

# Preface

Since the dawn of mankind, observers of the sky have wondered at the sudden appearance of new stars on the seemingly unchanging heavens and, for at least 2000 years, have recorded these phenomena in their annals and archives. Even in more modern times, since the discovery of SN1885A in S Andromeda which figured in the important “island universe” discussions of the 1920’s, the puzzle of supernovae (SNe) has played an important role in astrophysics. Only with the seminal work of Fritz Zwicky and Walter Baade in the 1930’s did we begin to understand the differences between novae and SNe and the importance of SNe as the fonts of energy for the interstellar medium and as drivers of chemical evolution in galaxies. As recently as the 1940’s and 1950’s the early days of radio astronomy were heavily influenced by the familiar names of Cassiopeia A and Taurus A, two young supernova remnants, and two Nobel prizes have been awarded for discovery and study of a related phenomenon, pulsars.

In spite of the great age of the study of SNe, since at least the Chinese records of SN185 and probably earlier, the field is, in fact, very young having only attracted a large devoted following since the spectacular Type II SN1987A in the Large Magellanic Cloud, the first naked-eye SN in more than 400 years.

On a seemingly non-intersecting parallel path,  $\gamma$ -ray bursts (GRBs) discovered by the Air Force VELA satellites in the 1960’s presented a mystery to researchers for 30 years. Finally, the launch of the Italian/Dutch *BeppoSAX* satellite in 1996 provided sufficiently fast and accurate positional information to allow detection and study of their “afterglows” at other wavelengths. These results then provided evidence that, at least at some level, the fields of GRB and SN studies merge through the possible connection of Type Ib/c SNe, so that one of our most recent astronomical puzzles appears to be at least partially solved by reference to our ancient interest in SNe.

Although discovery, observation, and interpretation of new examples of SNe and GRBs continues, the end of the *Compton Gamma-Ray Observatory (CGRO)* era in 2000 and of the *BeppoSAX* operations in 2002 provides a significant break-point for trying to summarize the current status of these extremely active areas of study. Thus, experts from many areas of SN and GRB research have agreed to contribute chapters to this monograph to assemble a coherent picture.

Because the two areas of research have still only partially merged, and may never totally merge because of the possibility that some types of GRBs originate in other physical processes, we have chosen to roughly divide this work into two

parts – SN research and GRB research with bridging chapters to explore the known and likely relations between the two areas. We hope that this monograph contributes some small part to our ultimate understanding of these exciting phenomena.

Before proceeding further, however, I would like to thank all of the people and institutions which have contributed to the assembly of this volume. Foremost, I wish to thank all of the chapter authors who have contributed their knowledge, expertise, time, and effort to providing up-to-date descriptions of the many areas of supernova and GRB research and for working so willingly with me on the preparation and editing of this volume. Obviously, nothing could have been accomplished without the support of the Office of Naval Research (ONR), which provides the 6.1 funding for my research, and the Naval Research Laboratory (NRL) which provides me with the time and facilities necessary. Although too many individuals to list have been supportive of my effort, I must separately thank Dr. Lee J Rickard, who has been extremely tolerant of my disappearing for days at a time and who has shielded me from so many other demanding and time consuming tasks.

*N.B.: Because the fields of supernova and GRB research tend to use somewhat different nomenclature for the same thing – radio supernova flux density light curves are often described by  $S \propto \nu^{\pm\alpha} t^{\pm\beta}$  while GRB workers tend to use  $F_\nu \propto \nu^{\pm\beta} t^{\pm\alpha}$  – I have attempted to standardize everywhere to the format  $F_\nu \propto \nu^{+\alpha} t^{+\beta}$ . I have also attempted to make all chapters consistent with using:  $\alpha$  = spectral index,  $\beta$  = decline rate,  $F_\nu$  = flux density,  $\gamma$  = gamma-rays,  $\Gamma$  = Lorentz factor,  $\tau$  = optical depth,  $t$  = time, and  $T$  = temperature. Although I have tried to minimize it, there may be some remaining variation in notation between chapters.*

Washington, DC, USA  
January 2003

Kurt W. Weiler  
Naval Research Laboratory

# List of Contributors

## **E. Baron**

University of Oklahoma  
Norman, OK 73019  
USA  
baron@mail.nhn.ou.edu

## **David Branch**

University of Oklahoma  
Norman, OK 73019  
USA  
branch@mail.nhn.ou.edu

## **Enrico Cappellaro**

Osservatorio Astronomico di Capodi-  
monte  
via Moiarriello 16  
80181 Napoli  
Italy  
cappellaro@na.astro.it

## **Roger A. Chevalier**

Department of Astronomy  
University of Virginia  
PO Box 3818  
Charlottesville, VA 22903  
USA  
rac5x@virginia.edu

## **Claes Fransson**

Stockholm Observatory  
Department of Astronomy  
SCFAB  
106 91 Stockholm  
Sweden  
claes@astro.su.se

## **Filippo Frontera**

Physics Department  
University of Ferrara  
Ferrara  
Italy  
and  
Ist. Astrof. Spaz. e Fis. Cosm.  
CNR  
Bologna  
Italy  
frontera@fe.infn.it

## **Titus J. Galama**

Astronomy Department  
Calif. Inst. of Technology  
Pasadena, CA 91125  
USA  
tjg@astro.caltech.edu

## **David A. Green**

Cavendish Laboratory  
University of Cambridge  
Madingley Road  
Cambridge CB3 0HE  
United Kingdom  
dag9@cam.ac.uk

## **Kevin Hurley**

University of California  
Space Sciences Laboratory  
Berkeley, CA 94720-7450  
USA  
khurley@sunspot.ssl.berkeley.edu

**Stefan Immler**

Dept. of Astron. and Astrophys.  
Pennsylvania State Univ.  
University Park, PA 16802  
USA  
immler@astro.psu.edu

**Koichi Iwamoto**

Department of Physics  
College of Science and Technology  
Nihon University  
Tokyo 101-8308  
Japan  
iwamoto@phys.cst.nihon-u.ac.jp

**David J. Jeffery**

NM Inst. of Mining and Technology  
Socorro, NM 87801  
USA  
jeffery@kestrel.nmt.edu

**Bruno Leibundgut**

European Southern Observatory  
Karl-Schwarzschild-Strasse 2  
85748 Garching  
Germany  
bleibundgut@eso.org

**Walter H.G. Lewin**

Center for Space Research  
and  
Department of Physics  
Massachusetts Inst. of Technology  
Cambridge, MA 02139-4307  
USA  
lewin@space.mit.edu

**Zhi-Yun Li**

Department of Astronomy  
University of Virginia  
Charlottesville, VA 22903  
USA  
zl4h@virginia.edu

**Abraham Loeb**

Astronomy Department  
Harvard University  
Cambridge, MA 02138  
USA  
aloeb@cfa.harvard.edu

**Keiichi Maeda**

Department of Astronomy  
and  
Research Centr. for Early Univ.  
School of Science  
The University of Tokyo  
Tokyo 113-0033  
Japan  
maeda@astron.s.u-tokyo.ac.jp

**Paolo A. Mazzali**

Astronomical Observatory of Trieste  
Via G.B. Tiepolo 11  
34131 Trieste  
Italy  
mazzali@ts.astro.it

**Richard McCray**

JILA  
University of Colorado  
Boulder CO 80309-0440  
USA  
dick@jila.colorado.edu

**Marcos J. Montes**

Naval Research Laboratory  
Code 7212  
Washington, DC 20375-5320  
USA  
montes@rsd.nrl.navy.mil

**Takayoshi Nakamura**

Department of Astronomy  
and  
Research Center for the Early  
Universe  
School of Science  
University of Tokyo  
Tokyo 113-0033  
Japan

**Ken'ichi Nomoto**

Department of Astronomy  
and  
Research Centr. for Early Univ.  
School of Science  
University of Tokyo  
Tokyo 113-0033  
Japan  
nomoto@astron.s.u-tokyo.ac.jp

**Nino Panagia**

STScI  
and  
Astrophysics Division  
Space Science Department of ESA  
3700 San Martin Drive  
Baltimore, MD 21218  
USA  
panagia@stsci.edu

**Saul Perlmutter**

Physics Division  
Lawrence Berkeley National Lab.  
University of California  
Berkeley, CA 94720  
USA  
saúl@lbl.gov

**Elena Pian**

INAF  
Astronomical Observatory of Trieste  
Via G.B. Tiepolo 11  
34131 Trieste  
Italy  
pian@ts.astro.it

**Brian P. Schmidt**

Research School of Astron. and Ap.  
The Australian National University  
via Cotter Road  
Weston Creek, ACT 2611  
Australia  
brian@mso.anu.edu.au

**Richard Sramek**

NRAO  
PO Box 0  
Socorro, NM 87801  
USA  
dsramek@nrao.edu

**F. Richard Stephenson**

Department of Physics  
University of Durham  
Durham DH1 3LE  
United Kingdom  
F.R.Stephenson@durham.ac.uk

**Nicholas Suntzeff**

Cerro Tololo  
Inter-American Observatory  
Casilla 603  
La Serena  
Chile  
nsuntzeff@noao.edu

**Massimo Turatto**

Osservatorio Astronomico di Padova  
vicolo dell'Osservatorio 5  
35122 Padova  
Italy  
turatto@pd.astro.it

**Eli Waxman**

Weizmann Institute of Science  
Rehovot 76100  
Israel  
waxman@wicc.weizmann.ac.il

**Kurt W. Weiler**

Naval Research Laboratory  
Code 7213  
Washington, DC 20375-5320  
USA  
Kurt.Weiler@nrl.navy.mil



<http://www.springer.com/978-3-540-44053-6>

Supernovae and Gamma-Ray Bursters

Weiler, K. (Ed.)

2003, XI, 472 p., Hardcover

ISBN: 978-3-540-44053-6