400 Years of Astronomical Discovery

The Accelerating Understanding of our Place in the Universe

Lynne Hillenbrand
California Institute of Technology
Galileo Galilei
(1564-1642)
Nicolaus Copernicus
(1473-1543)
Tycho Brahe (1546-1601)

Johannes Kepler (1571-1630)
From the beginning, astronomy has consisted of three interacting branches:

- Invention and Experiment
- Observation and Analysis
- Hypothesis and Theory
Isaac Newton
(1642-1727)

“I do not know what I may appear to the world, but to myself I seem to have been only like a boy playing on the sea-shore, and diverting myself in now and then finding a smoother pebble or a prettier shell than ordinary, whilst the great ocean of truth lay all undiscovered before me.”
Joseph von Fraunhofer (1787-1826)
William Herschel
(1738-1822)

Caroline Herschel
(1750-1848)
J.C. Kapteyn
(1851-1922)

A. A. Common, 1883
Albert Einstein
(1879-1955)
Henry Norris Russell (1877-1957)

Ejnar Hertzsprung (1873-1967)
Cecilia Payne Gaposchkin (1900-1979)

“Undoubtedly the most brilliant Ph.D. thesis ever written in astronomy.” Otto Struve
George Ellery Hale
(1868-1938)
Albert A. Michelson
(1852-1931)
Henrietta Leavitt (1868-1921)

Harlow Shapley (1885-1972)
Edwin Hubble
(1889-1953)

Walter Baade
(1893-1960)

ANOETHER UNIVERSE
SEEN BY ASTRONOMER

Dr. Hubble Describes Mass of
Celestial Bodies 700,000 Light
Years Away.

CHICAGO, Jan. 21 (AP) — For years
astronomers have speculated as to
whether various nebulous formations
in the heavens belong to this universe
or were "island" universes of their
own, immeasurable distances away.

FIGURE 1
Velocity-Distance Relation among Extra-Galactic Nebulae.
Karl Jansky
(1906-1950)

NEW RADIO WAVES TRACED TO CENTRE OF THE MILKY WAY

Mysterious Static, Reported by K. G. Jansky, Held to Differ From Cosmic Ray.

DIRECTION IS UNCHANGING

Recorded and Tested for More Than Year to Identify It as From Earth's Galaxy.

ITS INTENSITY IS LOW

Only Delicate Receiver Is Able to Register—No Evidence of Interstellar Signaling.

Discovery of mysterious radio waves which appear to come from the centre of the Milky Way galaxy was announced yesterday by the Bell Telephone Laboratories. The discovery was made during research studies on static by Karl G. Jansky of the radio research department at Holmdel, N. J., and was described by him in a paper delivered before the International Scientific Radio Union in Washington.

The galactic radio waves, Mr. Jansky said, differ from the cosmic rays and also from the phenomenon...
Fritz Zwicky  
(1898-1974)  

Vera Rubin  
(1928-)
Hans Bethe
(1906-2005)

Edwin Salpeter
(1924-2008)

A.G.W. Cameron
(1925-2005)

M. Burbidge, G. Burbidge, W. Fowler, & F. Hoyle
Penzias & Wilson

(1933- and 1936-)
Infrared & X-ray Pioneers

Robert Leighton
Gerry Neugebauer

Riccardo Giacconi

Harold Johnson
Frank Low
Efficient Light Detection

James Westphal

Judith Pipher
Roger Angel

Jerry Nelson
“California Planet Search” and “Geneva Extrasolar Planet” Teams

ORBITAL SEMI MAJOR AXIS (AU)

Picture Credit: E. Williams, G. Marcy, and L.-A. McConnaughie, (UC Berkeley), (SFSU)
>350 known “exo-planets”
“UCLA Galactic Center”
and
“Max Planck Institut IR/Submm”
Teams
“High-z Supernova Search” and “Supernova Cosmology Project” Teams
Massive Multiplexing

Adaptive Optics
Common Themes:

- Inspiration
- Cataloging the sky
- Deciphering physical nature of objects
- Establishing empirical relations / patterns
- Appreciating our place in the universe – location and relative size, evolution, whether we are common/unique.
- Cleverness in our pursuit of the unknown
- The pace of astronomical discovery shows no signs of slowing down!
From Galileo to Today to the Future:

- Technology and instrumentation
- Data collection and analysis
- Interpretation ➔ more questions