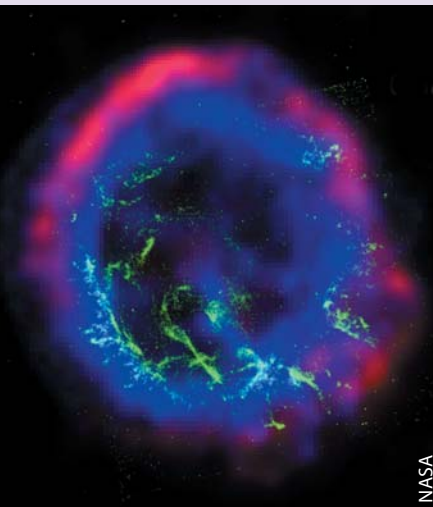


Astrophysics Launches Technology

ASTROPHYSICS

- Federal funding for astrophysics triggers innovations in science and industry
- From homeland security to medicine, astrophysics brings improvements through its spinoffs
- Technologies now used in digital cameras were developed by astrophysicists

MAKING CONSUMER ELECTRONICS FASTER & CHEAPER



- Astronomers developed X-ray and UV optics, which help improve microchips in PCs and other electronics
- Infrared detectors developed by astronomers are used in microchip quality-control systems, leading to more reliable and cheaper electronic products
- X-ray spectrometers that analyze cosmic plasmas are now checking for impurities that might hamper computer chip production

Air Force, Army, DOD, DOE, and NSF have funded research since the 1930s

LAUNCHING DIGITAL IMAGING



- CCD imagers designed for the Hubble Space Telescope now guide breast biopsy procedures, reducing surgery costs by 75%
- Adaptive optics from advanced telescopes help map the eye retina and may lead to improved surgery and corrective lenses
- CCD-enabled digital photography represented \$25 billion worldwide revenues in 2005

NSF, NASA, and NIST are among those funding research since the 1970s



ENHANCING SECURITY

- The most common type of airport luggage scanners uses detectors first developed for X-ray astronomy
- Technology from telescopes and observatories has been incorporated into satellites that monitor military activities around the globe
- Astronomical image-analysis techniques now sharpen photographs for police work

NASA, NSF, NIST, DOE, and DOD have funded research since the 1930s

R&D Pays Off – Support Astrophysics Research

Astrophysics — Today's Investment, Tomorrow's Rewards

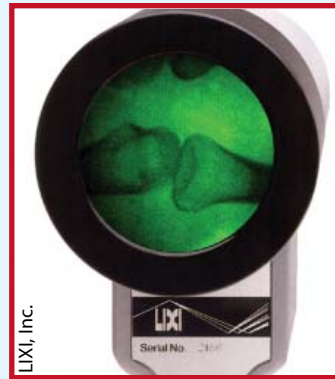


Computing Solutions

FORTH, a programming language developed at the National Radio Astronomy Observatory, has been used for tracking FedEx packages, analyzing auto engines, and manufacturing Kodak film.

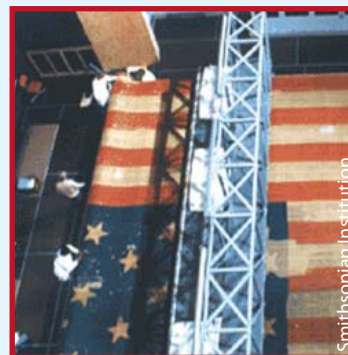
Portable X-rays

The portable Low Intensity X-ray Imaging Scope (Lixiscope) is now NASA's second largest source of royalties. It is common in emergency rooms, sports health facilities, and other areas where rapid, low level X-ray images are vital.



High-Performance Graphics

Powerful imaging and data-analysis tools originated from software written for the Mariner Mars probes.



Archeology & Artifacts

Astrophysicists used infrared-imaging technology to document the status of the Star Spangled Banner and to monitor its deterioration. Earth-imaging satellites are guiding archeologists to prehistoric cities buried beneath desert sands.

Prepared by:

American Institute of Physics, One Physics Ellipse, College Park, MD 20740; Phone: 301-209-3090; Fax: 301-209-0846; email: pss@aip.org.
The ten AIP Member Societies are: American Physical Society; Optical Society of America; Acoustical Society of America; The Society of Rheology; American Association of Physics Teachers; American Crystallographic Association; American Astronomical Society; American Association of Physicists in Medicine; AVS: Science & Technology of Materials, Interfaces, and Processing; and American Geophysical Union.
Find this and other Physics Success Stories online at www.aip.org/success.

Reaping the Rewards: A Century of R&D

ASTROPHYSICS TIMELINE

"Astronomy compels the soul to look upwards and leads us from this world to another." (Plato, 428 BC - 348 BC, *The Republic*)

1916 – Karl Schwarzschild predicts the existence of black holes. Einstein publishes his general theory of relativity.

1927 – US astronomer Edwin Hubble discovers the expansion of the universe. Karl Jansky discovers radio emissions from the center of the Milky Way.

1940s – George Gamow develops the "Big Bang" model.

1949 – A Naval Research Laboratory instrument aboard a V2 rocket detects X-rays from the Sun.

1964 – Bell Labs researchers Arno Penzias and Robert Wilson discover the cosmic microwave background radiation, the first light from the birth of the universe (Nobel Prize, 1978).

1969 – The CCD (charge-coupled device), the key technology in digital cameras, is invented at Bell Labs by Willard Boyle and George Smith.

1976 – The Very Large Array radio telescope in New Mexico begins collecting data.

1985 – The International Cometary Explorer is the first probe to fly through the tail of a comet.

1990 – The Hubble Space Telescope ushers in an era of unprecedented views of the universe.

1992 – The Cosmic Background Explorer (COBE) shows the first "baby picture" of the universe after the Big Bang.

1995 – Planets are discovered outside our solar system.

1998 – Lawrence Berkeley Laboratory and Harvard researchers observing exploding stars discover that the universe is accelerating its expansion.

2003 – The new Spitzer Space Telescope provides infrared views of the universe.

2006 – NASA's Stardust mission returns samples from comet Wild-2, our first glimpse of the original material that formed the solar system.

From Astrophysics R&D to Widespread Use

Funding and Initial Research:
NASA, DOD, NIST, NIH, DOE, NSF,
and DARPA, 1950s-90s.