Proposal Status Report

March 20, 2002

Principal Investigator:	Glenn E. Allen
Program:	Long-Term Space Astrophysics
Proposal Number:	NRA-99-01-LTSA-037
Proposal Title:	"A Study of the Non-Thermal X-Ray Emission of Shell-Type Supernova Remnants"
MIT Account Number:	6890477

The term of the second year of the award is the period from March 15, 2001 to March 14, 2002. As was the specified goal of the second year, we analyzed the spatial and spectral X-ray data for several young supernova remnants.

I published a paper about an analysis of the *ROSAT*, *ASCA*, and *RXTE* data for the supernova remnant SN 1006. A copy of this paper is enclosed. As described in the paper, we believe that we accurately modeled the nonthermal X-ray emission from the remnant. The results of this analysis are used to infer properties about the cosmic rays accelerated in the remnant and to argue that the strength of the magnetic field in the remnant is considerably larger than the value of about 10 μG reported elsewhere. The results were presented at the August 2001 International Cosmic Ray Conference in Hamburg, Germany.

I began analyzing new *Chandra* X-ray data for SN 1006. This analysis will yield the first measure of the strength of the magnetic field in the remnant for the first time. Preliminary results support our previous conclusion that the magnetic field strength in the remnant is much larger than 10 μG. The field strength seems to be about the strength expected based on an equipartition calculation. The result supports recent models that describe the how the shock structure is influenced by the efficient acceleration of cosmic rays. This work will be presented at the April 2002 High Energy Astrophysics Division meeting in Albuquerque and published this summer. A copy of the abstract for the talk is enclosed.

I began studying new *Chandra* X-ray data for the supernova remnant Cas A. The results of this work show that the forward shock is a region where cosmic-ray electrons are accelerated, which is consistent with theoretical expectations. The work was presented at the September 2001 Two Years of Science with Chandra symposium in Washington, DC. A copy of the poster paper is enclosed.

Dr. Thomas Pannuti, whose research work is supported by the award, analyzed *ROSAT*, *ASCA*, and *RXTE* data for the supernova remnant G347.3−0.5. The results show for the first time that thermal X-ray emission is produced in the remnant. As expected, the thermal emission is consistent with a model in which the remnant is expanding into a very low density environment. The results also provide an accurate description of the nonthermal emission from the remnant. Dr. Pannuti presented this work at several conferences. A copy of the paper for the proceedings of the August 2001 Neutron Stars in Supernova Remnants symposium in enclosed. The work will be submitted to the Astrophysical Journal in the next few months.

Dr. Pannuti began analyzing new *Chandra* data for the young remnants N103B and N132D in the Large Magellanic Cloud. The results provide the first evidence that these remnants produce X-ray synchrotron emission from electrons that have been accelerated to very-high energies. X-ray spectral models that include a synchrotron component fit the data better than models which do not include such a component. Furthermore, the values of the fitted parameters of the synchrotron model are consistent with the values expected from published radio data for the remnants. This work is important because it shows that the search for evidence of X-ray synchrotron emission from supernova remnants can be extended to remnants outside our own Galaxy. The results for these two remnants were presented at the January 2002 meeting of the American Astronomical Society in Washington, DC. A copy of the poster paper is enclosed.

Dr. Pannuti and I submitted several proposals to use the *ATCA*, *Chandra*, *VLA*, and *XMM*, instruments to observe other young supernova remnants. Dr. Pannuti presented his work on G347.3−0.5 at two public functions.

The goals of the third year are to publish the results of the research projects that are underway now and to analyze the spatial and spectral properties of other young supernova remnants to characterize the features of particle acceleration in young supernova remnants.

Glenn E. Allen