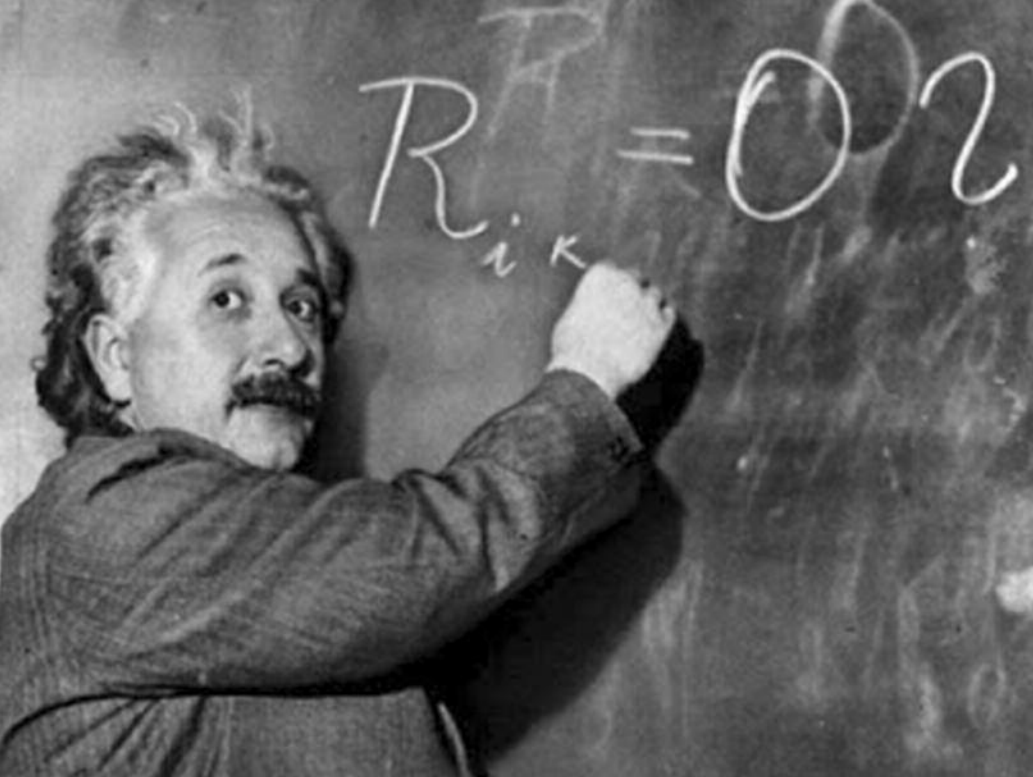


## **Enclosure 4**







# CELEBRATING THE 100<sup>TH</sup> ANNIVERSARY OF THE EINSTEIN EQUATIONS

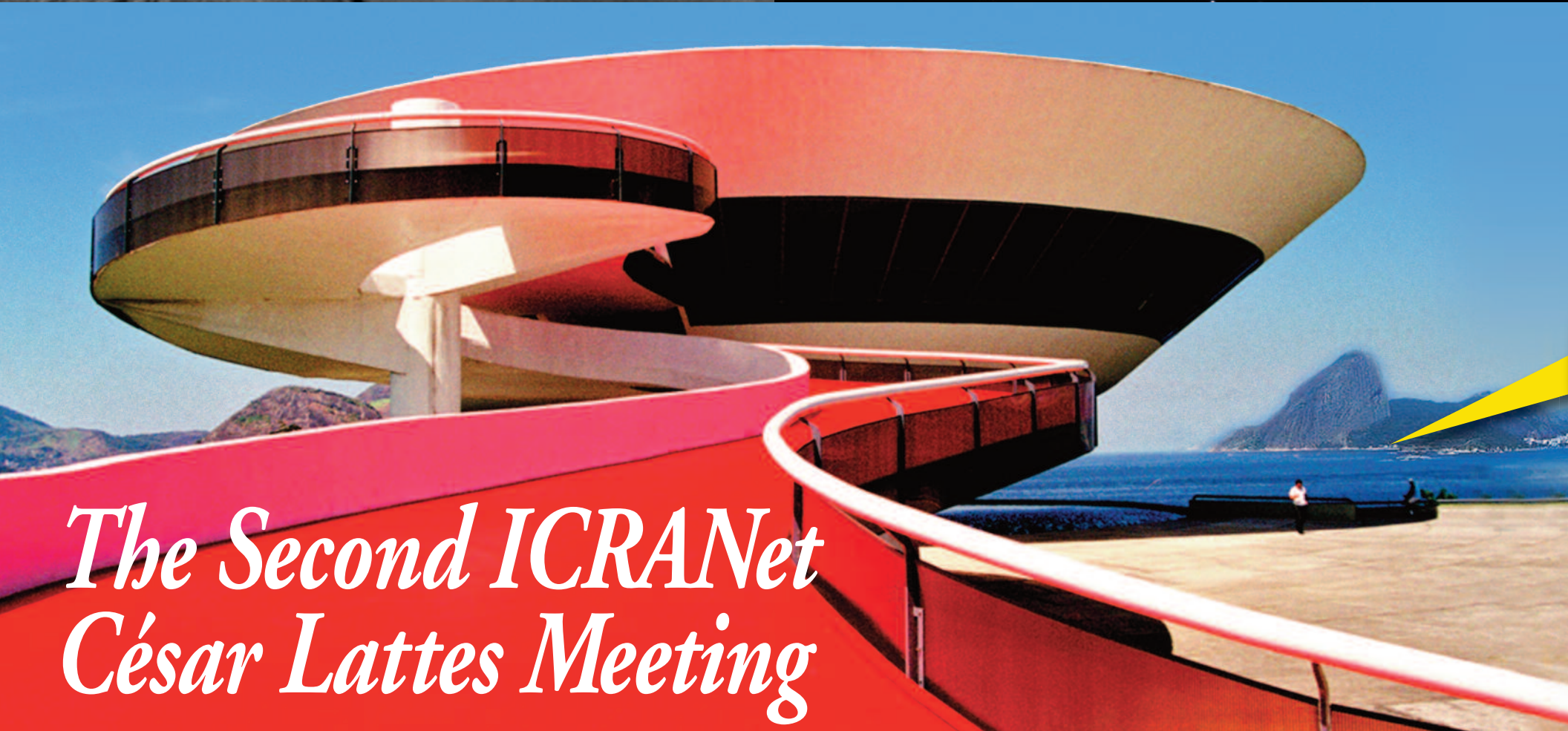


United Nations  
Educational, Scientific and  
Cultural Organization



In support of  
International  
Year of Light  
2015

**THE GOLDEN JUBILEE OF RELATIVISTIC ASTROPHYSICS**  
WILL BE CELEBRATED BY MGXIV AND SATELLITE MEETINGS IN  
ARMENIA, BRAZIL, CHINA, FRANCE, GERMANY, INDIA, ISRAEL,  
KOREA, MEXICO AND USA, IN 2015



## *The Second ICRANet César Lattes Meeting*



**Niterói-Rio de Janeiro,**  
April 13-18

**Recife,**  
April 20

**João Pessoa,**  
April 21

**Fortaleza,**  
April 22

*a Satellite  
Meeting of  
MG XIV*

# Supernovae, Neutron Stars and Black Holes

#### INTERNATIONAL ORGANIZING COMMITTEE

David Blair, Yvonne Choquet Bruhat, Thibault Damour, Paolo De Bernardis, C. W. Francis Everitt, Neil Gehrels, Riccardo Giacconi, Theodor Haensch, Stephen Hawking, Christine Jones Forman, Roy Kerr, Hagen Kleinert, Jutta Kunz, Claus Laemmerzahl, Tsvi Piran, Remo Ruffini (chair), Misao Sasaki, Humitaka Sato, Rashid Sunyaev, Gerard 't Hooft, Steven Weinberg

#### LOCAL ORGANIZING COMMITTEE

Valdir Barbosa Bezerra (UFPB, João Pessoa), Sergio Barbosa Duarte (CBPF, Rio de Janeiro), Ulisses Barres de Almeida (CBPF, Rio de Janeiro) (co-chair), Riccardo Belvedere (CBPF, CAPES, Rio de Janeiro), Fabio Briscese (UFPB, João Pessoa), Bruno Carneiro da Cunha (UFPE, Recife), Gustavo de Barros (UEZO, Rio de Janeiro), Dimiter Hadjimichef (UFRGS, Porto Alegre), Ernesto Kemp (UNICAMP, Campinas), Renato Klippert (UNIFEI, Itajubá), Mário Luiz Lopes da Silva (UFPE, Pelotas), German Lugones (UFABC, São Paulo), Manuel Malheiro (ITA, São José dos Campos), Sheyse Martins de Carvalho (UFF, CAPES, Rio de Janeiro), Alexandre Mesquita (UCS, Caxias do Sul), Fernando Nobrega Santos (UFPE, Recife), Ana Virginia Penacchioni (INPE, CAPES, São José dos Campos), Debora Peres Menezes (UFSC, Florianópolis), Rodrigo Picanço Negreiros (UFF, Rio de Janeiro) (co-chair), Luis Rangel Lemos (UFT, Palmas), Moisés Razeira (Unipampa, Caçapava do Sul), Carlos Romero (UFPB, João Pessoa), Virgílio Augusto Sales Araripe (IFCE, Ceará), Ronald Shellard (CBPF, Rio de Janeiro), Ivan Siutsou (CBPF, CAPES, Rio de Janeiro), Daniel Tavares da Silva (UFPE, Pelotas), Helio Teixeira Coelho (UFPE, Recife), Elena Zaninoni (CBPF, CAPES, Rio de Janeiro), César Zen Vasconcellos (UFRGS, Porto Alegre) (co-chair)

#### THE SECOND ICRANet CÉSAR LATTES MEETING

The meeting, dedicated to the coordination of the ICRANet Scientific activities in Brazil prior to the MGXIV meeting in Rome in July 2015, will celebrate the 100th anniversary of the Einstein Equations. The scientific meeting will take place at UFF and at CBPF. The inauguration and concluding remarks will take place at Fundação Planetário da Cidade do Rio de Janeiro. Public lectures will be delivered at the Museum of Contemporary Art (MAC), at the Cassino da Urca, at UFPE, at UFPB, at IFCE and at Planetário do Rio de Janeiro. The meeting will cover observational activities in the X, gamma ray and UHECR, theoretical progress in the relativistic astrophysics of Neutron Stars, Black Holes, Gravitational Waves and Cosmology as well as the development of the Brazilian Science Data Center (BSDC): from galactic and extragalactic sources and as far back in time to the appearance of the first structures in our Universe. Status and perspectives for the ICRANet projects, within the IRAP PhD and EMJD Program, the associated post-docs, and presence of senior research leaders within all the ICRANet Centers will be reviewed.

Details on: [www.icranet.org](http://www.icranet.org) - Contacts: [2cl@icranet.org](mailto:2cl@icranet.org)

#### Niterói (RJ) - UFF

The Fluminense Federal University.

#### Rio de Janeiro (RJ) - CBPF

Brazilian Center for Research in Physics.

#### Recife (PE) - UFPE

The Federal University of Pernambuco.

#### João Pessoa (PB) - UFPB

The Federal University of Paraíba.

#### Fortaleza (CE) - IFCE

The Federal Institute of Education of Ceará.

With the participation of (preliminary list)





THE SECOND ICRANet CÉSAR LATTES MEETING

April 13th -18th, 2015 –Rio de Janeiro, Brazil  
PRELIMINARY PROGRAM

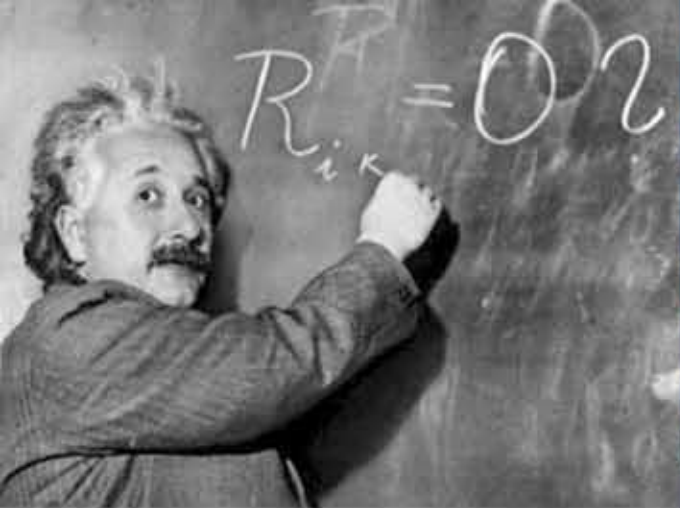
	MONDAY, 13APRIL PLANETÁRIO	TUESDAY, 14 APRIL UFF	WEDNESDAY, 15 APRIL UFF – MAC CASSINO DA URCA	THURSDAY, 16 APRIL CBPF	FRIDAY, 17APRIL PLANETÁRIO	SATURDAY, 18APRIL CBPF
	GAMMA-RAY BURSTS AND DARK MATTER	NEUTRON STARS AND WHITE DWARFS	ART AND SCIENCE	COSMOLOGY AND RELATIVITY AND POSTER SESSION	ASTROPARTICLE AND DATACENTER	TECHNICAL SCIENTIFIC DISCUSSIONS AND POSTER SESSION
CHAIRMAN	CUNHA CELSO Pres. Fundação Planetário	PENACCHIONI Ana INPE	NEGREIROS Rodrigo UFF	CHIAPPARINI Marcelo UERJ	MENEZES Debora UFSC	BARRES DE ALMEIDA Ulisses CBPF
9:00 – 9:30	Ambassadors and Representatives	RUEDA Jorge ICRANet	ARGUELLES Carlos ICRANet	ARBAÑIL VELA José D. ITA	GIOMMI Paolo ASDC	AHLEN Olof AEI/MPI
9:30 – 10:00	RUFFINI Remo ICRANet	ROMERO Carlos UFPB	HADJIMICHEF Dimiter UFRGS	CHARDONNET Pascal Savoie University	ARSIOLI Bruno ASDC	SIUTSOU Ivan CBPF
10:00 – 10:30	DE BERNARDIS Paolo “Sapienza” Univ.	NEGREIROS Rodrigo UFF	Public Lecture “Mario Schoenberg - an Intuitive Revolutionary between Art and Science” COHN Sérgio VERGARA Luiz G. – MAC	CARNEIRO DA CUNHA Bruno UFPE	NEMMEN Rodrigo IAG/USP	KARLICA Mile ICRANet
10:30 – 11:00	COFFEE BREAK			COFFEE BREAK		BEGUE Damien KTH
11:00 -11:30	WUENSCHÉ Carlos Alexandre INPE	DUARTE Sérgio CBPF	Transfer MAC-Niterói  COFFEE BREAK Bistrô MAC  Visit of MAC-Niterói	BENETTI Micol ON	DE LIMA Rafael ICRANet	R. LEMOS Luis Juracy UFT
11:30 – 12:00	DELLA VALLE Massimo OAC	ZEN VASCONCELLOS Cesar UFRGS		STROBEL Eckhard ICRANet	BARRES DE ALMEIDA Ulisses CBPF	KRUT Andreas “Sapienza” Univ.
12:00 – 12:30	IOCCO Fabio ICTP/UNESP	MALHEIRO Manuel ITA		CAMINHA Gabriel University of Ferrara	VECCHI Manuela USP (São Carlos)	STAHL Clément ICRANet
12:30 – 14:00	LUNCH		LUNCH Bistrô MAC	LUNCH		GREGORIS Daniele University of Stockholm
CHAIRMAN	DUARTE Sérgio CBPF	RUEDA Jorge ICRANet	Free Afternoon	ZEN VASCONCELLOS César UFRGS	MALHEIRO Manuel ITA	
14:00 – 14:30	IZZO Luca ICRANet	MARINHO Rubens ITA		BARROS Celso UFSC	DE ANGELIS Alessandro University of Udine	
14:30 – 15:00	MUCCINO Marco ICRANet	BELVEDERE Riccardo CBPF		FRAGA Bernardo ASDC	MATTHIAE Giorgio Roma 2	
15:00 – 15:30	G. DE OLIVEIRA Fernanda Nice Observatory	PEREIRA Jonas CBPF		ZANINONI Elena CBPF	SHELLARD Ronald CBPF	
15:30 – 16:00	PISANI Giovanni ICRANet	MARTINS Sheyse UFF		RAMOS Ramaton CBPF	NUÑEZ Luis UIS	
16:00 – 16:30	COFFEE BREAK			COFFEE BREAK		
16:30 – 17:00	PENACCHIONI Ana INPE	LENHO COELHO Eduardo UERJ		LUDWIG Hendrick Nice Observatory	Discussion Session LARGE COMPUTER INFRASTRUCTURES AND DATABASES  BEDIAGA Ignácio BRANDT Carlos (skype) EWALD Denise NEMMEN Rodrigo GIOMMI Paolo	
17:00 – 17:30	ENDERLI Maxime ICRANet	BECERRA Laura ICRANet  GÓMES DÍAZ L. Gabriel (skype) “Sapienza” Rome		DE ALMEIDA Luis UFAC		
17:30 – 18:00	SAWANT Disha University of Ferrara	BERNAL Cristian UFF	Chairman: PALMA Fabio Director IED-RIO	MENEZES Débora UFSC	CONCLUDING REMARKS	
18:00 - 19:00	Discussion Session CHARDONNET Pascal  PERSPECTIVES FOR THE EUROPEAN-LATIN AMERICAN IRAP PHD  Followed by a round table discussion	Discussion Session WHITE DWARFS, NEUTRON STARS, SUPERNOVAE  DUARTE Sérgio MALHEIRO Manuel NEGREIROS Rodrigo RUEDA Jorge	Visit of Cassino da Urca  REFRESHMENT	Discussion Session PERSPECTIVES FOR ASTROPARTICLE PHYSICS IN SOUTH AMERICA  BARRES DE A. Ulisses DE ANGELIS Alessandro MATTHIAE Giorgio NUÑEZ Luis SAHAKYAN Narek SHELLARD Ronald		
20:00 – 22:00	Public Lecture  Supermassive Black Holes and their role in the evolution of the Universe  BERGMANN Thaisa UFRGS	Public Lecture  Neutron Stars as cosmic laboratories  NEGREIROS Rodrigo UFF	Public Lecture  Urca Process and Gamow- Schoenberg  BARRES DE A. Ulisses GUZZO Marcelo - IFGW/UNICAMP RUFFINI Remo	Public Lecture  History of cosmic rays  MATTHIAE Giorgio Roma 2		

AEI/MPI - Albert Einstein Institute- Max Planck Institute  
ASDC – ASI Science Data Center  
CBPF- Centro Brasileiro de Pesquisas Físicas  
ICRANet - International Center for Relativistic Astrophysics Network  
ICTP - South American Institute for Fundamental Research  
IFGW/UNICAMP – Instituto de Física Gleb Wataghin  
INPE - Instituto Nacional de Pesquisas Espaciais

ITA - Instituto Tecnológico de Aeronáutica  
KTH - Royal Institute of Technology  
MPG - Max-Planck-Gesellschaft  
OAC - Osservatorio Astronomico di Capodimonte  
ON - Observatório Nacional  
UERJ - Universidade do Estado Do Rio De Janeiro  
UFAC - Universidade Federal do Acre

UFPB - Universidade Federal da Paraíba  
UFPE - Universidade Federal de Pernambuco  
UFRGS - Universidade Federal do Rio Grande Do Sul  
UFSC - Universidade Federal de Santa Catarina  
UFT - Universidade Federal do Tocantins  
UIS - Universidad Industrial de santander  
UNESP - Universidade Estadual Paulista





# International Conference on Gravitation and Cosmology

## the fourth **GALILEO-XU GUANGQI** meeting

## 第四届伽利略—徐光启会议

**Beijing - China**  
**May 4-8, 2015**



*Celebrating the*  
**100<sup>TH</sup> ANNIVERSARY OF THE**  
**EINSTEIN EQUATIONS**  
*the*  
**INTERNATIONAL YEAR OF LIGHT 2015**  
*and the*  
**GOLDEN JUBILEE**  
**OF RELATIVISTIC ASTROPHYSICS**



United Nations  
Educational, Scientific and  
Cultural Organization



In support of  
International  
Year of Light  
2015



*A satellite meeting  
of MGXIV*

1054' Supernova

宋至和元年客星

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Australia: David Blair - China (Beijing): Cai Rong-  
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Gary - China (Hsinchu): Geng Chao-Qiang - CNR: Ni-  
colais Luigi - ICRANet: Ruffini Remo (Co-Chair) -  
INFN: Ferroni Fernando - Italy: Della Valle Massimo -  
Japan: Misao Sasaki - South Korea: Lee Kimyeong

**Local Organizing Committee**  
Li-Ming Cao, Yun-Gui Gong, Zong-Kuan Guo, Qing-  
Guo Huang, Yi Ling, Yu-Feng Zhou











## RELATED LINKS

[Introduction](#)[Pictures](#)[Schedule&Talks](#)[Participants](#)[Wiki-space](#)[Associate Conferences/  
Workshops/Schools](#)

## The International Conference on Gravitation and Cosmology/The Fourth Galileo-Xu Guangqi Meeting

### Monday May.04 2015

**Room:**UCAS S101 **Chairperson:**Yue-Liang Wu

08:00		Registration		
09:00		Conference opening		
09:10	Jonathan Ellis	From String to the LHC via No-Scale Inflation		
09:50	C.N. Yang	MG14 award ceremony & Prof. C.N. Yang's talk "Fermi and his influence on me"		
10:10		Photo & Coffee break		

**Room:**UCAS S101 **Chairperson:**H. Tye

10:40	Remo Ruffini	Induced gravitational collapse in FeCO Core - Neutron star binaries and in Neutron star - Neutron star binaries		
11:20	Yue-Liang Wu	Alternative Principle of Quantum Gravity and Space-time Dynamics of the Universe		

**Room:**UCAS S101 **Chairperson:**Rong-Gen Cai

13:30	Petr Horava	Surprises with Naturalness		
14:10	Hong Lu	Black Holes in Higher-Derivative Gravity		
14:50		Coffee break		

**Room:**UCAS S101 **Chairperson:**Gary Shiu

15:05	Misao Sasaki	Reviving open inflation		
15:45	Bin Wang	The interaction between dark energy and dark matter		
16:25		Coffee break		

**Room:**UCAS S101 **Chairperson:**Remo Ruffini

16:40	Xuebing Wu	Discovery of a 12 billion solar mass black hole in the early Universe		
17:20	Yu-Qing Lou	Hypermassive Black Holes in the Childhood of Universe		

**Room:**UCAS S101 **Chairperson:**Rong-Gen Cai

19:00	Y.Q. Lou	MG14 award ceremony Prof. Y.Q. Lou's talk: Legacies of Professor T. D. Lee (李政道教授的传奇轶事)		
19:15	Remo Ruffini	Cosmic Matrix in the Jubilee of Relativistic Astrophysics		

### Tuesday May.05 2015

**Room:**6620 **Chairperson:**Misao Sasaki










08:30	A.Starobinsky	Present status of inflation and future perspectives		
09:10	Anzhong Wang	Precision cosmology and detectability of quantum gravitational effects in the early universe		
09:50		Coffee break		








**Room:**6620 **Chairperson:**Hong Lu

10:05	H. Tye	TBA		
10:45	Pisin Chen	A New Theory of Spacetime Quantization		
11:25	Jiang-Lai Liu	The PandaX Dark Matter Experiment		

<b>Room:6620 Chairperson:Yongge Ma</b>				
13:30	Abhay Ashtekar	Even a tiny cosmological constant casts a long shadow		
14:10	Zhanwei Han	Progenitors of Type Ia Supernovae		
14:50		Coffee break		
<b>Room:6620 Chairperson:Abhay Ashtekar</b>				
15:05	Yun Wang	Probing the Nature of Dark Energy		
15:45	Gary Shiu	String Theory and Cosmology		
16:25		Coffee break		
<b>Room:6620 Chairperson:Yi Ling</b>				
16:40	Carlo Rovelli	Loop Quantum Gravity and Planck Stars		
17:20	Sang Pyo Kim	Schwinger effect and Hawking radiation from charged black holes		
<b>Room:6620 Chairperson:</b>				
18:00		Banquet		
<b>Wednesday May.06 2015</b>				
<b>Room:6620 Chairperson:D. Blair</b>				
08:30	Barry Barish	The Path to Gravitational Wave Science		
09:10	Rita Bernabei	Dark Matter particles in the galactic halo		
09:50		Coffee break		
<b>Room:6620 Chairperson:Yu-Feng Zhou</b>				
10:05	Luciano Rezzolla	Electromagnetic signatures from merging binaries of compact objects		
10:45	Qian Yue	China Jinping underground laboratory and dark matter experiments inside		
11:25	Jin Chang	Dark matter particle detection in space		
<b>Room:6620 Chairperson:Sang Pyo Kim</b>				
13:30	Grant J Mathews	Constraints on the birth of the universe and the origin of cosmic dark flow		
14:10	Yu-Feng Zhou	Implications of the AMS-02 cosmic-ray antiproton data		
14:35	Q.G. Huang	Gravitational Wave: a probe into the physics in the early universe		
15:00		Coffee break		
<b>Room:6620 Chairperson:Yun-Song Piao</b>				
15:15	Yun-Gui Gong	Inflation with non-minimally derivative coupling		
15:40	Zong-Kuan Guo	Inflation coupled to a Gauss-Bonnet term		
16:05	Yu-Xiao Liu	Describing the ADD model in a warped geometry		
16:30		Coffee break		
<b>Room:6620 Chairperson:Qing-Guo Huang</b>				
16:45	Yongge Ma	Loop Quantum Cosmology of Scalar-Tensor Theories		
17:10	Milos Kovacevic	Flares in GRB within the Induced Gravitational Collapse scenario		



17:35	Yu Wang	Particle Acceleration of Gamma-ray Burst in The "Sponge" Structure		
<b>Thursday May.07 2015</b>				
<b>Room:6620 Chairperson:</b> Hongwei Yu				
08:30	Bo Feng	Scattering amplitude of gravity		
09:10	Xiao Zhang	The positive energy theorem for asymptotically AdS spacetimes		
09:50		Coffee break		
<b>Room:6620 Chairperson:</b> She-Sheng Xue				
10:05	Zhong-Kun Hu	Precision Gravitational Experiments with Cold Atom Interferometry		
10:45	Kenta Kiuchi	Recent progress of compact binary mergers simulations in Kyoto numerical relativity group		
11:25	C.G. Huang	Entropy of Rotating Isolated Horizons from Loop Quantum Gravity		
11:50	Wei Zheng	Probing the Early Universe with Gravitational Lensing		
<b>Room:6620 Chairperson:</b> Ji-Liang Jing				
13:30	Xuelei Chen	Prospects of probing dark energy, primordial non- Gaussianity and neutrinos with 21cm observations		
14:10	K.Bolejko	Signature of dark matter decay in the ISW effect		
14:35		Coffee break		
<b>Room:6620 Chairperson:</b> Yun-Gui Gong				
14:50	Wei-Tou Ni	New Constraints on Cosmic Polarization Rotation from the ACTPol, BICEP2 and POLARBEAR CMB B-Mode Observations		
15:15	C. Zhang	Test of general relativity by FAST telescope		
15:40	D. Gregoris	Cosmological application of the Shan-Chen equation of state		
16:05		Coffee break		
<b>Room:6620 Chairperson:</b> Zong-Kuan Guo				
16:20	Yi Ling	Holographic lattices and Metal-Insulator Transition		
16:35	Fangyu Li	B-mode produced by high-frequency gravitational waves and corresponding perturbation photon fluxes		
17:10	Huiquan Li	Brane decay and creation across horizons		
17:35	M. Sharif	Stability: Impact of Physical Factors		
<b>Friday May.08 2015</b>				
<b>Room:6620 Chairperson:</b> Qing Wang				
08:30	G. Vereshchagin	Cosmic absorption of ultra-high energy particles		
09:10	Junhui Fan	The spectral energy distribution for Blazars		
09:50		Coffee break		
<b>Room:6620 Chairperson:</b> Chao-Qiang Geng				
10:05	M.Shaposhnikov	Inflation and LHC		
10:45	She-Sheng Xue	How universe evolves with cosmological and gravitational constants		
11:25	P. Chardonnet	Renaissance in astrophysics: the primordial stars		

Room:6620 Chairperson:Anzhong Wang				
13:30	Kimyeong Lee	6-dim supersymmetric theories		
14:10	Bin Chen	Renyi entropy in AdS_3/CFT_2 correspondence		
14:50		Coffee break		
Room:6620 Chairperson:Zong-Hong Zhu				
15:05	C.Q.Geng	Multicomponent Dark Matter		
15:45	David Blair	Plans and Proposals for Australia-China Collaboration in Gravitational Wave Astronomy in the Audio Band & Closing remarks		



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# MG14 ROME 12-18 JULY 2015

## CELEBRATING THE 100<sup>TH</sup> ANNIVERSARY OF THE EINSTEIN EQUATIONS

### FOURTEENTH MARCEL GROSSMANN MEETING



## ON RECENT DEVELOPMENTS IN THEORETICAL AND EXPERIMENTAL GENERAL RELATIVITY, ASTROPHYSICS, AND RELATIVISTIC FIELD THEORIES

### LOCAL ORGANIZING COMMITTEE

Amati L., Angelantonj C., Barbiellini G., Bassan M., Battistelli E., Belinski V., Belli P., Benedetti R., Bernabei R., Bianchi M. (chair), Bianco C., Bini D., Buchert T., Burgio F., Capozziello S., Chakrabarti S., Chardonnet P., Dall'Agata G., De Angelis A., De Bernardis P., Della Valle M., Di Virgilio A., Fiorini E., Frasca S., Fré P., Frontera F., Giavalisco M., Giommi P., Gionti G., Ingrassia G., Jantzen R., Jetzer P., Lee H.W., Lerda A., Liberati S., Longo R., Mandolesi N., Marmo G., Masi S., Menotti P., Morselli A., Pelster A., Piacentini F., Pian E., Quevedo H., Riccioni F., Rosati P., Scarpetta E.V., Tavani M., Tino G., Titarchuk L., Vereshchagin G., Vitale S., Xue S.S., Zen Vasconcellos C.

### INTERNATIONAL ORGANIZING COMMITTEE

David Blair, Yvonne Choquet Bruhat, Thibault Damour, Paolo De Bernardis, C. W. Francis Everitt, Neil Gehrels, Riccardo Giacconi, Theodor Haensch, Stephen Hawking, Christine Jones Forman, Roy Kerr, Hagen Kleinert, Jutta Kunz, Claus Laemmerzahl, Tsvi Piran, Remo Ruffini (chair), Misao Sasaki, Humitaka Sato, Rashid Sunyaev, Gerard 't Hooft, Steven Weinberg

THE  
GOLDEN JUBILEE  
OF RELATIVISTIC  
ASTROPHYSICS  
WILL BE CELEBRATED  
BY MG14  
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MEETINGS IN  
ARMENIA,  
BRAZIL,  
CHINA,  
FRANCE,  
GERMANY,  
INDIA,  
ISRAEL,  
KOREA,  
MEXICO  
AND USA,  
IN 2015

### INTERNATIONAL COORDINATING COMMITTEE

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• **KOREA (Seoul):** Kim S.P., Lee H.K.  
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• **NORWAY:** Knutsen H.

• **POLAND:** Demianski M., Lewandowski J., Nurowski P., Sokolowski L.  
• **PORTUGAL:** Costa M., Moniz P., Pizarro de Sande e Lemos J., Silva L.O. • **ROMANIA:** Visinescu M.  
• **RUSSIA:** Aksenov A., Arkhangel'skaja I., Bisnovatyi Kogan G., Blinnikov S., Chechetkin V.M., Cherepaschuk A.M., Khriplovich I., Lipunov V.M., Lukash V., Novikov I., Rudenko V.N., Starobinskiy A.A.  
• **SERBIA:** Sijacki D. • **SLOVENIA:** Cadez A.  
• **SOUTH AFRICA:** Maartens R., Maharaj S.  
• **SPAIN:** Elizalde E., Garcia-Berro E., Ibanez J., Perez Mercader J., Verdaguer E.  
• **SWEDEN:** Abramowicz M.A., Marklund M., Ryde F.  
• **SWITZERLAND:** Durrer R., Jetzer P.  
• **TURKEY:** Aliev A., Gurses M. • **UKRAINE:** Zhuk A.  
• **UK:** Cruise A.M., Frenk C.S., Green M., Kibble T.  
• **USA:** Abel T., Ashtekar A., Bardeen J., Carlstrom J., Cornish N., Dermer C., DeWitt Morette C., Drever R., Flanagan E., Fryer C., Jantzen R. (chair), Kolb R., Lousto C., Mashhoon B., Mathews G., Matzner R., Melia F., Mester J., Michelson P., Nordtvedt K., Parker L., Pretorius F., Pullin J., Schwarz J., Shapiro I., Shapiro S., Shoemaker D., Smoot G., van Nieuwenhuizen P., Zhang B.  
• **UZBEKISTAN:** Zalaletdinov R.M. • **VATICAN CITY:** Gionti G.  
• **VENEZUELA:** Barreto W., Herrera L. • **VIETNAM:** Long H.N.

### THE MARCEL GROSSMAN MEETINGS

Since 1975, the Marcel Grossman Meetings have been organized in order to provide opportunities for discussing recent advances in gravitation, general relativity and relativistic field theories, emphasizing mathematical foundations, physical predictions and experimental tests. The objective of these meetings is to elicit exchange among scientists that may deepen our understanding of space-time structures as well as to review the status of ongoing experiments aimed at testing Einstein's theory of gravitation and relativistic field theories either from the ground or from space. Previous meetings have been held in Trieste (1975) and (1979), Shanghai (1982), Rome (1985), Perth (1988), Kyoto (1991), Stanford (1994), Jerusalem (1997), Rome (2000), Rio (2003), Berlin (2006), Paris (2009), and Stockholm (2012). Interested scientists should address a member from any one of the organizing committees or the conference secretariat.  
website: <http://www.icra.it/MG/mg14/> email: [mg14@icra.it](mailto:mg14@icra.it)

### THE UNIVERSITY OF ROME "LA SAPIENZA"

With approximately 120,000 students and 60 Institutions, the University "la Sapienza", "Studium Urbis" in Latin, has become the largest center of learning in the Mediterranean. It was founded in 1303 by Pope Bonifacio VIII. In 1431 by the will of Pope Eugenio IV the University was given a fixed endowment. In 1527 the students gave origin to various Academies and the topics of teaching were further extended. In 1660 three major institutions were founded: the main library "Alessandrina", the splendid Botanical Garden on the Gianicolo Hills, both still operating today, the church "S. Ivo" and the palace of "la Sapienza", designed by Borromini, today part of the Senate of the Italian Republic. In 1935 part of the University was transferred to the new campus, designed by Piacentini, where Tullio Levi-Civita and Enrico Fermi were members of the Faculty of Sciences.

With the participation of (preliminary list)









# PROGRAM



# Monday morning, July 13<sup>th</sup>

La Sapienza Roma - Aula Magna

09:00 - 10:00

## Inaugural Session

Chairperson: Paolo de Bernardis

## Welcoming addresses

Remo Ruffini (ICRANet), Yvonne Choquet-Bruhat (French Académie des Sciences),  
Jose' Funes (Vatican City), Ricardo Neiva Tavares (Ambassador of Brazil),  
Sargis Ghazaryan (Ambassador of Armenia), Francis Everitt (Stanford University)  
and Chris Fryer (University of Arizona)

## Marcel Grossmann Awards

Yakov Sinai, Martin Rees, Sachiko Tsuruta, Ken'ichi Nomoto,  
ESA (acceptance speech by Johann-Dietrich Woerner, ESA Director General)

## Lectiones Magistrales

10:00 - 10:35	<b>Yakov Sinai</b> (Princeton University) Deterministic chaos
10:35 - 11:10	<b>Martin Rees</b> (University of Cambridge) How our understanding of cosmology and black holes has been revolutionised since the 1960s
11:10 - 11:35	<b>Group Picture - Coffee Break</b>
11:35 - 12:10	<b>Gerard 't Hooft</b> (University of Utrecht) Local Conformal Symmetry in Black Holes, Standard Model, and Quantum Gravity

## Plenary Session: Mathematics and GR

12:10 - 12:40	<b>Katarzyna Rejzner</b> (University of York) Effective quantum gravity observables and locally covariant QFT
12:40 - 13:10	<b>Zvi Bern</b> (UCLA Physics & Astronomy) Ultraviolet surprises in quantum gravity
14:30 - 18:00	<b>Parallel Session</b>
18:45 - 20:00 Public Lecture	<b>Stephen Hawking (teleconference)</b> (University of Cambridge) Fire in the Equations

# Monday afternoon, July 13<sup>th</sup>

Code	Classroom	Title	Chairperson
AC2	ChN1	MHD processes near compact objects	Sergej Moiseenko
AT1 A	FF Cabibbo	Extended Theories of Gravity and Quantum Cosmology	Salvatore Capozziello, Gabriele Gionti
AT3 A	FF3	Wormholes, Energy Conditions and Time Machines	Francisco Lobo
AT4	FF6	Localized selfgravitating field systems in the Einstein and alternatives theories of gravity	Dmitry Galtsov, Michael Volkov
BH1 2-3	FM Majorana	BH1: Binary Black Holes as Sources of Multimessenger Astronomy BH2: Black hole in binary stellar system BH3: Black hole in galactic nuclei	Pablo Laguna, Anatoly M. Cherepaschuck, Stanislav O. Alexeyev
BH4 A	Blu2	Gravitational fields with sources: From compact objects to black holes	José P. S. Lemos, Paolo Pani
BN5	ChB	Self-forces and small-mass-ratio binaries	Adam Pound
BS2	FF8	Scalar fields in cosmology	Alfredo Macias
DE2	Blu1	Inhomogeneous Cosmology	T. Buchert, A. Coley, D. Wiltshire
DM1	Blu3	Interacting Dark Matter	Nikolaos Mavromatos
ES1	Matl	Exact Solutions in Four and Higher Dimensions: Mathematical Aspects	Georgy Alekseev
EU1	FF7	Semiclassical and Quantum Cosmology	Paulo Vargas Moniz
EU3	Blu4	Cosmological Singularities and Asymptotics	Spiros Cotsakis
GB2	FMCareri	The energy compositions and acceleration processes of GRB jets	Shiho Kobayashi, Stefano Covino
GN1	FF2	Gravitational physics of the galactic center	Heino Falcke
GW2	Blu5	Status of the Gravitational Wave Detectors	David Blair, Jean-Yves Vinet
NS1	FMAmaldi	Observational Constraints on the Micro and Macroscopic properties of Compact Stars	Jorge Rueda, Rodrigo Negreiros
PT1	Geo1	Tests of gravity with atom interferometers and clocks	Guglielmo Tino
PT2	Geo12	Theory of light propagation in gravitation fields	Volker Perlick
PT4 A	Geo11	Variation of Fundamental Constants	Victor Flambaum, Julian Berengut
QF1	MatV	Quantum Spacetime	Gherardo Piacitelli
QG3	MatPicone	Loop quantum gravity: cosmology and black holes	Jorge Pullin, Parampreet Singh
SF1-2	FMRasetti	SF1: Strong (EM) Field physics and Astrophysics SF2: Ground experiment and astrophysical observations in Strong Fiel Physics	Sang Pyo Kim, She-Sheng Xue
SN1-2 A	ChD	SN1: Supernova Explosionsand Neutron Stars Dynamics SN2: Numerican simulations,SN, and GRB, connecting with massive SN	Kostas Kokkotas, Valeri Chechetkin, Alexey Aksenov
ST2	FF4	Black Holes in String Theory	Gianguido Dall'Agata
WD1-3	FM Conversi	WD1: The Status of Magnetic White Dwarfs WD3: White Dwarfs in Binaries and the Role of Gavitational Wales	Enrique Garcia-Berro, S.O. Kepler, Mukremin Kilic



## Tuesday morning July 14<sup>th</sup>

### Plenary Session: Quantum and Gravity

Chairperson: Gabriele Veneziano

09:00 - 09:35	<b>Abhay Ashtekar</b> (Institute for Gravitation & the Cosmos) Recent Conceptual and Phenomenological Advances in Loop Quantum Gravity
09:35 - 10:10	<b>Sergio Ferrara</b> (PH-TH CERN - INFN, Frascati National Laboratories) Supersymmetry and Inflation
10:10 - 10:45	<b>Chris Hull</b> (Imperial College London) A review of generalized geometries in string theory
10:45 - 11:05	<b>Coffee Break</b>
11:05 - 11:40	<b>John Ellis</b> (King's College London) No-Scale Inflation: a Bridge between String Theory and Particle Physics?
11:40 - 12:15	<b>Andrew Strominger</b> (Harvard University) Conformal Symmetry in the Sky
12:15 - 12:50	<b>Samir Mathur</b> (The Ohio State University) Fuzzballs, Firewalls and all that
14:30 - 18:00	<b>Parallel Session</b>
18:45 - 20:00 Public Lecture	<b>Rashid Sunyaev</b> (Max Planck Institute for Astrophysics) Cosmic Microwave Background Radiation: In the Directions to Clusters of Galaxies, Recombination of Hydrogen in the Universe and Black-body Photosphere of our Universe

Tuesday afternoon July 14 <sup>th</sup>			
Code	Classroom	Title	Chairperson
AT1 B	FFCabibbo	Extended Theories of Gravity and Quantum Cosmology	Salvatore Capozziello, Gabriele Gionti
AT3 B	FF3	Wormholes, Energy Conditions and Time Machines	Francisco Lobo
BH4 B	FM Conversi	Gravitational fields with sources: From compact objects to black holes	José P. S. Lemos, Paolo Pani
BH6 A	FF7	Regular and Analogue Black Holes	Stefano Liberati, Carlos Barcelo
BH8	FM Majorana	Black Holes in Higher Dimensions (Black Rings and Black Strings)	Jutta Kunz
BN3 A	FM Amaldi	Double Neutron Stars and Neutron Star White Dwarf Binaries	Thomas Tauris
BN6	FF6	Post-Newtonian and Analytic Approximations	Alexandre Le Tiec
CM1	FM Rasetti	Cosmic Microwave Background measurements	Silvia Masi, Paolo de Bernardis
DE1 A	Blu2	Dark Energy and the Accelerating Universe	Alexei Starobinski, David Polarski
DE3	Blu1	Large Scale Structure and Statistics	Thomas Buchert, Hagen Kleinert
DM2	Blu3	Results and Strategies in Dark Matter Detection	Pierluigi Belli
ES3	Matl	Exact Solutions (Physical Aspects)	Susan Scott
GB3	FM Careri	Cosmology from GRBs	Lorenzo Amati, Massimo Della Valle
GL3	FF8	Gravitational lensing: theory and numerical modeling	Oleg Tsupko
GN2	FF2	New developments in Blazars research	Paolo Giommi, Paolo Padovani
HE1	Blu5	Experimental tests of fundamental physics with high energy gamma rays	Alessandro De Angelis, Razmik Mirzoyan
HR1	ChB	History of Relativity and Cosmology	Christian Bracco, Tilman Sauer
PT3 A	Geo1	Experimental Gravitation	Angela Di Virgilio, Claus Claus Lämmerzahl
PT4 B	Geo11	Variation of Fundamental Constants	Victor Flambaum, Julian Berengut
QF2 A	MatV	Quantum Field Theory on Curved Spacetime	Gerardo Morsella
QG2 A	MatPicone	Quantum Gravity Phenomenology	Giovanni Amelino-Camelia
SN1-2 B	ChD	<i>SN1: Supernova Explosions and Neutron Stars Dynamics</i> <i>SN2: Numerical simulations, SN, and GRB, connecting with massive SN</i>	Kostas Kokkotas, Valeri Chechetkin, Alexey Aksenov
ST3	FF4	Gauge/gravity and related correspondences	Rubik Poghossian

## Wednesday morning, July 15<sup>th</sup>

### Plenary Session: Precision test of GR

Chairman: Dittus Hansjoerg

09:00 - 09:35	<b>Claus Lammerzahl</b> (ZARM - Center Of Applied Space Technology And Microgravity) Experimental gravitation
09:35 - 10:10	<b>Francis Everitt</b> (Stanford University) Overview and Completion of Gravity Probe B
10:10 - 10:45	<b>Thibault Damour</b> (IHES) Gravitational Radiation and the Problem of Motion: A Centenary Assessment
10:45 - 11:05	<b>Coffee Break</b>
11:05 - 11:40	<b>Michael Kramer</b> (Max Planck Institute for Radio Astronomy) Probing gravity and fundamental physics with pulsars
11:40 - 12:15	<b>Jorge Rueda</b> (ICRANet) The binary systems associated to short and long GRBs and their detectability Probing gravity and fundamental physics with pulsars
12:15 - 12:50	<b>David Shoemaker</b> (MIT LIGO Laboratory) LIGO and the network of terrestrial gravitational wave detectors
14:30 - 18:00	<b>Free afternoon and Besso Foundation</b>
19:30	<b>Official Banquet</b>



## Thursday morning, July 16<sup>th</sup>

### Plenary Session: GRBs and galactic center black hole

Chairperson: Della Valle Massimo

09:00 - 09:35	<b>Tsvi Piran</b> (Hebrew University of Jerusalem) Neutron Star Mergers, Gravitational Waves, Gamma-Ray Bursts and the origin of Gold
09:35 - 10:10	<b>Neil Gehrels</b> (NASA) Explosions Throughout the Universe
10:10 - 10:45	<b>Marco Tavani</b> (University of Rome Tor Vergata)
10:45 - 11:05	<b>Coffee Break</b>
11:05 - 11:40	<b>Remo Ruffini</b> (ICRANet)
11:40 - 12:15	<b>Chris Fryer</b> (University of Arizona) Using Observations to Constrain the GRB Engine: Lessons from Core-Collapse Supernovae
12:15 - 12:50	<b>Stefan Gillessen</b> (Max Planck Institute for Extraterrestrial Physics): The Galactic Center: A stellar Ballet and a gaseous Scherzo
14:30 - 18:00	<b>Parallel Session</b>
18:45 - 20:00 Public Lecture	<b>Ken'ichi Nomoto</b> (University of Tokyo): <b>Sachiko Tsuruta</b> (Montana State University): Temperature of Neutron Stars

### Thursday afternoon, July 16<sup>th</sup>

Code	Classroom	Title	Chairperson
AC1 A	ChN1	Accretion processes onto Black Holes: Observation and Modeling	Sandip Chakrabarti
AT1 C	FF Cabibbo	Extended Theories of Gravity and Quantum Cosmology	Salvatore Capozziello, Gabriele Gionti
AT2 A	FF3	Extended Theories of Gravity and Quantum Cosmology	Salvatore Capozziello, Gabriele Gionti
BH7	FMConv.	Hairy Black Holes	Burkhard Kleihaus
BN1	FM Amaldi	Compact Binaries and Strong-Field Tests of Gravity	Paulo Freire, Michael Kramer
BN2	FF7	Numerical Analysis of Coalescing Binaries	Masaru Shibata
BN4	FF6	End of white dwarfs and type Ia Supernova	Yukikatsu Terada, Keiichi Maeda
BN7	FF2	Interfacing analytical and numerical relativity	Ian Hinder
CM2-3 A	FM Rasetti	Cosmology with the Cosmic Microwave Background: Implications of planck and Other Experiments in Temperature and polarization	C. Burigana, H.U. Nørgaard-Nielsen
DE1 B	Blu2	Dark Energy and the Accelerating Universe	Alexei Starobinski, David Polarski
DM3	FF5	Sterile neutrinos and cosmology	M. Shaposhnikov, A. Boyarsky, O. Ruchayskiy
ES2 A	Matl	Theoretical Issues in GR	Dieter Brill
EU2	FF8	Quantum Fields	Vladimir Belinski
GB4	FM Majorana	Photospheric Emission in GRBs	Gregory Vereshchagin, J Michael Burgess
GB5 A	FMCareri	GRBs and the Afterglow	Chris L. Fryer, Grant J. Mathews
GW1	Blu5	Sources of Gravitational Waves	Andrew Melatos
HE2	Blu4	High Energy Astrophysical neutrinos detection	Antonio Capone
HE4	Blu3	Space missions of high energy particles and gamma-rays	Shuang Nan Zhang, Oscar Adriani
NS2	ChB	New States of Matter and Strong Electromagnetic Fields in the Universe	Cesar Zen, Aurora Perez Martinez
NS4	ChD	Neutron stars in the context of stellar evolution and nucleosynthesis	Pascal Chardonnet
PT6	Geo1	Dynamics of extended test objects equations of motion and their solution	Eva Hackmann, Dirk Puetzfeld
QF3	MatV	Operator Algebras and Quantum Field Theory	Gandalf Lechner, Giuseppe Ruzzi
QG1 A	Geo12	Loop Quantum Gravity, Quantum Geometry, Spin Foams	Jerzy Lewandowski
QG2 B	MatPicone	Quantum Gravity Phenomenology	Giovanni Amelino-Camelia
ST4	FF4	String Pheno & Cosmo	Gianfranco Pradisi
WD2	Geo11	Origin and physics of Soft Gamma-ray Repeaters and Anomalous X-ray Pulsars	Manuel Malheiro, Renxin Xu

## Friday morning, July 17<sup>th</sup>

### Plenary Session: Cosmology and Space Science

Chairman: David Blair

09:00 - 09:35	<b>Marco Bersanelli</b> (Universita' degli Studi di Milano): The astrophysical results of the Low Frequency Instrument of Planck satellite
09:35 - 10:10	<b>Jean-Loup Puget</b> (Université Paris XI) The astrophysical results of the High Frequency Instrument of Planck satellite
10:10 - 10:45	<b>Viatcheslav Mukhanov</b> (LMU Munich) Quantum Universe
10:45 - 11:05	<b>Coffee Break</b>
11:05 - 11:40	<b>Samuel C. C. Ting</b> (Massachusetts Institute of Technology) The Latest Results from AMS on the International Space Station
11:40 - 12:15	<b>Francis Halzen</b> (University of Wisconsin-Madison) IceCube and the Discovery of High-Energy Cosmic Neutrinos
12:15 - 12:50	<b>Katherine Freese</b> (University of Michigan)
14:30 - 18:00	<b>Parallel Session</b>
18:45 - 20:00 Public Lecture	<b>Samuel C. C. Ting</b> (Massachusetts Institute of Technology) Encounters with Modern Physics

### Friday afternoon, July 17<sup>th</sup>

Code	Classroom	Title	Chairperson
AC1 B	ChN1	Accretion processes onto Black Holes: Observation and Modeling	Sandip Chakrabarti
AT1 D	FF Cabibbo	Extended Theories of Gravity and Quantum Cosmology	Salvatore Capozziello, Gabriele Gionti
AT2 B	FF3	Extended Theories of Gravity and Quantum Cosmology	Salvatore Capozziello, Gabriele Gionti
BH5	ChB	Geometric approaches to the thermodynamics of black holes	Hernando Quevedo
BH6 B	FF7	Regular and Analogue Black Holes	Stefano Liberati, Carlos Barcelo
BN3 B	ChD	Double Neutron Stars and Neutron Star-White Dwarf Binaries	Thomas Tauris
BS1	FF6	Black Hole foils, Boson stars	Meike List
CM2-3 B	FM Rasetti	Galaxy Clusters as probes for Cosmology and Dark Matter	Piero Rosati
DM4	Blu1	Selfgravitating systems and Dark Matter	Marco Merafina
ES2 B	Matl	Theoretical Issues in GR	Dieter Brill
GB1	FM Majorana	Fast radio bursts: observations, ideas, and prospects	Bing Zhang, Duncan Lorimer
GB5 B	Careri	GRBs and the Afterglow	Chris Fryer, Grant Mathews
GL2	FF8	Statistics and Geometry of Weak Lensing Data	Domenico Marinucci
GW3	Blu5	Lisa pathfinder and Space-Borne Gravitational Wave Detectors	Massimo Bassan, Michele Armano
HE3	Blu4	Future prospects in high energy astrophysics	Filippo Frontera, Aldo Morselli
NS3	FM Amaldi	QCD phase diagram: from nuclear astrophysics to heavy ion collisions	Debora Peres Menezes
NS5	FM Conversi	Highly magnetized neutron stars: theories, observations and connection with gamma-ray bursts	Nanda Rea
PT3 B	Geo1	Experimental gravitation	Claus Lämmerzahl, Angela Di Virgilio
PT5	Geo11	GR in the Solar System	Roberto Peron, Agnes Fienga
QF2 B	MatV	Quantum Field Theory on Curved Spacetime	Gerardo Morsella
QG1 B	Geo12	Loop Quantum Gravity, Quantum Geometry, Spin Foams	Jerzy Lewandowski
QG2 C	MatPicone	Quantum Gravity Phenomenology	Giovanni Amelino-Camelia
ST1	FF4	Branes and Instantons in String Theory	Alberto Lerda

## Saturday morning, July 18<sup>th</sup>

### Plenari Session: The frontiers

Chair: Felix Aharonian

09:00 - 09:35	<b>Karl Heinz Kampert</b> (Bergische Universitat Wuppertal) Ultra High Energy Cosmic Rays: What has been learned and where will we go?
09:35 - 10:10	<b>Christian Stegmann</b> (DESY) High energy gamma-rays
10:10 - 10:45	<b>Werner Hofmann</b> (Max Planck Institute for Nuclear Physics) Perspectives from CTA in Relativistic Astrophysics
10:45 - 11:05	<b>Coffee break</b>
11:05 - 11:40	<b>Paolo Giommi</b> (ASDC) Multi-frequency and Multi-messenger Astrophysics With Blazars: Recent Results and Predictions for Future Observations with VHE gamma-ray and Neutrino Detectors
11:40 - 12:15	<b>Rita Bernabei</b> (University of Rome Tor Vergata) Direct detection of Dark Matter particles
12:15 - 12:50	<b>Stefano Vitale</b> (University of Trento) LISA Pathfinder
12:50	<b>Remo Ruffini</b> (ICRANet) Concluding Remarks

FONDAZIONE MARCO BESSO



***Albert Einstein, Michele Besso and Marcel Grossmann***

*13-17 July 2015  
at Fondazione Besso  
Largo di Torre Argentina, 11*

***From Monday 13 to Friday 17 the exhibition will be open from 2:30 to 10:00 pm  
to all participants of MGXIV and accompanying persons.***

***Please, show your badge at the entrance.***

***Free access.***





**A celebration of**

***The International Year of Light by UNESCO***  
***The 100<sup>th</sup> Anniversary of the Einstein Equations***  
***The Golden Jubilee of Relativistic Astrophysics***

**a Parallel Meeting of MGXIV**

*under the aegis of*

**Besso Foundation**

**ICRANet**

**Hebrew University of Jerusalem**

**Albert Einstein Archives and Racah Institute for physics**

**Max-Planck-Institut für Wissenschaftsgeschichte**

**Monday 13**

Session “History of Science”, Chaired by **Jürgen Renn**

Exhibition and projection of: “Einstein Anno Zero”

(from RAI - TG2 Dossier)

**Wednesday 15 - 5:00-7:00 pm**

Exhibition

Ceremony by invitation only (137 invited)

Chairperson:

**Maria Lia Orsa Lumbroso**

Speakers:

**Remo Ruffini,**

Director ICRANet

**Jürgen Renn,**

Director Max-Planck-Institut für Wissenschaftsgeschichte

**Hanoch Gutfreund,**

Former President of The Hebrew University of Jerusalem

**Claudia Graf,**

granddaughter of Marcel Grossmann,

and **Tilman Sauer**

Presentation of the biography of Marcel Grossmann by Claudia Graf and Tilman Sauer  
Presentation of the two volumes  
by Princeton University co-authored by Hanoch Gutfreund and Jürgen Renn

Presentation of the book ICRANet and relativistic astrophysics  
Guided viewing of the exhibition by Hanoch Gutfreund.

**Thursday 16**

Session “History of Science”, Chaired by **Hanoch Gutfreund**  
Exhibition and projection of: “Il Caso Neutrino” (from RAI teche)

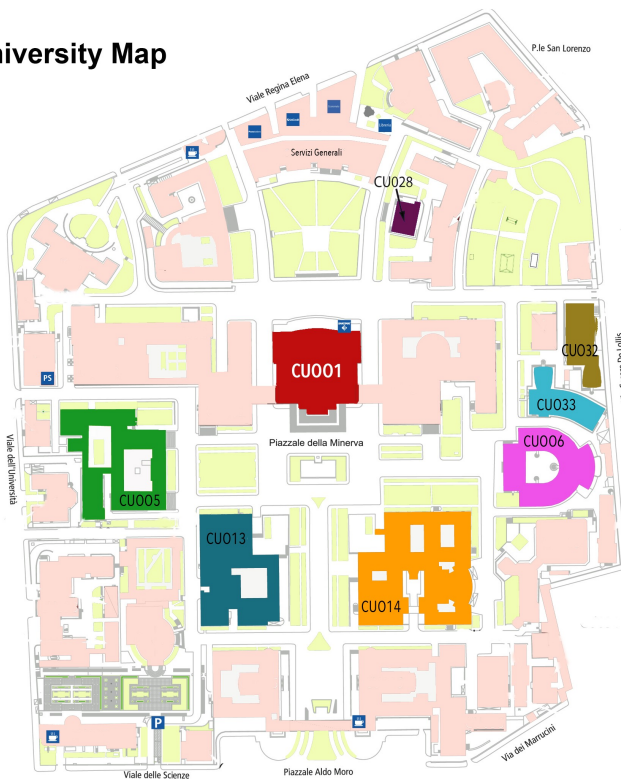


**SAPIENZA**  
UNIVERSITÀ DI ROMA



**Fourteenth Marcel  
Grossmann Meeting**

## University Map



**CU001** AULA MAGNA

**CU033** FISICA Fermi ( FF )  
aula Cabibbo  
aula 2  
aula 3  
aula 4  
aula 5  
aula 6  
aula 7  
aula 8

**CU013** FISICA Marconi ( FM )  
aula Amaldi  
aula Majorana  
aula Rasetti  
aula Careri  
aula Conversi

**CU032** CHIMICA Caglioti ( ChN )  
aula 1

**CU014** CHIMICA Cannizzaro ( Ch )  
aula D  
aula H  
aula B

**CU006** MATEMATICA Castelnuovo ( Mat )  
aula Picone  
aula I  
aula V

**CU005** GEOLOGIA ( Geo )  
aula 1  
aula 11  
aula 12

**CU028** AULETTE BLU ( Blu )  
aula blu 1  
aula blu 2  
aula blu 3  
aula blu 4  
aula blu 5

## **Aula Magna Entrance Instructions**

Because of the great number of participants, precise rules must be followed to enter the Aula Magna plenary sessions. We suggest you arrive by 8:00 to access the best seating possible.

8:00-8:40 First 5 rows of main seating area are reserved and accessed from the front entrance. Remaining rows are entered from the back terrace central doors.

8:40-8:50 Balcony is entered from the back terrace right door.

8:50-9:00 Overflow enters Fisica Marconi aula Amaldi for remote screen projection.

*MG14*

# *MARCEL GROSSMANN AWARDS*

*ROME 2015*

*ICRANet and ICRA*





*MG XIV*

# *MARCEL GROSSMANN AWARDS*

*ROME 2015*

*and*

## *TEST*



*ICRA Net  
and  
ICRA*

The 14th Marcel Grossmann Meeting – MG XIV

13<sup>th</sup> July 2015, Rome (Italy)

Aula Magna – University “Sapienza” of Rome

*The Institutional Award*

Goes to:

**EUROPEAN SPACE AGENCY (ESA)**

“for the tremendous success of its scientific space missions in astronomy, astrophysics, cosmology and fundamental physics which have revolutionized our knowledge of the Universe and hugely benefited science and mankind”

- presented to its Director General Johann-Dietrich Woerner

*The Individual Awards*

Goes to

**KEN'ICHI NOMOTO**

“for heralding the role of binary systems in the evolution of massive stars”

Goes to

**MARTIN REES**

“for fostering research in black holes, gravitational waves and cosmology”

Goes to

**YAKOV G. SINAI**

“for applying the mathematics of chaotic systems to physics and cosmology”

Goes to

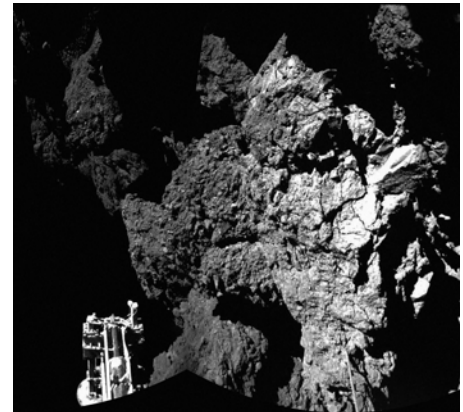
**SACHIKO TSURUTA**

“for pioneering the physics of hot neutron stars and their cooling”

Each recipient is presented with a silver casting of the TEST sculpture by the artist A. Pierelli. The original casting was presented to His Holiness Pope John Paul II on the first occasion of the Marcel Grossmann Awards.

**EUROPEAN SPACE AGENCY (ESA)** presented to its Director General, **Johann-Dietrich Woerner**

*“for the tremendous success of its scientific space missions in astronomy, astrophysics, cosmology and fundamental physics which have revolutionized our knowledge of the Universe and hugely benefited science and mankind”*



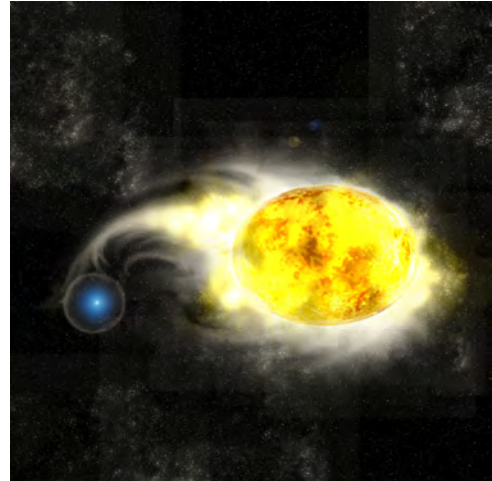
The Science Program of the European Space Agency (ESA, born originally as the European Space Research Organization ESRO) has been in existence for 50 years. During that time it has worked incessantly to provide the European scientific community with the very best tools in all fields of space science -- a path

of sustained excellence in discovery and innovation. Its founding fathers included figures of the caliber of Edoardo Amaldi, Pierre Auger and the cosmologist Hermann Bondi. As early as 1959, Auger pushed for a European institution in space research, the ESRO of which he became the first Director General, followed in 1967 by Bondi, who called on scientists to define the scientific guidelines for future space missions, including an historical meeting in September 1969 in Interlaken. So began the amazing European advance in space science. Fifty years ago Europe was struggling for a presence in a field dominated by the USA and USSR space programs. Today ESA science missions have achieved undisputed primacy in a number of fields. The landing on the Comet 67-P of the Philae probe released from the Rosetta spacecraft in late 2014 (see above right image of the actual landing of the comet), followed by the public worldwide, is perhaps the Agency's most visible achievement, a clear example of fascinating, inspirational science with a strong link to innovation. And Rosetta is only one of Europe's many strong successes in space science. Another mission, Planck, has provided the most precise map ever of the cosmic microwave background, the best available "baby picture" of the Universe. Or consider Herschel, observing in the far infrared; it has opened a new view of the formation of the different structures of the Universe, from stars and planets to galaxies and clusters of galaxies, showing how the shape of the Universe has evolved through time. Similar successes have been the X-ray observatory XMM-Newton, working in synergy with the ASI Beppo SAX mission, the NASA Chandra and SWIFT missions as well as with the other pillar of European Science the VLT ESO optical Observatory in Chile. These missions have been deciphering the violent behavior of the Universe, probing the physical behavior of matter under extreme conditions of gravity and temperature. This collaboration from the ground and from space has led to witnessing the onset of supernovae, to following live the gravitational collapse leading to a black hole formation, and to probing the nucleosynthesis process from the earliest stars till their final evolution, with the production of all the elements which make our life possible in the Universe. And there is more to come. The LISA Laser Interferometer Space Antenna aimed at the heroic detection of gravitational waves is a truly major fundamental physics experiment. Space has already shown what can be done in fundamental physics, with the successful launch of the NASA Gravity Probe B Mission in 2004, and the rigorous process of analysis that led to the definitive observation of the frame dragging effect of general relativity, as will be presented in this MGXIV. ESA's Science Program, by achieving space missions leading to world-leading scientific results, has been inspiring a generation of young Europeans towards science and engineering careers, thus fostering innovation, and over the longer term, growth in Europe, made all the more effective by the collaboration with national programs and resources. By pushing the boundaries of technological capabilities ESA has contributed immensely to the sustaining and enlarging of European technological and scientific skills and infrastructures, and to promoting innovation in both industry and academia. ESA has consistently aimed at inspiring people with missions that show the world-leading results Europeans can achieve by working together, joining creatively with many worldwide scientific and technological institutions. This was the vision of its founding fathers, a vision that continues to be realized 50 years on.



## KEN'ICHI NOMOTO

*“for heralding the role of binary systems in the evolution of massive stars”*



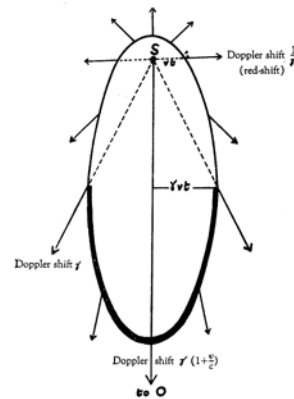
That Japan gave independent profound innovative contributions to physics is well known from the work of Hideki Yukawa. That fundamental advances have been achieved by collaborations with leading western scientists has been clearly manifested by the work of Tomonaga in close contact with Werner Heisenberg. In the field of modern cosmology the stage was set by the dialogue between Gamow, Hayashi and Enrico Fermi.

Out of this great tradition in astrophysics, through the intervening work of Sugimoto on computational astrophysics, comes the scientific figure of Ken'ichi Nomoto. Crucial among his many contributions on modeling the final evolution of stars has been to isolate the crucial role of the initial mass of stars above or below 8 solar masses. The role of the “electron capture supernovae” leads as a final outcome either to a white dwarf or to a neutron star, making Nomoto’s work essential for the understanding of the many different kinds of supernovae, both supernovae of type Ia and core-collapse through the modeling of SN 1987A.

Possibly the most original contribution which makes Ken Nomoto outstanding in the astrophysical community has been his linking of the final evolution of stars, traditionally addressed in a single system, to the binary nature of the supernova and hypernova progenitors. Far from being just an academic exercise made possible by the advanced computational facilities achieved by the Japanese school, this link has been shown to be central to the understanding of the physics of a sequence of astrophysical events such as binary X-Ray sources, pioneered by the Uhuru satellite, of supernovae, pioneered by the Kamiokande detection of SN 1987A neutrinos, and most recently of gamma-ray bursts, made possible by the renaissance started by Beppo Sax and continued by the Swift and Fermi satellites. In the understanding of this variety of astrophysical systems which today reveal a continuous evolutionary astrophysical scenario, the work of Ken Nomoto represents a fundamental long lasting contribution.

## MARTIN REES

*"for fostering research in black holes, gravitational waves and cosmology"*



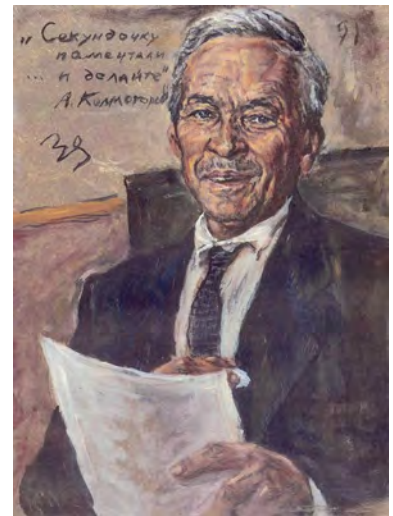
Born on June 23, 1942 in York, England, Martin Rees has received the most distinguished honors of Great Britain: Astronomer Royal since 1995,

life member for life of the House of the Lords since 2005 with the title Martin John Rees, Baron Rees of Ludlow, Order of Merit recipient in 2007, Fellow of the Royal Society since 1979, Master of Trinity College, Cambridge (2004 to 2012) and President of the Royal Society (2005 to 2010). His many prizes and awards include the Gold Medal of the Royal Astronomical Society, the Isaac Newton Prize, the Heineman Prize, the Bruno Rossi Prize, the Gruber Prize and the Crafoord Prize. We are particularly happy to present him with the MGXIV Marcel Grossmann Award in 2015, the year of the centenary of the Einstein equations as well the Golden Jubilee of Relativistic Astrophysics.

Martin belongs to a small group of astrophysicists born around 1942 who have greatly influenced the birth and the development of relativistic astrophysics, including Vladimir Belinski, Brandon Carter, Steven Hawking, Remo Ruffini and Rashid Sunyaev. As early as 1966 Martin published one of the classic papers of relativistic astrophysics, pointing out that "an object moving relativistically in suitable directions may appear to a distant observer to have a transverse velocity much greater than the velocity of light". This explanation of apparent "superluminal" astronomical motion (see above figure) still remains even today an outstanding example of science exposition for its sober completeness. In the subsequent years, Martin launched a new direction of cosmological research in Cambridge, a development which is reflected in his contribution to the book "Black Holes, Gravitational Waves and Cosmology" authored by Rees, Ruffini and Wheeler, a book whose conception was initiated during a meeting in Interlaken organized by Hermann Bondi, then Director General of ESRO. In its first twelve chapters Ruffini and Wheeler reviewed the physics of black holes and gravitational waves introducing such concepts as the ergosphere, the black hole orbit of maximum binding and the astrophysical sources of gravitational waves, pointing out the limits of revealing them with ground-based experiments. In the following six chapters Martin summarized the key developments of modern cosmology: Ryle's discovery of extragalactic radio sources at high cosmological redshift, Martin Schmidt's discovery of quasars, and Penzias and Wilson's discovery of cosmological background radiation. He describes all these topics with the passion and clarity he employed in overcoming the then fashionable steady state theory to bring students and collaborators back into the mainstream of relativistic astrophysics. This same passion and effectiveness has characterized his career ever since in many other scientific accomplishments and we are very grateful to him for sharing his ideas, his teaching and his research and extending their reach through his doctoral student Roger Blandford, Craig Hogan, and Priyamvada Natarajan as well as through his dedicated direction of the Institute of Astronomy in Cambridge for many years.

## YAKOV G. SINAI

*“for applying the mathematics of chaotic systems to physics and cosmology”*



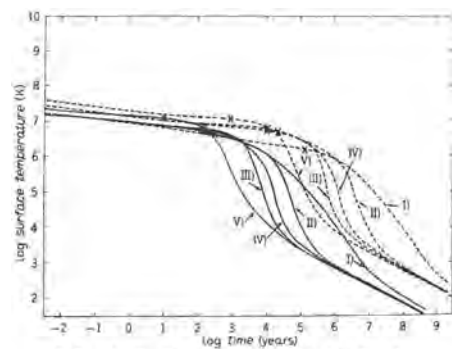
Andrey Nicolaevich Kolmogorov (see above portrait) and Lev Davidovich Landau have deeply influenced the development in Russia of mathematics and physics, respectively, bringing them to unprecedented levels admired by all the world. The Kolmogorov School has fostered the frontiers of mathematical knowledge in depth and breadth with such great minds as Israil Gelfand,

Vladimir Arnold and Yakov Sinai. Yakov Grigorievich Sinai (see above picture) has been a Professor at Moscow State University and a Senior Researcher at the Mathematical Department of the Landau Institute of Theoretical Physics, Russian Academy of Sciences since 1971 and since 1993 he has also been simultaneously a Professor of Mathematics at Princeton University. Yakov Sinai is one of the most influential mathematicians of our time, having achieved numerous groundbreaking results in the theory of dynamical systems, in mathematical physics and in probability theory. Many mathematical ideas bear his name, including the Kolmogorov-Sinai entropy, Sinai's billiards, Sinai's random walk, Sinai-Ruelle-Bowen measures, and Pirogov-Sinai theory. He is recognized as one of the deepest contributors to the mathematical theory of stochastic dynamical systems. Sinai received the prestigious Abel Prize in mathematics in 2014 and many of his mathematical results have been applied to physics. Particularly noteworthy for the general relativity community are his fundamental results on the stochastic nature of early cosmology obtained in his pioneering 1983 paper in collaboration with E.M. Lifshitz, I.M. Khalatnikov, K.M. Khanin, and L.N. Shchur. Landau had designated the problem of the initial cosmological singularity as one of the three fundamental problems of theoretical physics and the members of his school V. Belinski, I. Khalatnikov and E. Lifshitz then found the general cosmological solution near a big bang or big crunch singularity in a series of papers from 1969 into the 1970s. This “BKL solution” gives rise to a chaotic dynamical system characterized by a positive Kolmogorov-Sinai entropy. The chaotic behavior of the higher-dimensional analogs of the BKL solution has also been deciphered by T. Damour, M. Henneaux and H. Nicolai. The results of the Kolmogorov-Sinai school have thus illuminated the stochastic nature of the BKL cosmological solution. In this very special year 2015, which marks the Year of Light, the centenary of the Einstein equations and the Golden Jubilee of Relativistic Astrophysics, this Award is a tribute to Yakov Sinai for his own achievements as well as a celebration of the fruitful interaction between the Kolmogorov school in mathematics and the Landau school in physics, in the precise spirit of the Marcel Grossmann Meetings.



## SACHIKO TSURUTA

*“for pioneering the physics of hot neutron stars and their cooling”*



S. Tsuruta "Cooling and Heating of Neutron Stars" in  
"Physics and Astrophysics of Neutron Stars and Black Holes"  
R. Ruffini and R. Giacconi, Ed. second edition, CSP 2009

Beginning her undergraduate studies in Japan, Sachiko Tsuruta received foreign student fellowships and obtained her Bachelor degree in physics from the University of Washington in Seattle and then earned her Ph.D. from Columbia University. It was under the guidance of Al Cameron at NASA that she initiated her pioneering work on the nature of neutron stars giving particular attention to the issue of their cooling processes.

After her Ph.D. Sachiko started an intense itinerary of major scientific institutions scattered around the Northern Hemisphere. After a five year research position at the Harvard-Smithsonian CfA, she accepted research positions at NASA, Greenbelt and then the University of Sussex. She then took a position at the Max Planck Institute for Astrophysics in Munich, during which she received a dual position as a faculty member at Montana State University in the beautiful town of Bozeman, commuting back and forth in the following years. As far back as her early days in Seattle, Sachiko had met Hideki Yukawa and Chushiro Hayashi from Kyoto University as well as Satio Hayakawa from Nagoya University and Kazuhiko Nishijima from the University of Tokyo. In the following years her presence in Japan grew through a variety of visiting positions, during which she became an active member of that restricted group of astrophysicists active in the main institutions in Japan, including Yoshihide Kozai, Daichiro Sugimoto, Ken'ichi Nomoto, Yasuo Tanaka, and Minoru Oda in Tokyo (Oda received the MG VI Award), with Humitaka Sato and Katsuhiko Sato at Kyoto, with Satio Hayakawa (Hayakawa received a MG V award) and Hideyo Kunieda's group in Nagoya, with Jun Jugaku who had restructured the PASJ at Tokyo Observatory, with the nuclear physic group of Ryozi Tamagaki in Kyoto. Through their interactions and direction came to life the great development of Japanese astrophysical research in both theoretical and observational fields from the ground and from Space, that the world admires today. Yearly Sachiko has migrated from Montana to Japan, to the leading scientific institutions in Europe and around our northern Hemisphere.

Sachiko has truly been a pioneer in the study of neutron stars, including their composition, structure and thermal properties. She has extensively analyzed not only their equations of state and their cooling and heating properties but also the inner composition of their core, exploring the existence of hyperons, pions, kaons, quarks and their possible condensation in the cores and the associated URCA and other neutrino processes. Her work has also been extensively applied to the study of active galactic nuclei and supermassive black holes, both from theoretical point of view and in looking directly for its verification in observational data. She has been a splendid example of scientists working from the very beginning of relativistic astrophysics and following continuously and successfully through the latest developments. She has established a perfect example, especially for women: In her own words, "Since Japan still does not have many woman scientists, perhaps I can be a model for young Japanese women."

**The 14th Marcel Grossmann Meeting – MG XIV**  
**4<sup>th</sup> May 2015, Beijing (China)**  
**Zhongguancun Campus, UCAS**

The awards are delivered on May 4, 2015 at the MG14 satellite meeting the *International Conference on Gravitation and Cosmology: the Fourth Galileo-Xu Guangqi Meeting* in Beijing:

Goes to

**FRANK C.N. YANG**

“for deepening Einstein’s geometrical approach to physics in the best tradition of Paul Dirac and Hermann Weyl”

Delivered at 9:50 am

Goes to

**T.D. LEE** (award received by Yu-Qing Lou on behalf of Prof. T.D. Lee)

“for his work on white dwarfs motivating Enrico Fermi’s return to astrophysics and guiding the basic understanding of neutron star matter and fields”

Delivered at 7:00 pm

## FRANK C.N. YANG

*“for deepening Einstein’s geometrical approach to physics in the best tradition of Paul Dirac and Hermann Weyl”*



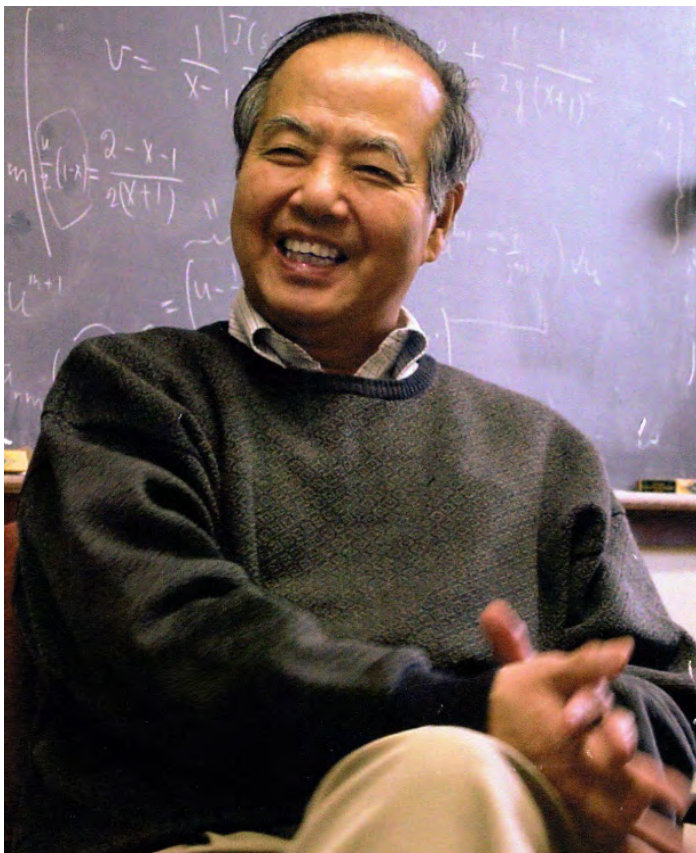
“... I would like to discuss some influence Fermi had in China: this is the case in

which two of Fermi’s Chinese students and collaborators had an unprecedented impact on science at the international level and triggered the scientific development of the largest nation in the world: China. During my second visit to China in 1979 I went to Kun Ming: it was quite an experience to see this beautiful location on the border of a lake so vividly described by Marco Polo. There was a train line constructed by the French reaching this town from Hanoi. There was also a beautiful university where two young students studied physics during World War II, there the professors from the Bei DA and Qing Hua university of Beijing and their families having escaped from the east of China ahead of the Japanese invasion. Their names were Chen Ning Yang and Tsung Dao Lee. At the end of the war they transferred to the USA: Frank C.N. Yang became Fermi’s assistant and T.D. Lee was followed in his Ph.D. thesis by Fermi. The remarkable scientific career of these two young Chinese scientists is well recorded in the history of science. After Nixon’s visit to China in 1972, Yang and Lee frequently went back to China to deliver lectures based on the Fermi tradition and today they are spending the greater part of their time in China organizing scientific centers and activities. In 1979 Yang gave a lecture at the second MG meeting in Trieste (see figure on the right: C.N. Yang speaking with a thoughtful Pam Dirac listening). During the Third Galileo-Xu Guangqi Meeting in 2011 I had another pleasant meeting with C.N. Yang. This also gave me the opportunity to see Beijing University again, having originally seen it in 1978 after the cultural revolution with all its libraries burned, now renewed and reaching a new splendor. Next to the Zhou Pei-Yuan Institute are the offices of the C.N. Yang Center. We talked about our common friend Isidor Rabi and his role in collaborating with Eisenhower as President of Columbia University prior to the latter’s election as President of the USA. We also talked about Fermi’s role in formulating his theory of beta decay, of the adventures of the A-bomb and H-bomb projects and many other topics. This also gave me the chance to introduce him to our ongoing projects with ICRANet in Brazil.”

*From “Einstein, Fermi, Heisenberg and Relativistic Astrophysics: Personal Reflections by Remo Ruffini” World Scientific Singapore 2015*

## T.D. LEE

*“for his work on white dwarfs motivating Enrico Fermi’s return to astrophysics and guiding the basic understanding of neutron star matter and fields”*



“... Returning to the main topic of Fermi and astrophysics, it is interesting that according to T.D. Lee Fermi’s original critical attitude expressed in his Trento lecture on the interior of stars was evolving towards the end of his life. As recalled by T.D. Lee in a talk held at a joint meeting of the APS and AAPT in February, 2010 “Remembering Enrico Fermi,” Fermi was beginning to warm up towards astrophysics in his final years: Fermi asked Lee during his Ph.D. thesis the approximate temperature of the Sun at its center. Lee replied, “Ten million degrees.” Fermi asked:

“How do you know?” Lee told him he had looked it up. Fermi asked if he’d verified the number and Lee replied, “It’s really complicated. It’s not so easy to integrate these equations.” Fermi suggested that Lee build a huge specialized slide rule that would enable the solution of two radiative transfer equations, one that involved the 18th power of the temperature, and the other that involved the reciprocal of temperature to the 6.5th power. Over the next few weeks Lee built a slide rule that was 6.7 feet long and carried out the necessary integration. ‘It was great fun’...

In the imperial Chinese tradition of the past, in each town in China there was a palace in which every year the best young astronomers were examined and selected and brought to the imperial palace to perform their study and research. Great credit goes to T.D. Lee for having reactivated this selection process on a large scale and having sent the most qualified young students not to the imperial palace in Beijing but to the leading universities in the USA for many years a similar program has been activated in Tokyo.

These experiences, as well as our more limited effort with ICRA and ICRANet, have been significant components in guaranteeing that most impressive scientific, technological and industrial development that the entire world admires today in China. In some sense this authentic scientific and cultural evolution of modern China was triggered directly and indirectly by the influence of Fermi.”

*From “Einstein, Fermi, Heisenberg and Relativistic Astrophysics: Personal Reflections by Remo Ruffini” World Scientific Singapore 2015*



13<sup>th</sup> Marcel Grossmann Meeting  
July 2012, Stockholm, Sweden

*Institutional Award*

ALBANOVA

for its innovative status as a joint institute established by Stockholm University and the Royal Institute of Technology and for fostering contributions to cosmology and astrophysics in the profound scientific tradition established by Oskar Klein.

- presented to the Rector of Stockholm University, Prof. Kåre Bremer.

*Individual Awards*

DAVID ARNETT

for exploring the nuclear physics and yet unsolved problems of the endpoint of thermonuclear evolution of stars, leading to new avenues of research in physics and astrophysics.

VLADIMIR BELINSKI and I.M. KHALATNIKOV

for the discovery of a general solution of the Einstein equations with a cosmological singularity of an oscillatory chaotic character known as the BKL singularity.

FILIPPO FRONTERA

for guiding the Gamma-ray Burst Monitor Project on board the BeppoSAX satellite, which led to the discovery of GRB X-ray afterglows, and to their optical identification.

12<sup>th</sup> Marcel Grossmann Meeting  
July 2009, Paris, France

*Institutional Award*

INSTITUT DES HAUTES ÉTUDES SCIENTIFIQUE (IHÉS)

for its outstanding contributions to mathematics and theoretical physics, and notably for having renewed basic geometrical concepts, and having developed new mathematical and physical aspects of spacetime.

- presented to Prof. Jean-Pierre Bourguignon

*Individual Awards*

JAAN EINASTO

for pioneering contributions in the discovery of dark matter and cosmic web and fostering research in the historical Tartu Observatory.

CHRISTINE JONES

for her fundamental contributions to the X-ray studies of galaxies and clusters tracing their formation and evolution and for her role in collaborations using clusters to study dark matter and in analyzing the effects of outbursts from supermassive black holes on the intracluster gas.

MICHAEL KRAMER

for his fundamental contributions to pulsar astrophysics, and notably for having first confirmed the existence of spin-orbit precession in binary pulsars.

11th Marcel Grossmann Meeting  
July 2006, Berlin, Germany

*Institutional Award*

FREIE UNIVERSITÄT BERLIN

for the successful endeavor of re-establishing — in the spirit of the Humboldt tradition — freedom of thinking and teaching within a democratic society in a rapidly evolving cosmos —presented to Dr. Dieter Lenzen, President of FUB

*Individual Awards*

ROY KERR

for his fundamental contribution to Einstein's theory of general relativity: "The gravitational field of a spinning mass as an example of algebraically special metrics."

GEORGE COYNE

for his committed support for the international development of relativistic astrophysics and for his dedication to fostering an enlightened relationship between science and religion.

JOACHIM TRUMPER

for his outstanding scientific contributions to the physics of compact astrophysical objects and for leading the highly successful ROSAT mission which discovered more than 200,000 galactic and extragalactic X-ray sources: a major step in the observational capabilities of X-ray astronomy and in the knowledge of our universe.

10th Marcel Grossmann Meeting  
July 2003, Rio de Janeiro, Brazil

*Institutional Award*

CBPF (Brazilian Center for Research in Physics)

for its role as a teaching and research institution and as a place originating fundamental physics ideas in the exploration of the universe.

—presented to its founders Cesar Lattes, José Leite Lopez and Jayme Tiomno

*Individual Awards*

YVONNE CHOQUET-BRUHAT AND JAMES W. YORK, JR.

for separate as well as joint work in establishing the mathematical framework for proving the existence and uniqueness of solutions to Einstein's gravitational field equations.

YUVAL NE'EMAN

for his contributions to science, epistemology, mathematics and physics from subnuclear to space sciences.

9th Marcel Grossmann Meeting  
July 2000, Rome, Italy

*Institutional Award*

SOLVAY INSTITUTES

for identifying and recording in discussions by the protagonists the crucial developments of physics and astrophysics in the twentieth century.

—presented to Jacques Solvay

*Individual Awards*

CECILLE AND BRYCE DEWITT

for promoting General Relativity and Mathematics research and inventing the “summer school” concept.

RICCARDO GIACCONI

for opening, five successive times, new highways for exploring the Universe.

ROGER PENROSE

for extending the mathematical and geometrical foundations of General Relativity.

8th Marcel Grossmann Meeting  
June 1997, Jerusalem

*Institutional Award*

HEBREW UNIVERSITY

for its role as a cradle of Science and Humanities and for hosting the manuscripts of Albert Einstein.

— presented to M. Magidor, President of the Hebrew University of Jerusalem

*Individual Awards*

TULLIO REGGE

for his contributions to the interface between mathematics and physics leading to new fields of research of paramount importance in relativistic astrophysics and particle physics.

FRANCIS EVERITT

for leading the development of extremely precise space experiments utilizing superconducting technology to test General Relativity and the Equivalence Principle.

7th Marcel Grossmann Meeting  
June 1994, Stanford, USA

*Institutional Award*

SPACE TELESCOPE SCIENCE INSTITUTE

for its critical role in the direction and operation of the Hubble Space Telescope, a truly unique international laboratory for the investigation and testing of general relativity in the context of modern astrophysics and cosmology.

— presented to Peter Stockman

*Individual Awards*

SUBRAHMANYAN CHANDRASEKHAR

for his contributions to the analysis of gravitational phenomena from Newton to Einstein and especially for leading the way to relativistic astrophysics with the concept of critical mass for gravitational collapse.

JIM WILSON

for having built on his experience in nuclear physics, thermonuclear reactions, and extensive numerical simulation to create a new testing ground for the novel concepts of relativistic astrophysics.

6th Marcel Grossmann Meeting  
June 1991, Kyoto, Japan

*Institutional Award*

RITP

for keeping alive first in Hiroshima and then in Kyoto research in relativity, cosmology, and relativistic field theory and the development of a school of international acclaim.

— presented to Professor K. Tomita

*Individual Awards*

MINORU ODA

for participating in the pioneering work of the early sixties in X-ray astronomy and for his subsequent molding of an agile and diversified Japanese scientific space program investigating the deepest aspects of relativistic astrophysics.

STEPHEN HAWKING

for his contributions to the understanding of spacetime singularities and of the large scale structure of the Universe and of its quantum origins.



5th Marcel Grossmann Meeting  
August 1988, Perth, Australia

*Institutional Award*

THE UNIVERSITY OF WESTERN AUSTRALIA

for its contributions to relativistic astrophysics.

— presented to the Vice Chancellor, Professor Robert Smith

*Individual Awards*

SATIO HAYAKAWA

for his contributions to research in gamma, X-ray and infrared radiation as well as cosmic rays.

JOHN ARCHIBALD WHEELER

for his contributions to geometrodynamics and Einstein's visions.

4th Marcel Grossmann Meeting  
July 1985, Rome, Italy

*Institutional Award*

THE VATICAN OBSERVATORY

for its contributions to the origin and development of astrophysics.

— presented to His Holiness Pope John Paul II

*Individual Awards*

WILLIAM FAIRBANK

for his work in gravitation and low temperature physics.

ABDUS SALAM

for his work in unifying fundamental interactions.

# TEST:

## Traction of Events in Space-Time

Anna Imponente  
National Gallery of Modern Art, Rome

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The TEST sculpture provides an innovative example of interaction between science and art, not abstractly interpreted as a result of a subsequent critical analysis but indeed an active and creative collaboration between an astrophysicist and a sculptor.

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In order to comprehend the meaning of collaboration between scientists and artists and to retrace its historical origin, we must go back to the Renaissance. There we find the so-called *Weltanschauung* and the idea of unitary art as a continuous and inseparable process of recognition of the structure of reality. This underlies the experience of Leonardo Da Vinci's talent, expressed in his drawings, of not separating scientific enquiry from artistic research.

In the seventeenth century, the "climb to the stars" of the stage machinery in baroque scenography, nourished by imagination, had loosened this link. It had coincided, on the one hand, with experimental Galilean sciences pursuing exact research towards a rational comprehension of the universe, and on the other hand, with the flourishing of the poetics of subjectivity, taste and feeling, the *beaux arts*, and a stratification of painting into specialistic genres.

In the nineteenth century, however, a new reversal of this trend can be observed: the scientific achievements of H.L. Helmholtz in the field of optics and of E. Chevreul in that of chemistry helps *pointillistes* painters in the separation of color. Furthermore, at the beginning of the twentieth century (1907) the Cubist revolution, which changes the concepts of space and time towards a simultaneity of vision, is synchronized with Einstein's theory of special relativity (1905).

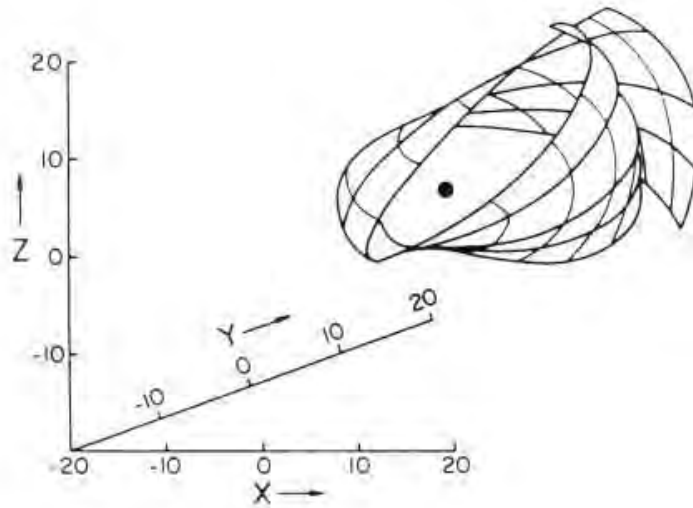
$$\dot{r} = \rho^{-2} \{ [E(r^2 + a^2) - a\Phi]^2 - \Delta(\mu^2 r^2 + K) \}^{1/2}$$

$$\dot{\theta} = \rho^{-2} \{ K - (\Phi - aE)^2 - \cos^2 \theta [a^2(\mu^2 - E^2) + \Phi^2 \sin^{-2} \theta] \}^{1/2}$$

$$\dot{t} = -a\rho^{-2}(aE \sin^2 \theta - \Phi) + \rho^{-2}(r^2 + a^2)\Delta^{-1}P$$

$$\dot{\phi} = -\rho^{-2}(aE - \Phi \sin^{-2} \theta) + a\rho^{-2}\Delta^{-1}P$$

$$E = .968, \quad \Phi = 2, \quad Q = 10, \quad a = e = 1/\sqrt{2}$$



Equations for a family of geodesics in a Kerr black hole and their graphical representation (*M. Johnston and R. Ruffini, 1974*).

The relationship between Remo Ruffini and Attilio Pierelli was not one of director/implementer nor could it exactly be defined as a four-handed performance. It has instead been a line of work suggested to the artist by a graphic design which had already been scientifically tested and computerized by M. Johnston and Ruffini at Princeton University in 1974.

This scientific investigation concerned the calculation of the geometric motion of five particles moving in space-time according to the application of a solution of Einstein's equations; the *in vitro* materialization and the visible replica of the discovery of a phenomenon existing in our own galaxy, namely the *black hole*, consisting of a stellar mass which is sucked into itself by gravitational collapse under the effect of its own self-gravity.

The encounter between Ruffini and Pierelli was not just a coincidence. On the one hand, there is the scientist, who in investigating astrophysical laws has always matched the exactness of results with the acknowledgement of a natural elegance of formulas, approaching an aesthetic outline of the detailed calculations. On the other hand, there is the sculptor, who appeases his eagerness for geometry by the contemplation of intricate reflecting symmetries and by perspective-illusive visions based on proportionate sizes, with the intention of proving the poetry of pure science before it becomes a technological adventure. In the theoretical formulation of his research on space, Pierelli has surveyed the history of mathematical thought and non-Euclidean geometries, deriving his hyperspatial shapes from the investigations of Gerolamo Saccheri, a Jesuit philosopher and mathematician of the seventeenth century.

The intuition of the aesthetic potential of this new form derived from the integration of Einstein's equations and describing the geodesics or trajectories of bodies around a black hole is compared by Ruffini to the "Greeks' discovery of  $\pi$  and the circle, which led to Hellenic architecture and the column" (interview with R. Ruffini by F. Bellonzi, Rome, 1985). Initially in 1981 the structural novelty of this form was understood by the architect Maurizio Sacripanti when he considered it as a space one can enter with one's own body and perceive directly with one's senses (M. Sacripanti in *Catalogo Roma*, Palazzo delle Esposizioni, 1981).

The initiation of this new work has the flavor of a challenge that the sculptor makes to himself, namely to represent the trajectories in a plastic form given their spatial co-ordinates—height, width and length—and to re-interpret them as an aesthetic object, using his own judgement to verify its artistic coherence.



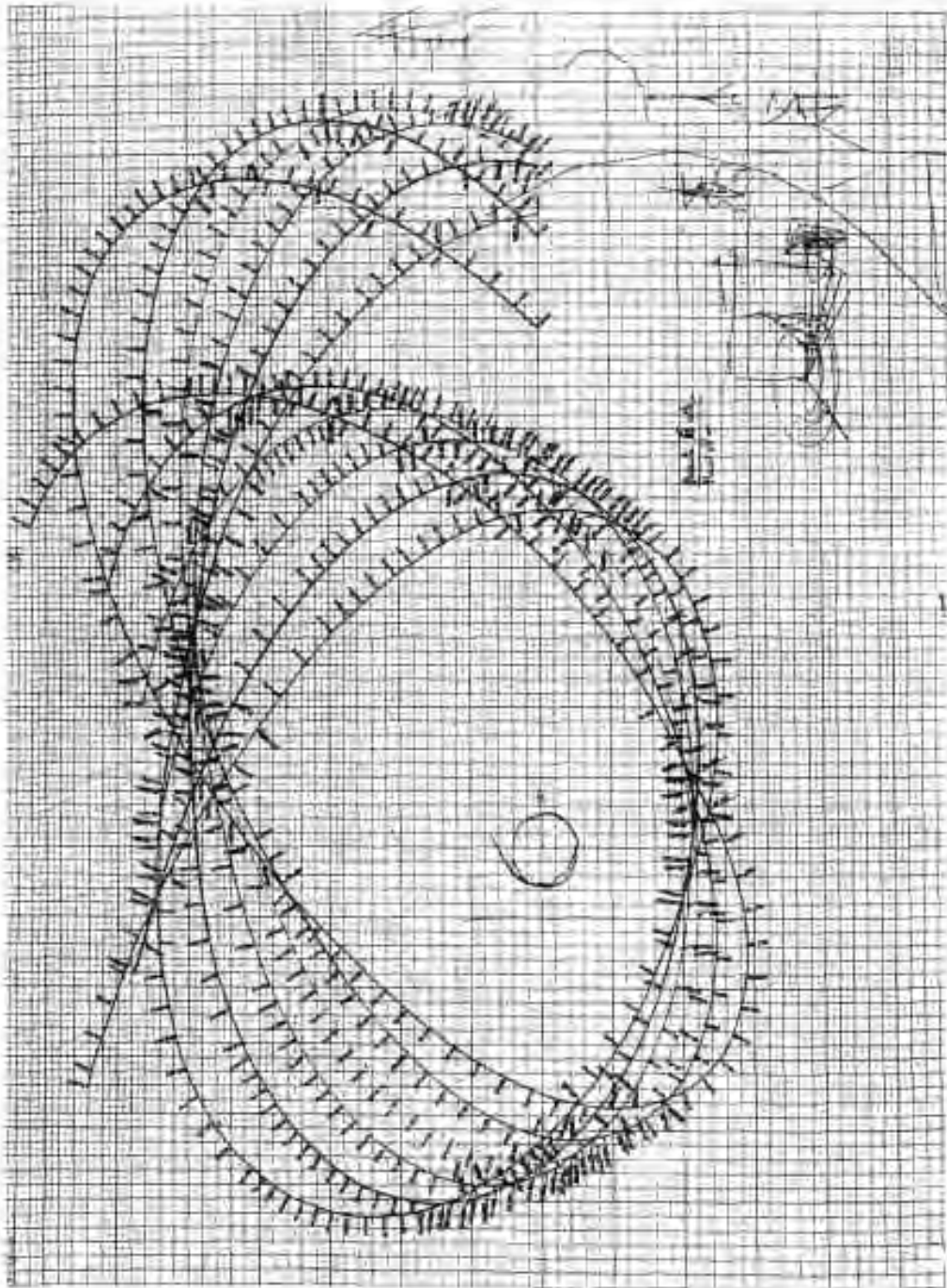


TEST, sculpture by A. Pierelli, photo by S. Takahashi.

The realization of this project seems to be conceptually complex and revolutionary. It is meant to describe a motion, but not a terrestrial one, as the futurists and Boccioni had already done in 1913 with the famous sculpture *Unique forms in space continuity*. Nor should it be the motion of a body set free in the earth's gravitational field, which would fall either vertically or with elliptical or hyperbolic motions. Instead it should resemble a Möbius strip without being so simple, since it would be differentially dragged by the rotational field of the black hole in the geometry of space-time. Hence the acronym TEST which stands for "Traction of Events in Space-Time." Thus the sculpture has no privileged interpretational directions and no supporting pedestal which might associate it with a central perspective view: no "top" or "bottom," no "right-side" or "left-side." Any orientation gives a complete and faithful realization.

Rather one should imagine it in rotation, with its surface being independent of any relation with the source of natural light ("ambientation" is the fundamental issue of sculpture), ignoring any possible atmospheric effect; in other words, the opposite of a "Mobile" of Calder which awaits a gust of wind to reanimate itself and come alive. Here, the metal light alone outlines and designs the vision of the rotating black hole. The transformation of this sequence of events into a solid form is portrayed by abstracting their properties and reducing everything to a direct perception of its essence, a *Wesenschau*. This representation does not lend itself to psychological or science-fictional interpretation and suggestion; the collective imagination can perceive and attain an emotional projection and exemplification of the universe, of egoism, since it involves a prehensile shape which absorbs and sucks in matter. Moreover, the title TEST, only by pure chance, includes the monogram "ET" which recalls the mythical encounter of a human being with the extra-terrestrial of Steven Spielberg's fairy-tale film. There the emblematic image of the finger contact between the two had been borrowed from Michelangelo's *Creation of Man* in the Sistine Chapel while the return to space resembled a mythical ascension on the trail of the Christmas comet.

From a scientific point of view, the clear and lucid form of this sculpture might remind one of the application of mathematical logic to ideographic instantaneity that Giuseppe Peano carried out towards the end of the last century (G.C. Argan, 1985). And from a properly artistic perspective, it can be related to the philosophy of Russian Constructivism around 1920, and to the first clear perception, by Naum Gabo, of the unity of all visible forms and of the existence of aesthetic ones only in accordance with physical and



Three-dimensional trajectories of particles near a Kerr black hole  
(*Calculations by V. Bellezza and V. Ferrari, drawing by M. Sacripanti*).

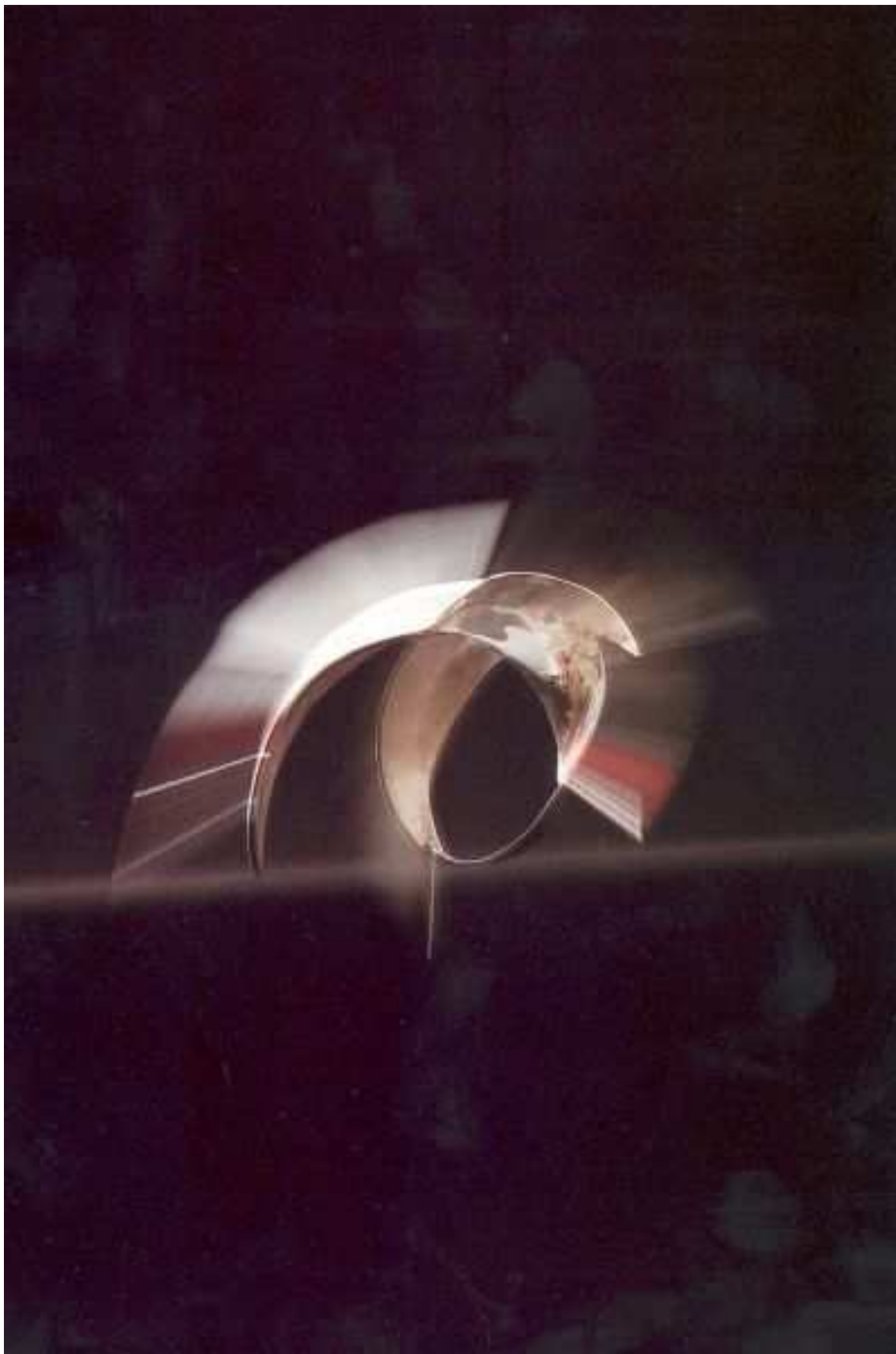
mathematical laws.

In the more recent context, characterized towards the late seventies by strong neo-expressionist and subjectivistic artistic movements, or neo-mannerist re-evaluation of art from the past, interaction with science has meant above all the adoption and use of advanced technologies, the so-called “computer art.” However, the use of media totally different from the traditional ones can change only the visual perception of the image and produce only a technical updating of the communication without necessarily yielding a new artistic message. On the other hand a “snapshot” which is new in concept and ichonography can also be expressed through the use of traditional and experimented techniques. Its very novelty may be expressed through the use of modules of different sizes and composition: namely in the form of a 20cm silver object, as in 1985, or in that of a 50cm bronze one, or in steel tubes, like the  $340 \times 470 \times 260 \text{cm}^3$  structure which was shown at the Venice Biennial Exhibition of 1986.

In the silence of his studio the artist finds his knowing craftsmanship, in making the moulds to be forged into metal and in his attempts to achieve the right shape of the torsions which express the intuition of their artistic value, with the light and opacity of the metal. With his mind, he tries not to betray the accuracy promised to the measurements of the curvatures and strives to make them coincide with his own geometric dream.

The discovery of a form which is not an invention, but bears the simple beauty and the perfection of an archetype existing in nature, leads one to re-experience aesthetically the same emotion that must have been felt by whoever discovered it first.

—English translation by Susanna Hirsch



TEST, sculpture by A. Pierelli, photo by S. Takahashi.



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*Acceptance speech of C.N. Yang*

*On Receiving the Marcel Grossmann Award from ICRAANet, Pescara, Italy*



I remember that it was at the Second Marcel Grossman Meeting in Trieste in 1979, that I formulated the phrase “Symmetry Dictates Interactions” , which describes the principle that governs the structure of interactions.

I am happy to receive this award from an organization based in Italy, the country I feel closest to, after China and the USA.

Enrico Fermi (1901-1954)

Enrico Fermi was one of the Great Sons of Italy in Her Long History.

Prometheus in Greek Mythology, 燧人氏 in Chinese Mythology, taught Mankind How to use *Chemical Energy*

Enrico Fermi in reality, taught Mankind How to use *Nuclear Energy*.

Enrico Fermi was, of all the great physicists of the 20th century, among the most respected and admired. He was respected and admired because of his contributions to both theoretical and experimental physics, because of his leadership in discovering for mankind a powerful new source of energy, and above all, because of his personal character. He was always reliable and trustworthy. He had both of his feet on the ground all the time. He had great strength, but never threw his weight around. He did not play to the gallery. He did not practise one-up-manship. He exemplified, I always believe, the perfect Confucian gentleman.

Fermi from 1950 to 1951 was a Member of the General Advisory Committee (GAC) of the Atomic Energy Committee (AEC) chaired by Oppenheimer. He then resigned with a quote: “You know, I don’t always trust my opinions about these political matters”.

Shakespeare’s Sonnets No. 94

*They that have power to hurt and will do none,  
That do not do the thing they most do show,  
Who, moving others, are themselves as stone,  
Unmoved, cold, and to temptation slow;  
They rightly do inherit heaven’s graces,  
And husband nature’s riches from expense;  
They are the lords and owners of their faces,  
Others but stewards of their excellence.*

In my years in Chicago, Fermi was personally very kind to me. I remember in June 1948, I had problems with the US Immigration Office. Fermi and Professor Allison, the Director of Chicago’s Institute, went with me to the Immigration Office in Chicago. The Head of the office was so overwhelmed by the presence of Fermi that all my Immigration problem were resolved immediately.

Fermi made many first rate contributions to physics. His contemporaries, including himself, considered his beta decay theory the most important. To bring out the great impact that paper had on physicists in the early 1930s, allow to me to tell you a story.

Fermi made many first rate contributions to physics. His contemporaries, including himself, considered his beta decay theory the most important. To bring out the great impact that paper had on physicists in the early 1930s, allow to me to tell you a story.

Y: *What do you think was Fermi's most important contribution to theoretical physics?*

W:  *$\beta$ -decay theory.*

Y: *How could that be? It is being replaced by more fundamental ideas. Of course it was a very important contribution which had sustained the whole field for some forty years: Fermi had characteristically swept what was unknowable at that time under the rug, and focused on what can be calculated. It was beautiful and agreed with experiment. But it was not permanent. In contrast the Fermi distribution is permanent.*

W: *No, no, you do not understand the impact it produced at the time. Von Neumann and I had been thinking about  $\beta$ -decay for a long time, as did everybody else. We simply did not know how to create an electron in a nucleus.*

Y: *Fermi knew how to do that by using a second quantized  $\psi$ ?*

W: *Yes.*

Y: *But it was you and Jordan who had first invented the second quantized  $\psi$ .*

W: *Yes, yes. But we never dreamed that it could be used in real physics.*

In the fall of 1954 Fermi was critically ill. Murray Gell-Mann and I went to the Billwigs Hospital to see him for a last time. He was thin, but not sad. He was reading a book full of stories about men who had succeeded, through sheer willpower, to overcome fantastic obstacles and misfortunes.

As we bade goodbye and walked towards the door of his room, he said:

*"Now I have to leave physics to your generation."*



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*ICRANet*  
*International Center for Relativistic Astrophysics Network*

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**Founded by:** Republic of Armenia, ICRA, Republic of Italy, University of Arizona, Stanford University, Vatican City State

**Date of foundation:** February 10, 2005 (Adhesion of Brazil: August 12, 2011)

ICRANET promotes international scientific cooperation and undertakes research in the field of Relativistic Astrophysics. Its activities are:

- development of scientific research
- teaching at doctorate and post-doctorate level
- long-term and short-term scientific training
- organization of workshops and scientific meetings
- arrangement of exchange programs for scientists and associates
- development of new standards of electronic communication among the Research Centers
- establishment of integrated data banks for all celestial bodies in all observable wave bands
- cooperation and affiliation with international scientific organizations and technology transfer with industry.

Scientific areas covered include cosmology, high-energy astrophysics, theoretical and mathematical physics. ICRANET coordinates the research activities of Member Universities and Research Centers operating in different geographical areas. A series of new seats for the activities are being developed in order to achieve these goals. The first has been completed and is fully operative in Pescara. The second, third and fourth are being established in Nice, Rio de Janeiro and Yerevan. Projects for additional Centers in Stanford (USA), Central Asia, China and Australasia are considered. ICRANET encourages the mobility of scientists among the Centers and offers fellowships to young students at graduate, post-graduate and post-doctoral levels within the framework of special training programs. ICRANET also sponsors the IRAP-PhD Joint Doctorate Program sponsored by Erasmus Mundus, CAPES, and ICRANet and recognized by the following Universities and Institutions: Albert Einstein Institut, Institut des Hautes études scientifiques (IHES), University of Bremen, University of Cologne, University of Ferrara, University of Nice “Sophia Antipolis”, University of Oldenburg, University of Rome “Sapienza”, University of Savoie.

ICRANET is at the service of the scientific institutions and the Member States that wish to cooperate in the field of Relativistic Astrophysics.











# International Center for Relativistic Astrophysics Network

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## 14TH ITALIAN-KOREAN SYMPOSIUM ON RELATIVISTIC ASTROPHYSICS

*July 20-24, 2015*  
*ICRANet, Pescara (ITALY)*

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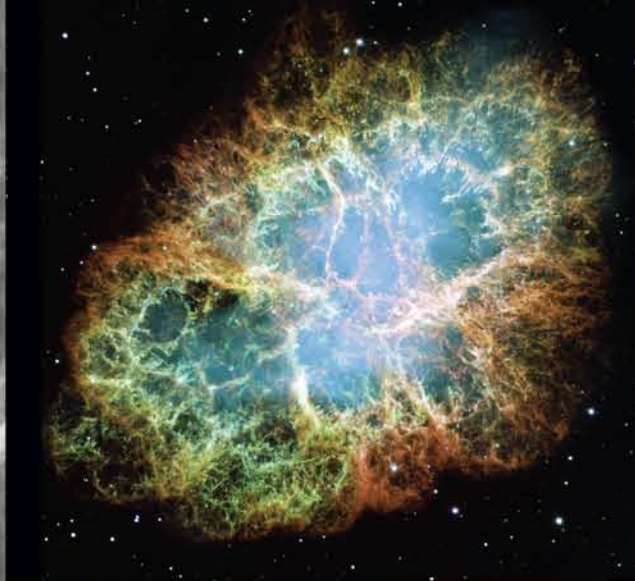
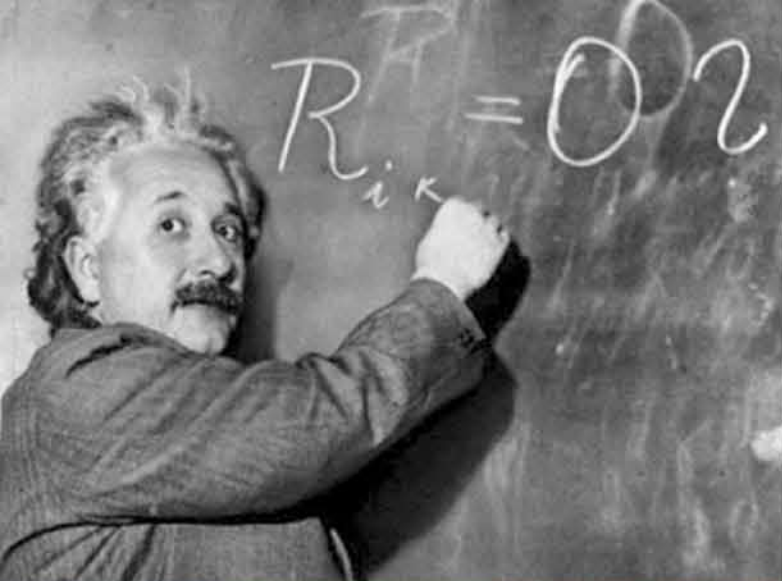
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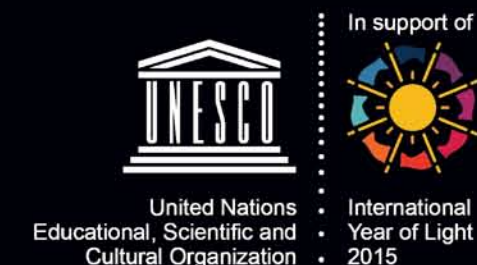
14th Italian-Korean Symposium on Relativistic Astrophysics  
July 20-24, 2015  
ICRANet (Pescara)

	Monday 20  <b>Black Holes and Neutron Stars</b>	Tuesday 21  <b>GRBs and Supernovae</b>	Wednesday 22  <b>Black Holes</b>	Thursday 23  <b>General Relativity and Gravitation</b>	Friday 24  <b>Strong field and cosmology</b>
	<i>Chair:</i> Hyung Won Lee	<i>Chair:</i> Sung-Won Kim	<i>Chair:</i> Jin Young Kim	<i>Chair:</i> Hyun Kyu Lee	<i>Chair:</i> Jong Hyuk Yoon
09:00-09:45	Remo Ruffini	Hyung Won LEE  <i>Perturbations in FOR gravity</i>	Sung-Won Kim  <i>Hawking Radiation of Dynamic Wormhole</i>	Francis Everitt	Jin Young Kim  <i>Exploring the light bending by non-linear QED effect in a ground laboratory</i>
09:45-10:30	Sang Pyo Kim  <i>Spontaneous Emission of Fermions from Charged Black Holes</i>	Bruno Da Cunha	Reza Mansouri  <i>Cosmological Black Holes: How different are they?</i>	Jong Hyuk Yoon  <i>Hamiltonian reduction via the (2+2) formalism and exact solutions to Einstein's equations</i>	Mansour Haghighat
10:30-11:15	Jorge Rueda	JeongCho Kim  <i>Gravitational Wave Parameter Estimation using amplitude corrected TaylorF2</i>	Carlo Luciano Bianco	Vladimir Belinski  <i>On the integrable supergravity</i>	Clément Stahl  <i>Fractal matter distribution and supernovae</i>
11:15-11:35			<i>Coffee Break</i>		
11:35-12:20	Hyun Kyu Lee  <i>Tidal deformation parameter for a stiffer equation of state</i>	Wang Yu	Chanyong Park  <i>Holographic Hadrons in the Nuclear Medium</i>	Robert Jantzen  <i>The GR frequency relation between an emitting ring and a stationary receiver in the Kerr equatorial plane: a pedagogical example</i>	Hendrik Ludwig
12:20-13:05	Fernanda Oliveira	Luca Izzo	Wonwoo Lee  <i>Entropy preference of black holes in dilaton- Einstein-Gauss-Bonnet theory</i>	Donato Bini  <i>Extended bodies with structure up to the mass quadrupole in black hole spacetimes</i>	Andreas Krut
13:05-15:00			<i>Lunch Break</i>		
	<i>Chair:</i> S.-S. Xue	<i>Chair:</i> G.V. Vereshchagin	Departure from ICRANet at 14:30  <b>Trip to “Cantina Tollo”</b>  (departure from Tollo to Pescara at 18:00/18:30)	<i>Chair:</i> R. Jantzen	<i>Chair:</i> Mansour Haghighat
15:00-15:45	Chul Min Kim  <i>Acceleration of protons by laser radiation pressure and its implications for experimental astrophysics</i>	Liang Li		Abishev Medeu	Xiaofeng Yang
15:45-16:30	Aurora Perez Martinez	Marco Muccino		Carlos Arguelles	Hyung Won Lee  Conclusions
16:30-16:50	Kuantay Boshkayev	Giovanni Pisani		Rahim Moradi	
16:50-17:10	<i>Coffee Break</i>			<i>Coffee Break</i>	
17:10-17:30	Federico Cipolletta	Milos Kovacevic		Yerlan Aimuratov	
17:30-17:50	Alexander Isayev  <i>Constraining magnetic field strength in compact stars with quark cores</i>	Maxime Enderli		Federico Cipolletta	

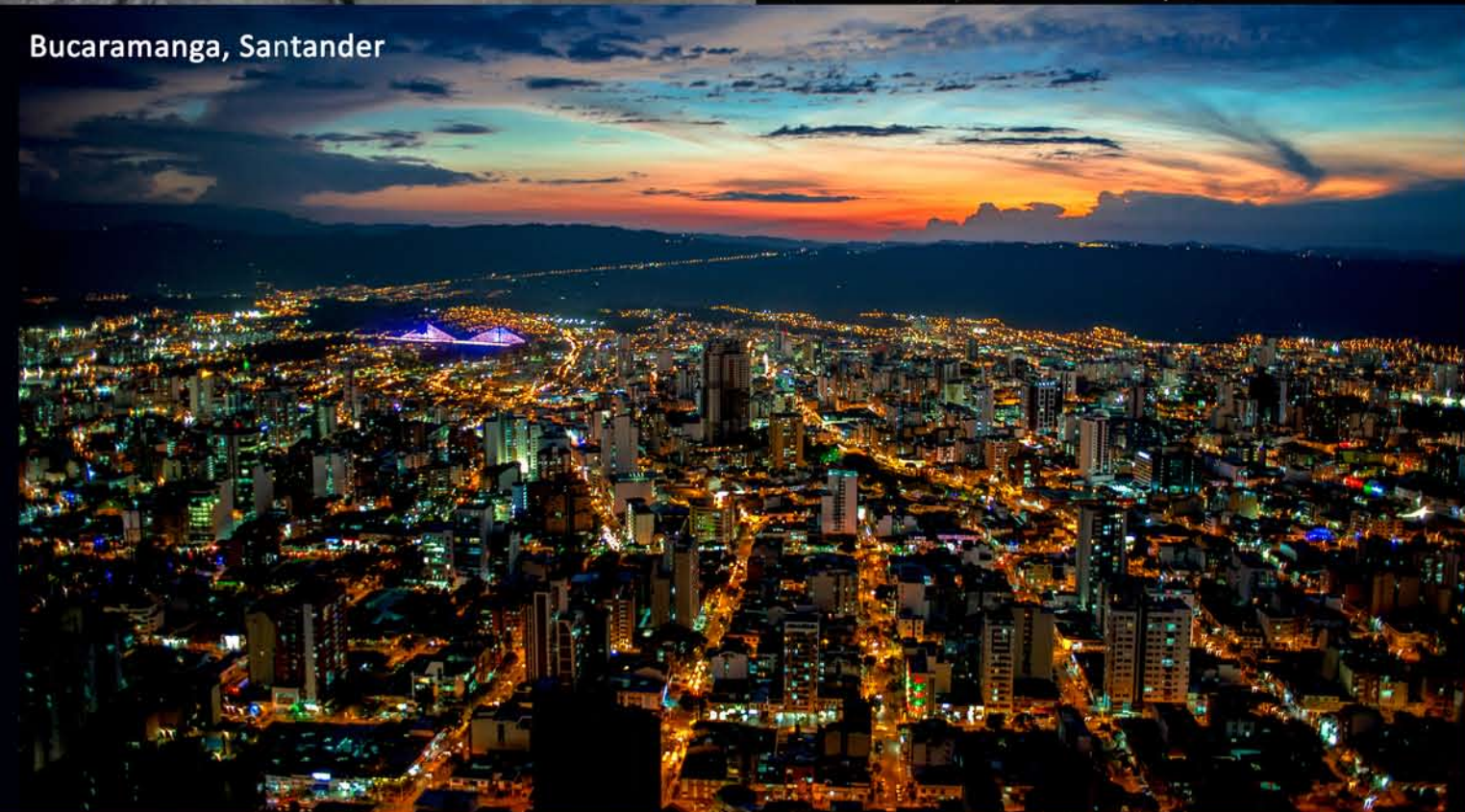




# CELEBRATING THE 100<sup>TH</sup> ANNIVERSARY OF THE EINSTEIN EQUATIONS THE GOLDEN JUBILEE OF RELATIVISTIC ASTROPHYSICS



CELEBRATED in 2015 by MGXIV and SATELLITE MEETINGS in:  
BRAZIL (2CL), CHINA (GX4), COLOMBIA (1JG), MEXICO (1SV) and USA



## The 1<sup>st</sup> Colombia-ICRANet Julio Garavito Armero Meeting on Relativistic Astrophysics

### INTERNATIONAL ORGANIZING COMMITTEE

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Giovanni Pinzón (UNAL, OAN) - Eduardo Rodríguez (UNAL)

César Valenzuela (Univalle) - Santiago Vargas (UNAL, OAN)

**November 23-25: Universidad Industrial de Santander - Bucaramanga**

The Julio Garavito's reluctance to accept the new concepts of the Einstein's theory based on non-Euclidean geometries witnesses how the Einstein's message did not reach the astronomical community in the world in the first 50 years of his theory. On the contrary, in the next 50 years, general relativity became one of the most mathematically elegant existent physical theories and a significant milestone of astronomy, astrophysics, and physics in general. This satellite meeting of the MGXIV in Rome is part of the ICRANet celebrations of the International Year of Light by UNESCO, as well as the 100 Anniversary of the Einstein Equations and the Golden Jubilee of Relativistic Astrophysics. This meeting also celebrates the recent signature of the scientific cooperation agreement between UIS and ICRANet. The topics cover theoretical and observational aspects of neutron stars, black holes, supernovae, gravitational waves, high-energy astrophysics and cosmology. The status and prospects of the ICRANet projects in Latin America especially in Colombia, will be also discussed.

More details at: <http://www.icranet.org/1jg>



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## PROGRAM IN BUCARAMANGA 23-25 NOVEMBER 2015

***Place: Universidad Industrial de Santander – Auditorio Ágora***

***2<sup>nd</sup> floor Facultad de Ciencias Humanas***

Time/Day	Monday 23 Nov	Tuesday 24 Nov	Wednesday 25 Nov
8:45-9:00	OPENING		
	<b><i>Relativistic astrophysics /Solution of Einstein equations Applied in Astrophysics/ Classic and Quantum Gravity</i></b>	<b><i>Supernova/Neutron Stars/Numerical Simulations in astrophysics/ Future Observational Projects in High-Energy Astrophysics in Latin America</i></b>	<b><i>AGN/Cosmology/Lar ge Scale Structure/ Solution of Einstein Equations Applied in Astrophysics</i></b>
CHAIRMAN	<i>L. Nuñez</i>	<i>E. Montoya</i>	<i>F. Lora</i>
9:00-9:50	Herrera	Lora	Mirabel
9:50-10:40	González	Ruiz	Forero
10:40-11:10	COFFEE BREAK/POSTER SESSION		
11:10-12:00	Quiroga	Rueda	Rodríguez
12:00-12:40	Pachón		Sanabria
12:40-14:30	LUNCH BREAK/POSTER SESSION		
CHAIRMAN	<i>J. D. Sanabria</i>	<i>J. Rueda</i>	<i>M. Ruiz</i>
14:30-15:20	Restuccia	Forero	Gutiérrez
15:20-16:10	Montoya	Barres	Castañeda
16:10-16:30	COFFEE BREAK/POSTER SESSION		
16:30-17:20	Mayorga	Nuñez	Dubeibe
17:20-18:10			
	BREAK		
19:00-20:00	Concierto Grupo Expresión Musical EMUIS	Public Conference Luis Herrera Cometta	

## TITLES AND ABSTRACTS PER DAY

***Monday (November 23)***

### ***Relativistic astrophysics /Solution of Einstein equations Applied in Astrophysics/ Classic and Quantum Gravity***

**- Luis Herrera Cometta (USAL-Salamanca, Spain; UCV-Caracas, Venezuela):**

*Title: Sources of gravitational radiation*

*Abstract:*

The main purpose of this work is to establish the relationship between gravitational radiation and source properties. As an emblematic example of this relationship we recall that gravitational radiation is an irreversible process, accordingly there must exist an entropy production factor in the equation of state (dissipation) of the source. We review a recently proposed framework for studying axially symmetric dissipative fluids. Some general results are discussed at the most general level. We then proceed to analyze some particular cases, e.g. the shear-free case, the perfect fluid case under the geodesic condition, and a dissipative, geodesic fluid. We shall consider the quasi-static approximation, which consists in assuming that the system is evolving, but is always in equilibrium (the characteristic time scale is much larger than the hydrostatic time). We finally analyze the very early stages of the non-equilibrium, assuming that all characteristic times under consideration are smaller than the hydrostatic, the thermal adjustment and the thermal relaxation time scales. We conclude by bringing out the attention to some open issues.

**- Guillermo González (UIS-Bucaramanga, Colombia):**

*Title: Stationary Axially Symmetric Relativistic Thin Discs with Nonzero Radial Pressure*

*Abstract:*

A detailed analysis of the surface energy-momentum (SEMT) tensor of stationary axially symmetric relativistic thin discs with nonzero radial pressure is presented. The physical content of the SEMT is analyzed and expressions for the velocity vector, energy density, principal stresses and heat flow are obtained. We also present the Counterrotating Model (CRM) interpretation for these discs by considering the SEMT as the superposition of two counterrotating perfect fluids. We analyze the possibility of counter rotation along geodesics as well as counter rotation with equal and opposite tangential velocities and explicit expressions for the velocities are obtained in both of the cases. By assuming a given choice for the counterrotating velocities, explicit expressions for the energy densities and pressures of the counterrotating fluids are then obtained. Some simple thin disc models obtained from the Kerr solution are also presented.

**- Gonzalo Quiroga (UIS-Bucaramanga, Colombia):**

*Title: Center of Mass and spin for isolated sources of gravitational radiation*

*Abstract:*

We define the center of mass and spin of an isolated system in General Relativity. The resulting relationships between these variables and the total linear and angular momentum of the gravitational system are remarkably similar to their Newtonian counterparts, though only variables at the null boundary of an asymptotically flat spacetime are used for their definition. We also derive equations of motion linking their time evolution to the emitted gravitational radiation. The results are then compared to other approaches. In particular one obtains unexpected similarities as well as some differences with results obtained in the Post Newtonian literature. These equations of motion should be useful when describing the radiation emitted by compact sources such as coalescing binaries capable of producing gravitational kicks, supernovas, or scattering of compact objects.

**- Leonardo A. Pachón (UdeA-Medellín, Colombia):**

*Title: Dynamical Consequences of Frame Dragging around Astrophysical Objects*

*Abstract:*

**- Alvaro Restuccia Nuñez (Un. Antofagasta-Antofagasta, Chile):**

*Title: The space-time and the relativistic symmetry in General Relativity and Quantum Gravity*

**Abstract:**

*It is well known the great significance of Einstein achievement in obtaining a relativistic formulation of the gravitational interaction through a theory, General Relativity, describing the geometric evolution of spacetime in terms of a pseudo Riemannian manifold. The theory is intrinsically background independent. The Einstein's equations may be formulated in a Hamiltonian form by using the ADM formulation. We emphasize the geometrical structure of the constraints and the well posedness of the initial value problem of the Hamiltonian formulation of Einstein's equations. The initial data are the starting point to analyze the quantum formulation of General Relativity. It is well known the difficulties in obtaining a perturbative quantum formulation of it. However, there have been interesting developments on the perturbative quantization of the maximal supersymmetric extension of General Relativity in four dimensions: N=8 Supergravity, as well as advances on the non-perturbative quantization of M-theory and the role of supersymmetry on it. They provide non-perturbative aspects to the well-established perturbative quantization of Superstring theory. In this context, a new proposal to quantum gravity has been recently introduced. It is known as Horava - Lifshitz gravity. The idea is to abandon the relativistic symmetry at high energies with the hope to recover it at low energies. The approach allows the introduction of higher order derivative terms, compared to GR, as new interaction terms in the potential. There are a finite number of them compatible with the symmetry of the formulation. These terms improve the quantum behavior of the propagator at UV energies while reduces it to the relativistic propagator when the theory flows to IR energies. The theory becomes power counting renormalizable. We will discuss the state of the art of this proposal and we will compare it to the already mentioned approaches to quantum gravity.*

**- Edison Montoya (UIS-Bucaramanga, Colombia):**

*Title: Loop Quantum Cosmology: Effective dynamics*

**Abstract:**

*It is presented a brief overview of Loop Quantum Cosmology and its effective theory, which describes the full quantum dynamics of semiclassical states. This effective theory is studied from the numerical point of view. Solutions to the Bianchi A universes are shown in order to illustrate the resolution of the big bang singularity.*

**- Bernardo Mayorga (UIS-Bucaramanga, Colombia):**

*Title: Julio Garavito Armero and the reception of the new science in Colombia*

**Abstract:**

*Julio Garavito Armero was a Colombian engineer, as well as a self-taught astronomer and mathematician, in the late nineteenth and early twentieth centuries. He just had undergraduate studies at the Universidad Nacional de Colombia, in Bogotá, but his concerns and love of science led him to stand out significantly in all fields he got into. Garavito witnessed the most dramatic revolutions of the two last centuries in scientific thinking: on the one hand, the foundation of mathematics driven by the non-Euclidean geometry and set theory, and on the other the appearance of the theory of relativity in physics. Like many other scientists of his time, he was reluctant to accept new ideas. In his case, perhaps due to lack of direct contact with European centers of thought in which the new theories were being developed.*

**- 7 pm: Concierto Grupo Expresión Musical EMUIS**

**Tuesday (November 24)**

***Supernova/Neutron Stars/Numerical Simulations in astrophysics/ Future Observational Projects in High-Energy Astrophysics in Latin America***

**- Fabio Lora Clavijo (UIS-Bucaramanga, Colombia):**

*Title: A jungle of general relativistic numeric codes?*

*Abstract:*

To describe astrophysics scenarios involving compact objects, Numerical Relativity has played an important role. In this talk, we focus on the different approaches to solve the GR equations as well as the different codes developed to evolve numerically systems like BHBH, BHNS and NSNS binaries.

**- Milton Ruiz (UIS-Bucaramanga, Colombia):**

*Title: Numerical relativity: from vacuum to matter spacetimes*

*Abstract:*

Numerical relativity has reached a stage of maturity that allows to study realistic astrophysical scenarios involving compact objects such as the inspiral and coalescence of binary black holes, binary black hole-neutron stars, binary neutron stars, etc. These studies are extremely important for our understanding of the physics of compact objects and, more generally, the physics of matter under extreme conditions. These systems are also prominent sources of both gravitational waves and electromagnetic signals. Combining the information from gravitational waves and the electromagnetic radiation ("multi-messenger astronomy") lets us fully understand the physics of compact objects. In this talk, I will summarize the current status and prospects of current research in numerical relativity. The talk will focus on multi-messenger sources of gravitational waves.

**- Jorge A. Rueda H. (ICRANet-Rome, Italy):**

*Title: Neutron stars in relativistic astrophysics: the case of gamma-ray bursts and supernovae*

*Abstract:*

I will give a review of the salient properties of the interior equation of state and structure of rotating neutron stars (NSs) as well as the consequent exterior spacetime properties. Then, I will discuss an application of the knowledge of the NS properties in an extreme astrophysical system: the energetic long-duration gamma-ray bursts (GRBs) associated with type Ic supernovae (SNe). For this I focus on the induced gravitational collapse (IGC) scenario that introduces a binary system as the progenitor of GRB-SNe: a carbon-oxygen (CO) core forming a compact binary with NS. The explosion of the CO core triggers a massive accretion process onto the NS bringing it to the critical mass value, inducing its gravitational collapse to a black hole with consequent emission of the GRB. I will show our most updated results from numerical simulations in full general relativity of the entire process from the SN explosion all the way up to the collapse of the NS.

**- Yeinzon Rodríguez (UIS-Bucaramanga, Colombia):**

*Title: From Scalar Galileons to Generalized and Covariantized (non-Abelian) Vector Galileons*

*Abstract:*

With the purpose of building cosmological inflationary models whose field equations are second order or less, getting rid of the Ostrogradsky's instability, we elaborate on the construction of the scalar Galileons and find the generalized and covariantized action both for a vector field that is not subject to any gauge invariance and for a multiplet of vector fields that enjoys a global non-Abelian gauge invariance. This paves the way for a systematic study of anisotropies both in the cosmic expansion and in the statistical distribution of fluctuations during inflation.

**- Jaime Forero (Uniandes-Bogotá, Colombia):**

*Title:*

*Abstract:*



**- Ulisses Barres de Almeida (CBPF-Rio de Janeiro, Brazil):**

*Title: Astroparticle Physics in South America: CTA and the synergy with current and future facilities.*

**Abstract:**

*In this talk I will introduce the current scenario for astroparticle physics in South America, a field which is strongly developing in the continent. The talk will concentrate on a detailed presentation of the status of the Cherenkov Telescope Array (CTA) project, which is the main dedicated observatory in the field, to be installed in the Chilean Andes, near Paranal, and with installation of prototypes planned to start in 2017. A number of other astroparticle physics projects are either in activity or planned for the continent in the next decade, and I will discuss some of them and the potential synergies these could have with CTA. A background to the whole presentation is the potential network of facilities and collaborations in astroparticle physics which is building up in the continent and which should mature and further develop to respond to the great scientific potential present for the field in this special corner of the world.*

**- Luis A. Nuñez (UIS-Bucaramanga, Colombia):**

*Title: Launching Cosmogeophysics at Eastern Colombia*

**Abstract:**

We present updated panorama of Astroparticle at Eastern Colombia describing several ongoing projects. Particularly we shall show recent advances in using astroparticle techniques to study volcanos in Colombia. We shall also present recent advances concerning Latin American Giant Observatory, LAGO-Collaboration.

**- 7pm: Public Conference (General Audience):**

**Prof. Dr. Luis Herrera Cometta (Universidad de Salamanca, Spain; UCV-Caracas, Venezuela)**

*Título: RELATIVIDAD Y SENTIDO COMÚN*

**Resumen:**

Se demuestra que los resultados que emergen tanto de la relatividad especial como de la relatividad general, no solo no contradicen el sentido común, sino que dichas teorías se obtienen a partir de una aplicación sistemática de dicho sentido.

**Wednesday (November 25)**

**AGN/Cosmology/Large Scale Structure/ Solution of Einstein Equations Applied in Astrophysics**

**- Félix Mirabel (CEA Saclay Service d'Astrophysique-France, IAFE-U. Buenos Aires, Argentina):**

*Title: Black holes in the Universe in the last decades*

*Abstract:*

It was obtained observational evidences on the existence of black holes, of stellar mass as well as with masses equivalent to millions, even billion solar masses. These astrophysical black holes are sources of phenomena of very high energies in the universe, and constitute unique laboratories to confront with observations the theories at the frontier of physics. I shall show that, besides being objects of interest for physics, black holes of various sizes played an important role in the evolution of the cosmos, and in the formation and the evolution of the galaxies, since the "Dark Ages" of the Universe more than 13 billion years ago, until our days.

**- Jaime Forero (Uniandes-Bogotá, Colombia):**

*Title: The Cosmic Web as a Cosmological Probe*

*Abstract:*

I will review recent advances in the techniques to observe and simulate the large scale structure of the Universe as traced by galaxies in large spectroscopic surveys. In this context I will show how the redshift dependence of the Alcock-Paczynski test can be used to measure the expansion history of the Universe. I will close by summarizing future observational prospects to measure cosmological parameters in the high redshift Universe, focusing on the Dark Energy Spectroscopic Instrument (DESI), a new spectroscopic survey planned to start in 2018.

**- José David Sanabria Gómez (UIS-Bucarmanga, Colombia):**

*Title: Stationary black diholes*

*Abstract:*

We present a stationary black diholes solution representing two counter-rotating Kerr-Newman black holes endowed with opposite electric charges, constructed on the basis of one of the Ernst-Manko-Ruiz equatorially antisymmetric solutions of the Einstein-Maxwell equations. We also demonstrate that each dihole constituent satisfy identically the well-known Smarr's mass formula.

**- Fransol López Súspe (USTA-Bucarmanga, Colombia):**

*Title:*

*Abstract:*

**- Antonio C. Gutiérrez (UTB-Cartagena, Colombia; UNAM-México DF, México):**

*Title: The physics of relativistic disks, an up-to-date report*

*Abstract:*

We present the current status of what is known about the thin disks model in general relativity, discuss some novel perceptions and present some future prospects. We discuss a relativistic model describing a thin disk surrounded by a halo in the presence of a non-trivial electromagnetic field. We interpret the model in two ways. First, the physical properties of the halo and disk are described by the distributional energy-momentum tensor of a general fluid in canonical form. Second, the variational multifluid thermodynamics formalism is used, allowing us to determine all the thermodynamic variables associated with the matter content of the disk. Both of the interpretations are not contradictories. However, the asymptotic behavior of the relevant physical quantities indicates that the dynamics encoded in the multifluid scenario gives a richer physical content to the solution.

**- Leonardo Castañeda (UNAL-OAN-Bogotá, Colombia):**

*Title: Cosmological Perturbation Theory and Precision Cosmology*

*Abstract:*

Modern cosmology has been one of the branches where the General Theory of Relativity (GR) has found a deep development on both theoretical and observational level. Cosmology has passed in a few decades to become one of the most precise science and and it is a favorable scenario, perhaps the only today, to be the real laboratory not only for theories of gravitation, but for various areas of physics, such as the case of particle physics, astrophysics and many others. During this talk some results from the Gravitation and Cosmology Group of the Observatorio Astronomico concerning to the relativistic cosmological perturbation theory at second-order and its consequences are discussed. A new proposal for the evolution of cosmic magnetic fields synthesized in a cosmic dynamo equation at second order, is shown. Some observable effects of such magnetic fields in the power spectrum of cosmic background (CMB) are explicitly computed. Also, results of the cosmological perturbation theory in modified theories of gravity (in particular  $f(R)$  gravity) are addressed.

**- Fredy Dubeibe (U. Los Llanos-Villavicencio, Colombia):**

*Title: Geodesic chaos in general relativity*

*Abstract:*

In this talk, I will present some tools for the determination and analysis of the dynamics of time-like geodesics in General Relativity. With special emphasis, the Poincaré section method, Lyapunov exponents and its applicability in this context are discussed. Finally, an overview of recent results and the possible consequences of the regular (or chaotic) behavior of the orbits in the detection of gravitational waves are presented.

## POSTER CONTRIBUTIONS

**- Jorge García-Farieta (UdeA-Medellín, Colombia):**

*Title: Effect of observational holes in the multifractal characterization of the galactic clustering using SDSS mask*

*Abstract:*

Some observational estimates suggest that the universe behaves as a multifractal object where the galaxy clustering is based on the generalization of the dimension of metric space. We study from this point of view, the spatial distribution of matter, a large scale in the universe with galaxy catalogs and using masks Sloan Digital Sky Survey of Galactic redshift (SDSS) including observational holes, particularly samples DR7, DR10 and DR11. Homogeneous catalogs were built with a radial selection function by a uniform distribution and "shuffle" method for a main sample of 486078 galaxies limited in redshift  $0.002 < z < 0.2$ . Additionally we build a random distribution of observational holes in right ascension and declination in the footprint of SDSS-BOSS that containing all points of the aforementioned masks sampling. Using the sliding window technique was determined the fractal dimension and lacunarity spectrum to characterize the hierarchical clustering in these catalogs as well as its dependence on the radial distance. Preliminary results show that the clustering of galaxies exhibits behavior that depends on the radial distance, with a transition to homogeneity below 180 Mpc/h.

**- Sindy Rocío Mojica Gómez (University of Oldenburg, Germany):**

*Title: Neutron Stars Universal Relations in Einstein-Gauss-Bonnet-dilaton*

*Abstract:*

Motivated by string theory, we studied neutron stars in Einstein Gauss Bonnet dilaton theory (EGBD). Neutron stars are considered laboratories to test general relativity and theories beyond. We calculated observables such that: mass, angular momentum, moment of inertia and quadrupole moment for rapidly rotating neutron stars in EGBD gravity. We are also interested in obtain quasinormal modes for neutron stars by using realistic equations of state. In order to determine the dependence on neutron stars matter constituents and the coupling parameter from the EGBD approximation, we have proven that universal relations for neutron stars may exist in EGBD theory, when the angular momentum is fixed and the moment of inertia and quadrupole moment are scaled.

**- María José Guzmán Monsalve (Instituto de Astronomía y Física del Espacio, Universidad de Buenos Aires, Argentina):**

*Title: Teleparallelism: a different insight of gravity*

*Abstract:*

Teleparallel gravity, a gauge theory for the translation group, turns up to be fully equivalent to general relativity. Due to this equivalence, it provides a whole new insight into gravitation. It breaks several paradigms related to the geometric approach of general relativity, and introduces new concepts in the description of the gravitational interaction. The action that describes this theory depends on the torsion scalar  $T$ , which differs from the Ricci scalar by a surface term. This scalar is made up of the Weitzenböck connection, which depends only in the only dynamical field in the theory: the tetrad field. In this work we will review the internal consistency of the theory through the Hamiltonian formalism, and we will present an extension of this theory: modified teleparallel gravity (best known as  $f(T)$  gravity), and its main accomplishments in cosmology, together with black hole solutions.

**- Andrés Felipe Vargas Sánchez (Universidad de Los Andes-Bogotá, Colombia):**

*Title: Charged Regular Black Hole and its Maximal Extension (PART I)*

*Abstract:*

In this work a simple static, spherically symmetric regular black hole solution satisfying the weak energy condition is obtained within non-linear electrodynamics theory. We show that for most cases there exists a unique event horizon which is located almost at the Schwarzschild radius. Asymptotically we recover the Reissner-Nordstrom solution and in the limit case when  $q=0$  the black hole is reduced to the Schwarzschild one. We then construct the maximal or Kruskal extension and study the dynamics of the Einstein-Rosen bridge generated. Finally, a family of black hole solutions which remain to be studied are presented.

**- Nicolás Morales-Durán (Universidad de Los Andes-Bogotá, Colombia):**

*Title: Charged Regular Black Hole and its Maximal Extension (PART II)*

**Abstract:**

In this work a simple static, spherically symmetric regular black hole solution satisfying the weak energy condition is obtained within non-linear electrodynamics theory. We show that for most cases there exists a unique event horizon which is located almost at the Schwarzschild radius. Asymptotically we recover the Reissner-Nordstrom solution and in the limit case when  $q=0$  the black hole is reduced to the Schwarzschild one. We then construct the maximal or Kruskal extension and study the dynamics of the Einstein-Rosen bridge generated. Finally, a family of black hole solutions which remain to be studied are presented.

**- Camilo Delgado-Correal (Università di Ferrara, Italia):**

*Title: Identification of low luminosity high redshift galaxies by using galaxy clusters as cosmic telescopes*

**Abstract:**

Current models of structure formation suggest that the first galaxies formed at  $z \gtrsim 10$  when the universe was  $< 500$  Myr old, so the detection and characterization of galaxies at these early epochs is critical to estimate the star formation rate density and their contribution to the reionization. The CLASH project (Cluster Lensing And Supernova survey with Hubble) combines an HST Treasury program to obtain panchromatic (ACS+WFC3) imaging of 25 carefully selected massive clusters, with other multi-wavelength observations, including a large spectroscopic campaign with VLT/VIMOS. Gravitational lensing, which is particularly powerful in several CLASH clusters, improves the efficiency of finding low-luminosity (i.e.  $L < L^*$ ) galaxies, which are thought to play a critical role in reionizing the Universe at  $z \sim 10$ . In this talk we will give some high-lights of the CLASH-VLT project and show the sample of  $\sim 200$  magnified lensed galaxies at  $3 < z < 7$ , whose photometric and spectroscopic data can be used to characterize the physical properties of the low-luminosity population at high- $z$ , thus complementing field studies at  $L > \sim L^*$ .

**- Diego Felipe Muñoz Arboleda (UNAL-Bogotá, Colombia):**

*Title: Brick Wall Model in the ThFD Formalism*

**Abstract:**

A detailed review of t'Hooft brick wall model is made in order to understand the Bekenstein-Hawking entropy as a thermal entropy due to quantum fields existing in the neighborhood of the event horizon of a black hole. The ground state is correctly identified (Boulware state) from the original model to eliminate the existing divergences. Finally, using the ThFD (Thermo Field Dynamics) formalism an extended brick wall model is made.

**- Jesús Rodríguez Sandoval (Universidad de Los Andes-Mérida, Venezuela):**

*Title: Effective Equations of the Quantum FRW Flat Universe in the Radiation Dominated Era*

**Abstract:**

We compute effective equations of the quantum FRW flat universe in the radiation dominated era at order  $\hbar$ , described in terms of Ashtekar variables employing methods provided by the geometrical formulation of quantum mechanics. Additional terms of quantum nature correct the classical equations of motion. As a consequence, the initial singularity of the classical model is removed and a Big Bouncing scenario takes its place. We also obtain an expression for the effective action of the model.

**- Andrei Jaimes Motta (UIS-Bucaramanga, Colombia):**

*Title: Particle flow simulation, with geomagnetic correction, reaching Bucaramanga (956 m a.s.l.)*

**Abstract:**

Under the project LAGO (Latin American Giant Observatory), it was born in the Guane + observatory it consists of three kinds of detectors WCD (Water Cherenkov Detector), the WCD has a cylindrical geometry of diameter 1.20 m, they are distributed in an isosceles triangle of side 200 m. In order to know the flow of particles from cosmic rays reaching the city of Bucaramanga a day (24 hours), the simulation was carried out of the rain of secondary generated in the atmosphere by primary group, among which are protons, photons, particles collider type, iron nuclei and helium. The following calculation was made by means Corsika software (Cosmic Ray Simulations for Kascade), taking into account parameters such as the zenith angle of incidence of the particles in the atmosphere which is between 0 and 90 degrees, the range of energies that have (5 GeV to 1,000,000 GeV), cutting rigidity (5 Gv), the atmospheric model E1 corresponding to tropical areas, height

above sea level (95900 cm), the horizontal and vertical component of the geomagnetic field (27.23 mT and 16.89 mT) respectively. In addition to the data obtained were made a geomagnetic correction with the help of MAGCOS software (Magnetocosmics), which allows knowing the path of charged particles that reach the Earth's magnetic field, taking into account parameters such as geographical location and the altitude above sea level. The simulation was carried out in order to calibrate the Guane+ observatory located at Universidad Industrial de Santander (UIS).

**- Sergio Andrés Torres Suárez (UNAL-Bogotá, Colombia):**

*Title: T.B.D.*

*Abstract: T.B.D.*

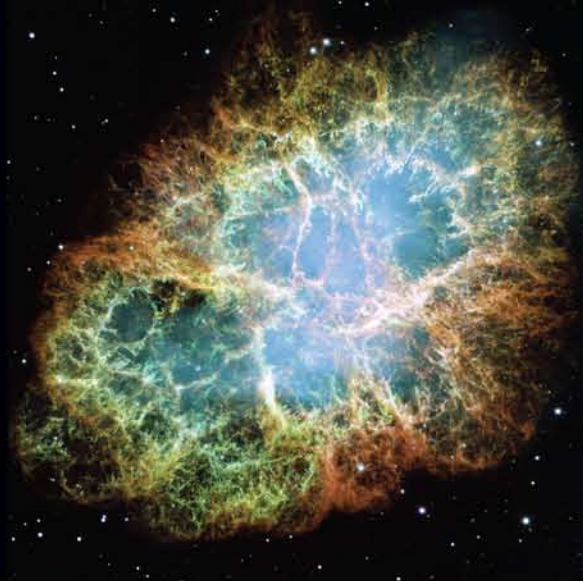
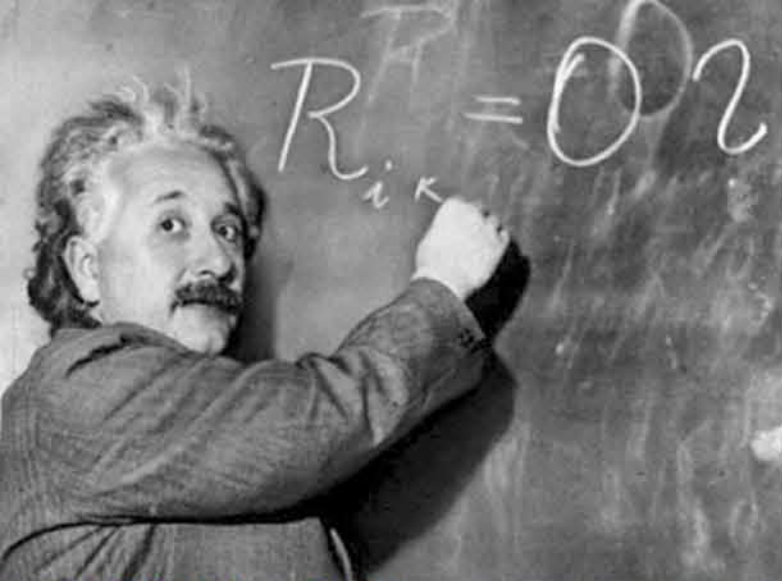
**- Carlos Sierra (UIS-Bucarmanga, Colombia):**

*Title: MOMENT TRANSPORT EQUATIONS AND ITS APPLICATION TO THE PERTURBED UNIVERSE*

*Abstract:*

The objective of this contribution is to review an standardization procedure that allows us to calculate the parameter  $f_{NL}$ , related to a cosmological model, using the moment transport equations and some adequate gauge transformations. The motivation of this study relies on the difficulty at obtaining the non-gaussianity parameters of cosmological models by means of the  $\delta N$  formalism, because there does not exist a standard analytic procedure to obtain the derivatives of the amount of expansion or number of e-folds  $N$ . To overtake this difficulty, the use of the moment transport equations is proposed so that the difficulty at obtaining the  $N$  derivatives is trade by a direct and standardized way of calculating the evolution of the correlators of the field perturbations.





# CELEBRATING THE 100<sup>TH</sup> ANNIVERSARY OF THE EINSTEIN EQUATIONS THE GOLDEN JUBILEE OF RELATIVISTIC ASTROPHYSICS



CELEBRATED in 2015 by MGXIV and SATELLITE MEETINGS in:  
BRAZIL (2CL), CHINA (GX4), COLOMBIA (1JG), MEXICO (1SV) and USA



## The 1<sup>st</sup> Colombia-ICRANet Julio Garavito Armero Meeting on Relativistic Astrophysics

### INTERNATIONAL ORGANIZING COMMITTEE

Alvaro Ramírez García (UIS) - Eduardo Posada Flórez (CIF) - Jorge Rueda (ICRANet)

Nathalia Rippe (Planetario de Bogotá) - Remo Ruffini (chair) (ICRANet)

Juan Manuel Tejeiro Sarmiento (UNAL)

### LOCAL ORGANIZING COMMITTEE

Pedro Bagueño (Uniandes) - Leonardo Castañeda (UNAL, OAN)

Guillermo Gonzalez (UIS) - William Herrera (UNAL) - Edison Montoya (UIS)

Luis Núñez (chair) (UIS) - Leonardo Pachón (UdeA)

Giovanni Pinzón (UNAL, OAN) - Eduardo Rodríguez (UNAL)

César Valenzuela (Univalle) - Santiago Vargas (UNAL, OAN)

**November 26: Planetario de Bogotá - November 27: UNAL-Auditorio Edificio CyT**

The Julio Garavito's reluctance to accept the new concepts of the Einstein's theory based on non-Euclidean geometries witnesses how the Einstein's message did not reach the astronomical community in the world in the first 50 years of his theory. On the contrary, in the next 50 years, general relativity became one of the most mathematically elegant existent physical theories and a significant milestone of astronomy, astrophysics, and physics in general. This satellite meeting of the MGXIV in Rome is part of the ICRANet celebrations of the International Year of Light by UNESCO, as well as the 100 Anniversary of the Einstein Equations and the Golden Jubilee of Relativistic Astrophysics. This meeting also celebrates the recent signature of the scientific cooperation agreement between UIS and ICRANet. The topics cover theoretical and observational aspects of neutron stars, black holes, supernovae, gravitational waves, high-energy astrophysics and cosmology. The status and prospects of the ICRANet projects in Latin America especially in Colombia, will be also discussed.

More details at: <http://www.icranet.org/1jg>

UNAL - Edificio de Ciencia y Tecnología







## PROGRAM IN BOGOTÁ 26-27 NOVEMBER 2015

Time/Day	Thursday 26 Nov	Time/Day	Friday 27 Nov
8:45-9:00	OPENING	8:30-9:20	Comerón
9:00-9:50	Ruffini	9:20-10:10	Mirabel
10:00-10:45	Obra mapping 3D "Albert el triunfo de la imaginación"	10:10-10:30	COFFEE BREAK
10:45-11:10	COFFEE BREAK	10:30-11:10	Barres
11:10-12:00	Mirabel	11:10-11:50	Forero
12:00-12:50	Izaurieta	12:00-14:00	LUNCH BREAK
		14:00-14:40	Granda
		14:40-15:20	Martínez
		15:20-15:40	COFFEE BREAK
		15:40-16:20	Nuñez
		16:20-17:00	Rueda

## TITLES AND ABSTRACTS PER DAY

*Thursday (November 26)*

*Lectures for General Audience*

*Place: Domo Planetario de Bogotá*

**- Remo Ruffini (Director of ICRANet-Rome, Italy):**

*Title: Supernovae, Neutron Stars, Black Holes and Gamma ray Bursts: in celebration of the Golden Jubilee of Relativistic Astrophysics*

*Abstract:*

*Place: Auditorio Planetario de Bogotá*

**- Félix Mirabel (CEA Saclay Service d'Astrophysique-France, IAFE-U. Buenos Aires, Argentina):**

*Title: Black holes in the Universe in the last decades*

*Abstract:*

It was obtained observational evidences on the existence of black holes, of stellar mass as well as with masses equivalent to millions, even billion solar masses. These astrophysical black holes are sources of phenomena of very high energies in the universe, and constitute unique laboratories to confront with observations the theories at the frontier of physics. I shall show that, besides being objects of interest for physics, black holes of various sizes played an important role in the evolution of the cosmos, and in the formation and the evolution of the galaxies, since the "Dark Ages" of the Universe more than 13 billion years ago, until our days.

**- Fernando Izaurieta (Universidad de Concepción, Chile):**

*Title: 100 Años de Espaciotiempo: Celebración del Centenario de la Relatividad General de Einstein*

*Abstract:*

Hace un siglo, Albert Einstein formuló uno de los conceptos más difíciles de comprender de toda la Física: el espacio y el tiempo están unidos en una sola entidad dinámica, cambiante, cuya geometría se curva y vibra bajo la influencia de la materia.

Esta idea revolucionaria es la Teoría de la Relatividad General. Tuvo un origen humilde, con un joven Einstein soñando con cómo sería montar un rayo de luz. Pero finalmente nos ha llevado a comprender desde el origen del Universo a partir del Big Bang hasta entidades tan extrañas y misteriosas como los Agujeros Negros, en cuyo centro el tiempo mismo parece finalizar. Un siglo después de su formulación, las ideas de Einstein son más fructíferas que nunca. Estamos en frente de grandes interrogantes por resolver, como qué son la Materia y Energía Oscuras o la naturaleza de la geometría espaciotemporal a nivel cuántico. Tratando de resolver estos y otros misterios nos hemos encontrado con ideas tan excitantes como Dimensiones Extra, el Multiverso, Supergravedad y Teoría de Cuerdas.

**Friday (November 27)**

**Morning: Technical Scientific Talks**

**Place: Auditorium of the “Ciencia y Tecnología CyT” building at Universidad Nacional de Colombia - Bogotá**

**- Fernando Comerón (Representative of the European Southern Observatory – ESO in Chile):**

*Title: Highlights of the program of the European Southern Observatory*

**Abstract:**

The European Southern Observatory (ESO), currently one of the world-leading organizations in astronomy, is beginning the construction of the European Extremely Large Telescope (E-ELT), which will become the largest telescope in the world when it enters operations in the mid-2020s. In many ways the current ESO program is paving the way for the E-ELT, both technically and scientifically, and it also offers a combination of facilities that cover a wide range of astronomical goals. Some highlights of current and planned facilities will be presented, with special mention to GRAVITY, a new instrument designed to test the close environment of the black hole at the center of our Galaxy.

**- Félix Mirabel (CEA Saclay Service d'Astrophysique-France, IAFE-U. Buenos Aires, Argentina):**

*Title:*

**Abstract:**

**- Ulisses Barres de Almeida (CBPF-Rio de Janeiro, Brazil):**

*Title: Astroparticle Physics in South America: CTA and the synergy with current and future facilities.*

**Abstract:**

*In this talk I will introduce the current scenario for astroparticle physics in South America, a field which is strongly developing in the continent. The talk will concentrate on a detailed presentation of the status of the Cherenkov Telescope Array (CTA) project, which is the main dedicated observatory in the field, to be installed in the Chilean Andes, near Paranal, and with installation of prototypes planned to start in 2017. A number of other astroparticle physics projects are either in activity or planned for the continent in the next decade, and I will discuss some of them and the potential synergies these could have with CTA. A background to the whole presentation is the potential network of facilities and collaborations in astroparticle physics which is building up in the continent and which should mature and further develop to respond to the great scientific potential present for the field in this special corner of the world.*

**- Jaime Forero (Uniandes-Bogotá, Colombia):**

*Title: The Cosmic Web as a Cosmological Probe*

**Abstract:**

I will review recent advances in the techniques to observe and simulate the large scale structure of the Universe as traced by galaxies in large spectroscopic surveys. In this context I will show how the redshift dependence of the Alcock-Paczynski test can be used to measure the expansion history of the Universe. I will close by summarizing future observational prospects to measure cosmological parameters in the high redshift Universe, focusing on the Dark Energy Spectroscopic Instrument (DESI), a new spectroscopic survey planned to start in 2018.



## ***Afternoon: Technical Scientific Talks***

***Place: “Paraninfo Edificio Insignia Julio Garavito Armero” at Universidad Nacional de Colombia - Bogotá***

***- Luis Norberto Granda (Univalle-Cali, Colombia):***

*Title: Dark Energy and the expanding universe*

*Abstract:*

The cosmology has undergone a revolution since the discovery of the accelerated expansion of the universe at the end of the 1990's. Since then, physicists have been developing theories about what causes this accelerated expansion, which was called dark energy. The simplest candidate for dark energy is the cosmological constant, but it suffers from the known problem of fine tuning. Many dynamical approaches to dark energy have been proposed by using scalar fields of different nature or by modifying the gravity at cosmological distances. We are at the very beginning of the quest to understand this fundamental problem, and the final answer is still far away.

***- Roberto Martínez (UNAL-Bogotá, Colombia):***

*Title: Dark matter o partículas inertes.*

*Abstract:*

Haremos una breve presentacion de los datos mas relevantes que permiten concluir la existencia de la materia oscura a nivel galactico. Presentaremos un modelo de fisica de particulas elementales invariante de gauge  $SU(3)_C \times SU(2)_L \times U(1)_Y \times U(1)_X$  con tres familias de fermiones y libre de anomalias. Dicho modelo contiene una corriente neutral adicional y puede explicar correctamente la oscilacion de neutrinos y la diferencia de masas. El modelo contiene un campo escalar singlete  $SU(2) \times U(1)$  como candidato a materia oscura. Con el campo escalar se puede explicar la densidad requilada de materia oscura y ademas, para un conjunto de parametros del modelo, todavia no es excluido por los datos experimentales de LUX para deteccion directa de materia oscura.

***- Luis A. Nuñez (UIS-Bucaramanga, Colombia):***

*Title: Launching Cosmogeophysics at Eastern Colombia*

*Abstract:*

We present updated panorama of Astroparticle at Eastern Colombia describing several ongoing projects. Particularly we shall show recent advances in using astroparticle techniques to study volcanos in Colombia. We shall also present recent advances concerning Latin American Giant Observatory, LAGO-Collaboration.

***- Jorge A. Rueda H. (ICRANet-Rome, Italy):***

*Title: Neutron stars in relativistic astrophysics: the case of gamma-ray bursts and supernovae*

*Abstract:*

I will give a review of the salient properties of the interior equation of state and structure of rotating neutron stars (NSs) as well as the consequent exterior spacetime properties. Then, I will discuss an application of the knowledge of the NS properties in an extreme astrophysical system: the energetic long-duration gamma-ray bursts (GRBs) associated with type Ic supernovae (SNe). For this I focus on the induced gravitational collapse (IGC) scenario that introduces a binary system as the progenitor of GRB-SNe: a carbon-oxygen (CO) core forming a compact binary with NS. The explosion of the CO core triggers a massive accretion process onto the NS bringing it to the critical mass value, inducing its gravitational collapse to a black hole with consequent emission of the GRB. I will show our most updated results from numerical simulations in full general relativity of the entire process from the SN explosion all the way up to the collapse of the NS.

Additional information on some of the invited speakers of the “First Colombia-ICRANet Julio Garavito Armero Meeting”

**-Ulisses Barres de Almeida (Centro Brasileiro de Pesquisas Físicas-Brazil; ICRANet-Italy):**

Barres is an expert in high-energy astrophysics with more than 100 scientific publications in this field. Barres is the Responsible for LST Actuator Interface Plates of the Cherenkov Telescope Array (CTA), the Brazilian Representative to the CTA/LST Steering Committee, and Member of the Publication Committee of the MAGIC Collaboration.

**- Fernando Comerón (European Southern Observatory – ESO in Chile):**

Comerón is from April 2013 the Representative of ESO in Chile; expert in galactic structures, large scale star formation, very low mass stars, brown dwarfs, stellar kinematics, and the dynamics of the interstellar medium.

**-Luis Herrera Cometta (Universidad Central de Venezuela – UCV, Venezuela and Universidad de Salamanca – USAL, Spain):**

Herrera is considered one of the greatest experts of the Einstein’s theory of general relativity in Latin America. Herrera has published about 200 articles in selected areas of classical general relativity, among them exact solutions of Einstein equations in presence of anisotropy and thermodynamics within general relativity. Under his guide, a school of relativists has flourished in Latin America. For more information:

[https://es.wikipedia.org/wiki/Luis\\_Alfredo\\_Herrera\\_Cometta](https://es.wikipedia.org/wiki/Luis_Alfredo_Herrera_Cometta)

**- Fernando Esteban Izaurieta Aranda (Universidad de Concepción, Chile):**

Izaurieta has experience in General Relativity, multidimensional supergravity, and Lanczos–Lovelock gravity, torsional Langrangian, Chern-Simons theories, M and branes theory. In addition, he is interested in the solutions of general relativity equations as well phenomenology of Cartan’s gravity and cosmology in multidimensional supergravity. For an updated list of publications type “find a izaurieta” at <http://inspirehep.net/>.

**- Felix Mirabel (Commissariat aux Energies Atomique et Alternatives-France, Instituto de Astronomia y Ciencias del Espacio-UBA, CONICET-Argentina):**

Mirabel lead to the discovery of Microquasars, the Apparent Superluminous Motions in the Galaxy, and initiated the multi-wavelength ground base research that lead to the discovery of Luminous Infrared Galaxies and Tidal Dwarf Galaxies. Besides, he has worked in several other areas of modern astrophysics (solar system, star formation, galactic structure, active galaxies, compact objects...), integrating observations in all wavelengths, from gamma-rays to radio waves which has led to the publication of more than 600 articles in the highest impact-factor international journals of astrophysics. Mirabel has been Representative and Head of the Office of Science in Chile of the European Southern Observatories – ESO and Director of Research at Commissariat aux Energies Atomique et Alternatives CEA in France. Currently, Mirabel is Conseiller scientifique at CEA in France and “Investigador Superior” of CONICET-Argentina.

**- Alvaro Restuccia (Universidad de Antofagasta-Chile):**

Restuccia is one of the most recognized researchers in Latin America in field of theoretical

Con una dilatada trayectoria de mas de 40 años como investigador y formador de generaciones de investigadores, es una de las figuras más reconocidas en América Latina en el ámbito de la Física Teórica con importantes contribuciones en supersimetrías, multibranas/superbranas, teorías de calibre, teorías de cuerdas y teorías topológicas.

**- Jorge Armando Rueda Hernández (ICRANet):**

Rueda is an expert in physics and astrophysics of compact objects such as white dwarfs, neutron stars, and black holes. He has published about 100 articles in topics ranging from exact solutions of Einstein-Maxwell equations to the physics in the interior of neutron stars and accretion processes onto compact stars. He has supervised several PhD theses of Latin American students from Argentina, Brazil and Colombia within the International Relativistic PhD Program – IRAP PhD; and coordinates the ICRANet activities in Latin America, including the *CAPES-ICRANet Program* of academic exchange. For more information:

[http://adsabs.harvard.edu/cgi-bin/nph-abs\\_connect?library&libname=Jorge+Rueda&libid=5451529bd5](http://adsabs.harvard.edu/cgi-bin/nph-abs_connect?library&libname=Jorge+Rueda&libid=5451529bd5)

**-Remo Ruffini (ICRANet):**

Remo Ruffini is the founder and current Director of ICRANet. He is one of the fathers of relativistic astrophysics; together with John Archibald Wheeler introduced the modern concept of “black hole”, and he has made several contributions in the field of relativistic astrophysics among them the concept of relativistic boson stars, the black hole mass formula, and the maximum possible value for the mass of a non-rotating neutron star. Remo Ruffini has published about 1000 scientific articles and 10 books in selected topics of relativistic astrophysics and cosmology. For more information:

[http://www.icranet.org/index.php?option=com\\_content&task=view&id=813](http://www.icranet.org/index.php?option=com_content&task=view&id=813)

[https://en.wikipedia.org/wiki/Remo\\_Ruffini](https://en.wikipedia.org/wiki/Remo_Ruffini)

[http://adsabs.harvard.edu/cgi-bin/nph-abs\\_connect?library&libname=Remo+Ruffini&libid=5451529bd5](http://adsabs.harvard.edu/cgi-bin/nph-abs_connect?library&libname=Remo+Ruffini&libid=5451529bd5)



# International Conference on Gravitation and Cosmology

## The First Sandoval Vallarta Caribbean Meeting

Mexico City - November 30-December 3, 2015

### Universidad Nacional Autónoma de México (UNAM)



*Celebrating the*  
**100<sup>TH</sup> ANNIVERSARY OF THE**  
**EINSTEIN EQUATIONS**  
*the*  
**INTERNATIONAL YEAR OF LIGHT 2015**  
*and the*  
**GOLDEN JUBILEE**  
**OF RELATIVISTIC ASTROPHYSICS**



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With the participation of (preliminary list)





**1st Sandoval-Vallarta Caribbean Meeting on Relativistic Astrophysics**  
**Nuclear Sciences Institute, UNAM, Mexico City**

<http://www.icranet.org/1sv/>

Preliminary program 27.11.2015

	Monday, 30 November	Tuesday, 1 December	Wednesday, 2 December	Thursday, 3 December
	Neutron Stars, Black Holes, Supernovae, GRBs	Observations, Cosmology and Gravitation tests	Gravitation, Lensing, Black Holes, Dark Matter, GRBs	Observations, Gamma-ray astronomy, cosmic rays.
<b>Morning</b>	Chair: Luis Felipe Rodriguez	Chair: Felix Mirabel	Chair: Alfredo Macias	Chair: Ulisses Barres De Almeida
09:45-10:00	Opening address			
10:00-10:45	Remo Ruffini <i>Supernovae, Neutron Stars, Black Holes and Gamma ray Bursts: in celebration of the Golden Jubilee of Relativistic Astrophysics</i> (presented by Jorge Rueda)	Luis Felipe Rodriguez <i>Tidal disruption of stars and clouds by massive black holes</i>	Alfredo Macias <i>On the incompatibility of GR and quantum theory</i>	Miguel Chávez <i>Current Status of the Large Millimeter Telescope</i>
10:45-11:30	Gus Sinnis <i>An Eye on the High-Energy Universe: The HAWC TeV Gamma-Ray Observatory</i>	Fernando Comerón <i>Highlights of the program of the European Southern Observatory</i>	Volker Perlick <i>Influence of a plasma on the light deflection by compact objects</i>	David Hughes <i>The Event Horizon Telescope: VLBI observations of supermassive black-holes with the Large Millimeter Telescope.</i>
11:30-12:15	Felix Mirabel <i>Black Holes in cosmology and Galaxy evolution</i>	Carlos Arguelles <i>New evidence of 50 keV fermionic dark matter from Milky Way &amp; Galactic observables</i>	Ulisses Barres De Almeida <i>Astroparticle Physics in South America: CTA and the synergy with current and future facilities</i>	Omar López-Cruz <i>How Big Can Supermassive Black Holes Grow?</i>
12:15-12:45	<b>Coffee break</b>			
12:45-13:30	Jorge Rueda <i>Hypercritical accretion onto neutron stars and the induced gravitational collapse paradigm of gamma-ray bursts associated with supernovae</i>	Jeff Peterson <i>Fast Radio Bursts</i>	Roberto Sussman <i>Credible modelling of realistic large scale cosmic structures with exact solutions of General Relativity</i>	Elías Castellanos <i>Scalar Field Configurations as Cosmological Condensed Matter Systems</i>
13:30-14:15	Dany Page <i>Probing the Neutron Star Crust from its Thermal Relaxation in Transiently Accreting Binaries</i>	Tonatiuh Matos <i>Dark matter as Scalar Fields</i>	Nora Bretón <i>Scattering of light by Born-Infeld electromagnetic black holes</i>	Eckehard W. Mielke <i>Rotating Boson Stars</i>
14:15-16:30	<b>Lunch at the Engineering Faculty Restaurant, UNAM</b>			
<b>Afternoon</b>	Chair: Carlos Arguelles	Juan Carlos Degollado	Chair: Nora Bretón	Chair: Eckehard W. Mielke
16:30-17:15	Hernando Quevedo <i>Geometrothermodynamics</i>	Dynamics of scalar fields around black holes	Fabio De Colle <i>Gamma Ray Bursts</i>	Dennis Philip <i>On analytic solutions of wave equations in Schwarzschild spacetime</i>
17:15-18:00	Nissim Fraija <i>Magnetic fields and high-energy neutrinos in Gamma-Ray Bursts</i>		José Antonio De Diego <i>High—Redshift Universe Through Gravitational Lensing</i>	Christine Gruber <i>Inflation as a thermodynamical phase transition from Geometrothermodynamics</i>
	<b>19:00-19:30 Visit to the Polyforum Siqueiros</b>	<b>19:00 Lecture at Istituto Italiano di Cultura in Mexico City</b> “The Golden Jubilee of Relativistic Astrophysics - a dialogue between Albert Einstein and Diego Rivera” <b>A. Macias, J. Rueda, R. Ruffini</b>		18:00 Concluding Remarks
	<b>20:30 Banquet at “El Palacio de los Azulejos”</b>			