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# Supernova Environmental Impacts

*Edited by*

Alak Ray

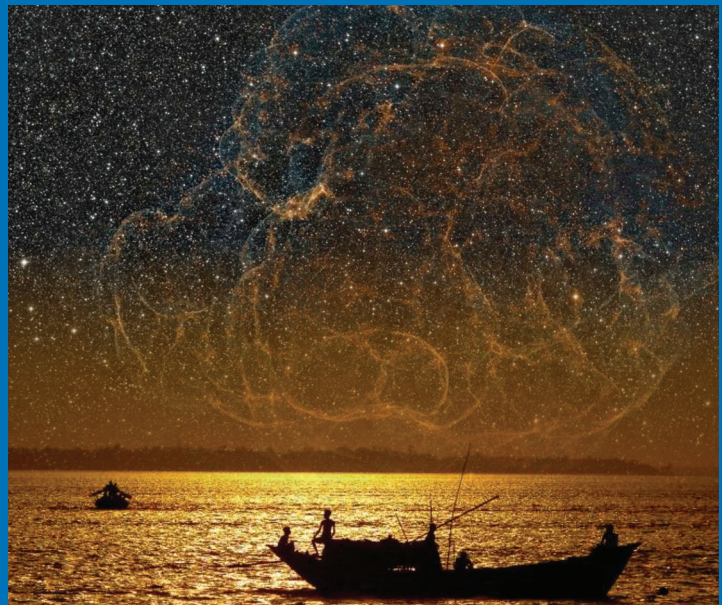
Richard A. McCray

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SUPERNOVA ENVIRONMENTAL IMPACTS

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*COVER ILLUSTRATION:*

The cover illustration is a montage of the Supernova Remnant Simeis 147 over a view of River Ganga near Kolkata.

# IAU SYMPOSIUM PROCEEDINGS SERIES

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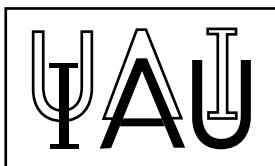
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# SUPERNOVA ENVIRONMENTAL IMPACTS

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THE INTERNATIONAL ASTRONOMICAL UNION  
HELD AT RAICHAK ON GANGES NEAR  
CALCUTTA, INDIA  
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Edited by

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## Preface

As the title of this volume indicates, the unifying theme of this Symposium was the interaction of supernovae with their environments, both interstellar and circumstellar. New telescopes spanning the entire electromagnetic spectrum have caused the study of supernovae (SNe) and supernova remnants (SNRs) to advance at a breathtaking pace. In only a decade, automated synoptic surveys have increased the detection rate of supernovae by more than an order of magnitude and have enabled discovery of highly unusual supernovae. Observations of gamma rays SNRs with ground-based Cherenkov telescopes and the Fermi telescope have given us new insights into particle acceleration in supernova shocks. Far-infrared observations from the Spitzer and Herschel observatories are telling us much about the properties and fate of dust grains in SNe and SNRs. Multi-wavelength surveys have yielded new insights into the influence of SNe on the ecosystems of galaxies.

Core-collapse SNe have a great diversity of light curves and spectral evolution. We now understand that their diversity is determined largely by the history of mass loss from the progenitor star, which determines the distribution of circumstellar matter and the structure of the star immediately before it explodes. The remarkable SN2009ip shows that the some supernova progenitors have major episodes of mass loss only a few years before they finally explode. The impact of the explosion debris with the extended stellar envelope may result in a supernova of exceptional luminosity, such as SN2006gy. Explosions of stars with extended circumstellar envelopes give rise to X-ray and radio supernovae. Such systems blur the distinction between SNe and SNRs. Alternatively, if the supernova progenitor has lost most of its envelope and has become a relatively compact star, the explosion may be sub-luminous, as is the case of SN1987A. A strong stellar wind from a blue giant progenitor to a supernova may create a cavity in the circumstellar environment, displacing the interstellar matter to great distance from the supernova. Thus, the evolution of the supernova progenitor may have a great influence on the subsequent evolution of X-ray and radio emission from the SNR. Moreover, supernova explosions can stimulate star formation by compressing interstellar gas and can also help to terminate star formation by dispersing gas in star-forming molecular clouds. Supernovae in low-density regions, such as superbubbles or galactic bulges, cannot effectively radiate energy therefore may drive global outflows, affecting the galactic ecosystem.

In 2011, the Scientific Organizing Committee proposed that an IAU Symposium be held in India during January 7 - 11, 2013. After some initial search for sites within India, the organizers selected the venue of the Symposium at The Fort Raichak on the banks of river Ganga about 65 km south of the city of Kolkata (formerly Calcutta). In hindsight, the IAU's decision was a good fortune for the supernova community. Most speakers that the organizers proposed as Invited Speakers were able to attend, and many young researchers presented exciting new results in oral presentations and poster sessions. Apart from professional astronomers (including PhD students), graduate students and advanced undergraduates with strong interest in astronomy took part in the meeting. Students and professional astronomers participated from many countries of north and south as well as from all regions of India.

The scientific program started with a session on SN 1987A, the nearest SN in recent times in the Large Magellanic Cloud and continued with recent developments of supernova models and surveys to find new supernovae. Almost all aspects of research on different types of core-collapse supernovae and their interactions with the surrounding medium, including observational studies of light curves and spectra in the radio, mm,

optical, UV, X-ray and gamma-ray bands using many ground and space based telescopes and facilities were presented at the Symposium. There was also an impromptu session on SN 2009ip where research in progress was discussed on the first evening. Research on various aspects of Supernova Remnants (as a young supernova ages and develops full-scale interaction with the interstellar medium), how they affect galactic outflow, star formation and superbubbles and large scale structure of the host galaxies, acceleration of high energy cosmic rays were presented in the five days of the meeting. The unifying theme of the Symposium was the physics of shocks and the observations of their radiation in both SNe and SNRs. The website of the conference at: <http://www.tifr.res.in/iau296/> has many details of the scientific programme and rationale, members of the Local and Scientific Organizing Committees, talks and posters presented at the Symposium etc. It also has a link to the videographic recordings of the talks presented at the meeting arranged according to the scientific sessions. These recordings will remain deployed at this site for a period up to the end of 2015.

On the second evening of the Symposium a classical Indian Dance programme of the Odissi genre was presented by Sharmila Biswas and her disciples from the Odissi Vision and Movement Centre, Kolkata. The Symposium ended with a cruise up the River Ganga to take the delegates from Raichak to Calcutta.

All delegates to the Symposium stayed in the same Hotel Complex throughout the meeting, which significantly enhanced the interactions both formal and informal among the participants. Many individuals and organizations helped in multiple ways to make the IAU Symposium 296 a successful scientific meeting in a rural setting in the state of West Bengal. Generous funding was received from the International Astronomical Union, Tata Institute of Fundamental Research, Mumbai, Indian Institute of Astrophysics, Bangalore and the Indian National Science Academy, New Delhi. The organizers thank the Director, the Dean, Natural Sciences Faculty and the Registrar, Tata Institute of Fundamental Research, Mumbai for administrative support and help. The organizers appreciate the conference work carried out by Messers Surendra Kulkarni, Nassim Khan and Ms. Magnes Johny and the help rendered by the members of the Local Organizing Committee and the student volunteers. The organizers thank Prof. Malabika Sarkar, Vice Chancellor, Presidency University, Calcutta and Prof Somak Raychaudhury for critical help in liaising with local agencies and representatives of the Governments of West Bengal and India.

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Catherine Cesarsky (France)  
Yang Chen (China)  
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