Massive stars produce iron during the last stage of the fusion process that makes them shine. Once fusion ends in the star's core, the now-cooler interior can no longer support the weight of the outer layers. The ensuing collapse and supernova explosion spews iron into the universe, enriching the surrounding region and becoming subsumed into gas clouds that provide the material for future star formation.

Meet the Iron Lady

Sultana Nahar, research associate in the Department of Astronomy, attended a conference last summer and discovered she had an unusual nickname: the Iron Lady.

"After my talk, someone I did not know spoke with me and called me the Iron Lady," she said. "I was very surprised."

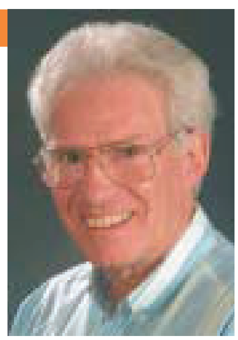
Physicists and astronomers around the world depend on her computationally intensive mathematical models of the iron atom when interpreting complicated spectra produced by high-energy astrophysical processes, such as those that occur near black holes at the centers of active galaxies. Iron is relatively abundant in the universe; it has a complicated spectrum, with 26 electrons potentially contributing to thousands of spectral lines, depending on the ionization state of the gas.

"It's very difficult to represent (iron) mathematically and to get the atomic parameters," Nahar said. Her detailed calculations of iron spectra allow astronomers to describe the physical conditions, such as temperature and pressure, of hot gas accretion disks around black holes. She works with Professor Anil Pradhan (see p. 14) and graduate students in the atomic physics group. "We're among the biggest users of time at the Ohio Supercomputer Center," she said. Their group, in turn, is part of the Iron Project, an international collaboration devoted to determining atomic parameters.

Although astronomy receives more press coverage for its stunning photos of celestial wonders, Nahar's research gets to the heart of how stars, planetary nebulae, and quasars produce high-energy X-rays. Her work was recently featured in *Thikana*, a Bengali newspaper published in the United States, which led to her second nickname: "the Pride of Bangladesh."

She earned her Ph.D. in theoretical atomic physics at Wayne State University in Detroit in 1987 and completed a postdoctoral appointment at Georgia State University before coming to Ohio State as a postdoctoral researcher in 1990.

Universe Is Professor's Laboratory



Gary Steigman, professor in the Departments of Astronomy and Physics, came to Ohio State to build a group in theoretical astrophysics and cosmology.

"The Ohio State cosmology group is now viewed as one of the strongest in the U.S.," Steigman said. The large, vibrant group is the result of a joint effort between physics and astronomy. Members of the group use the universe to probe and test ideas about physics at the very highest energies and smallest scales.

Last year, Steigman spent time at the Institute for Theoretical Physics in Santa Barbara, California. "My work there was an extension of what I've always done," he said. And what he's done has been on the cutting edge of cosmology: using the early universe as a means of testing fundamental physics.

According to Steigman, theorists work in areas directly related to observational data, which in turn stimulate new observations. Steigman's theoretical research interests range from the detection of neutrinos to the study of dark matter in the universe.

"Dark matter problems are a hot topic now," Steigman said. "Although gravity keeps us together, an inventory of the estimated total mass in the universe demonstrates a problem: There is not enough mass to hold galaxies together, yet they stay together. There is also evidence of accelerated expansion of the universe, but theory predicts that gravity should slow down the expansion.

"We use the universe as a laboratory," he said. "Particle physics, astronomy, and cosmology are all connected. We are trying to fully understand the beginning of the universe, from the formation of elements in the first few minutes and from the radiation left over from the big bang. Using the universe and its evolution, we can probe aspects of physics inaccessible to the terrestrial. Large accelerators are limited in particles that can be produced and detected."

Astronomy Professor Sellgren Studies Stardust

(The real thing, not the dreamy kind)

Kristen Sellgren, professor of astronomy, has a variety of research interests including interstellar dust, interstellar molecules, the Galactic Center, and star formation

She is currently involved in three major research projects. The first examines dust around stars of different temperatures and aims to answer the question of how light is absorbed by molecules in a galaxy and then re-radiated. Aromatic hydrocarbons, which are important in the process of creating life from inanimate matter, are at the focus of this investigation.

Dr. Sellgren also is studying the correlation between carbon levels and the strength of the 16.4-micron emissions of planetary nebulae to determine whether or not they are carbon-dominated. Data collected by the Infrared Space Observatory (ISO) suggests this may be the case. (It was previously thought that oxygen was the dominant element.) A correlation between carbon abundance and the 16.4-micron feature strength would support suggestions from laboratory astrochemistry identifying the 16.4-micron feature with aromatic hydrocarbons.

A third research project, dependent on the availability of viewing time and necessary funds, aims to study the dust emissions from red giants to determine how stars lose their mass as they leave the main sequence and become planetary nebulae. Targets for this project include the Large and Small Magellenic Clouds and possibly the Milky Way.

Sellgren is also collaborating with the Spitzer Space Telescope team on observations made with the infrared observatory. She recently returned from research leave at the Jet Propulsion Laboratory in Pasadena, California, where she completed the first of a series of papers on brand-new Spitzer results on infrared spectra of reflection nebulae.