Université Nice SOPHIA ANTIPOLIS

Observatoire de la CÔTE d'AZUR

UNIVERSITE CHAMBERY SAVOIE

Stockholm University

ERASMUS MUNDUS JOINT DOCTORATE

INTERNATIONAL RELATIVISTIC ASTROPHYSICS DOCTORATE PROGRAM

SAPIENZA UNIVERSITÀ DI ROMA

Max-Planck-Institut für Gravitationsphysik ALBERT-EINSTEIN-INSTITUT

university of ferrara
600 YEARS OF LOOKING FORWARD.

FROM DARK MESS TO LIGHT

ERASMUS MUNDUS IRAP PHD

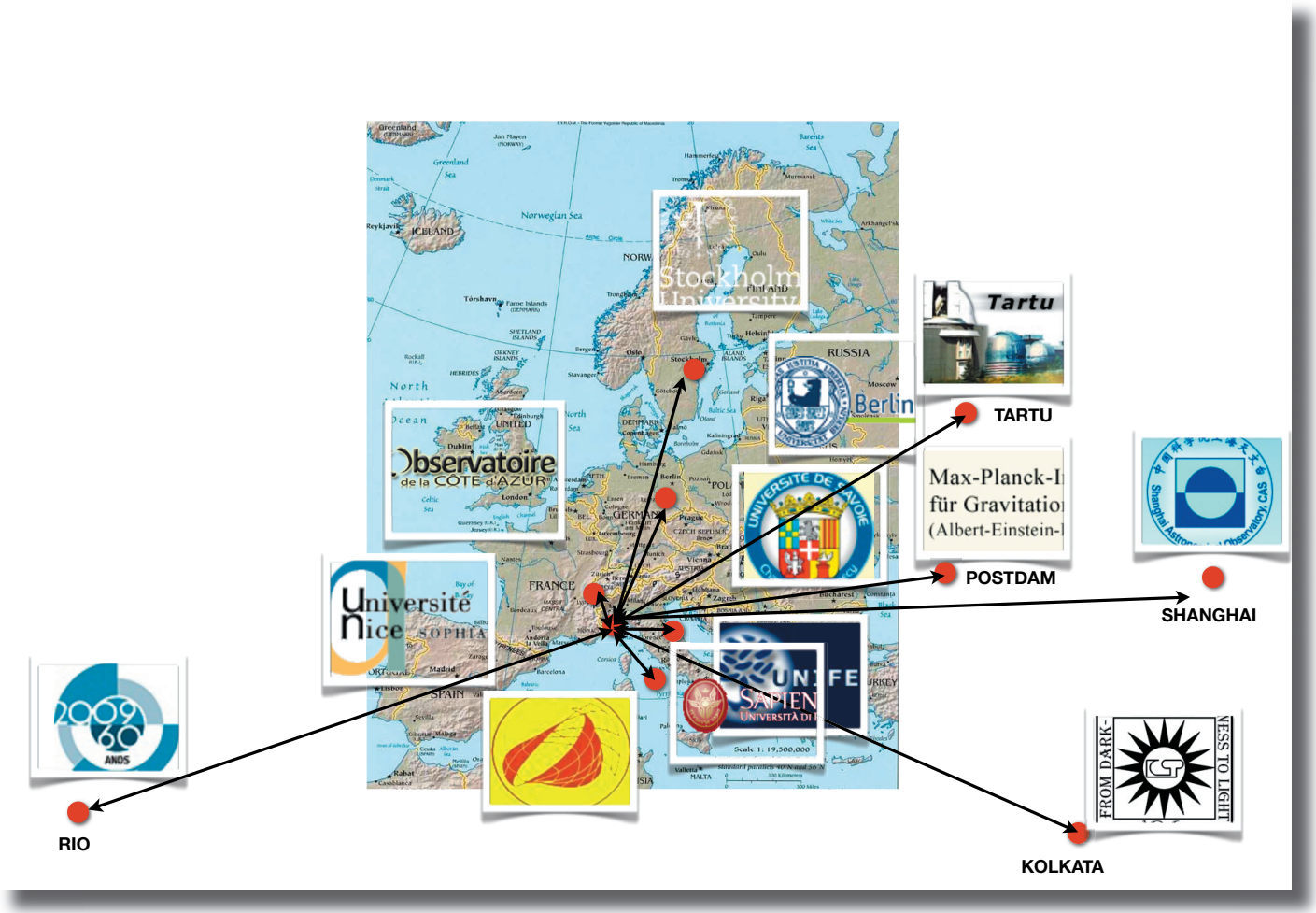
We propose a high level PhD training program with a diploma delivered by thirteen participating Institutions residing in Europe and Asia. This diploma carries with itself the prestigious label of "Erasmus Mundus" from the European commission.

The IRAP PhD program intends to create the condition of high level education in Astrophysics mainly in Europe to create a new generation of leading scientists. No single university in Europe today has the expertise required by the new generation of scientists by itself. For this reason we have identified universities which offer a very large complementary expertise.

Each student admitted to the Ph.D. program will be part of a team inside one of the laboratories of the consortium . Each year they will have the opportunity to visit other laboratories of the consortium and enlighten themselves with new topics in the forefront research from true experts. In this way the students will come in direct contact with some of the leading scientists in the world working in general relativity, relativistic astrophysics, cosmology and in quantum field theory. In addition to the theoretical centers, we associate experimental and observational centers as well. This will provide to the Ph.D. students the opportunity for a complete education in theoretical relativistic astrophysics, observational astrophysics and also an experience on how to design, develop and carry out a specific astrophysical mission.

All the institutions participating in IRAP PhD have a great experience in international collaborations 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. 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. The High Energy Astrophysical Group of Ferrara University, which contributed to the development of the Beppo-SAX satellite, has obtained the Bruno Rossi Prize in 1998 of the American Astronomical Society and the Descartes Prize of European Committee in 2002 for the Beppo-SAX discovery of the gamma ray burst afterglow and thus the solution of the 30 yr mystery about the sites and distances of gamma ray bursts. The Observatory de la Cote d'Azur 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.

Nice is the coordinating organization and we will use the "savoir faire" of the "Ecole Doctorale" in terms of logistic and administrative experience on the management of Ph.D. students.

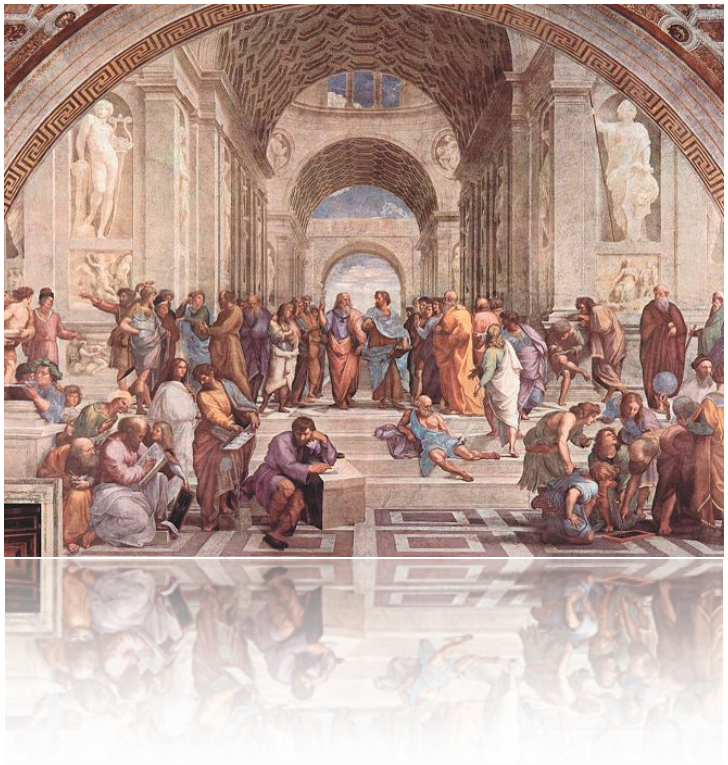

Stockholm University
Tartu
RUSSIA
Berlin
TARTU
Observatoire de la COTE d'AZUR
Max-Planck-I
für Gravitatio
(Albert-Einstein-I
POSTDAM
Shanghai Astronomical Observatory, CAS
SHANGHAI
Université Nice SOPHIA
FRANCE
SAPIENZA UNIVERSITÀ DI
Scale 1 : 19,500,000
2009 60 ANOS
RIO
FROM DARK- NESS TO LIGHT
KOLKATA

A complete Network all around the World

- UNIVERSITY OF NICE - SOPHIA ANTIPOLIS (Co-ordinating institution),	FRANCE
- SHANGHAI ASTRONOMICAL OBSERVATORY,	CHINA
- FREE UNIVERSITY OF BERLIN,	GERMANY
- AEI - POTSDAM,	GERMANY
- TARTU OBSERVATORY,	ESTONIA
- STOCKHOLM UNIVERSTIY,	SWEDEN
- UNIVERSITY OF FERRARA,	ITALY
- UNIVERSITY OF ROME - LA SAPIENZA,	ITALY
- BRAZILIAN CENTRE FOR PHYSICS RESEARCH,	BRAZIL
- OBSERVATORY OF THE CÔTE D'AZUR,	FRANCE
- INDIAN CENTRE FOR SPACE PHYSICS,	INDIA
- INTERNATIONAL CENTER FOR RELATIVISTIC ASTROPHYSICS NETWORK,	ITALY
- UNIVERSITY OF SAVOIE,	FRANCE

THE FACULTY

The IRAP PhD Faculty is the core of the Erasmus Mundus Doctorate. 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, "the charter thesis" 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.



Prof. Remo RUFFINI (Director); UNIVERSITY OF ROMA «LA SAPIENZA» & ICRANet

Prof Sandip Kumar CHAKRABARTI, INDIAN CENTRE FOR SPACE PHYSICS

Prof. Pierre COULLET, UNIVERSITY OF NICE-SOPHIA ANTIPOLIS

Prof. Yipeng JING, SHANGHAI OBSERVATORY

Prof. Hagen KLEINERT, FREE UNIVERSITY OF BERLIN

Prof. Mario NOVELLO, BRAZILIAN CENTRE FOR PHYSICS RESEARCH

Prof. Kjell ROSQUIST, STOCKHOLM UNIVERSITY

Prof. Farrokh VAKILI, OBSERVATORY OF THE COTE D'AZUR

Prof. Filippo FRONTERA, UNIVERSITY OF FERRARA

Prof. Jaan EINASTO, TARTU OBSERVATORY

Prof. Hermann NICOLAI, ALBERT EINSTEIN INSTITUTE

Prof. Pascal CHARDONNET (coordinator), UNIVERSITY OF SAVOIE

OUR RESEARCH PROGRAM

Following the successful scientific space missions by the European Space Agency (ESA), NASA and European Countries, and the European Southern Observatory (ESO) in Chile, as well as the high-energy particle activities at CERN in Genève, relativistic astrophysics has made a great step forward. IRAP is 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 perform analysis of the observational data received from the above facilities and to develop models to interpret them . For all that basic knowledges in astronomy, astrophysics and cosmology are mandatory. This activity is necessarily international, as no single university can cover the broad expertise required.

This has resulted in the programme offered by IRAP PhD in one of the youngest and most dynamic 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 as well as of the Center of ICRANet at Villa Ratti, where the coordination of the Doctorate will take place. The participation of the Freie Universität Berlin and of the Einstein Institute in Potsdam offers the possibility of teaching in relativistic field theories at the highest level. The University of Savoie offers the link to the particle physics at CERN. The activities at the University of Rome, at Stockholm University and at ICRA and 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. The University of Ferrara will be present with lectures and researches in the topics they have pioneered such as design and the development of experiments for space missions in X and gamma ray astrophysics, observational astronomy and theoretical astrophysics. 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.

FIELD OF EXPERTISE

- Cosmology, Gravitation and Multidimensions

- Cosmology and Large Scale Structure of the Universe

- Early Cosmology and Fundamental Relativity

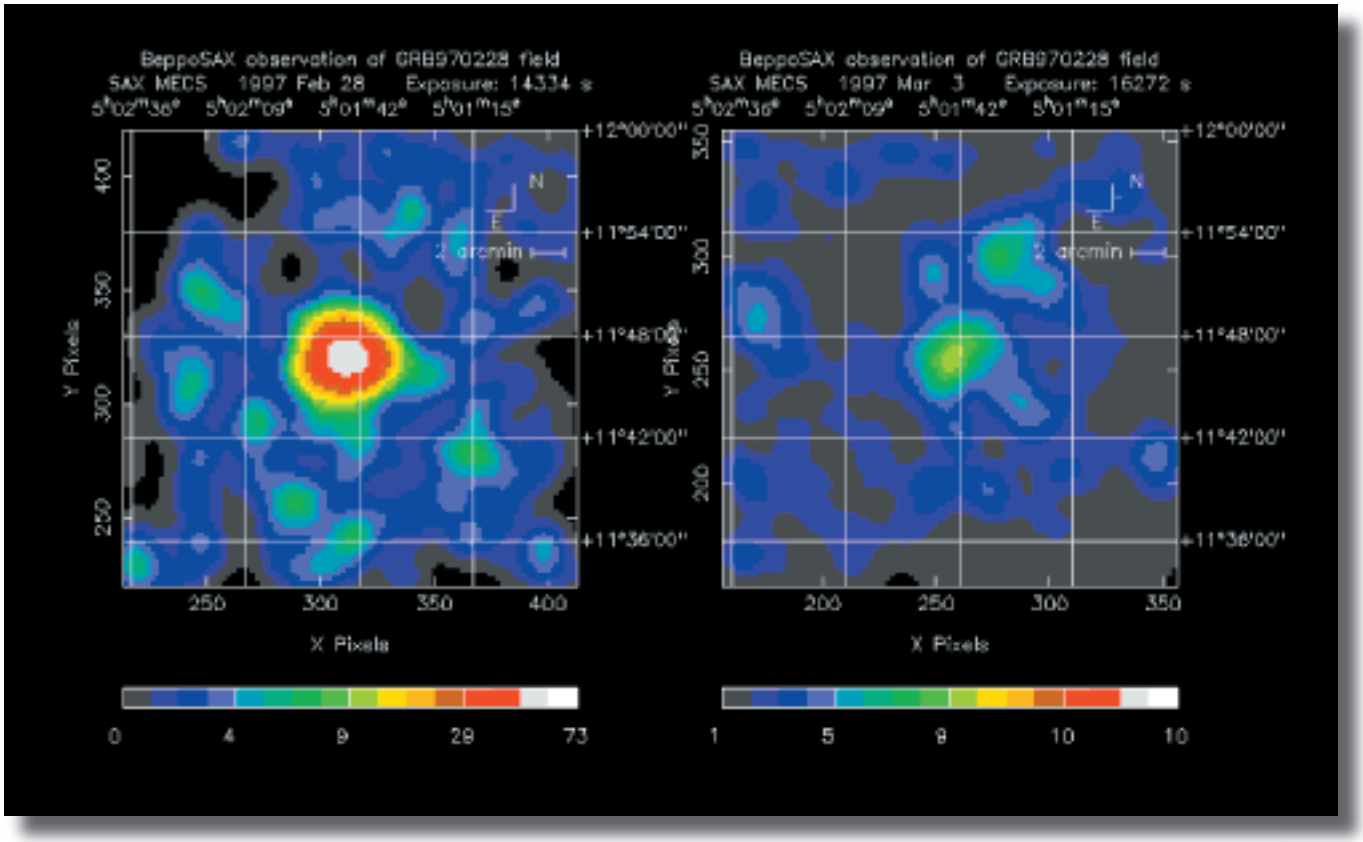
- Relativistic Astrophysics around compact objets

- Chaos in Astrophysical and Cosmological Problems

- Structure and Morphology of Galaxies: Equilibrium and Stability

- Gamma-ray bursts

- High Energy Astrophysics


BeppoSAX observation of GRB970228 field
SAX MECS 1997 Feb 28 Exposure: 14334 s
5h02m36s 5h02m09s 5h01m42s 5h01m15s
+12°00'00"
+11°54'00"
+11°48'00"
+11°42'00"
+11°36'00"
N
E
2 arcmin
Y Pixels
X Pixels
250
300
350
400
0
4
9
29
73
BeppoSAX observation of GRB970228 field
SAX MECS 1997 Mar 3 Exposure: 16272 s
5h02m36s 5h02m09s 5h01m42s 5h01m15s
+12°00'00"
+11°54'00"
+11°48'00"
+11°42'00"
+11°36'00"
N
E
2 arcmin
Y Pixels
X Pixels
200
250
300
350
1
5
8
10
10

A NEW PHD TRAINING SCHOOL IN ASTROPHYSICS

Each annual batch of students will begin an academic year in our Ph.D. program which has a duration of three 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 a period of one month each. These sessions are unique occasions to create a spirit of school inside our Ph.D. even if the students will be working in various partner institutions for their respective research. In this way they are part of a group and the organization coordinator will coordinate the avaibility and movements of professors and students. During these month-long 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 from our students.

The future scientists have to assume leadership role in new investigations in astronomy and astrophysics. To this effect, they will be trained to be skillful in writing and communicating.

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 a competence in leadership and project management through one month session of our PhD students in Observatoire de la Cote d'Azur.

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 shared with our students.

LECTURES PROPOSED IN ERASMUS MUNDUS IRAP PHD

FUNDAMENTAL COURSES

COURSES	PROFESSORS
ULTRA HIGH ENERGY GAMMA RAY SOURCES	Felix AHARONIAN (ICRANet & Max Planck)
THE APPROACH TO THE SINGULARITY	Vladimir BELINSKI (ICRANet)
RELATIVISTIC EFFECTS IN GRBS	Carlo BIANCO (ICRANet)
ACCRETIONS ON BLACK HOLES AND NEUTRONS STARS	Sandip CHAKRABARTI (Indian Centre for Space Physics)
PARTICLE PHYSICS APPLIED TO ASTROPHYSICS	Pascal CHARDONNET (Universite de Savoie)
EXOBIOLOGY	Sandip CHAKRABARTI (Indian Centre for Space Physics)
GENERAL RELATIVITY	Thibault DAMOUR (ICRANet & IHES)
LARGE SCALE STRUCTURE OF THE UNIVERSE	Jaan EINASTO (ICRANet AND Tartu Observatory)
SIGNAL TREATMENT	Andrea FERRARI (Universite de Nice)
X-RAYS AND GAMMA RAYS ASTRONOMY	Filippo FRONTERA (Universita di Ferrara)
X RAYS CLUSTERS	Riccardo GIACCONI (ICRANet)
PLANETOLOGY	Tristan GUILLOT (Observatoire de la Cote d'Azur)
FORMATION OF GALAXIES	Ypeng JING (Shanghai Observatory)
ON THE KERR SOLUTION	Roy KERR (ICRANet)
RELATIVISTIC FIELD THEORY	Hagen KLEINERT (Freie Universitat Berlin)
PLANETOLOGY	Alessandro MORBIDELLI (Observatoire de la Cote d'Azur)
DEVELOPMENT ON BKL WORK	Hermann NICOLAI (Einstein Institute Postdam)
NON SINGULAR COSMOLOGY	Mario NOVELLO (CBPF Brazil)
EXTRAGALACTIC ASTROPHYSICS	Jose PACHECO (Observatoire de la Cote d'Azur)
GRAVITATIONAL WAVES	Tania REGIMBAU (Observatoire de la Cote d'Azur)
SINGULARITIES AND GENERAL RELATIVITY	Kjell ROSQUIST (Stockholm University)
BLACK HOLES AND FUNDAMENTAL PHYSICS	Remo RUFFINI (ICRANet AND Roma La Sapienza)
THERMALIZATION AND COLLECTIVE EFFECTS IN ASTROPHYSICS	Gregory VERESHCHAGIN (ICRANet)
GRAVITATIONAL WAVES	Jean-Yves VINET (Observatoire de la Cote d'Azur)
ULTRA RELATIVISTIC ELECTRON POSITRON PLASMA	She-Sheng XUE (ICRANet)


© ESO

PRESENTATION

OF THE UNIVERSITIES,

INSTITUTIONS

AND

THE RESEARCH

LABORATORIES

UNIVERSITY OF NICE

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 euro-mediteranean 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. 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.

SHANGHAI ASTRONOMICAL OBSERVATORY

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.

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.

FREE UNIVERSITY OF BERLIN




Germany is represented in the Network by the Free University Berlin which is one of the top addresses of the German university szene. It is one of the nine Institutions that has been proclaimed to be an elite university by the novel excellemce program of the federal govenment receiving special funding. The Campus of the Freie Univeristät Berlin Berlin is an attractive place for both practical and historical reasons. It is situated in the park-like district of Berlin-Dahlem, the home of an academic colony of worldwide reputation. The most famous German researchers of the early 20th century lived and worked there, among them Einstein and Heisenberg. Otto Hahn's former home is just around the corner of the Physics Department, close to the former Kaiser-Wilhelm Institute of Physics where Hahn, Meitner, and Strassmann discovered the fission of uranium in 1938 .

The physics department is situated 100 meters from the place where Einstein lived after moving to Berlin from Zürich in 1914 (Ehrenbergstrasse with zoomed bronze memorial plate at the entrance) Heisenberg, Fritz Haber, Adolf Butenandt, Otto Hahn, Lise Meitner, Otto Meyerhof, Max Planck, Max von Laue and Otto Warburg. One Nobel Prize winner, the biologist Hans Fischer, even received the news of his award during his stay at the Harnack House. Ricarda Huch, the Swiss art historian Heinrich Wolfflin, and the Indian philosopher Rabindranath Tagore also added to the House's luster and prestige. In 1935, in direct opposition to the government, Max Planck led an impressive commemoration of Fritz Haber here. The Kaiser-Wilhelm Institutes were later re-organized and renamed in the former physicist's honor as the Max Planck Institutes. In July 2006 the campus hosted the great Marcel-Grossmann meeting 11 which attracted around 1000 scientst working in General Relatvity from all over the world (see http://www.icra.it/MG/mg11/).

In 2005 the famous library designed by the British Architect Normal Foster was opened to the students and represents a pleasant study environment with more than 700 000 books. Within the Erasmus Mundus program, the students will be able to profit from the special strength of the Freie University which is Quantum Field Theory with its various applications in astrophysics. This field is presently represented by Hagen Kleinert who has written many textbooks in theoretical physics ranging from quantum physics, statistical physics, the physics of polymers, defects in condensed matter, vortices in superfluids and superconductors, to general relativity. Students can even learn the modern field of econophysics from him (see http://users.physik.fu-berlin.de/~kleinert/kleinert/?p=booklist). He has won a number of prizes such as the Max born medal and the Majorana medal and has published more than 380 scientifuc articles (see http://users.physik.fu-berlin.de/~kleinert/kleinert/?p=articles&page=all).

ALBERT EINSTEIN INSTITUTE

Max-Planck-Institut
für Gravitationsphysik
Albert-Einstein-Institut

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 IRAP PhD and do their research works in any of the participating institutions including the Einstein Institute in Potsdam. 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

TARTU OBSERVATORY

TARTU OBSERVATOORIUM

The cosmology group of Tartu Observatory was formed about 20 years ago by merging of former theoretical cosmology and galactic astronomy groups. Presently it has 14 staff members (2 of them work part-time) and one PhD student. The head of the group is Dr. Enn Saar. As in Tartu there are no possibilities for astronomical observations of scientific significance in cosmology, our group is using observations made elsewhere. The main scientific orientations are the following.

1. Studying the structure, formation and evolution of the universe on large scales. We have used the 2dFGRS and SDSS surveys to study the density field, to select groups, clusters and superclusters of galaxies. In order to test the inflationary paradigm we studied the observational traces of baryon oscillations, predicted by inflation theories. Dark energy determines the formation and evolution of the largest elements of structure -- galaxy superclusters and giant voids. In a nearby region of the SDSS we can compare the locations and other properties of galaxies and quasars. At the present, quasars tend to avoid galaxies. We have made detailed studies of the structure of extremely large superclusters, using novel methods to describe their internal structure. We have performed numerical simulations of structure formation and evolution, and compared results with observations. We have studied the influence of large-scale waves on the filament network, on the richness of superclusters and voids, and on the properties of voids. Also we have developed new statistical methods to describe the structure.

2.We found strong observational limits on the properties of leptonically annihilating dark matter (particle mass and the annihilation cross-section). This type of dark matter is one of the most attractive possibility to explain the unexpectedly large flow of energetic positrons from the Galactic centre direction.

3. When studying the structure of the Galaxy, exact statistics of stellar surveys, and stellar classification is very important. We proposed a new method for estimating the colour indices of supergiants. This will allow a precision mapping of the absorption by Galactic dust. We analysed available stellar catalogues of effective temperatures and used the results for producing a new preliminary homogenized catalogue of merged temperature data. The Galaxy contains gas, both in hot star formation regions, and cold hydrogen far from them. We have mapped the gas distribution, using radio data, and were able to find cold gas clouds in the data. The Tartu cosmology group has collaboration with many other groups in Estonia, Finland, Spain, Germany, Italy, France, USA, UK and Mexico.

STOCKHOLM UNIVERSITY

At Stockholm University teaching and research are carried out at the highest level. The University participates in regional, national and international collaboration, in debate and in social change. More than 50,000 students and 6,000 members of staff within the humanities, law, science, social sciences and teacher training come together in a space where open minds meet and thrive.

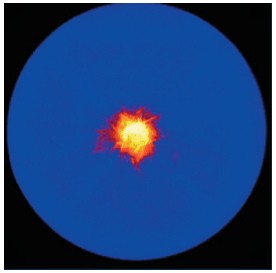
Astrophysics and cosmology

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 and 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.

Graduate studies

The graduate programs at AlbaNova include the subjects of Relativistic 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), 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.

UNIVERSITY OF FERRARA



university of ferrara
600 YEARS OF LOOKING FORWARD.

The University of Ferrara is one of the oldest in Italy. It was founded in 1391. Very famous people studied in Ferrara. For example, Nicholas Copernicus received here his gaduation in Law (Canonical Right). Currently 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 and Space Physics.

At the highest level, the University of Ferrara has set up the Institute for Higher Studies, IUSS - Ferrara 1391, that offers Doctorate programs to national and international students through a proper selection. One of them is the Doctoral Program in Physics, with several curricula, among which Astrophysics. The main reference structure for all PhD students in Physics is the Physics Department, that performs research activity in different fields, from nuclear and subnuclear physics to solid state physics and its applications (e.g., nanotechnologies, photovoltaic cells and solar applications, crystallography), physics of atmosphere, astroparticle physics and high energy astrophysics.

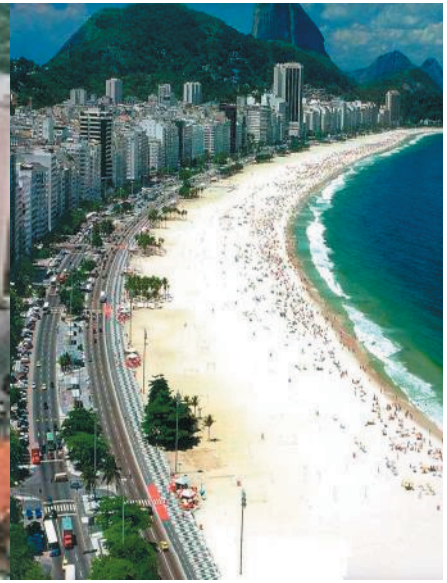
PhD students of the astrophysics curriculum join the High Energy Astrophysics Group (HEAG), led by Prof. Filippo FronteraThis group, since many years, is involved, through national and international collaborations, in experimental, observational, and recently, theoretical X-/gamma-ray astrophysics. Among the major programmes recently managed by HEAG, 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 a thirty year mystery, that of the Gamma Ray Burst (GRB) sites, was discovered though the discovery of the GRB afterglow. For this discovery, the Bruno Rossi Prize 1998 of the American Astronomical Society and the Descartes Prize 2002 of the European Committee, have been obtained. The current research activity in high energy astrophysics, with national and international collaborations, mainly concerns studies of GRBs, compact objects in binary systems, and the development of Laue lens telescopes for soft gamma-ray astronomy. For the experimental developments, of key importance is the Large Italian hard X-ray facility (LARIX), developed by HEAG, that includes a 100 m tunnel. It is used either for detector test and calibration and for hard X-/gamma-ray focusing telescope development and test. As an example, the facility has been used for the ground calibration of the JEM-X instrument above the INTEGRAL satellite.

UNIVERSITY OF ROMA «LA SAPIENZA»

SAPIENZA
UNIVERSITÀ DI ROMA

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. 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.

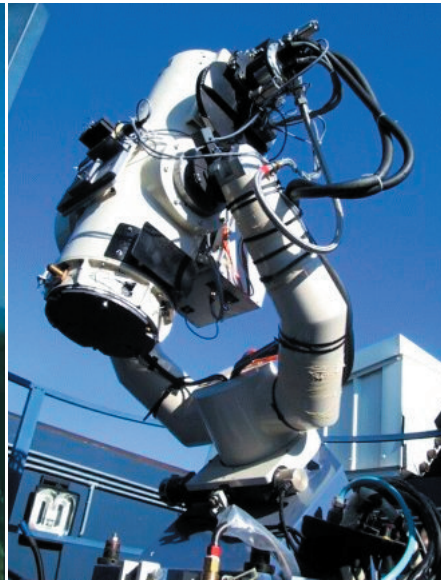
BRAZILIAN CENTER FOR PHYSICS RESEARCH



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 ICRA-Net 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.

OBSERVATOIRE DE LA COTE D'AZUR

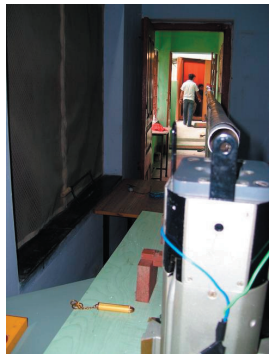


Observatoire de la Côte d'Azur (OCA) is a multi-disciplinary research institute with 200 permanent scientists and more than 100 engineers and technicians involved in Astronomy, Astrophysics and Geophysics academic research based on major ground-based instruments: e.g. VLT and VLTI at ESO, the VIRGO gravitational 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.

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.

INDIAN CENTRE FOR SPACE PHYSICS



Indian Centre for Space Physics (ICSP) is a relatively new space research institute situated in the city of Kolkata (Calcutta), well known for giving the phrase "Black Hole" (from Black Hole of Calcutta) to the world. Historically it the intellectual and culrural capital of India, being home or work place of all the Indian citizen Nobel Laureates. It is also the home of great physicists like M.N. Saha (Saha Equation), S.N. Bose (Bose-Einstein Statistics), J.C. Bose (Microwave communication pioneer etc.). It is a Government Aided Institution. ICSP has experts in the Physics of compact objects, Astrophysical Flows around black holes and neutron stars, Astro-biology/Astrochemistry, Study of Ionospheric disturbances with very low frequency radio waves etc. In addition Instrumentation Section has X-ray laboratory and X-ray detector developing units. It is also involved in sending small payloads with miniature instruments to near space environment using small balloon flights. In the study of Astrophysical Flows we concentrate on the transonic flows which are relavent for compact objects where General Relativity is important. The Advective Disk paradigm clearly has the advantage that it explains major spectral and timing properties within the framework of a single theoretical model. Other approaches do not assume any theoretical models, and add components on a case by case basis.

In Astrobiology/Astrochemistry problem we are trying to obtain the origin and evolution of complex molecules, especially those which are useful for formation of life. Very complex molecules have been observed in star forming regions and we synthesize them by coupling the hydrodynamic simulations and chemical evolutions during collapse and fragmentation in the star forming regions. We have been able to show that Glycene/Alanine etc. can be produced in the collapse process. In the study of the ionospheric disturbances by using Very Low Frequency (VLF) radio waves, we use radio antennas and receivers to detect the effects of terrestrial and extra-terrestrial disturbances on the ionospheric properties. We show that even Gamma Ray Bursts/Soft Gamma-ray repeaters can be detected using the earth's ionosphere as a giant dtector. In Instrumentation, we developed high resolution X-ray imagers which are achromatic. For the first time, Fresnel Zone Plates were studied with parallel and diverging beams and were sent to space in RT-2 payloads on board Russian Satellite CORONAS-PHOTON. These detectors are sending regular data. Already Several GRBs were detected and solar flares have been observed. The instruments are now ready to study solar flares when the Sun becomes active.

INTERNATIONAL CENTER FOR RELATIVISTIC ASTROPHYSICS

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 asthe 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. 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.

UNIVERSITY OF SAVOIE

Situated between Grenoble and Lyon, close to the Swiss and Italian borders, the University of Savoie is a state-financed multi-disciplinary establishment of higher education, recognized at regional, national and international levels. In an exceptional environment, the University of Savoie offers its 12,000 students a wide range of courses a three European levels: BA/BSc, MA/MSc and PhD. The quality of this scientific environment is further enhanced by the proximty of the CERN Genva, the largest particle accelerator in the world, and the nano-technologies research cluster in Grenoble.

Doing Research at LAPTH :

the scientific orientations The main scientific orientations of the laboratory are threefold:

-mathematical physics in the team Fields, Strings and Symmetries. The key words to characterise the remarkably successful work done in this team are “gauge and string theories” and “quantum integrable systems”. Besides, within this team, a line of research has been developed, since 2000, in the field of biophysics and it gained momentum with the arrival of a biologist in 2008, for a long term stay. This research is carried out in close association with mathematicians from LAMA under the sponsorship of the federation MSIF. To take this recent evolution into account the team is now labelled Fields, Strings and Symmetries, Biophysics.

- particle physics: the future commissioning of the LHC has been a very strong motivation for this team to develop, on the one hand, techniques to allow precise calculations of ”multileg” processes which will be dominant at the LHC, and on the other hand, to work on the phenomenological analysis of present and future data from colliders and astrophysical observations. The key words are “precision (loop) calculations” and “phenomenological studies of QCD, new physics, dark matter”. Needless to say that the proximity of LAPP and CERN is an advantage which is exploited by the team.

- particle astrophysics and cosmology: the extraction of cosmological parameters, the analysis of dark matter via its cosmological and astrophysical signatures and its modeling, the precise modeling of cosmic rays and the detailed comparison with cosmic particle spectra, the understanding of energetic astrophysical sources are the main topics studied in this team. The continuous amount of precise data from astrophysical and cosmological observations has been a constant source of motivation for this team, the work of which has a strong international impact.

LAPTH is part of the PHAST “Physics and Astrophysics” doctoral school to which ENS-Lyon and University of Claude Bernard Lyon 1 also belong . In the period from January 2005 to June 2009, 14 students who prepared their doctorate at LAPTH successfully defended their thesis