

# Enclosure 10



# Collaborations in Relativistic Astrophysics with China

The exchange in the field of astrophysics between Italy and China has a long history dating back to the transfer to China of a telescope by Li Mǎdòu ([Matteo Ricci](#)) and the translation in Chinese of the Euclid's books by his student [Xu Guangqi](#) in the 16th century.

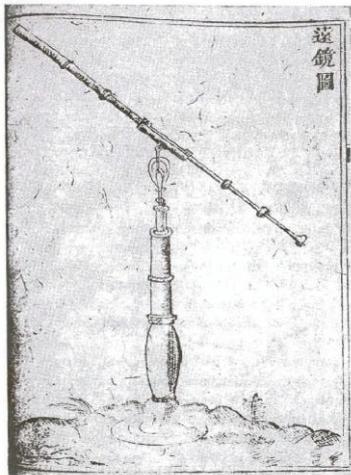
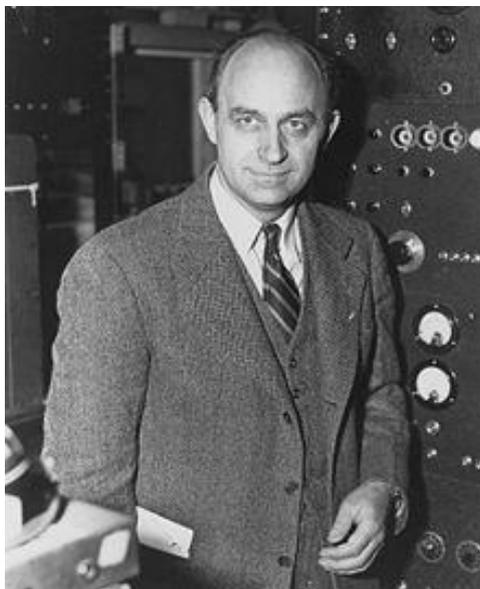


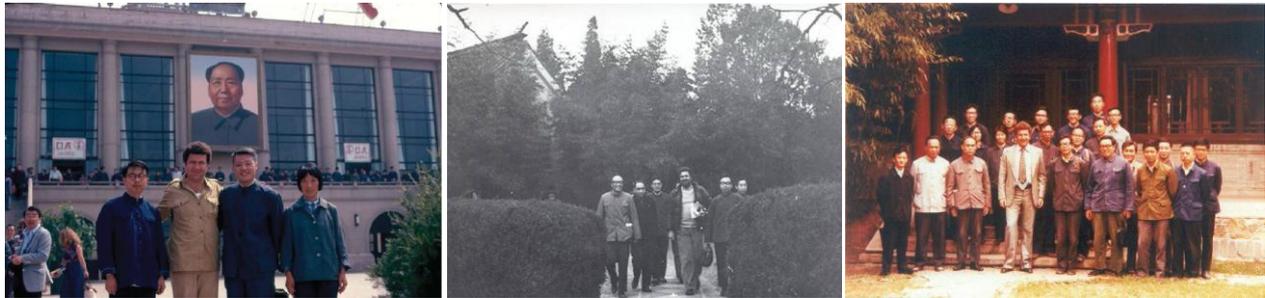
Fig. 2. - Il cannocchiale.  
Da *Il Telescopio* 遠鏡說 di G. A. SCHALL.



In recent years the modern contributions in the field of Astrophysics has been carried forward by professor [T.D. Lee](#) and in the fields of Relativistic Field Theories and Einstein General Relativity Theory by professor [C.N. Yang](#), both Nobel Laureates in 1956. They both were Chinese students of [Enrico Fermi](#) in 1940s.

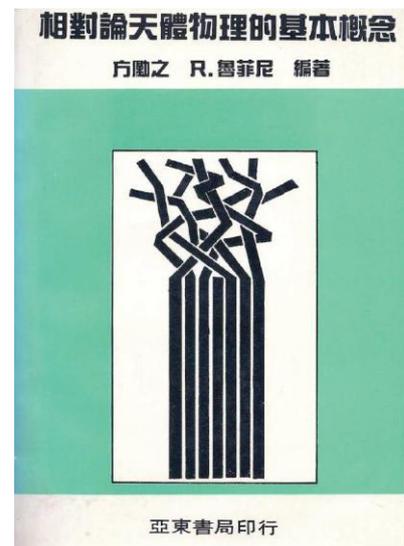
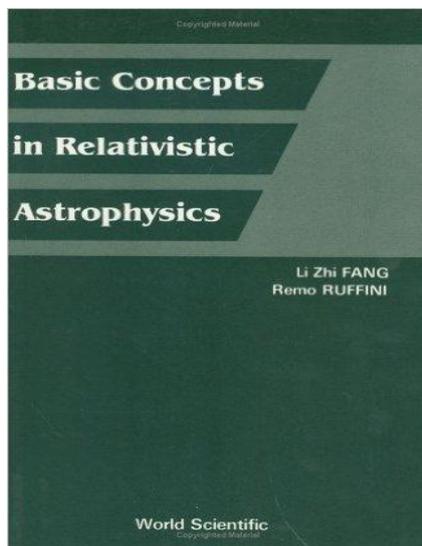


Following the first visit to China of professor [Remo Ruffini](#) in 1978, by invitation of the Chinese Academy of Sciences ([CAS](#)) a vast number of collaborations have started in the field of Relativistic Astrophysics, following the classic article “Introducing the Black Hole” by Remo Ruffini and John Archibald Wheeler (Physics Today, January 1971, pages 30-41) in the Institute Advance Study ([IAS](#)) at Princeton.



*The first visit of prof Remo Ruffini to China, Beijing and Tsinghua Universities, National Observatories of CAS*

Based on a series of lectures delivered in China, [Li Zhi Fang](#) and Remo Ruffini wrote book “Basic Concepts of Relativistic Astrophysics” (World Scientific, 1983, Chinese version, Shanghai Scientific publisher 1981).



This fundamental and didactical book has been worldwide used by undergraduate and graduate students for many generations.

In 1982, with Nobel Laureate and president of the International center of theoretical physics ([ICTP](#)) prof. [Abdus Salam](#) and the president of China Association for Science and Technology ([CAST](#)) prof. [Zhou Peiyuan](#), prof. Remo Ruffini organized

3rd Marcel Grossmann Meeting, Shanghai (China), 1982.  
<http://www.icranet.org/MGMeetings>

Proceedings was edited by prof [Hu Ning](#) of [Beijing University](#) and Institute of theoretical physics ([ITP](#)), Chinese Academy Science ([CAS](#)). This was the first international scientific meeting participated by important western scientists in China after the cultural revolution, greatly impacting on not only Chinese and western scientific communities, but also the government policy “opening door to the world” advocated by Premier [Deng Xiao Ping](#) in that time.



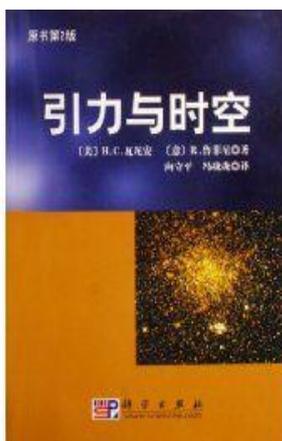
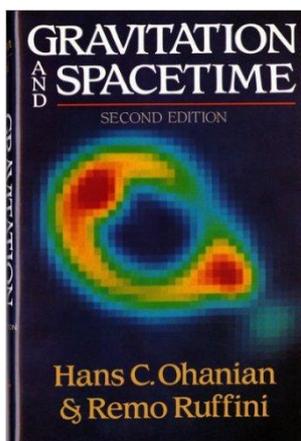
*Premier [Zhou En Lei](#) and prof. [Abdus Salam](#) in 1965*

Since then, the collaboration between China and Italy grew exponentially and the attention was turned to foster a collaboration also with the US and to strengthen relations between China and the US, [ICTP](#) and the [Vatican Observatory](#). Together in 1985 we created the International Center for Relativistic Astrophysics ([ICRA](#)) at the [University of Rome “la Sapienza”](#) with founding members [Riccardo Giacconi](#) (Baltimore Space Telescope Institute), Abdus Salam ([ICTP](#) and [TWAS](#)), George Coyne ([Vatican Observatory](#)), Remo Ruffini (University of Rome, la Sapienza”), and Fang Lizhi (University of Science and Technology in Hefei, [USTC](#)). ICRA has been the foundation for many successful developments and training Chinese scientists in Relativistic Astrophysics.



*ICRA members: Nobel Laureates Riccardo Giacconi and Abdus Salam, prof Li Zhi Fang*

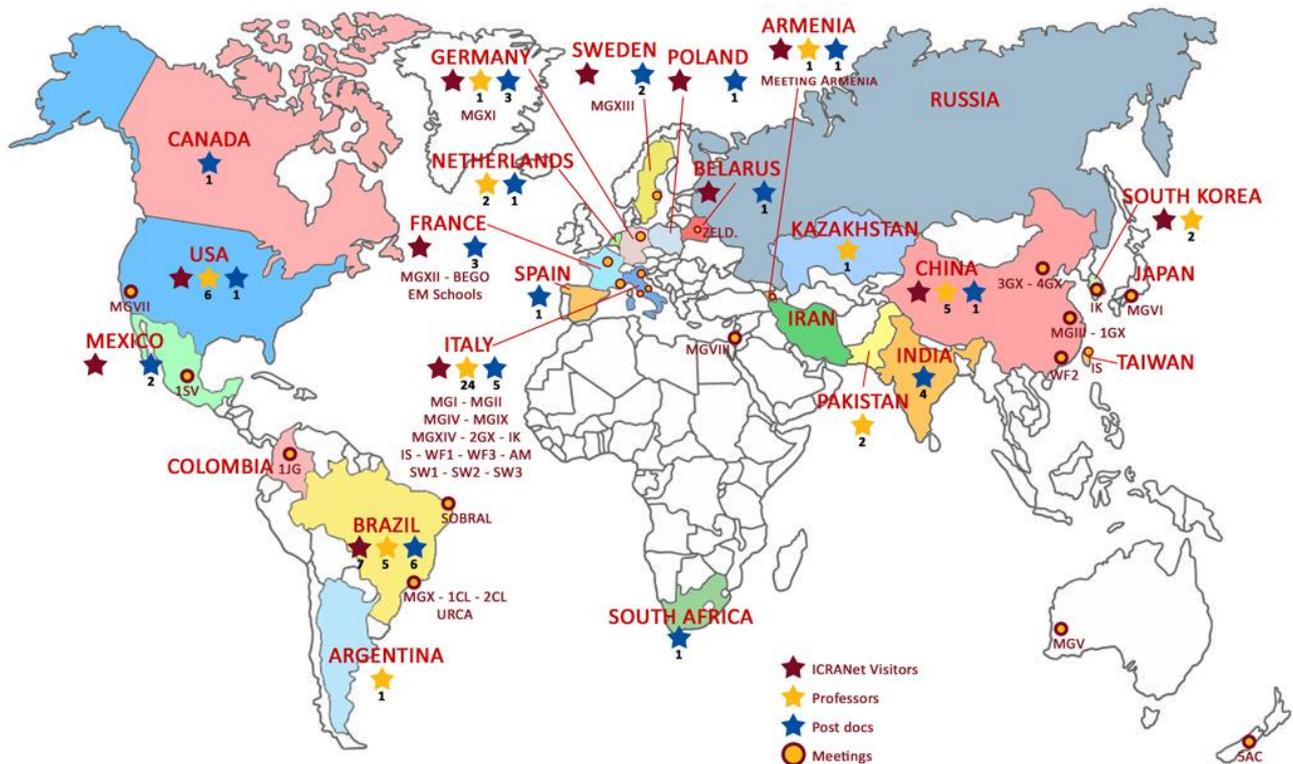
A large number of Chinese students have received their PhD in Italy, a large number of Chinese researches and post-docs have visited ICRA, and then been recommended to visit other western Institutions, among them Jing Yi-Peng, Li Miao, Feng Long-Long, Gao Jian-Gong, Xian Shuo-Ping and others, they became leading professors in important Institutions after their return to China. A large number of joint publications have appeared in international journals and many advanced scientific books have been published in Chinese, English and Italian. As example, the advanced monograph on the Einstein General relativity, “Gravitation and Spacetime” by Hans C. Ohanian and Remo Ruffini (W.W. Norton & Company, 1994) was translated into Chinese (Chinese Scientific publisher, 2006) by Prof. Ruffini former students Xiang Shou-Ping and Feng Long-Long, and now is an important referenced book in Chinese and Western Universities.



On March 19, 2003, the Establishment and the Statute of [ICRANet](#) were signed and recognized in the same year by the [Republic of Armenia](#) and the [Vatican State](#). ICRANet has been created in 2005 by a law of the Italian Government, ratified by the Italian Parliament and signed by the President of the Italian Republic [Carlo Azeglio Ciampi](#) on February 10, 2005. The Republic of Armenia, Italy, the Vatican State, ICRA, the [University of Arizona](#) and the [Stanford University](#) are the founding members.

On September 12, 2005 the Steering Committee was established and had its first meeting. Remo Ruffini and Fang Li-Zhi were appointed respectively Director and Chairman of the Steering Committee. On December 19, 2006 the Scientific Committee was established and had its first meeting in Washington DC. prof. Riccardo Giacconi was appointed Chairman and prof. John Mester (Stanford University) Co-Chairman.

On September 21, 2005 the Director of ICRANet signed with the Ambassador of Brazil Dante Coelho De Lima the adhesion of the [Federative Republic of Brazil](#) to ICRANet. The entrance of Brazil, requested by the President of Brazil [Luiz Ignácio Lula Da Silva](#) has been unanimously ratified by the Brazilian Parliament. On August 12, 2011 the President of Brazil [Dilma Rousseff](#) signed the entrance of Brazil in ICRANet. This map illustratively indicates ICRANet scientific activities and connections, including international scientific agreements, conferences, workshops, adjunct professors and exchanged visitors of professors, postdoctors and students in countries and scientific institutions worldwide, see [here](#).



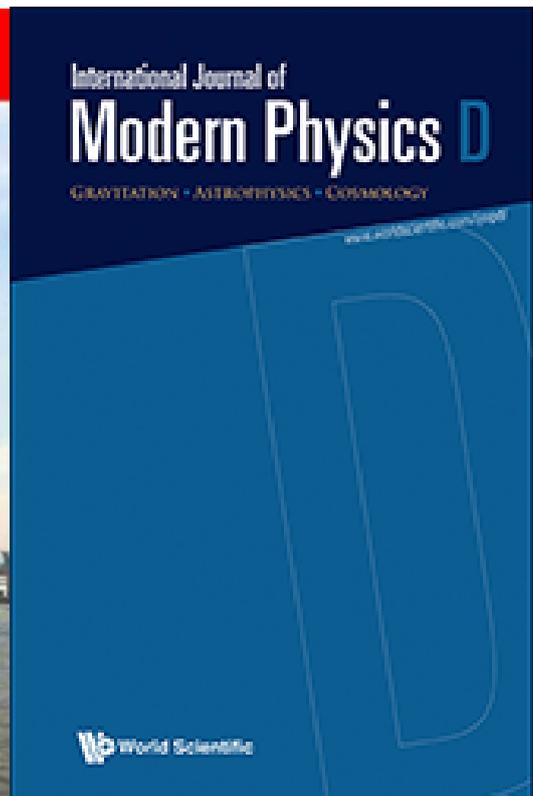
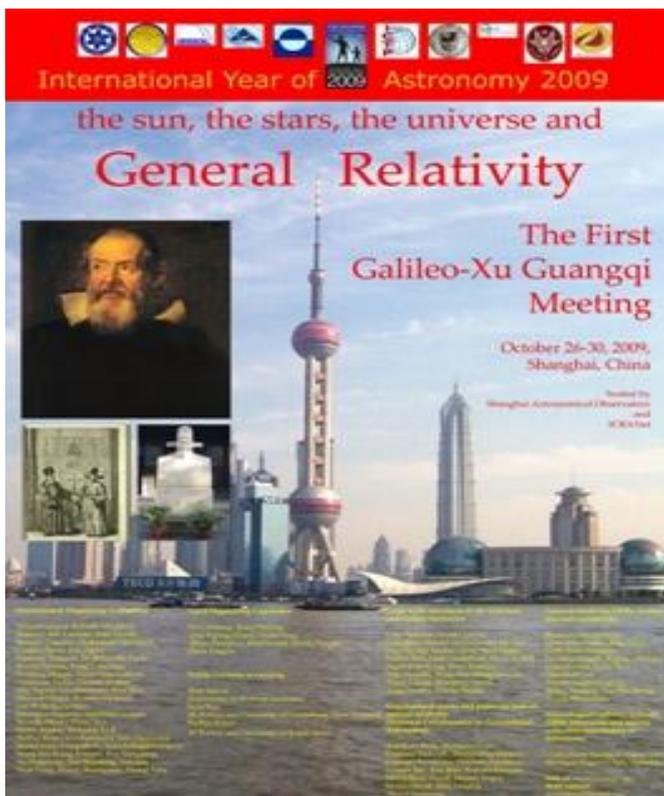
From 2004 to 2008, in the coordinate center of ICRANet at Pescara, Italy, a series of six Italian-Sino workshops on cosmology and relativistic astrophysics have been established by Profs. Remo Ruffini and Li Zhi Fang. These workshops were participated by both western, Chinese, oversee Chinese researches and Ph.D. students in the frontier of research of Relativistic Astrophysics. Chinese participants were hosted by ICRANet and supported by Chinese research fund for their travels. They all are nowadays key elements of Chinese international scientific projects in cooperation with western scientific communities in many active research fields. It should be mentioned that one of these meeting was in [Nice University](http://www.nice-university.fr), France, another hosted and supported by [Chinese Academia Sinica](http://www.cas.ac.cn) and universities in Taiwan.

<http://www.icranet.org/IS-Workshops>

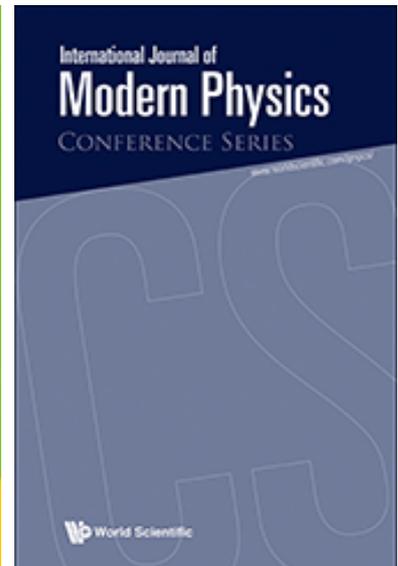


From 2009 to present, a series of joint meetings by ICRA Net and Chinese Institutions joint meetings has regularly been established in China, namely, The Galileo Xu Guangqi (GX) meetings <http://www.icranet.org/GXMeetings>

- 1st Galileo-Xu Guangqi Meeting, Shanghai (China), 2009 was organized by the Shanghai Observatory, CAS, Shanghai Jiao Tong University and ICRA Net. Proceedings was edited by David Blair, Jing Yi Peng, Remo Ruffini, SheSheng Xue, <http://www.worldscientific.com/toc/ijmpd/20/10>



- 2<sup>nd</sup> Galileo-Xu Guangqi Meeting, Ventimiglia (Italy) and Nice (France), 2010 was organized by the Nice University, [Beijing Observatory](http://www.beijing-observatory.com), CAS and ICRANet. Proceedings was edited by Remo Ruffini, <http://www.worldscientific.com/toc/ijmpcs/12>



- 3<sup>rd</sup> Galileo-Xu Guangqi Meeting, Beijing (China), 2011 was organized by Chinese National Observatory, CAS and ICRA.Net. Proceedings was edited by Zhen Cao, Xuelei Chen, Remo Ruffini, SheSheng Xue, Chengmin Zhang, Shuangnan Zhang; <http://www.worldscientific.com/toc/ijmpd/22/11>



- 4<sup>th</sup> Galileo-Xu Guangqi Meeting, Beijing (China), 2015 was organized by the ITP, Kavli Institute for Theoretical Physics in China at the Chinese Academy of Science ([KITPC](#)) and ICRANet to have an International Conference on Gravitation and Cosmology also for celebrating the 100 years anniversary of Einstein General Relativity. The conference was also cosponsored by the State Key Laboratory of Theoretical Physics ([SKLTP/ITP-CAS](#)), Kavli Institute for Theoretical Physics China (KITPC/ITP-CAS), Gravitation and Relativistic Astrophysics division of Chinese Physics Society ([CPS](#)), International Center for Theoretical Physics-Asian Pacific ([ICTP-AP](#)), Chinese Center for Advanced Science and Technology ([CCAST](#)), [Yunnan Observatories](#) at Chinese Academy of Sciences, Department of Astronomy at the University of Science and Technology of China (USTC), International College of University of Chinese Academy of Sciences ([IC-UCAS](#)), the Theoretical Physics Center for Science Facilities ([TPCSF](#)) at the Chinese Academy of Sciences (CAS), and ICRANet.



The Conference Proceedings was edited by Rong-gen Cai, Remo Ruffini, Yue-liang Wu.



These meetings were very successful, with more than hundred participants and most of them were from China, provided a platform for exchanging scientific idea both on theoretical and experimental aspects, in fact, many preliminary proposals of Chinese international scientific projects were first reported and discussed during these meetings. All these meetings in China were partially supported by the Neutral Science Foundation of China ([NSFC](#)) and other Chinese financial agencies.

It should be mentioned that in this most recent meeting GX4, Beijing, 2015, profs. T. D. Lee and C.N Yang received the [Marcel Grassmann awards](#) for their fundamental contributions to modern science in 20 century. The Vice president [Zhang Yaping](#) of CAS participated this great event of ceremony.



The Marcel Grassmann awards were 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”.*

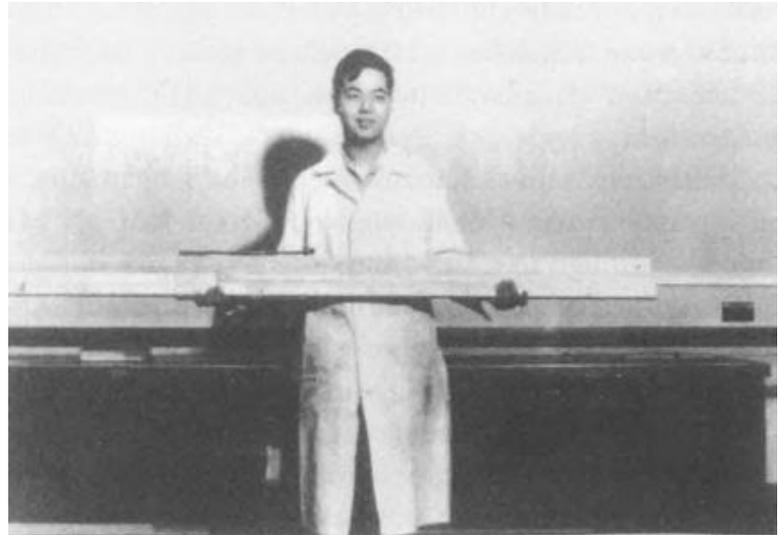
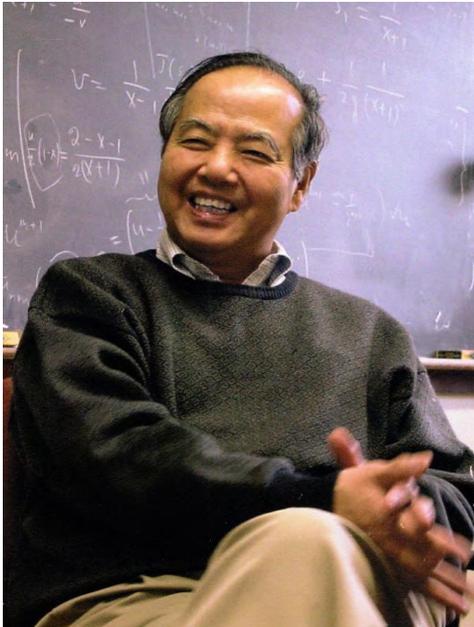


“... I would like to discuss some influence Fermi had in China: this is the case in which two of Fermi’s Chinese students and collaborators had an unprecedented impact on science at the international level and triggered the scientific development of the largest nation in the world: China. During my second 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 ICRA Net 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.*

In this ceremony of Marcel Grassmann award, prof. C.N. Yang delivered an enlighten speech personally recalling prof. E. Fermi and his physics revolutionally impacting on human being life.



In this year 2017, we are finalizing the organization of the Fifth Galileo-Xu Guangqi Meeting (GX5) to be held in June 2017 in [Emei mountain](#), [Sichuan](#), China in conjunction with the 2017 Annual meeting of the Division of Gravitation and Relativistic Astrophysics of the Chinese Physical Society. In this Fifth GX5, in addition to presentations and discussions of scientific developments of Relativistic Astrophysics and related fields, we are planning to celebrate the reaching of the understanding of Gamma Ray Bursts (GRBs) afterglow phenomenon in the 20th anniversary of their discovery by Italian-Dutch satellite, [BeppoSax](#) in 1997. As in previous GX meetings, ongoing and preliminarily planned Chinese research projects and proposals with international co-operations will be arranged for presentations and discussions. These include the current collaboration between the research group of Astrophysics in Italian Ferrara University, prof. Filippo Frontera, and Chinese Institute of High Energy Physics ([IHEP](#)), CAS (High Energy Physics, Chinese Academy of Science), prof. Li Tipei and Zhuang Shuannan concerning the Hard X—ray Modulation Telescope ([HXMT](#)) mission by China's first astronomical satellite, as well as world-wide leading underground experimental projects for dark matter studies, [PandaX](#) in Sichuan China and [Gran Sasso Laboratory](#) in [Abruzzo](#), Italy.



*International Center for Relativistic Astrophysics Network*



In addition to these regular meetings, a collaboration agreement between ICRANet and IHEP, CAS is already operative. Relevant is also the fundamental roles of profs. Remo Ruffini and Shuang Nan Zhang in directing their activities.

On the 4th of November 2016, the agreement between ICRANet and the IHEP, CAS has been renewed. This new agreement was signed by Prof. Shuangnan Zhang, Director of Center for Particle Astrophysics and Prof. Ruffini, Director of ICRANet. This agreement will be valid for other five years and the joint activities will consist in:

- promotion of theoretical and observational research activities within the field of Relativistic Astrophysics;
- the institutional exchange of faculty members, researchers, post- doctoral fellows and students;
- promotion of technological developments between IHEP and ICRANet;
- development of Data Centers for astrophysical data in all wavebands;
- the organization of training and teaching courses;
- the organization of seminars, conferences, workshops or short courses;
- joint publications



ICRANet coordinating center in Pescara, Italy (left) and IHEP, CAS in Beijing (right). The text of the agreement can be found [here](#), see also Enclosure 5.

On July 15 2015, the similar agreement, the Memorandum of Understanding (MOU) between ICRA Net and Leung Center for Cosmology and Particle Astrophysics ([LeCoSpa](#)), National Taiwan University, was renewed for other five years. Signature was made by the director of ICRA Net prof Remo Ruffini and director of LeCoSpa prof Pisin Chen in Besso Foundation in Rome, Italy.



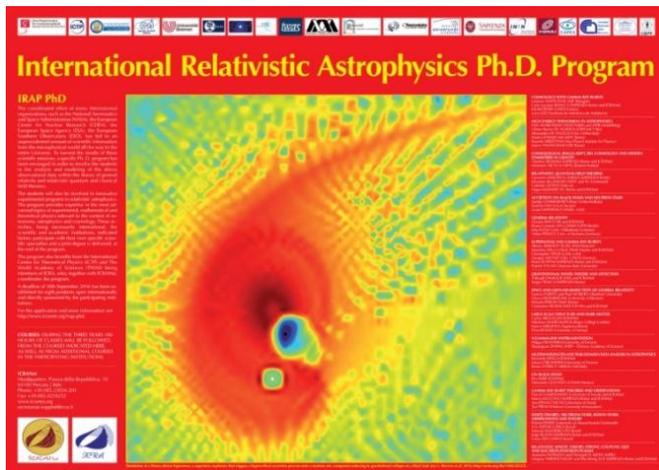
The text of the agreement can be found [here](#), see also Enclosure 5.

On November 7, 2016, Professor Remo Ruffini gave a seminar entitled “Supernovae, Hypernovae and Binary Driven Hypernovae” at [Shanghai Jiao Tong University](#), where the father of the Chinese rocket industry [Hsue-Shen Tsien](#) graduated from and now professor T.D. Lee has established a research Institute. The organizer of this event was the youngest member of the Chinese Academy of Sciences, Professor Jing Yipeng, director of the new formed center of Astronomy & Astrophysics ([CAA](#)), professor in the Department of Physics at this university and a former PhD student of Professor Ruffini. In this occasion Professor Ruffini and Professor Jing Yipeng discussed the cooperation between ICRANet and CAA including the 5th Galileo-Xu Guangqi Meeting (GX V) in June 2017. The collaboration agreement between ICRANet and CAA of Shanghai Jiao Tong University was discussed and currently proceeded by Professors Remo Ruffini and Jing Yi Peng. All these will open the way to the entrance of China into ICRANet as a member state.



Indeed China today is one of the countries with the highest education levels and consequently with many far-reaching advances in observations of the universe from space, from Earth and from underground laboratories. These developments in which China is engaged as well as their laboratories, radio telescopes and space missions are all very much appreciated by the international scientific community. In order to promote this great tradition and its success in the development of an international school of relativistic astrophysics, ICRANet is leading an international coordination to create an astrophysical data center and engage students and professors in this endeavor through the IRAP PhD doctorate. Brazil, Russia, India, China and South Africa are joining this effort with Italy.

As recalled, ICRANet has established the joint international PhD program (IRAP) and the Shanghai Observatory of Chinese Academy of Science (CAS) has been already one of the members of the [IRAP PhD consortium](#)



This PhD program has involved Chinese students, Wang Yu, Li Liang, Wu Yuanbin, Yang Xiao Feng and Chang Yi Liang, Han Wenbiao, see [here](#) and also Enclosure 7. We list some of very recent publications participated by Chinese researchers and students :

R. Ruffini, G. V. Vereshchagin, and S.-S. Xue, "Electron-positron pairs in physics and astrophysics: From heavy nuclei to black holes" *Phys. Rep.* 487, 1 (2010).

W.-B. Han, R. Ruffini, and S.-S. Xue, "Electron and positron pair production in gravitational collapse", *Phys. Rev. D* 86 (2012) 084004.

R. Ruffini, Y.-B. Wu and S.-S. Xue, "Einstein-Euler-Heisenberg theory and charged black holes", *Physics Review D* 88, 085004 (2013).

A. Rueda, R. Ruffini, Y.-B. Wu, and S.-S. Xue, "Surface tension of the core-crust interface of neutron stars with global charge neutrality", *Phys. Rev. C* 89, 035804 (2014).

P. S. Chen and R. Ruffini, Did Gamma Ray Burst Induce Cambrian Explosion?, 2015, *Astronomy Reports* 59, 469, arXiv: 1403.7303.

R. Ruffini, Y. Wang, et al., Induced Gravitational Collapse in FeCO Core-Neutron Star Binaries and Neutron Star-Neutron Star Binary Mergers, 2015, *IJMPA*, 30, 28.

R. Ruffini, Y. Wang, et al., GRB 130427A and SN 2013cq: A Multi-wavelength Analysis of An Induced Gravitational Collapse Event, 2015, *ApJ*, 798, 10, arXiv:1405.7505.

R. Ruffini, M. Muccino, Y. Wang, et al., GRB 090510: A Genuine Short GRB from A Binary Neutron Star Coalescing into A Kerr-Newman Black Hole, 2016, *ApJ*, 831, 2, arXiv: 1607.02400.

R. Ruffini, M. Muccino, Y. Wang, et al., On The Classification Of GRBs and Their Occurrence Rates, 2016, *ApJ* 832, 2, arXiv: 1602.02732

G. B. Pisani, R. Ruffini, Y. Wang, et al., On The Universal Late X-ray Emission Of Binary-driven Hypernovae And Its Possible Collimation, 2016, ApJ, 833, 2, arXiv: 1610.05619.

R. Ruffini, M. Muccino, Y. Wang, et. al, GRB 140619B: A Short GRB from A Binary Neutron Star Merger Leading To Black Hole Formation, 2016, ApJ, 808,2, arXiv: 1412.1018

R. Ruffini, J. Rodriguez, Y. Wang, et l., On The Rate and On The Gravitational Wave Emission Of Short And Long GRBs, submitted to ApJ, arXiv: 1602.03545

L. Li, Y. Wang, et al., A Correlated Study Of Optical And X-ray Afterglows Of GRBs, 2015, ApJ, 805,1, arXiv: 1503.00976.

Y. L. Chang, B. Arsioli, P. Giommi, P. Padovani, 2WHSP: A Catalog Of HE And VHE Gamma-ray Blazars And Blazar Candidates, arXiv:1609.05808.

L. Li, R. Ruffini, Y. Wang, et al., A Comprehensive Study Of Color Indices of Gamma-Ray Bursts: Colors Evolution And Their Physics Implication, Submitted to ApJS.

These days, a framework agreement between Agenzia Spaziale Italiana ([ASI](#), Italian Space Agency) and CAS has been recently signed. An existing collaboration agreement between ASI and ICRANet is consenting, under the guidance of Prof. Paolo Giommi, the implementation of the Brazilian Science Data Center (BSDC), located at ASI, at the ICRANet Center in Pescara, in Rome, at the ICRANet Center at CBPF in Rio de Janeiro and at the University of Rio Grande do Sul in Porto Alegre. The BSDC is being developed as a world-class data center for astrophysics, capitalizing on the experience gathered at the ASI Science Data Center (ASDC) in the data analysis and on the theoretical work developed at ICRANet seats in Pescara, Rome and Yerevan. All ICRANet centers in Armenia, Brazil, France and Italy, as well as all Centers worldwide with signed collaboration agreements with ICRANet will benefit of the BSDC for their research activities.

We are also planning to present a request for financial support to the BRICS for the creation of a BRICS Science Data Center (or BRICS-SDC), coordinated by ICRANet on the topics of Relativistic Astrophysics. BRICS is an association of five major emerging national economies: Brazil, Russia, India, China and South Africa (please see <https://en.wikipedia.org/wiki/BRICS>). BRICS has recently established its Scientific, Technological and Innovation (STI) Framework Programme (please see: <http://brics.rfbr.ru/rffi/eng/brics>) with the pilot call in 2016. With the goal to participate in the next 2017 call, we are thinking to present a proposal of a joint activity with Brazilian, Russian, Indian, Chinese and South African Institutions, coordinated by ICRANet as an international organization.

Recently, we are planning to make an agreement/MOU with National Natural Science Foundation of China (NSFC) to have some financial supports to the ICRANet activities in both China and Italy, as well as exchange program of researchers and students.

Today China has been making unprecedented progresses in the development of observational activities from space, from the ground and underground. Everyone worldwide admires these great developments, from Chinese radio telescopes to Chinese underground laboratories and Chinese space missions. The past great success of our almost forty years of collaboration will also bring attention to the possible entrance of China into ICRANet to foster the great tradition and success in developing a school of knowledge in relativistic astrophysics, to participate to a coordinated proposal to BRICS for a common data Center and to promote participation of students and professors in joint IRAP PhD activities.