well as in other institutions working in relativistic cosmology and astrophysics fields; coordinating, developing and supporting experimental and observational researches in the field of relativistic astrophysics, theoretical and observational cosmology, particularly the groups associated to the Relativistic Astrophysics International Center – ICRA, and other institutions having agreements with CBPF; supporting existing research areas and stimulating new innovative proposals in the field of cosmology, relativity and astrophysics; supporting scientific information exchange between members of ICRA in order to develop international programs; developing an electronic network to exchange information between laboratories and departments working with relativistic astrophysics and theoretical and observational cosmology; promoting and organizing seminars, workshops, courses and other meetings related to its activities.

The Institute of Cosmology, Relativity and Astrophysics is also responsible for coordinating ICRANet activities in Brazil, based on the Brazil-Italy agreement signed on September 21st 2005 by the Brazilian Government.

Due to the experience in teaching at Master and Doctorate level, inside ICRA-Br / CBPF, we could propose a large variety of courses in Classical and Quantum Field Theory in Curved Space-Time, Astro-particle, Astrophysical Aspects of Non-Linear Eletrodynamics, General Relativity and Gravitation. In add, some invited professors in ICRA-BR / CBPF can give advanced lectures for the benefit of the students in the Erasmus Mundus program.





LETTER OF ENDORSEMENT

ERASMUS MUNDUS ACTION 1 B APPLICATION

I undersigned, Luigi Frati, confirm that the Università degli Studi di Roma "La Sapienza" fully undertakes to coordinate the Erasmus Mundus- Action 1 B-Doctoral Programs:

> IRAP International Relativistic Astrophysics

Submitted by:

- Université de of Nice Sophia Antipolis
- Università di Roma La Sapienza
- Freie Universitaet Berlin
- Université de Savoie
- Università degli studi di Ferrara
- ETH Zurich
- Stockholm Universitet

The Università degli Studi di Roma "La Sapienza" will award the degree in "Dottorato di Ricerca in Astrofisica relativistica " and undertakes to contribute to the joint-Phd program curriculum design, teaching and research. Moreover, the Università degli Studi di Roma "La Sapienza" will facilitate the practical placement of staff and students in its facilities.

I have read and approved the contents of the proposal submitted to the Agency. I undertake to comply with the principles of good partnership practice.

Signature ector

Roma 28/04/2009

Ripartizione IX Relazioni internazionali Indirizzo per corrispondenza: Plazzalo Aldo Moro 5 00185 ROMA Sede: Patazzo Botoani, Corso Vittorio Emanuele II, 244 ROMA T (+39) 06 49910435 (+39) 06 49910089 Mattea capefil@uniroma1.h vorw.uniroma1.h

		Α.	1 ORGAI	NISATI	ON					
Role in the o	consortium /ant role only)	Applicant / Coordinating Organisation Partner Organisation Associated member								
Official name of the organisation:		SAPIENZA – Università di Roma								
If applicable, orgoname in latin ch	ganisation's aracters									
Acronym:										
N° of the Erasmus Univers Higher Education Institutio		sity Charter (if applicable), for Europ ns only				pean 29415-IC-1-2007-1-IT-ERASMU EUC-1				MUS-
Department applicable:	, if	Dipartimento d	i Fisica (F	Physics	s Depa	artment)			
Official Addr	ess	Piazzale Aldo N	Piazzale Aldo Moro 5							
Postal Code	:	00185		Town	n:	Rom	na			
Region:				Country:		HAL				
Internet address:		http://www.uniroma1.it - http://www.phys.uniroma1.it								
Telephone 1:		+39 0649911 Telephone				Fax				
Na	me of the person	A.2. LEGAL REPRESENTATIVE Initited to legally commit the organisation (for the coordinating organisation					sation only)			
Last Name:	Mr	Frati			Fir	First Name:			İ	
Function:	Function:		Rector							
Address (Only if different from official address above):		SAPIENZA – Università di Roma Piazzale Aldo Moro, 5 00185 Roma (ITALY)								
A.3. CONTACT PERSON / COORDINATOR (responsable for the management of the project in the organisation)										
Last Name:	Mr	RUFFINI			Fir	First Name: R			ЛО	
Function:		Professor of Physics								
@ : ruffini@icra.it		Telephone: +390649914304			Fa	Fax number			-39064454992	
Address (Only if different from official address above):										

PART B: Description of the Organisation							
B.1. NATURE OF THE ORGANISATION							
Status: (leave only the relevant status)	É Public É Private (an organisation which has received over 50 % of its annual r two years, or which is controlled by public bodies or their repr	evenues from public sources over the preceding resentatives can be declared as "public")					
Type of organisation: (leave only the relevant type(s))	 Chamber of industry Enterprise large (> 500 employees) SME Professional associations Social partners (trade unions, etc) Assoc. of professors and researchers Assoc. of Universities / Research centres Other (please specify under B.2) 						
B.2. PURPOSE AND ACTIVITY OF THE ORGANISATION							

The Physics Department of the University of Rome "Sapienza" consists of 50 Full Professors, 47 Associate Professors and 40 Researchers. The activities cover almost all fields of physics, from Astrophysics and Cosmology, from both theoretical and observational points of view, to nuclear, subnuclear and elementary particle physics, to condensed matter physics, to theoretical and mathematical physics. Many collaboration exists on such topics also with other Research Centers such as Astronomical Observatory of Rome, CNR (National Research Council), ENEA (National Institute for Energy and Environment), ICRA (International Center for Relativistic Astrophysics), ICRANet (the only international organization working in the field of relativistic astrophysics - its seat is in Pescara, Italy), INAF (National Institute for Astrophysics), INFN (National Institute for Nuclear Physics). The concentration in the Department of so many different topics of research and the collaboration with so many different groups and institutions allows a very strong interaction between them. This promotes a truly interdisciplinary approach to the research on topics which are traditionally crossing different fields, such as Astroparticle physics or the physics of collapsed objects. This interdisciplinary approach is a key point in the training of the next generation of researchers. In addition to the Ph.D. program in physics, which consists of many different curricula, including also Astrophysics, the University of Rome "Sapienza" participate to the International Ph.D. Program on Relativistic Astrophysics (IRAP-PhD), together with ETH Zurich, Freie Universität Berlin, ICRA, Institut des Hautes Etudes Scientifiques, Observatoire de la Côte d'Azur, Università di Ferrara, Université de Nice Sophia Antipolis and Université de Savoie. The six participating Universities jointly deliver the Ph.D. degree.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

University of Rome "Sapienza" can provide a large variety of courses in all the above mentioned fields of physics, from both a theoretical and experimental approach. Professors of the University will give invited advanced lectures and serve as Thesis Advisor for the students of the Erasmus Mundus program, which will benefit also of the multidisciplinary approach described above.



Chambéry, le 14 avril 2009

Présidence

Affaire suivie par : Eric BRUNAT Vice-Président en charge des Relations Européennes et Internationales Tél. : 04 79 75 91 15 Fax : 04 79 75 83 65 vpri@univ-savoie.fr

N/Réf. : PRE/GA/sch/2008-09/148

Objet : Erasmus Mundus International Relativistic Astrophysics Doctorate IRAP PhD

If we look to the priority of research in Europe through the next decades, Space Science sounds to be essential. The European Space Agency (ESA) is involved in not less than 17 space missions. For exemple, to conceive and execute the Huygens mission on Titan it took more than 20 years. Europe is also present through ESA on the main research with ground based telescope in Chile.

Clearly, the complete achievement of Europe Space Science will need outstanding human capacities. In that respect, this **Erasmus Mundus International Relativistic Astrophysics Doctorate program** will actively contribute to educate the future generation of scientists in this field. Inside the network is mobilised the previous successful collaboration between University of Savoie, University of Nice Sophia Antipolis, Observatoire de la Côte d'Azur, Freie University of Berlin, University of Roma La Sapienza and Institut des Hautes Etudes Scientifiques. Stockholm University will join the network as well as Ferrara University and the Institut des Hautes Etudes Scientifiques. Thanks to the collaboration with Shangai Observatory, Rio CBPF and Bose National Centre for Basic Sciences, partners from China, Brazil and India will be added. The past collaboration between the partners mentionned above will assure a perfect coordination of this new activity.

In that respect, with this commitment letter I do confirm that the University of Savoie will actively participate to the consortium. In my capacity of President of the University of Savoie, I am aware that the University of Savoie is involved in this application. The research and education required by the joint program will be carried out by Professor Pascal Chardonnet from the Laboratoire d'Annecy-le-Vieux de Physique des Particules - LAPP. The University of Savoie will support this joint program.

Sincerely yours,

1979 2009 L'Université de Savoie a 30 ans

Présidence

27 rue Marcoz - BP 1104 73011 CHAMBERY CEDEX Tél. : 33 (0)4 79 75 84 22 Fax : 33 (0)4 79 75 83 51 Mél : presidence@univ-savoie.fr

Siège social

Université de Savoie B.P. 1104 73011 Chambéry cedex France

Gilbert ANGENIEUX President of the University of Savoie

Copies : Eric BRUNAT, Vice-Président en charge des Relations Européennes et Internationales Pascal CHARDONNET, LAPP Direction de Relations Internationales

A. 1 ORGANISATION										
Role in the co	onsortium	Applicant / Coordinating Organisation								
(leave the releva	(leave the relevant role only)									
Official name of the organisation:		Université de Savoie								
in latin characters	s									
Acronym:	UDS									
N° of the Erasmus University Char Education Institutions only		rter (if applicable), for European Higher 28233-IC-1-2002-1-FR Erasm EUC-1						2002-1-FR Erasmus-		
Department,	if applicable:	UFR Sciences Fondamentales et Appliquées / LAPTH								
Official Addre	ess	27, Rue Marcoz B.P. 1104								
Postal Code:		73011		Towr	า:	CHA	HAMBERY			
Region:	Region:		Count			ry:				
Internet addre	ess:	http:// www.univ-savoie.fr								
Telephone 1:	Telephone 1: +33479758585		Telephor						+33479759105	
A.2. LEGAL REPRESENTATIVE Name of the person entitled to legally commit the organisation (for the coordinating organisation only)						n only)				
Last Name:	Last Name: Mr, Ms		ANGENIEUX			First Name:			BERT	
Function:		PRESIDENT								
Address (Only address above):										
A.3. CONTACT PERSON / COORDINATOR (responsable for the management of the project in the organisation)										
Last Name: Mr, Ms		CHARDONNET		Fin	First Name:		PAS	SCAL		
Function:	Professor of Physics									
@ : chardonnet@lapp.in2p3.fr		Telephone: +33625622554			Fax	x num	nber	+	-33450279495	
Address (Only if different from official address above):		LAPTH, 9 CHEMIN DE BELLEVUE BP 110 74940 ANNECY-LE-VIEUX CEDEX FRANCE								

PART B: Description of the Organisation							
B.1. NATURE OF THE ORGANISATION							
Status: (leave only the relevant status)	Public Private (an organisation which has received over 50 % of its annual revenues from public sources over the preceding two years, or which is controlled by public bodies or their representatives can be declared as "public")						
Type of organisation: (leave only the relevant type(s))	 Chamber of industry Enterprise large (> 500 employees) SME Professional associations Social partners (trade unions, etc) Assoc. of professors and researchers Assoc. of Universities / Research centres Other (please specify under B.2) 						
B.2.PURPOSE AND ACTIVITY OF THE ORGANISATION							

LAPTH (Laboratoire d'Annecy-le-Vieux de Physique Théorique) is a mix research unit co-directed by the CNRS and the University of Savoie. The laboratory depends on the Physics and Mathematics Department of CNRS. It consists of 25 permanent members (15 CNRS staff, 6 professors and 4 Administration staff), 4 PhD students and 2 post-doctoral associates. The laboratory hosts many French and foreign visitors throughout the year and their stay at the LAPTH varies from a day to several months. LAPTH also takes great advantage of sharing its building with experimental colleagues in LAPP who participate in large and important experiments to understand the nature of elementary particles and of the cosmos. Three main fields are studied by the LAPTH theorists: Elementary Particle Physics, Cosmology/astrophysics and Mathematical Physics. LAPTH is part of Université de Savoie which has a master in theoretical Physics with Ecole Normale Supérieure of Lyon. The graduate courses include a solid background in particle physics, statistical physics and astroparticle. Raymond Stora is Emeritus Director of research from our laboratory. He has the considerable distinction of being the winner of the Max Planck Medal for 1998. LAPTH and LAPP are in the same building and this favour the close connections between theoreticians and experimentalists. LAPP is involve in physics at CERN with LHC but also in astrophysics with AMS (Anti Matter Spectrometer), VIRGO (the Virgo detector for gravitational waves is located within the site of the European Gravitational Observatory at Cascina) and HESS (High Energy Stereoscopic System). The close link to CERN, the dual specificity to a theoretical group leader in his field and an international particle physics laboratory lead naturally to participate to this Eramus Mundus in Astrophysics. In add LAPTH is involved in Dark matter studies, Anisotropies of diffuse cosmic background radiation, Type-la supernovae and cosmological parameters, Cosmology with extra dimensions, Gamma ray bursts, Cosmic rays of extreme energy.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

Due to the experience in teaching at Master and Doctorate level, inside Université de Savoie, we could propose a large variety of courses in fundamental particle physics, astro-particle as well as specific training courses in languages programming. In add, some invited professors in LAPTH/LAPP give advanced lectures for the benefit of the students in the Erasmus Mundus program.



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SHANGHAI ASTRONOMICAL OBSERVATORY CHINESE ACADEMY OF SCIENCES

Add: 80 Nandan Road,Shanghai,China Tel: 0086-21-64386191 Fax: 0086-21-64384618 Postcode: 200030 http://center.shao.ac.cn

April 10,2009

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To whom it may concern,

Shanghai Astronomical Observatory (SHAO) will actively participate in the joint programme "Erasmus Mundus Joint Doctorate(EMJD) in Relativistic Astrophysics" as a non-European Institution Partner. I am aware that SHAO is involved in its application. The research and education required by the joint programme will be carried out by Key Laboratory of Research in Galaxies and Cosmology led by Professor Yipeng Jing. SHAO will provide all necessary support for this joint programme.

Sin (iaov recto Shanghai Astronomioal vatory
PART A: Identification of the applicant and other participating organisations

Parts A and B must be filled in separately for each organisation involved in the project (including associated members). The application must be accompanied by copies of letters from the legal authority of each participating organisation confirming their support to the joint programme and their agreement with the submitted application (*not necessary for associated members*)

		A. 1 0	RGANISA	TION				/		
Role in the consortium		Applicant / Coordinating Organisation Associated member								
Official name of the organisation:		Shanghai Astronomical Observatory								
If applicable, organisation's name in latin characters										
Acronym:		SHAO								
N° of the Erasmus University Char Education Institutions only		rter (if applicable), for European Higher								
Department,	if applicable:									
Official Addre	SS	Nandan RD 80								
Postal Code:		200030		Towr	Town:		Shanghai			
Region:		Countr			ntry:	China y:				
Internet address:		http://www.shao.ac.cn/								
Telephone 1: +862164386191		Telephone 2		ne 2:		Fax			+862164384618	
	Name of the person entitl	A.2. LEGAL	REPRES	ENTA ation (fo	TIVE r the co	ordinat	ing orga	nisatioi	n only)	
Last Name:	Last Name:		Hong			First Name:			Хіаоуи	
Function:		Director								
Address (Only if different from official address above):										
	A. (respons	3. CONTACT P sable for the manag	PERSON /	COOR project	DINA in the o	TOR rganisa	tion)			
Last Name:		Jing			Fire	First Name:			eng	
Function.		Professor								
ypjing@shao.ac.cn		Telephone: +862164410713			Fax	x num	ber	4	-862164384618	
Address (Only if different from official address above):										

PART B: Description of the Organisation							
B.1. NATURE OF THE ORGANISATION							
Status: (leave only the relevant status)	Public Private (an organisation which has received over 50 % of its annual revenues from public sources over the preceding two years, or which is controlled by public bodies or their representatives can be declared as "public")						
Type of organisation: (leave only the relevant type(s))	 X Higher Education Institution X HE research centre/organisation Private research centre/organisation Public research centre/organisation (not HE) Graduate/Doctoral School Public authority (local) Public authority (national) Public authority (regional) Chamber of commerce / crafts 	 Chamber of industry Enterprise large (> 500 employees) SME Professional associations Social partners (trade unions, etc) Assoc. of professors and researchers Assoc. of Universities / Research centres Other (please specify under B.2) 					
B.2. PURPOSE AND ACTIVITY OF THE ORGANISATION							

Please provide a short presentation of your organisation in relation with the activities covered by the project and more particularly concerning its postgraduate (masters/doctorate level) and international cooperation activities (max. 20 lines).

Shanghai Astronomical Observatory is a Research Institute of the Chinese Academy of Sciences (CAS). The observatory provides Masters and Doctors postgraduate training, and has about 120 postgraduate students. The Key Laboratory of Research in Galaxies and Csomology is the department engaged in the current project. The Key Laboratory is a previliged research center supported by CAS, and is currently involved in a few key national research projects in astrophysics. For example, its director, Yipeng Jing, manages the Chinese State Key Research Project (also known as the "973 project")

on the "Formation and evolution of large scale structures and galaxies", which is the biggest research network in astrophysics in China, with about 50 senior researchers, 50 postdoc researchers and a large number of PhD students. Jing studied in Rome University, got his PhD degree in SISSA Trieste, did postdoctoral research at Max-Planck Institute for Astrophysics, and have had close collaborations with many EU astrophysics institues. The participation of Shanghai will give the European researchers the opportunity to forge new collaborations with the fastest growing research community in the world.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

Shanghai Astronomical Observatory is actively working on Galaxy Formation, Large scale structures in the Universe, Modified Gravity, Black Hole detection, accretion theory of black holes, and high energy astrophysics. The Key Laboratory will participate in the joint research projects in these fields, and jointly supervise the PhD students.



April 23, 2009

To whom it may concern,

Stockholm University will actively participate in the joint programme "Erasmus Mundus Joint Doctorate (EMJD) in Relativistic Astrophysics" as an European Institution Partner. I am aware that Stockholm University is involved in its application. The research and education required by the joint programme will be carried out by the Department of Physics led by professor Kjell Rosquist. Stockholm University will provide all necessary support for this joint programme.

Sincerely yours Ann-Caroline Nordström

Ann-Caroline Nordström Director, Head of Administration



Parts A and E members). Th participatir	3 must be filled in se 1e application must 1g organisation con submitted ;	parately for each t be accompani firming their sup application (<i>not</i>	n organisat ied by cop port to the necessary	tion inv)ies of joint p for as:	olved lettei rogra sociat	I in the r s froi imme ted me	e project m the lead and the mbers	ct (inc egal a eir agr)	authority of each reement with the	
		A.10	RGANISA				<u> </u>	<u>, </u>		
Role in the co	onsortium ant role only)	Applicant / Coordinating Organisation Partner Organisation Associated member								
Official name of the organisation: If applicable, organisation's name in latin characters		Stockholm University								
Acronym:		SU								
N° of the Erasmus University Cha Education Institutions only		rter (if applicable	rter (if applicable), for European Higher 29366 ERASN					-IC-1-2008-1-SE- IUS-EUCX-1		
Department,	if applicable:	Department of Physics								
Official Address		AlbaNova University Center								
Postal Code:		106 91		Town	Town: Stockhol		:kholm	n		
Region:		Country: SWEDEN					EDEN			
Internet address:		http:// www.physto.se						1		
Telephone 1: +46855378600			Telephon	elephone 2:		Fax			+46855378601	
	Name of the person entitl	A.2. LEGAL	t the organisa	ENTAT ation (for	f IVE the co	ordinat	ing orgar	nisatior	n only)	
Last Name:	Ms	Nordström		Fir	First Name:			Ann-Caroline		
Function:		Director, Head of Adminstration								
Address (Only if different from official address above):		Stockholms universitet Universitetsförvaltningen 106 91 Stockholm								
	A. (respons	. 3. CONTACT P sable for the manage	ERSON / (ement of the	COOR	DINA n the o	TOR irganisa	ition)			
Last Name:	Mr	ROSQUIST			Fir	First Name:		KJELL		
Function:		professor								
@ : kr@physto.se		Telephone: +46855378729			Fa	Fax number			+46855378601	
Address (Only	/ if different from official									

T

PART B: Description of the Organisation							
B.1. NATURE OF THE ORGANISATION							
Status: (leave only the relevant status)	Public Private (an organisation which has received over 50 % of its annual revenues from public sources over the preceding two years, or which is controlled by public bodies or their representatives can be declared as "public")						
Type of organisation: (leave only the relevant type(s))	 X Higher Education Institution HE research centre/organisation Private research centre/organisation Public research centre/organisation (not HE) Graduate/Doctoral School Public authority (local) Public authority (national) Public authority (regional) Chamber of commerce / crafts 	 Chamber of industry Enterprise large (> 500 employees) SME Professional associations Social partners (trade unions, etc) Assoc. of professors and researchers Assoc. of Universities / Research centres Other (please specify under B.2) 					
B.2.PURPOSE AND ACTIVITY OF THE ORGANISATION							

Please provide a short presentation of your organisation in relation with the activities covered by the project and more particularly concerning its postgraduate (masters/doctorate level) and international cooperation activities (max. 20 lines).

The Department of Physics at Stockholm University (SU) is part of the AlbaNova University Center which is a joint center with the Royal Institute of Technology. The SU physics department is large with some 30 full professors and a comprehensive education program covering basic physics and many research areas at the graduate level, both experimental and theoretical. The department has an active collaboration with the Department of Astronomy. The SU physics and astronomy departments are also collaborating with the AlbaNova based Physics department of the Royal Institute of Technology. Much of the research in astrophysics and cosmology is performed within the newly formed Oskar Klein Centre for Cosmo Particle Physics which has long term support from the Swedish Research Council.

The graduate programs at AlbaNova include the subjects of Astrophysics, Cosmology and Astroparticle physics, with both theoretical and observational specializations. The local expertise incorporates the areas of relativistic astrophysics (gamma-ray bursts, active galactic nuclei and general relativity), observational astrophysics and cosmology (gamma-ray observations, active galactic nuclei and supernova cosmology) and dark matter (candidate phenomenlogy). The ongoing research in these areas at AlbaNova involves in particular gamma-ray bursts, active galactic nuclei (massive black holes in the center of galaxies), theoretical cosmology and general relativity, gamma-ray observations (in particular with the Fermi Gamma-ray Space Telescope), supernova cosmology, and astroparticle physics with dark matter phenomenology.

Provide a short description of the organisation's specific role in the project (max. 10 lines)

Within the proposed graduate program, the Department of Physics at Stockholm University will provide graduate courses and student supervision. The plan is that this will be done in close collaboration with the partners at the Department of Astronomy (SU) and the Physics department at the Royal Institute of Technology. The courses will cover mainly High Energy Astrophysics and Advanced General Relativity for the benefit of the students within the program.

People:

Kjell Rosquist, Department of Physics, Stockholm University (local coordinator) Claes-Ingvar Björnsson, Department of Astronomy, Stockholm University Felix Ryde, Department of Physics, Royal Institute of Technology





April 29, 2009

To whom it may concern,

Tartu Observatory will actively participate in the joint program "Erasmus Mundus Joint Doctorate (EMJD) in Relativistic Astrophysics" as an European Institution Partner.

I am aware of its application.

The research and education required by the joint program will be carried out within the research, curriculum and doctorate program in Astrophysics and Cosmology, led by Dr. Enn Saar. The research activity of graduate and doctorate students of this program will be carried out in Cosmology Department in collaboration with Tartu University. Tartu Observatory will provide all the necessary support for this joint program.

Sincerely yours,



PART A: Identification of the applicant and other participating organisations

Parts A and B must be filled in separately for each organisation involved in the project (including associated members). The application must be accompanied by copies of letters from the legal authority of each participating organisation confirming their support to the joint programme and their agreement with the submitted application (*not necessary for associated members*)

		A. 1	ORGANIS	ATION				,	
Role in the consortium		Applicant / Coordinating Organisation Associated member							
Official name of the organisation's name		Tartu Observatory							
in latin characters									
Acronym:		то							
N° of the Erasmus University Ch Higher Education Institutions on		arter (if applicable), for European ly							
Department, if applicable:		Cosmology							
Official Address		Tartu Observatory							
Postal Code	Postal Code:		EE-61602		own:		vere		
Region:		Tartumaa		Count	ry: Estonia		nia		
Internet address:		http://www.aai.ee							
Telephone	Telephone 1: +372-7410265		Telephon		2:		Fax		+372-7410205
A.2. LEGAL REPRESENTATIVE Name of the person entitled to legally commit the organisation (for the coordinating organisation only)						on only)			
Last Name:	Dr.	LEEDJÄRV		Firs	First Name:		LAURITS		
Function:	Function:		DIRECTOR						
Address (Only if different from official address above):									
A.3. CONTACT PERSON / COORDINATOR (responsable for the management of the project in the organisation)									
Last Name:	Prof.	Einasto		First Name:		ne:	Jaai	1	
Function:		Senior scientist of Cosmology Department							
@ : einasto@aai.ee		Telephone: +372-7410110			Fax	Fax number		4	-372-7410205

PART B: Description of the Organisation							
B.1. NATURE OF THE ORGANISATION							
Status: (leave only the relevant status)	Public Frivate (an organisation which has received over 50 % of its annual revenues from public sources over the preceding						
two years, or which is controlled by public bodies or their representatives can be declared as "public")							
(leave only the relevant type(s))	X Higher Education InstitutionX No-profit research organisation						
B.2. PURPOSE AND ACTIVITY OF THE ORGANISATION							
Please provide a short presen particularly concerning its po <i>lines).</i>	ntation of your organisation in relation with the activities covered by the project and more stgraduate (masters/doctorate level) and international cooperation activities (max. 20						
Tartu Observatory is a research and educational organization in Astrophysics, Cosmology and Atmospheric Physics. It participates in graduate and postgraduate programs in these fields in collaboration with Tartu University (teaching and supervision of master and doctoral theses, as well as post-doctoral studies). Research in cosmology is done in cooperation with astronomers in Valencia University (Spain), Potsdam Astrophysical Institute (Germany), ICRAnet (Italy) and other centres. Tartu Observatory takes part in the preparation of the GAIA Mission to study the structure of our Galaxy, in particular the merging history of the Galaxy, and the structure of Dark Halo. In collaboration with Turku Observatory (Finland) Tartu Observatory participates in the Planck Mission; our responsibility is, among other tasks, the preparation of the catalogue of superclustors to study the Supracy Zoldovich offect in clustors and superclustors.							
Provide a short description of the organisation's specific role in the project (max. 10 lines)							
The Cosmology Department of Tartu Observatory will offer teaching and supervision in the problems of the large-scale structure of the Universe, both in the observational and statistical aspects, and in the numerical modeling of formation of structure. Tartu Observatory has a long experience and an outstanding list of results in this subject, and has fruitfully collaborated with ICRA in the study of fractal properties of structure in the Universe. Our specific role is in the study of the structure and morphology of superclusters, detailed modeling of the structure and evolution of galaxies of different morphological type, and evolution of the large-scale structure, including effects due to dark matter and dark energy.							