The field of relativistic astrophysics has become one of the fastest progressing fields of scientific development. This is due to the fortunate interaction of a vast number of international observational and experimental facilities in space, on the ground, underground, in the polar ice caps, and in the deep ocean, supported by a powerful theoretical framework based on Einstein’s theory of general relativity and relativistic quantum field theory. In 1995, the International Center for Relativistic Astrophysics in Rome (ICRA) initiated an International Network of Centers in the field of Relativistic Astrophysics (ICRANet) which has this year acquired the status of International Organization. The ICRANet combines the research powers of leading institutions in the Americas, Australia, Asia and Europe. The coordinating center is located in the town of Pescara, Italy. In parallel with these activities, the International Relativistic Astrophysics Ph.D. Program (IRAP Ph.D.) has been created with the goal of training a highly qualified number of Ph.D. students in this exciting field of research. So far, the participating institutions are: ETH Zurich, Freie Universität Berlin, Observatoire de la Côte d’Azur, Università di Roma “La Sapienza”, Université de Savoie. The IRAP Ph.D. is granted by all these institutions. Each program cycle lasts three years. The courses and related scientific activities cover a broad range of scientific topics including the mathematical and geometrical structure of spacetime, relativistic field theories of fundamental interactions both at the classical and quantum levels, astronomical and astrophysical observational techniques, and the associated phenomenological and theoretical descriptions. The research style is by its own nature interdisciplinary and international. The students will take courses at all participating institutions.

This is the announcement of the fourth IRAP Ph.D. cycle. The year 2005 signals the one hundredth anniversary of the “annus mirabilis” in which Einstein revolutionized the field of physics. In addition to the courses and research on relativistic field theory, black holes and cosmology the Graduate school will co-organize:

four “lezione magistrali” in Nice in October 2005 by Remo Ruffini, Nathalie Deruelle, Yuvval Ne’eman, Thibault Damour;

“Einstein and relativistic astrophysics”: December 2005 – April 2006, Pescara, exhibition and lectures;

“The reference frame” An International meeting, February 2006 in Nice;

XI Marcel Grossmann Meeting in S. Petersburg, July 2006.

The Courses – Each Student will have to follow 180 hours of courses during the three years of the Ph.D. program. The Courses can be chosen among the following ones. There is also the possibility to follow the courses of the other Ph., Mathematics, Astronomy and Astrophysics Ph.D. programs in each participating institution, after approval by the faculty.

CHAOTIC BEHAVIOR IN ASTROPHYSICAL SYSTEMS AND COSMOLOGY I. Lectures delivered at Pescara ICRANet Center by Prof. Vladimir Belinski.

SELECTED TOPICS ON GAMMA-RAY BURST THEORY. Lectures delivered at Pescara ICRANet Center by Dr. Carlo Luciano Bianco, Dr. Luca Origlia, Dr. Sheng Yuan.

PHYSICS OF GRAVITY. Lectures on the mathematical and physical foundation of general relativity held at the Università di Roma “La Sapienza” by Dr. Domenico Forzi and Prof. Robert T. Jantzen.

HIGH ENERGY UNIVERSE. Lectures delivered at Università di Saisse by Prof. Pascal Chardonnet.

MATHEMATICAL PROBLEMS OF GENERAL RELATIVITY THEORY. Lectures delivered at ETH Zurich by Prof. Detrmeir Christodoulaou.

NON-LINEAR DYNAMICS AND APPLICATIONS TO ASTROPHYSICS. Lectures delivered at Università di Roma “La Sapienza” by Prof. Pascale Coullet.

INTRODUCTION TO STRING THEORY. Lectures delivered at Università di Roma “La Sapienza” by Prof. Thiabalt Damour.

THE BINARY PULSARS: THEORY AND OBSERVATIONS. Lectures delivered at Université de Nice Sophia Antipolis and Pescara ICRANet Center by Prof. Nathalie Deruelle and Prof. Michael Kramer.

THE STRUCTURE, AND DYNAMICS OF SELF-GRavitating SYSTEMS. Lectures delivered at Pescara ICRANet Center by Prof. Simonetta Filippi and Alessio Sepulveda.

FERMI-THOMAS MODELS IN ATOMIC PHYSICS AND SELF-GRavitating SYSTEMS. Lectures delivered at Université de Nice Sophia Antipolis, Università di Roma “La Sapienza” and Pescara ICRANet Center by Prof. Francesco Guerra and Prof. Remo Ruffini.

CHAOTIC BEHAVIOUR IN ASTROPHYSICAL SYSTEMS AND COSMOLOGY II. Lectures delivered at the Free University in Berlin and Pescara ICRANet Center by Prof. Hagen Kleinert and Prof. Axel Pelster.

THE REFERENCE FRAME: FROM EARTH TO CMB. Lectures delivered at Università di Roma “La Sapienza” by Prof. François Mignard.

GENERALIZED KALUZA-KLEIN THEORIES. Lectures on the mathematical and physical foundation of multidimensional unified field theories, held at the Università di Roma “La Sapienza” by Dr. Giovanni Montani.

SELECTED THEORETICAL MODELS IN ASTRONOMY AND ASTROPHYSICS. Lectures delivered at Observatoire de la Côte d’Azur by Prof. José Pacheco.

THEORETICAL PHYSICS. Lectures with a special emphasis on the late phases of thermonuclear evolution of stars, general relativity and cosmology delivered at Università di Roma “La Sapienza” by Prof. Remo Ruffini.

The Faculty

Carlo Bernardini
Università di Roma “La Sapienza”

Julien Burgosino
Università di Nice Sophia Antipolis

Pascal Chardonnet
Université de Savoie

Domenico Christodoulaou
ETH Zurich

Jacques Colin
Observatoire de la Côte d’Azur

Pierre Coullet
Università di Roma “La Sapienza”

Simone Filippi
Università “Campus Bio-Medico” di Roma

Carlo Bernardini
Università di Roma “La Sapienza”

Giovanni Gallavotti
Università di Roma “La Sapienza”

Hagen Kleinert
Freie Universität Berlin

François Mignard
Observatoire de la Côte d’Azur

Jose Pacheco
Observatoire de la Côte d’Azur

Ugo Moschella
Università della Insubria Como

Remo Ruffini (Director)
Università di Roma “La Sapienza”

Kensuke Yoshida
Università di Roma “La Sapienza”

The ICRANet, initiated in 1995 to coordinate research in the field of Relativistic Astrophysics (by the Istituto di Ricerca Astrofisica, Italy), is the International Relativistic Astrophysics Ph.D. Program (IRAP Ph.D.).

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Invitation for Applicants 2006

The field of relativistic astrophysics has become one of the fastest progressing fields of scientific development. This is due to the fascinating interaction of a vast number of international observational and experimental facilities in space, on the ground, underground, in the polar ice caps, and in the deep ocean, supported by a powerful theoretical framework based on Einstein's theory of general relativity and relativistic quantum field theory. In 1995, the International Center for Relativistic Astrophysics in Rome (ICRA) initiated an International Network of Centers in the field of relativistic Astrophysics (ICRANet) which acquired the status of an International Organization in 2003. The ICRANet combines the research powers of leading institutions in the Americas, Asia, Australia, and Europe. The coordinating center is located in the town of Pescara, Italy. In parallel with these activities, the International Relativistic Astrophysics Ph.D. Program (IRAP Ph.D) has been created with the goal of training a highly qualified number of Ph.D. students in this exciting field of research. So far, the participating institutions are: ETH Zurich, Freie Universität Berlin, Institut des Hautes Études Scientifiques, Observatoire de la Côte d’Azur, Università di Roma “La Sapienza”, and Université de Savoie. The IRAP Ph.D is granted by all these institutions. Each program cycle lasts three years. The courses and related scientific activities cover a broad range of scientific topics including the mathematical and geometric structure of spacetime, relativistic field theories of fundamental interactions both at the classical and quantum levels, astronomical and astrophysical observational techniques, and the associated phenomenological and theoretical descriptions. The research style is by its own nature interdisciplinary and international. The students will take courses at all participating institutions.

This is the announcement of the 5-th IRAP PhD cycle. In addition to the courses and research on relativistic field theory, black holes and cosmology, the Graduate School will take part in the Eleventh Marcel Grossmann Meeting in Berlin, July 2006, in the 12th Brazilian School on Cosmology and Gravitation in September 2006, in the General Relativity Tutorials at the Center Emile Borel at the Institut Henri Poincaré in October 2006, and will also take part in topical seminars in the ICRANet centers in Pescara, at the University of Nice Sophia Antipolis, as well as at the University of Rome “La Sapienza” during all three years of this cycle.

The Courses – Each student will have to follow 180 hours of courses during the three years of the Ph.D. program. There is also the possibility to follow courses from the other PhD programs in each participating institution, after approval by the faculty. Courses can be chosen from the following list:

**RELATIVITY THEORY.**
- Lectures delivered at Università di Roma “La Sapienza” by Prof. Remo Ruffini.
- Lectures with a special emphasis on the late phases of thermonuclear evolution of stars, general relativity and cosmology delivered at University of Rome “La Sapienza” by Prof. Remo Ruffini.

**QUANTUM FIELD THEORIES.**
- Lectures delivered at the Freie Universität in Berlin and Pescara ICRANet Center by Prof. Hagen Kleinert and Prof. Axel Pelster.

**SYSTEMS AND COSMOLOGY II.**
- Lectures delivered at Borel Center in Paris, at the General Relativity Trimester at Gravitation in September 2006, in the 12th Brazilian School on Cosmology and Gravitation in September 2006, in the General Relativity Tutorials at the Center Emile Borel at the Institut Henri Poincaré in October 2006, and will also take part in topical seminars in the ICRANet centers in Pescara, at the University of Nice Sophia Antipolis, as well as at the University of Rome “La Sapienza” during all three years of this cycle.

**THE STRUCTURE AND DYNAMICS OF SELF-GRAVITATING SYSTEMS.**
- Lectures delivered at Pescara ICRANet Center by Prof. Simonetta Filippi and Alonso Sepulveda.

**PHYSICS OF GRAVITY.**
- Lectures delivered at Pescara ICRANet Center by Prof. Dr. Maria Grazia Bernardini.
- Lectures delivered at Pescara ICRANet Center by Dr. Marco Guzzo and Prof. Dr. Marco Gammaitoni.

**THERMAL-DYNAMICAL MODELS IN ATMOSPHERIC PHYSICS AND SELF-GRAVITATING SYSTEMS.**
- Lectures delivered at Université de Nice Sophie Antipolis, Università di Roma “La Sapienza” and Pescara ICRANet Center by Prof. Francesco Guarrera and Prof. Raffa Ruffini.

**RELATIVITY AND ASTROPHYSICS.**
- Lectures delivered at the Freie Universität in Berlin and Pescara ICRANet Center by Prof. Hagen Kleinert and Prof. Axel Pelster.

**HIGH ACCURACY ASTROMETRY AND RELATIVITY.**
- Lectures delivered at Università di Roma “La Sapienza” by Sergio Kleinert and Prof. François Mignard.

**GENERALIZED KALUZA-KLEIN THEORIES.**
- Lectures delivered at the Freie Universität in Berlin and Pescara ICRANet Center by Prof. Hagen Kleinert and Prof. Axel Pelster.

**SELECTED TOPICS IN RELATIVISTIC QUANTUM FIELD THEORIES.**
- Lectures delivered at Pescara ICRANet Center by Prof. Vahid Guzziyan.

**SELECTED TOPICS IN RELATIVISTIC CONCEPTS AND COSMOLOGY.**
- Lectures delivered at Université de Nice Sophie Antipolis by Dr. Donato Birn and Prof. Robert T. Jantzen.

**HIGH ENERGY UNIVERSE.**
- Lectures delivered at Université de Savoie by Prof. Pascal Chardonnet.

**MATHEMATICAL PROBLEMS OF GENERAL RELATIVITY THEORY.**
- Lectures delivered at ETH Zurich by Prof. Dimitrios Christodoulopou.

**NON-LINEAR DYNAMICS AND APPLICATIONS TO ASTROPHYSICS.**
- Lectures delivered at Università di Roma “La Sapienza” by Dr. Piero Coudert.

**INTRODUCTION TO STRING THEORY.**
- Lectures delivered at Borel Center in Paris, at the Università di Roma “La Sapienza” and Pescara ICRANet Center by Prof. Thibault Damour.

The Host Institution for the call of 2006–2007 is the Université de Nice Sophia-Antipolis Grand Château 28 Avenue Valrose 21 B.P. 2135 06103 NICE CEDEX 2

**Application and Fellowship.**
In 2006-2007 nine positions will be available, six with fellowship support. The application deadlines is July 10, 2006.

See http://www.icra.it/IRAPPhD.
The International
Relativistic Astrophysics Ph.D.

Invitation for Applicants 2007

The field of relativistic astrophysics has become one of the fastest growing fields in science. This is due to the coordinated interaction of a vast number of international proposals and experimental facilities in space on the ground, underground, in the oceans and in the JET operas. The fortunate coincidence of these years of a considerable support to this endeavor by a powerful theoretical framework based on the theory of general relativity and relativistic quantum field theories. Many international collaborations have been established to develop new experimental and observational fields. Since 2005, the International Center for Relativistic Astrophysics (ICRA) in collaboration with the International Network of Centers in the field of Relativistic Astrophysics (ICRANet) dedicated to foster international collaboration in the theoretical field of Relativistic Astrophysics. Since 2005 ICRA has acquired the status of a Research Organization with a coordinating center in Pavia (Italy). ICRA has been created with the goal of training a highly qualified number of Ph.D. students in this exciting field of research. For the participating institutions and ETH Zurich, Free University Berlin, University of Bologna (Bochum Astrophysics), Università Roma Tre, University of Siena, and University of Sannio, the Institute Hautes Études Scientifiques and Observatoire de la Côte d'Azur, the Ph.D. cycle lasts three years. The courses and related scientific activities take place in all participating institutions. They cover a broad range of scientific topics including the mathematical and geometric aspects of the classical and quantum field theories of fundamental interactions, the classical and quantum relativistic field theories of astrophysical and cosmological importance, and some of the more mathematical and theoretical de

This is the announcement of the sixth ICRA Ph.D. cycle. In addition to the courses and research groups, there will be a series of seminars and workshops including the Thirteenth Colloquium Pescara and at the University of Rome "La Sapienza", the Bogo Meeting in Nardis and the XII Marcoule Groffenkrain meeting in Paris. During the cycle, there will be lectures including advanced theoretical courses on the relativistic astrophysics of stars, the black holes, and the cosmic strings. The program includes a broad range of scientific topics including the mathematical and geometric aspects of the classical and quantum field theories of fundamental interactions, the classical and quantum relativistic field theories of astrophysical and cosmological importance, and some of the more mathematical and theoretical de

Many topics in the Einstein- Maxwell equations.

2. General Relativity and Cosmology.

3. Cosmological physics.

4. Relativistic Astrophysics.

5. Quantum Field Theory in curved space-time.


9. Quantum Cosmology.

10. Quantum Gravity.


12. Superstrings.

13. Quantum Field Theory.

14. Quantum Chromodynamics.

15. Quantum Electrodynamics.

16. Quantum Gravity.

17. Quantum Cosmology.

18. Quantum Field Theory.

19. Quantum Chromodynamics.

20. Quantum Electrodynamics.

21. Quantum Gravity.

22. Quantum Cosmology.

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150. Quantum Electrodynamics.

151. Quantum Gravity.

152. Quantum Cosmology.

153. Quantum Field Theory.

154. Quantum Chromodynamics.
The International Relativistic Astrophysics Ph.D. Program (IRAP Ph.D) is an advanced physics Ph.D. program created with the goal of training a new generation of relativistic astrophysicists. This program is jointly delivered by six Universities: ETH Zurich, Freie Universität Berlin, Università di Ferrara, Università di Roma “La Sapienza”, Università di Nice Sophia Antipolis, and Università degli Studi di Napoli “Federico II.” ICRANet, the International Center for Relativistic Astrophysics, in Pescara, Italy, serves as a coordinating Center in Pescara, Italy.

The IRAP PhD program is designed for students who are interested in pursuing a career in research and teaching in the field of relativistic astrophysics. The program covers a broad range of scientific topics including the mathematical and theoretical descriptions of the relativistic phenomena observed in the universe. The program is aimed at training a new generation of astrophysicists who will contribute to the advancement of our understanding of the universe.

The application deadline for the 2009-2010 cycle is August 31. For further details and applications, please visit the IRAP PhD program website.

The courses – Each student will have to follow 180 hours of courses during the three years of the Ph.D. program. There is also the possibility to follow courses from the other Universities jointly delivering the IRAP Ph.D. program.

Contact: Stefania Malavasi, IRAP PhD Program, IRAP, Université de Toulouse, 31400 Toulouse, France, stefania.malavasi@irap.fr
the International Relativistic Astrophysics Ph.D.

INVITATION FOR APPLICANTS 2009

In 2009-2010 ten positions will be available, six with fellowships support. Applications and fellowship will be evaluated, as well as those received after the deadline, in order to trust to the selection process. The application deadline is September 15, 2009. Tel. +39 06 49914254, e-mail: secretariat@iraphd@icra.it

Applications and fellowship: In 2009-2010 ten positions will be available, six with fellowship support. See the application deadline: September 15, 2009. Tel. +39 06 49914254, e-mail: secretariat@iraphd@icra.it

The International IRAP Ph.D. program of research and teaching is a collaboration between several institutions from Brazil, China and India. The University of Rome, at Sapienza University, and at ICRA offer teaching programs in all the fields of relativistic astrophysics, including cosmology and 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 ICRAthe 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), known for its research on compact objects, as well as in solar physics and astrophysics; in Brazil, with ICRA, at GRIF, where a successful program of research and teaching in relativistic astrophysics has been established in recent years.

The Courses – Each student will have to follow 180 hours of courses during the three years of the Ph.D. program. There is also the possibility to follow courses from the other Physics, Mathematics, Astronomy and Astrophysics Ph.D. programs in each participating institution, after approval by the faculty. Courses can be chosen from the following list:

- **Core Lectures**
  - Ultra High Energy Gamma Ray Sources
    - Colin A. Maier (ICRA and Max Planck)
  - Relativistic Effects in GRBs
    - Carlo Bianco (ICRA)
  - Accretion on Black Holes and Neutrons Stars
    - Sandra Chakrabarti (Indian Centre for Space Physics)
  - Particle Physics Applied to Astrophysics
    - Pascal Chardonnet (Savoie University)
  - Exobiology
    - Sandra Chakrabarti (Indian Centre for Space Physics)
  - General Relativity
    - Mariko Tamizuki (ICRA and IHEP)
  - Large Scale Structure of the Universe
    - Juan Eiroa (ICRA and Taru Observatory)
  - Signal Treatment
    - Andrea Ferranti (Nasa University)
  - X-rays and Gamma Rays Astronomy
    - Filippos Frontera (Ferrara University)

- **Lectures Clusters**
  - Riccardo Giacconi (ICRA)
  - Planetaryology
    - Giuseppe Guillet (Observatoire de la Côte d’Azur)
  - Formation of Galaxies
    - Orlando Marzola (Universitäts-Max-Planck-Institut für Gravitationsphysik)
  - On the Kerr Solution
    - Roy Kerr (ICRA)
  - Relativistic Field Theory
    - Xavier Kneur (Free University of Berlin)
  - Planetary Formation
    - Alexandre Marchal (Observatoire de la Côte d’Azur)
  - Development on BKL Work
    - Havan Nurmiev (Max Planck Institute for Gravitational Physics)
  - Non-Singular Cosmology
    - Mario Novello (ICRA and IHEP)
  - Extragalactic Astrophysics
    - José Paciocco (Observatoire de la Côte d’Azur)
  - Black Holes and Fundamental Physics
    - Simonetta Filippi (ICRA and Rome La Sapienza)
  - Thermализation and Collective Effects
    - Gregor Vereshaching (ICRA)

- **Gravitational Waves**
  - Simonetta Filippi (ICRA and Rome La Sapienza)
  - Gas and Stellar Dynamics
    - Alexey Komin (ICRA)
  - Signal Treatment
    - Andrea Ferranti (Nasa University)
  - Development of BKL Work
    - Havan Nurmiev (Max Planck Institute for Gravitational Physics)

- **Applications and Fellowship**
  - In 2009-2010 ten positions will be available, six with fellowship support. See the application deadline: September 15, 2009. Tel. +39 06 49914254, e-mail: secretariat@iraphd@icra.it

- **The Host Institution for the call of 2009-2010**
  - The Université de Nice Sophia Antipolis, 28 Avenue G. R. de Gaulle, B.P. 21, 06103 NICE CEDEX 2

- **The Faculty**
  - Giuseppe Guillet (ICRA and Rome La Sapienza)
  - Simonetta Filippi (ICRA and Rome La Sapienza)
  - Sandro Chakrabarti (Indian Centre for Space Physics)
  - Pascal Chardonnet (Savoie University)
  - Orlando Marzola (Universitäts-Max-Planck-Institut für Gravitationsphysik)
  - Havan Nurmiev (Max Planck Institute for Gravitational Physics)
  - Riccardo Giacconi (ICRA)
  - Andrea Ferranti (Nasa University)
  - Simonetta Filippi (ICRA and Rome La Sapienza)
  - Giuseppe Guillet (Observatoire de la Côte d’Azur)
  - Orlando Marzola (Universitäts-Max-Planck-Institut für Gravitationsphysik)
  - Riccardo Giacconi (ICRA)

- **ICRANet**
  - Xue She Sheng (ICRANet and Tartu Observatory)