VNIVERSITAT DE VALÈNCIA

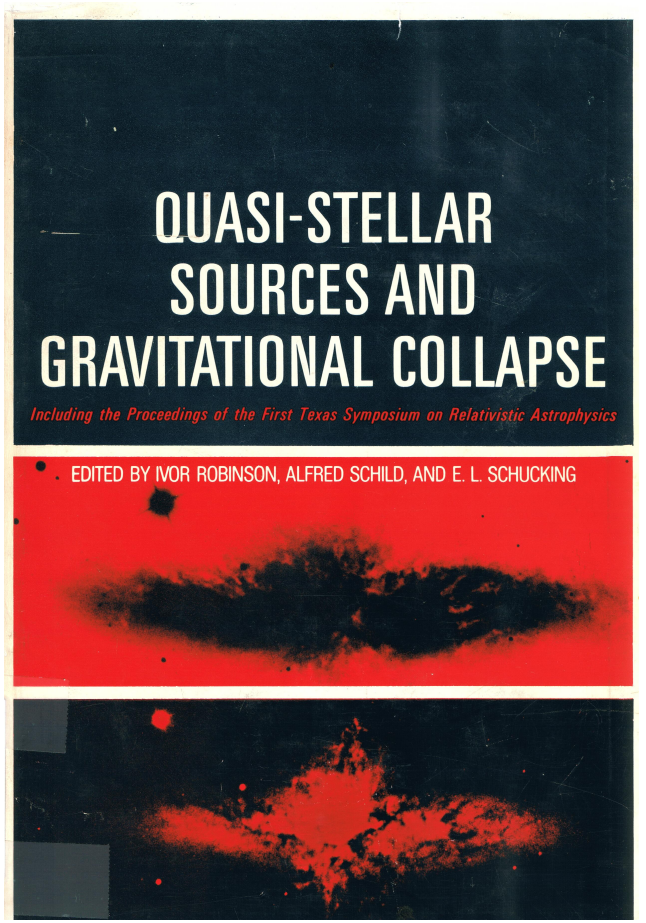
Relativistic Astrophysics

(Round-table meeting)

Day 4: Relativity vs. Astrophysics *This Day will focus on astrophysical problems where General Relativity plays a fundamental role. Challenges and difficulties encountered by relativists modelling specific astrophysical scenarios will be confronted to those ones found by astrophysicists needing General Relativity as a key conceptual ingredient. Particular emphasis will be placed on gravitational waves and compact objects*(ERE2010, URL site: www.iaa.es/ere2010/website/modules/tinyd0/)

Spanish Relativity Meeting - ERE 2010 (Granada, 6th – 10th September 2010)

Relativistic Astrophysics: Some historical brush-strokes (I)



Ivor Robinson, Alfred Schild, & E. L. Schucking

Proceedings from the First Texas Symposium on Relativistic Astrophysics (December 16-18, 1963)

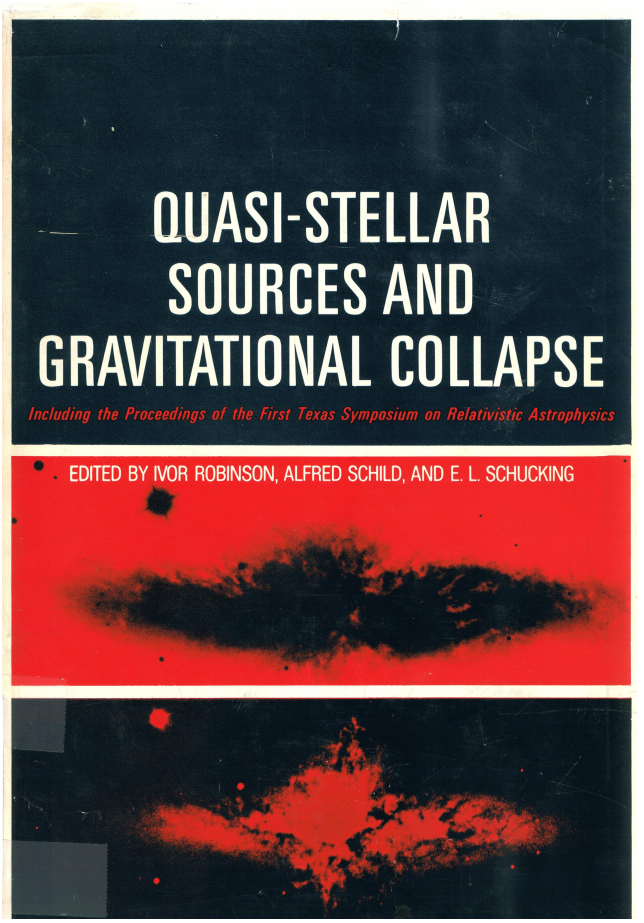
(The University of Chicago Press, 1965)

PREFACE:

In June, 1963, Peter Bergmann and the editors of this volume sent out invitations to a symposium which began as follows:

For more than ten years, the nature of the strong extragalactic radio sources has been one of the most fascinating problems of modern astronomy. For a time, it was believed that such radio sources were due to collision of galaxies. But it has emerged in the course of the last few years that this explanation is untenable in most of the cases. The spectacular nature of strong radio sources becomes clear if one considers the enormous amounts of energy involved. The estimates indicate that more than 10^{60} ergs are consumed in such a process, a weight of more than five hundred thousand suns. This energy requirement has so far ruled out nearly all of the explanations and theories put forward to explain such extraordinary events.

In February, Fred Hoyle and William Fowler suggested that energies which lead to the formation of radio sources could be supplied through the gravitational collapse of a supersstar . Such an object, with a mass between one hundred thousand and one hundred million solar masses, would be located in the center of the galaxy . The gravitational collapse of this supersun could supply the necessary energy if it were to shrink down close to the Schwarzschild radius.



Ivor Robinson, Alfred Schild, & E. L. Schucking

Proceedings from the First Texas Symposium on Relativistic Astrophysics (December 16-18, 1963)

(The University of Chicago Press, 1965)

PREFACE (cont.):

Last March, astronomers and radio-astronomers in Australia and California identified two extragalactic radio sources with galaxies of a type never seen before. The source 3C273B seems to be a superstar, and according to Harlan Smith, has a diameter of about a ligth-week. It is the brightest known object in the universe, about a million million times brighter than the Sun. According to Sandage and Smith, its brightness varies by about 50%. The intriguing new discoveries and the theory put forward by Hoyle and Fowler open up the discussion of a wealth of exciting questions. Among the problems raised are the following: *a) The astronomers observed some unusual objects connected with radio sources. Are these the debris of a gravitational implosion? b) By what machinery is gravitational energy converted into radio waves? c) Does gravitational collapse lead, on our present assumptions, to indefinite contraction and a singularity in spacetime? d) If so, how must we change our theoretical assumptions in order to avoid this catastrophe? ...*

SUMMARY OF AFTER-DINNER SPEECH (by T. Gold)

... It was, I believe, chiefly Hoyle's genius which produced the extremely attractive idea that here we have a case that allowed one to suggest that the relativists with their sophisticated work were not only magnificent cultural ornaments but might actually be useful to science!. Everyone is pleased: the relativists who feel they are being appreciated, who are suddenly experts in a field they hardly knew existed; the astrophysicists for having enlarged their domain, their empire, by the annexation of another subject – general relativity. It is all very pleasing, so let us all hope that it is right. What a shame it would be if we had to go and dismiss all the relativists again...

Relativistic Astrophysics: Some historical brush-strokes (II)

Hoyle, F.; Fowler, William A.; Burbidge, G. R.; Burbidge, E. Margaret, *On Relativistic Astrophysics*, **ApJ, 139, 909 (1964).**

ON RELATIVISTIC ASTROPHYSICS

F. Hoyle
St. John's College, Cambridge, England, and
California Institute of Technology, Pasadena, California

William A. Fowler
California Institute of Technology, Pasadena, California

G. R. Burbidge and E. Margaret Burbidge
University of California, San Diego, La Jolla, California

Received October 5, 1963

ABSTRACT

In this paper we have attempted to discuss the relation of massive highly condensed objects to astrophysics in general, rather than only to the radio-source problem. Because situations in which general relativistic effects play a dominant role have not received much attention in astrophysics, a brief review of the relativistic properties of collapsed objects is given in Section I of the paper.

In Section II we have given especial attention to two problems: (1) Galaxies may contain considerable quantities of inert or "hidden" mass, not simply in the form of white dwarfs or neutron stars. (2) Highly collapsed objects may act as energy sources, not just explosively, but over extended time intervals.

The first of these problems has implications both for nucleosynthesis and for the mass-to-light properties of stellar systems. The second appears applicable to a wide range of phenomena, ranging from supernovae in our Galaxy to whole radio galaxies. A continuous source of optical synchrotron electrons appears necessary both in the Crab Nebula and in the jet of M87. We suggest their origin lies in processes that are physically similar and in which considerations of general relativity play a dominant role.

Relativistic Astrophysics: Some historical brush-strokes (III)

RELATIVISTIC ASTROPHYSICS

VOLUME 1

Stars and Relativity

YA. B. ZELDOVICH AND I. D. NOVIKOV

Revised and Enlarged from the Original Russian Edition
by the Authors

Translated by ELI ARLOCK

Edited by
Kip S. Thorne and W. David Arnett

THE UNIVERSITY OF CHICAGO PRESS
Chicago and London

(University of Chicago Press, 1971).

Russian edition 1967.

RELATIVISTIC ASTROPHYSICS

VOLUME 2

The Structure and Evolution of the Universe

YA. B. ZEL'DOVICH AND I. D. NOVIKOV

Revised and Enlarged from the Original Russian Edition
by the Authors and the Editor

Translated by LESLIE FISHBONE

EDITED BY
GARY STEIGMAN

THE UNIVERSITY OF CHICAGO PRESS
Chicago and London

(University of Chicago Press, 1983).

Russian edition 1975.

24th and 25th Texas Symp. on Relativistic Astrophysics: Parallel Sessions

- **24th Texas Symposium on Relativistic Astrophysics (Vancouver, Dec 8-12, 2008)**

TEXAS 2008

Gamma Ray Bursts / High Energy Cosmic Rays

CMB Polarization / SZ Surveys

Black Hole mergers / EM signature of Gravity Waves

Gravitational Lensing / Supernovae

Inflation / Galaxy Clusters

High-magnetic field Pulsar / Pulsar timing

Dark Matter / Dark Energy

Horizons / Black Holes in AGNs

- **25th Texas Symposium on Relativistic Astrophysics (Heidelberg, Dec 6-10, 2010)**

Photo: Georg Nagy

Black holes, accretion and jets

Gravitational waves

Transient phenomena (SNe, GRBs)

Reports from space-based gamma-ray telescopes

Galactic and extragalactic cosmic rays

VHE gamma-ray sources

Astroparticle Physics

Large scale, intergalactic magnetic and radiation fields

Next generation major instruments

Nobel Prizes in Physics/Astrophysics

2006 : John C. Mather, George F. Smoot Prize motivation: ”for their discovery of the blackbody form and anisotropy of the cosmic microwave background radiation”. Field: Astrophysics, instrumentation

2002 : Raymond Davis Jr., Masatoshi Koshiba Prize motivation: ”for pioneering contributions to astrophysics, in particular for the detection of cosmic neutrinos”. Field: Neutrino astrophysics

Riccardo Giacconi Prize motivation: ”for pioneering contributions to astrophysics, which have led to the discovery of cosmic X-ray sources”. Field: Astrophysics

1993 : Russell A. Hulse, Joseph H. Taylor Jr. Prize motivation: ”for the discovery of a new type of pulsar, a discovery that has opened up new possibilities for the study of gravitation”. Field: Astrophysics

1983 : Subramanyan Chandrasekhar Prize motivation: ”for his theoretical studies of the physical processes of importance to the structure and evolution of the stars”. Field: Astrophysics

William A. Fowler Prize motivation: ”for his theoretical and experimental studies of the nuclear reactions of importance in the formation of the chemical elements in the universe”. Field: Astrophysics

1978 : Arno A. Penzias, Robert Woodrow Wilson Prize motivation: ”for their discovery of cosmic microwave background radiation”. Field: Astrophysics

1974 : Sir Martin Ryle, Antony Hewish Prize motivation: ”for their pioneering research in radio astrophysics: Ryle for his observations and inventions, in particular of the aperture synthesis technique, and Hewish for his decisive role in the discovery of pulsars”. Field: Astrophysics

1967 : Hans A. Bethe Prize motivation: ”for his contributions to the theory of nuclear reactions, especially his discoveries concerning the energy production in stars”. Field: Astrophysics

1921 : Albert Einstein Prize motivation: ”for his services to Theoretical Physics, and especially for his discovery of the law of the photoelectric effect”. Field: Theoretical physics