MG17

MARCEL GROSSMANN AWARDS

Pescara 2024

ICRANet and ICRA

MG XVII

MARCEL GROSSMANN AWARDS

PESCARA 2024

and

TEST

The 17th Marcel Grossmann Meeting – MG XVII

July 9, 2024, Pescara (Italy)

Individual Awards

Goes to

DI LI

"For his groundbreaking contributions to the scientific definition of the most sensitive radio telescope and his numerous innovations in characterizing the dynamic universe, resulting in precise measurements of the interstellar magnetic field and advancing the field of fast radio bursts into a high-statistics era".

Goes to

CHRISTOPHER LEE FRYER

"For his pioneering and groundbreaking theoretical and numerical simulation contributions that have advanced our understanding of supernovae, gamma-ray bursts, and binary stellar evolution connecting them".

Institutional Awards

"For the innovative detection and comprehensive analysis of a large population of fast radio bursts, significantly increasing their statistics, including repeating sources, which have boosted our understanding of their origin and their application in mapping the universe structure and composition".

Goes to:

CHIME/FRB Team

- presented to Professor **Victoria Kaspi**

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.

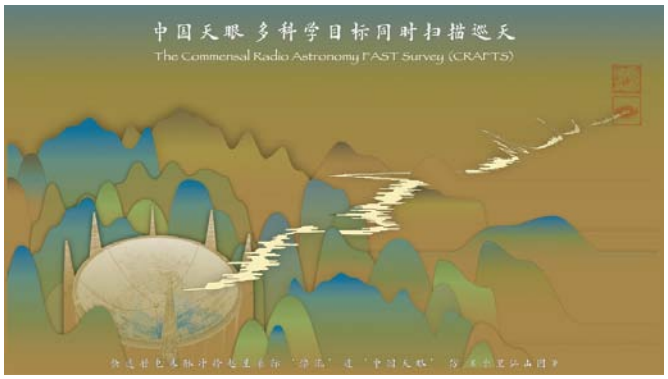
Professor **DI LI**

"For his groundbreaking contributions to the scientific definition of the most sensitive radio telescope and his numerous innovations in characterizing the dynamic universe, resulting in precise measurements of the interstellar magnetic field and advancing the field of fast radio bursts into a high-statistics era".

Dr. Di Li, trained in both nuclear physics and astronomy, is a distinguished observer and astrophysicist, holding faculty positions at the National Astronomical Observatory of China and Tsinghua University. As the Chief Scientist of the Five-hundred-meter Aperture Spherical radio Telescope (FAST), the largest antenna ever constructed, Dr. Li's research has been repeatedly recognized, with his papers being voted among the "Top 10 Scientific Advances in China" in 2021 and 2022. He has been honored with the 2022 "Outstanding Science and Technology Achievement" medal by the Chinese Academy of Sciences and the 2023 "National Innovation and Initiation Award".

Dr. Li has played a pivotal role in major national and international astronomical facilities, particularly FAST and the Square Kilometer Array (SKA). He spearheaded the development of novel techniques, facilitating the world's first multi-purpose radio survey, the Commensal Radio Astronomy FAST Survey (CRAFTS), which significantly increased survey efficiency and led to numerous groundbreaking discoveries, including new pulsars and fast radio bursts (FRBs).

Dr. Li pioneered a novel inversion technique to determine the temperature distribution of interstellar dust using the Fourier transform. He also (co-)discovered interstellar oxygen and other molecules. He developed the HI-Narrow Self-Absorption (HINSA) technique, which enabled precise measurements of the interstellar magnetic field through HINSA Zeeman measurements.



Artist's impression of FAST's observation of FRBs based on Li et al. 2021. A "river" of bursts, based on real pulse profiles of FRB 121102, flow from its host galaxy into the FAST telescope. The mountains are based on burst count and energies distribution of the source, mimicking the painting "A Vast Land" by WANG Ximeng of the Song Dynasty.

Dr. Li has made groundbreaking contributions to the understanding of FRBs, which are believed to be originated from compact objects such as neutron stars and black holes. In 2021, he published the largest FRB signal dataset, surpassing all previous publications combined. His analysis revealed the bimodal energy distribution of repeating FRBs, providing insights into their diverse mechanisms and stochastic nature. He proposed and demonstrated that a single parameter (σ_{RM}) can describe the complexity of FRB environments. He later invented the Pincus-Lyapunov Diagram (PLD) to characterize the randomness and chaos in dynamic events, including FRBs, earthquakes, and solar bursts. His work has shown that FRBs exhibit stochastic behavior akin to Brownian motion, contributing significantly to a unified understanding of these enigmatic phenomena.

Professor **CHRISTOPHER LEE FRYER**

"For his pioneering and groundbreaking theoretical and numerical simulation contributions that have advanced our understanding of supernovae, gamma-ray bursts, and binary stellar evolution connecting them".

Dr. Chris Fryer is a Los Alamos National Laboratory (LANL) scientist working on a broad range of computational physics problems in turbulence, radiation hydrodynamics, nuclear physics, and plasma physics. Fryer has leveraged this work to advance our understanding of astrophysical transients and compact remnant formation. His seminal work tying science advances at LANL to astrophysical phenomena has led to his election as a fellow of LANL, the American Physical Society, and the American Association for the Advancement of Science.

He was also awarded the E.O. Lawrence award for his work tying fundamental physics to astronomy. As Director of the Center for Nonlinear Science, Fryer guides next-generation scientists in discovering synergies between fundamental physics and broader science applications.

Dr. Fryer's groundbreaking work on the "convection-enhanced" engine behind supernova explosions has become a standard paradigm scenario, leading to significant contributions to the field. His studies on the predictions of this engine for supernova energies, transient emission, ejecta remnants, and compact remnant formation have paved the way for potential astrophysical observations, including neutrinos, gravitational waves, and observations of supernova remnants.

Artist image of the He-merger gamma-ray burst model developed by Fryer.

Dr. Fryer has been pivotal in driving synergies between fundamental physics and astrophysical observations. His work has demonstrated the importance of gamma-ray astronomy as probes of nuclear physics, working with the nuclear physics community (e.g., Joint Institute for Nuclear Astrophysics, Center for Nuclear Astrophysics across Messengers) to help co-design nuclear physics experiments tailored for upcoming hard X-ray and gamma-ray satellite missions. Dr. Fryer has worked within the International Center for Relativistic Astrophysics Network to tie relativistic astrophysics to plasma physics, fluid dynamics, turbulence, radiation, atomic physics, and in advanced three-dimensional numerical simulations of the binary-driven hypernova (BdHN) model of gamma-ray bursts with Laura M. Becerra, Jorge A. Rueda, and Remo Ruffini.

His pioneering work with S. E. Woosley and D. H. Hartmann in 1999 on the evolution of massive binaries leading to gamma-ray bursts has also impacted a broad range of high-energy astrophysics phenomena, including X-ray binaries and gravitational wave sources, advancing our understanding of gamma-ray burst progenitors by highlighting the crucial role of binaries, profoundly inspiring the building blocks of the BdHN model. They also include some of the first studies of offsets of short-duration gamma-ray bursts, as well as population studies of long-duration burst progenitors.

Chris Fryer signing the wall of ICRANet Headquarter in Pescara.

CHIME / FRB Team

"For the innovative detection and comprehensive analysis of a large population of fast radio bursts, significantly increasing their statistics, including repeating sources, which have boosted our understanding of their origin and their application in mapping the universe structure and composition".

The Canadian Hydrogen Intensity Mapping Experiment (CHIME) is a revolutionary radio telescope at the Dominion Radio Astrophysical Observatory in British Columbia, Canada. It is a collaborative effort by the University of British Columbia, McGill University, and the University of Toronto. One of CHIME's primary missions is to study Fast Radio Bursts and use them to study the matter distribution in the Universe.

CHIME's design has been innovative for radio astronomy. It consists of four large, stationary parabolic reflectors focusing incoming radio waves onto over a thousand antennas connected by a powerful and robust processing system that can process vast amounts of real-time data via advanced algorithms. This combination of design allows CHIME to monitor the northern sky fully and continuously, leading to its highly efficient detection of FRBs.

The CHIME/FRB team has notched several landmark discoveries, significantly advancing our understanding of the FRB population. They have published the first large FRB catalog, enabling a multitude of population studies. Their work has led to the identification of

remarkable single sources, including the first periodic repeater, a source showing sub-second periodicity, a Galactic magnetar that produces FRB-like emission, the closest FRB (found to be in a globular cluster), and over 50 unique repeating sources. These discoveries have paved the way for major community follow-up

Individual Awards

DEMETRIOS CHRISTODOULOU
"For his many lasting contributions to the foundation of mathematical physics including the dynamics of relativistic gravitational fields. Notably for: contributing in 1971, at the age of 19, to derive with Remo Ruffini the mass-energy formula of black holes as a function of their angular momentum, charge and irreducible mass. Christodoulou turned then to the study of partial differential equations and mathematical physics, to which he remained dedicated for the rest of his career. Highlights in this area include the theoretical discovery of the nonlinear memory effect of gravitational waves (Phys. Rev. Letters 1991), the monograph (1993) in collaboration with Sergiu Klainerman on the global nonlinear stability of the Minkowski spacetime, the monograph (2009) on the formation of black holes in pure general relativity by imploding gravitational waves, and the monographs (2007 and 2019) on the formation and further development of shocks in fluids."

GERARD 't HOOFT
"for his persistent devotion to the study of the quantum field theory boundary conditions at the black hole horizon".

TSVI PIRAN
"for extending Relativistic astrophysics across international frontiers, a true companion in the search for the deeper meaning of Einstein's great theory".

STEVEN WEINBERG
"for unwavering support for the MG meetings since their inception, a true companion in the search for the deeper meaning of Einstein's great theory".

Institutional Awards

"for the creation of the world's best X-ray map of the entire sky, for the discovery of millions of previously unknown accreting supermassive black holes at cosmological redshifts, for the detection of X-rays from tens of thousands of galaxy clusters, filled mainly with dark matter, and for permitting the detailed investigation of the growth of the large scale structure of the universe during the era of dark energy dominance".

S.A. LAVOCHKIN ASSOCIATION
- presented to its Designer General Alexander Shirshakov

MAX PLANCK INSTITUTE FOR EXTRATERRESTRIAL PHYSICS (MPE)
- presented to Professor Peter Predehl, Principal Investigator of eROSITA

SPACE RESEARCH INSTITUTE (IKI) OF THE RUSSIAN ACADEMY OF SCIENCES
- presented to Professor Rashid Sunyaev, Principal Investigator of SRG Observatory in Russia

Institutional Awards

PLANCK SCIENTIFIC COLLABORATION (ESA)

"for obtaining important constraints on the models of inflationary stage of the Universe and level of primordial non-Gaussianity; measuring with unprecedented sensitivity gravitational lensing of Cosmic Microwave Background fluctuations by large-scale structure of the Universe and corresponding B-polarization of CMB, the imprint on the CMB of hot gas in galaxy clusters; getting unique information about the time of reionization of our Universe and distribution and properties of the dust and magnetic fields in our Galaxy"

- presented to Jean-Loup Puget, the Principal Investigator of the High Frequency Instrument (HFI)

HANSEN EXPERIMENTAL PHYSICS LABORATORY AT STANFORD UNIVERSITY

"to HEPL for having developed interdepartmental activities at Stanford University at the frontier of fundamental physics, astrophysics and technology"

- presented to Research Professor Leo Hollberg, HEPL Assistant Director

Individual Awards

LYMAN PAGE

"for his collaboration with David Wilkinson in realizing the NASA Explorer WMAP mission and as founding director of the Atacama Cosmology Telescope"

RASHID ALIEVICH SUNYAEV

"for the development of theoretical tools in the scrutinising, through the CMB, of the first observable electromagnetic appearance of our Universe"

SHING-TUNG YAU

"for the proof of the positivity of total mass in the theory of general relativity and perfecting as well the concept of quasi-local mass, for his proof of the Calabi conjecture, for his continuous inspiring role in the study of black holes physics"

Institutional Award
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

Individual Awards
KEN'ICHI NOMOTO
"for heralding the role of binary systems in the evolution of massive stars"

MARTIN REES
"for fostering Research in black holes, gravitational waves and cosmology"

YAKOV G. SINAI
"for applying the mathematics of chaotic systems to physics and cosmology"

SACHIKO TSURUTA
"for pioneering the physics of hot neutron stars and their cooling"

FRANK C.N. YANG
"for deepening Einstein's geometrical approach to physics in the best tradition of Paul Dirac and Hermann Weyl"

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"

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.

12th Marcel Grossmann Meeting
July 2009, Paris, France

Institutional Award
INSTITUT DES HAUTES ÉSTUDES 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 then 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 di Janiero, 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, Josè 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, epistimology, 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 relativisic 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 them 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.

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 **E**vents in **S**pace-**T**ime

Anna Imponente
National Gallery of Modern Art, Rome

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.

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 *Weltanschaung* 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).

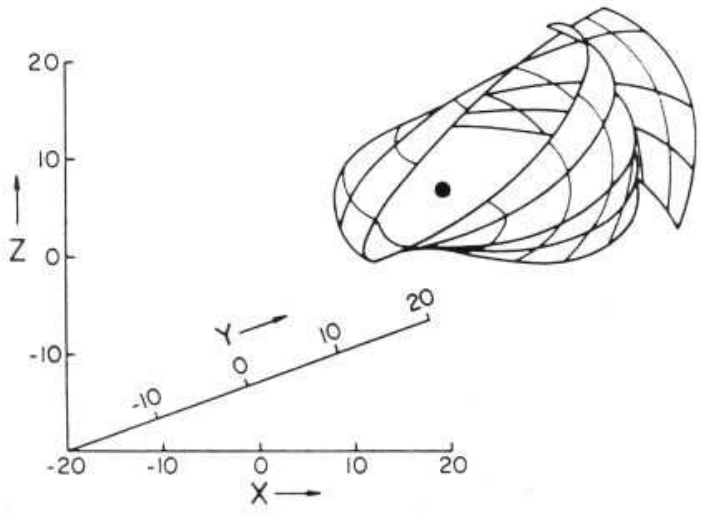
$$\dot{r} = \rho^{-2}\{[E(r^2+a^2) - a\Phi]^2 - \Delta(\mu^2 r^2 + K)\}^{1/2}$$

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

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

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

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



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 π 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).

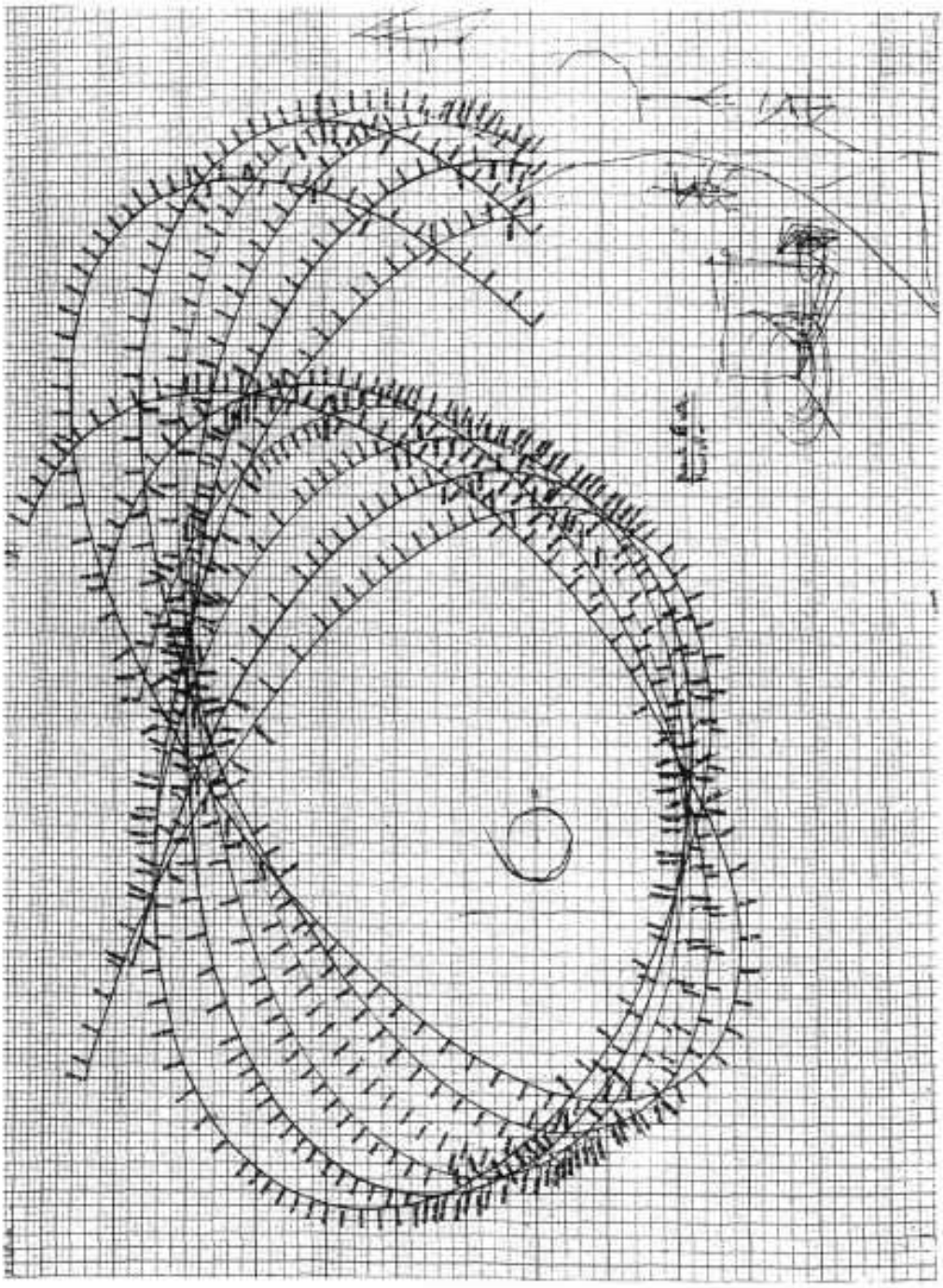
The initiation of this new work has the flavor of a challenge that the sculptor makes to himself, namely to represent the trajectories in a plastic form given their spatial co-ordinates—height, width and length—and to reinterpret them as an aesthetic object, using his own judgement to verify its artistic 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 priviledged 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 extraterrestrial 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-manner-ist 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 $340\times470\times260\text{cm}^3$ 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.

Bibliography

A. Imponente, Catalog presentation of the show of A. Pierelli, *TEST, Trascinamento di Eventi Spazio Temporali*, Rome, Galleria MR, September-October (1985).

G.C. Argan, *Conversazione con A. Imponente, A. Pierelli, R. Ruffini*, June (1985).

H.C. Kennedy, *Storia di un matematico* (La Curva di Peano, p.49), P. Boringhieri, Torino (1983).

R. Ruffini, *Stelle, galassie, universo*, catolog of the show *5 Miliardi di Anni*, Rome, Palazzo delle Esposizioni, May-June 1981, Multigrafica Editrice (1981).

V. Bellezza, V. Ferrari, R. Ruffini, M. Sacripanti, *Lo spazio di un buco nero ruotante*, catolog of the show *5 Miliardi di Anni*, Rome, Palazzo delle Esposizioni, May-June 1981, Multigrafica Editrice (1981).

R. Giacconi, R. Ruffini, *Physics and astrophysics of neutron stars and black holes*, North Holland, Amsterdam (1978).

M. Johnston, R. Ruffini, *Phys. Rev.* **D10**, 2324, New York (1974).

R. Ruffini, J.A. Wheeler, *Introducing the black hole*, in *Physics Today*, New York, January (1971).

Typeset with LaTeX by Bob Jantzen.

ICRANet

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Members: Republic of Armenia, ICRA, Republic of Italy, University of Arizona, Stanford University, Vatican City State
Date of foundation: February 10, 2005

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. New centers are being established in Nice, Rio de Janeiro, Yerevan, Minsk and Isfahan. Projects for additional Centers in Stanford (USA), Central Asia, China, Australasia, Germany and Pakistan 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 is at the service of the scientific institutions and the Member States that wish to cooperate in the field of Relativistic Astrophysics.