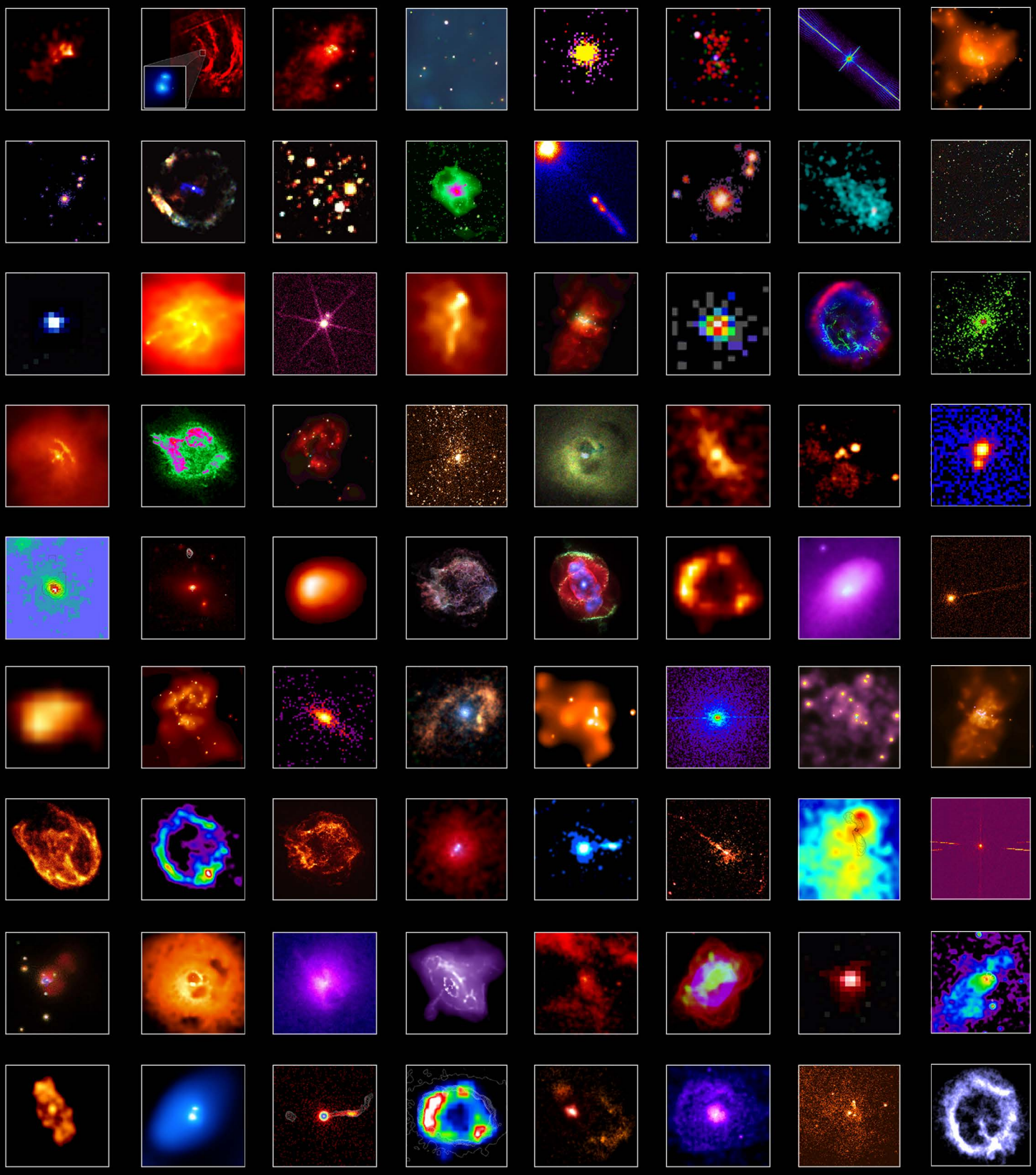

1999 - 2001

Two Years of Chandra

CHANDRA
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Two years ago on July 23, 1999, the Space Shuttle Columbia launched into orbit with NASA's Chandra X-ray Observatory stored safely in its cargo bay. Just a few hours later, Chandra was released into deep space by the team led by Eileen Collins, the first female ever to command the Shuttle. Since its launch, Chandra has been making history, not only for women in space, but in the field of astrophysics as a whole. With its spectacular mirrors and instrumentation, Chandra allows astronomers to observe X-rays from the Universe as they never have before.

Having taken its place along with the Hubble Space Telescope and the now defunct Compton Gamma-ray Observatory in NASA's fleet of "Great Observatories," Chandra continues to dazzle and amaze scientists with its discoveries. Now beginning its third full year of observations, Chandra continues its journey into the realm of high-energy astrophysics where black holes, supernovae, and a host of other exotic cosmic phenomena rule.

Some of the scientific highlights from the past year with Chandra include:

M82: A starburst galaxy (central region) in the constellation Ursa Major. Astronomers using Chandra found an ultraluminous X-ray source near, but not coincident, with the nucleus of M82. The power output and other properties of this source suggest that it is due to a black hole containing about 1000 times the mass of the Sun. If this mass estimate is correct, then it will be one of Chandra's most significant discoveries – providing evidence for missing link between smaller stellar black holes and the supermassive variety found at the centers of most galaxies. If, on the other hand, it turns out this object is really a stellar-sized black hole that is beaming X-rays toward us, then this would also be a major finding since it would be the first definite detection of a such an object.

Cygnus A: A galaxy, some 700 million light years away, with a central supermassive black hole. This stunning image will be used for years as the example of how radio sources create hot cavities in the gas contained in a cluster of galaxies. Chandra's image shows a giant football-shaped cavity within X-ray emitting hot gas surrounding the galaxy Cygnus A. The cavity in the hot gas has been created by two powerful jets emitted from the central black hole region. The jets themselves terminate in radio and X-ray emitting "hot spots," some 300,000 light years from the center of the galaxy.

GRB991216: A gamma-ray burst that exploded roughly 8 billion years ago. The discovery by Chandra of X-ray emission from iron ions about a day after this outburst is still giving theorists fits. An international team of researchers used the Chandra X-ray Observatory to detect never-before-seen properties in the X-ray afterglow of a gamma-ray burst -- mysterious blasts of high-energy radiation, believed to be the most powerful explosions in the Universe.

The Chandra Deep Fields: Two separate areas of the sky observed by Chandra for 1 million seconds each. These two separate fields show the Universe was teeming with black holes billions of years ago. The Chandra Deep Field South also provided evidence for the discovery of an object known as a "Type II" quasar, an extremely distant quasar shrouded in gas and dust thought to be a key to understanding how galaxies form. These fields will be a treasure trove of information that scientists can mine for years to come.

47 Tucanae: A globular cluster located about 15,000 light years from Earth in the constellation of Tucana. The Chandra observations of this object provided a big step forward in resolving the core of a globular cluster containing about a million stars. Astronomers used Chandra to take a census of the central region of this globular cluster and found a host of millisecond pulsars and, significantly for theorists, the absence of a massive black hole. As the oldest stellar systems in the Milky Way Galaxy, globular clusters are laboratories for stellar and dynamical evolution.

The Arches Cluster: A cluster of young stars located in the central region of the Milky Way Galaxy about 25,000 light years from Earth. The Chandra observation of the Arches shows an envelope of 60-million-degree gas around a very young cluster of stars. This compact cluster is composed of hot, massive stars that live short, furious lives lasting only a few million years. During this period, gas evaporates from these stars in the form of intense stellar winds. The envelope of hot gas observed by Chandra is thought to be due to collisions of the winds from numerous stars. The idea that colliding stellar winds can generate hot winds may change the way people think about star clusters, and starburst galaxies.

The Antennae (NGC 4038/4039): Colliding galaxies about 60 million light years from Earth located in the constellation Corvus. This beautiful Chandra image of these merging galaxies shows many bright sources, which adds to the story of ultraluminous X-ray sources. These sources, which emit ten to several hundred times more X-ray power than similar sources in our galaxy, are thought to be either massive black holes, or black holes that are beaming energy toward Earth.

"These images and spectra are just a sampling of the spectacular data acquired with Chandra during the first two years in orbit. The Observatory continues to operate incredibly smoothly and perform exceptionally well -- a tribute to the dedicated team from NASA, industry, and the science community responsible for designing, building, launching, and now operating Chandra. We are amazed by what we are seeing, and Chandra is surely living up to its billing as one of NASA's Great Observatories."

-Harvey Tananbaum
Director, Chandra X-ray Center