

MG IX MM

MARCEL GROSSMANN AWARDS

ROME 2000

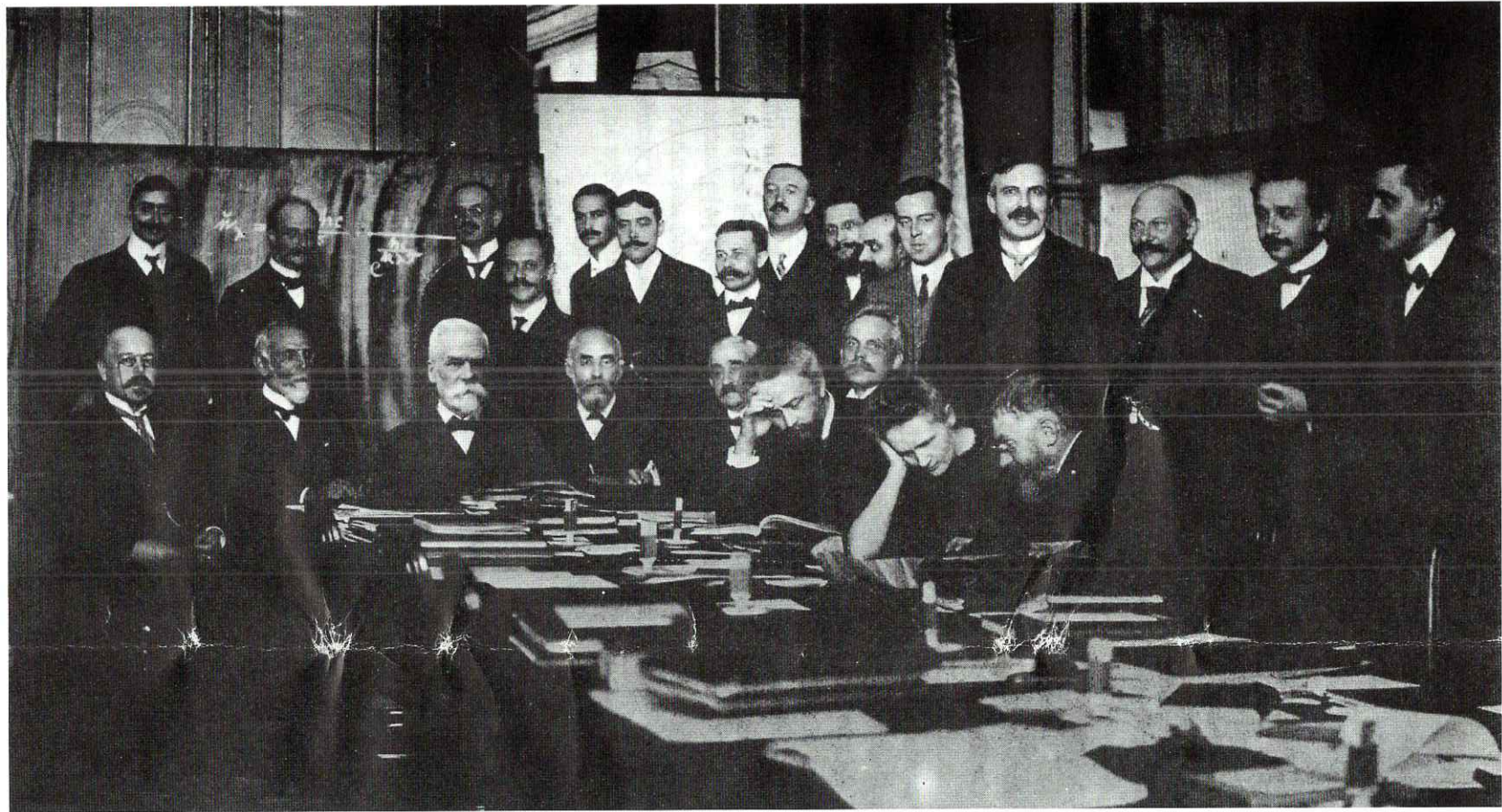
and

TEST

ICRA

International Center for Relativistic Astrophysics

First Solvay Meeting



GOLDSCHMIDT
NERNST

PLANCK
BRILLOUIN

RUBENS
SOMMERFELD
SOLVAY
LINDEMANN
DE BROGLIE
LORENTZ

HASENOHRL
HOSTELET
KNUDSEN
WARBURG
PERRIN

HERZEN
WIEN
Madame CURIE

JEANS
RUTHERFORD
POINCARÉ

KAMERLINGH ONNES

EINSTEIN

LANGEVIN

9th Marcel Grossmann Meeting

July 2000, Rome

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.

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.



Riccardo Giacconi receiving his "laurea honoris causa" (honorary degree) at the University of Rome "la Sapienza."

**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

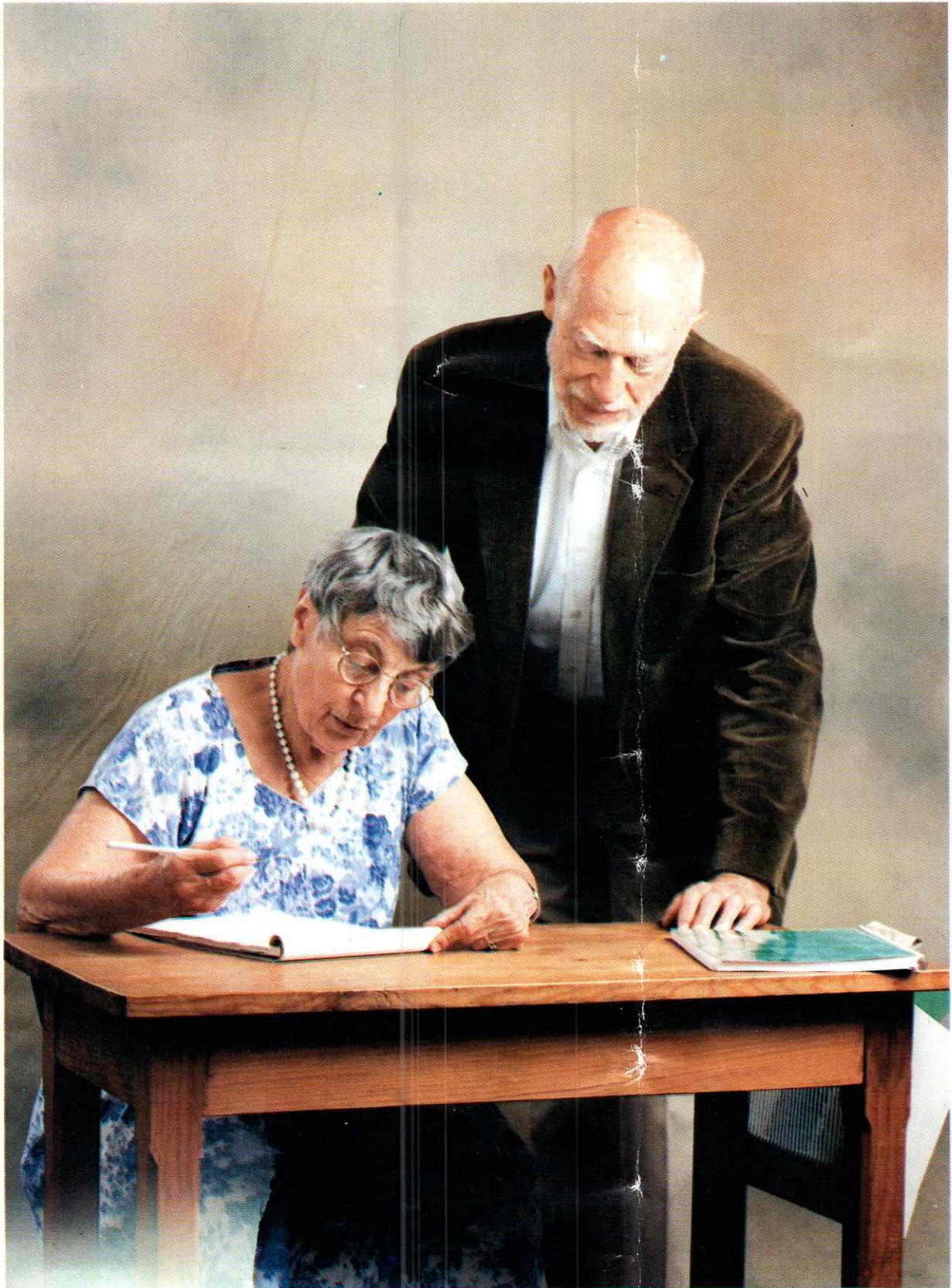
for having built on his experience in nuclear physics, thermonuclear reactions, and extensive numerical simulation to create a new testing ground for the novel concepts of relativistic astrophysics.

**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,



Cecille and Bryce DeWitt

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
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.



Roger Penrose

TEST

TEST: Traction of Events in Space-Time

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 *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

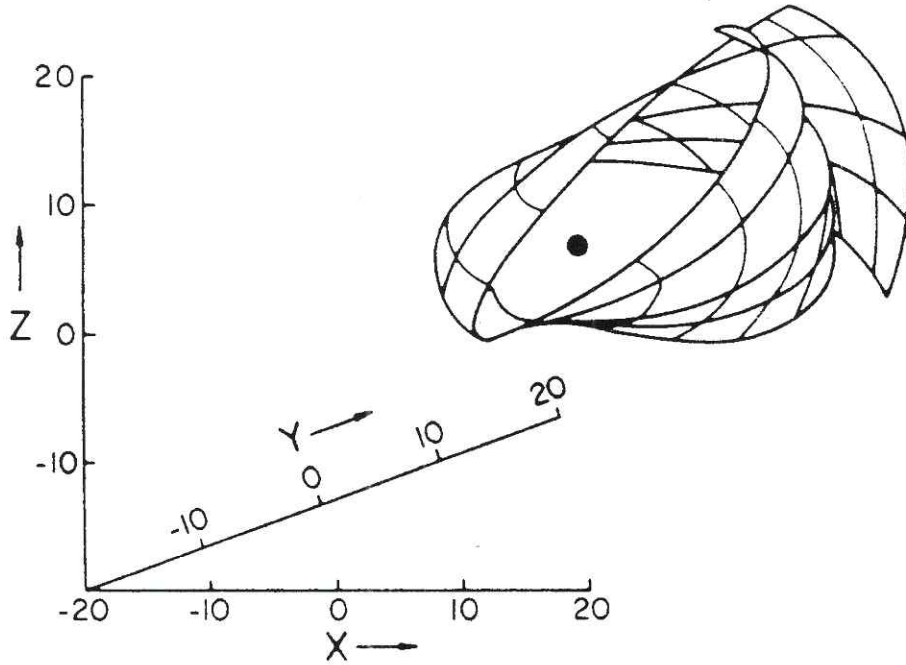
$$\dot{r} = \rho^{-2} \{ [E(r^2 + a^2) - a\Phi]^2 - \Delta(\mu^2 r^2 + K) \}^{1/2}$$

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

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

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

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



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

towards a simultaneity of vision, is synchronized with Einstein's theory of special relativity (1905).

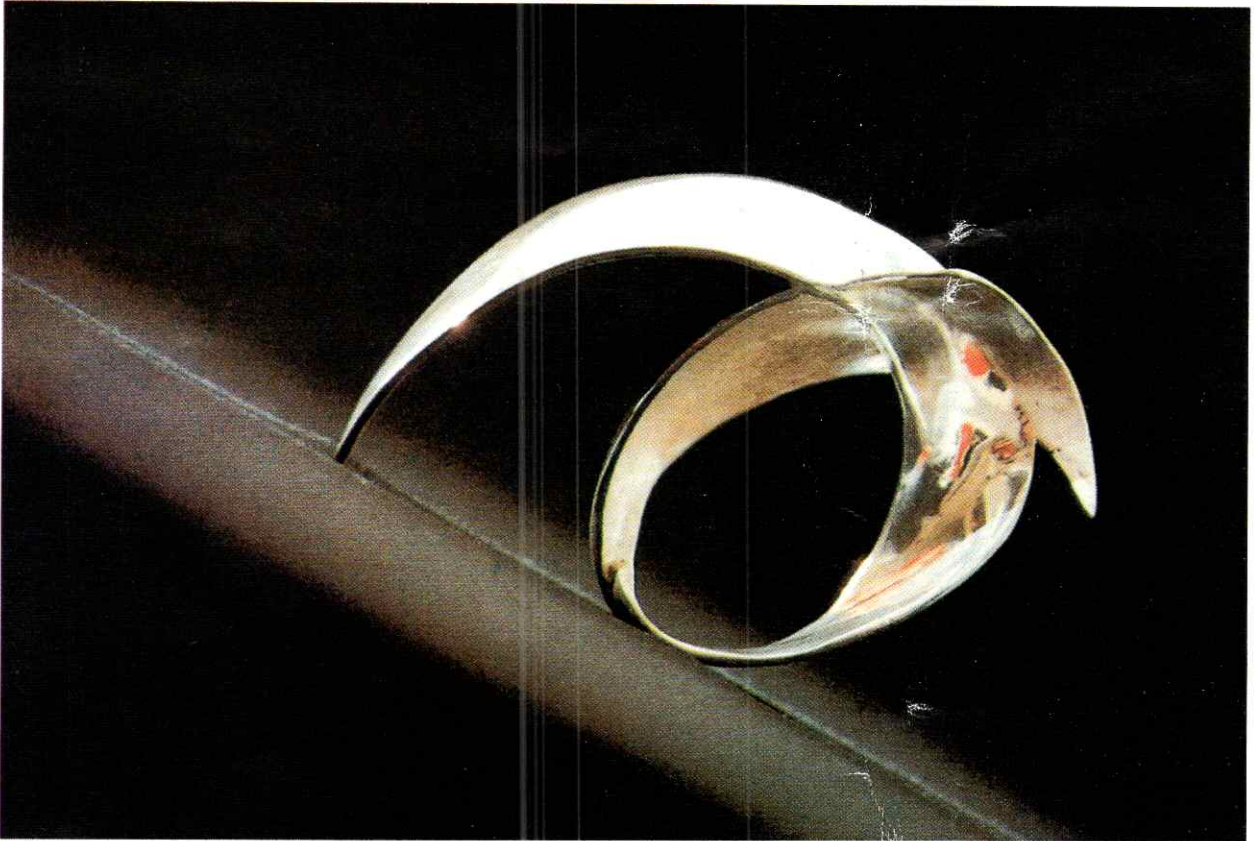
The relationship between Remo Ruffini and Attilio Pierelli was not one of director/implementer nor could it exactly be defined as a four-handed performance. It has instead been a line of work suggested to the artist by a graphic design which had already been scientifically tested and computerized by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



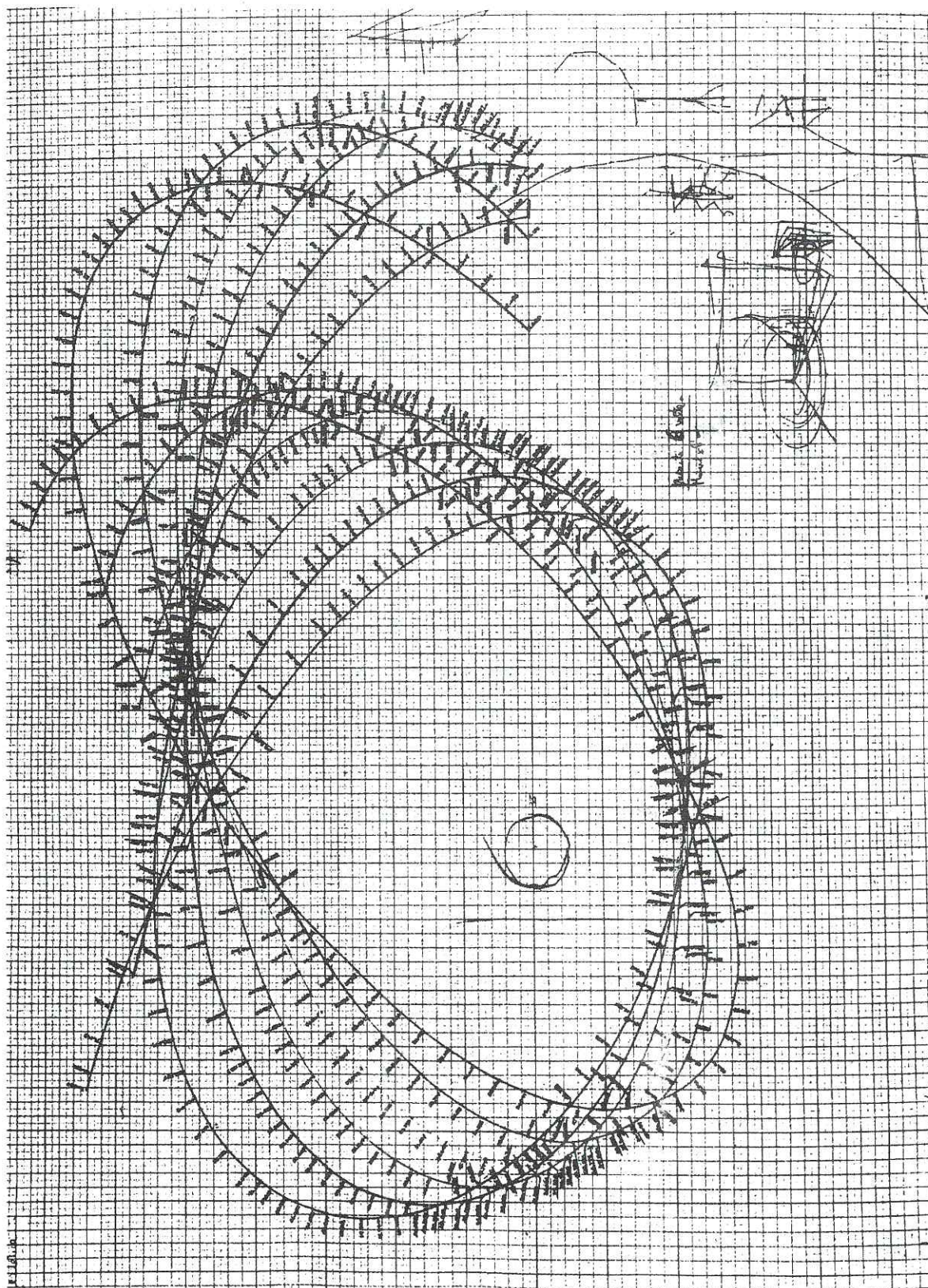
TEST, sculpture by A. Pierelli, photo by S. Takahashi.

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.

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 ("ambiantation" 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



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

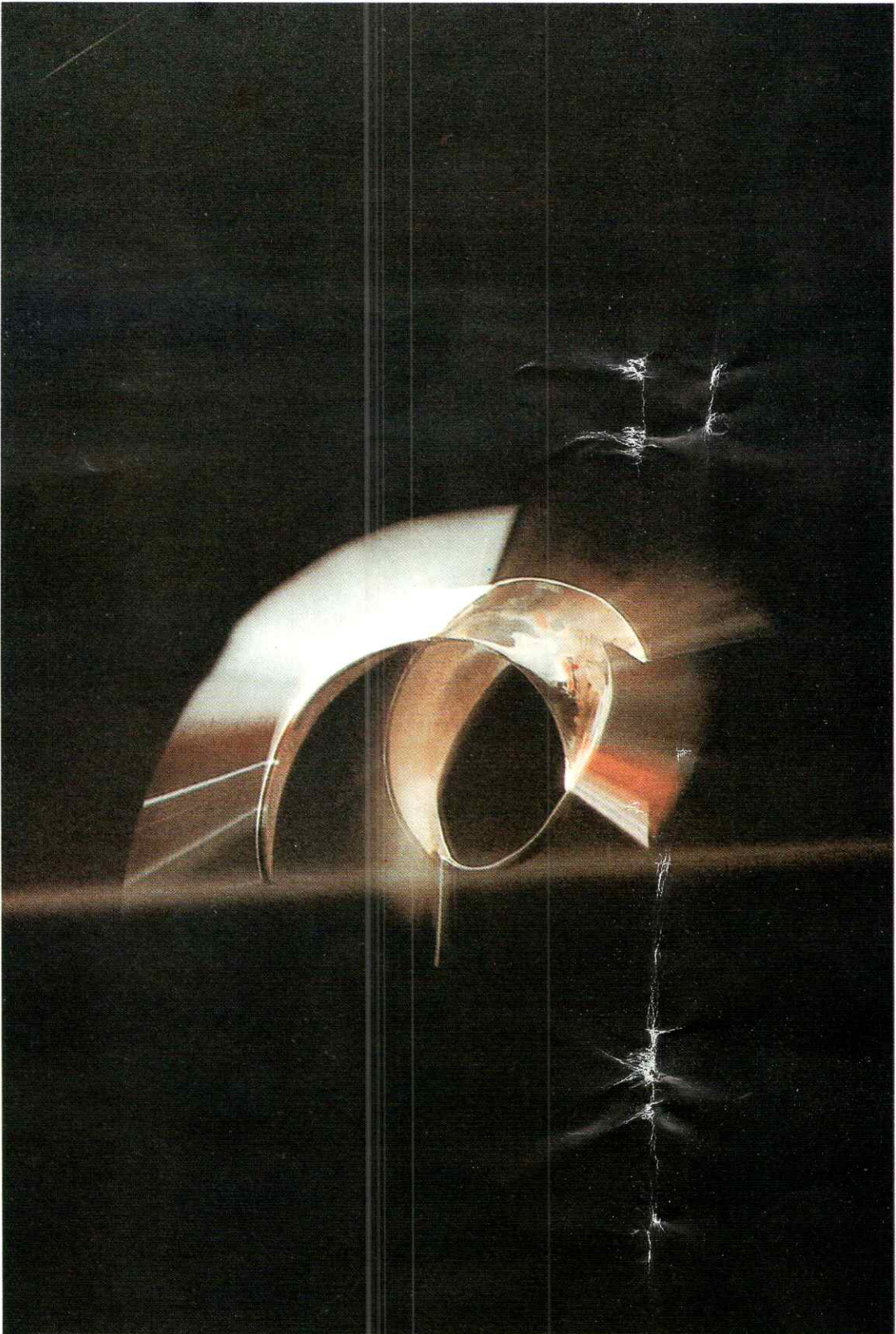
century (G.C. Argan, 1985). And from a properly artistic perspective, it can be related to the philosophy of Russian Constructivism around 1920, and to the first clear perception, by Naum Gabo, of the unity of all visible forms and of the existence of aesthetic ones only in accordance with physical and 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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