

# The Evolving Universe

- A collaboration between SAO and NMNH

- Jonathan McDowell

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with thanks to our NMNH colleagues

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# October 2011: The Evolving Universe exhibit opens at NMNH



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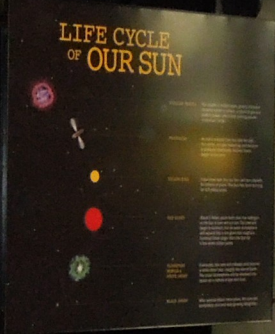
# Our Sun

The life of a star

Our Sun  
is home

Star—the Sun

LIFE OF A STAR



8.3 Billion  
Years to go





Light and  
Color

DIFFERENT  
KINDS OF  
LIGHT & COLOR



26,000 Years

Our Galaxy: The Milky Way  
Star Death

Our Solar System

axies Far, Far

## Concept:

Response to an NMNH proposal opportunity

telecon with B Stauffer Apr 2009, proposal submit Jun 2009

Proposal approved early 2010?

First DC trip June 2010 – exhibit opened Oct 2011

Low budget: \$50K

Limited scope: photo exhibit

Goals - educational

- Bring the story of modern astrophysics to a broader public: the universe outside the solar system

- Feature images from different wavebands and explain the need for infrared and x-ray telescopes

Goals – institutional

- Build links between SAO and NMNH and discover how to collaborate

- Showcase SAO telescope images on the National Mall

- Increase visibility of SAO on the Mall (from ~ zero...)

## Did you know that the Smithsonian has an astrophysical observatory?

The Smithsonian Astrophysical Observatory (SAO), founded in 1890, is a research bureau of the Smithsonian Institution. Located in Cambridge, Massachusetts, and affiliated with the Harvard College Observatory, SAO is part of one of the largest and most diverse astrophysical institutions in the world. The observatory and its more than 300 scientists conduct research in astronomy, astrophysics, and earth and space sciences.

Most of the images in this exhibition were taken by telescopes and cameras developed, built, and operated by the Smithsonian Astrophysical Observatory.



Smithsonian  
National Museum of Natural History  
Smithsonian Astrophysical Observatory

# The Evolving Universe

Our Solar System

Our Galaxy

A Universe of Galaxies

The Big Bang

Behind the Science

Visit the Exhibit

## Experience The Evolving Universe exhibit at the National Museum of Natural History.

October 21, 2011 – July 7, 2013

**Take a mind-bending journey from Earth to the far reaches of space—back to the beginning of the universe about 13.6 billion years ago.**

The farther we peer into space with powerful telescopes, the farther back into the history of the universe we see. The light from our Sun—a mere 93 million miles away—takes only a few minutes to reach Earth. But when we look at stars and galaxies in the night sky, we are seeing light that has traveled for millions—even billions—of years to reach us.

By looking back in time, we can observe how the universe has evolved from its beginnings.

**Start [in our solar system](#) and travel out into space, or begin [at the Big Bang](#) and travel forward in time.**

This exhibition is made possible by **The Windland Smith Rice Nature's Best Photography Fund**



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**object:**  
Centaurus A Galaxy - NGC 5128

**distance from Earth:**  
12 million light-years

**size:**  
260,000 light-years

**telescope:**  
Chandra X-ray Observatory, Rosetta  
Panoramic Supernova Telescope,  
MaxPlanck/ESO 2.2 m Telescope

**light:**  
X-ray (blue), infrared/radio (orange),  
and visible (white, brown)

**description:**  
One of the most luminous and massive galaxies known, Centaurus A is a strong source of both radio and X-ray emissions. The supermassive black hole at its center is highly active, ejecting 10,000-light-year-long jets of superheated gas (blue) and cooler matter (orange) from the disk of the galaxy. The material in the jets travels about 3 million km (1.9 million miles) per minute—half the speed of light.

**credit:**  
Amy Marcopoli/ESA et al., Smithsonian STScl/STScI  
© Harvard U., 2009-2010



# Our Solar System

is home to planets, asteroids, moons, and one star—the Sun.





Our we are stars

A star

A STAR IS BORN



Stars consist mostly of lighter-than-air hydrogen and helium gas. Extreme pressure and temperature at a star's core set off nuclear fusion and changes the gas atoms into different elements such as carbon and iron.  
All the raw materials that make up everything in the universe—including Earth and our bodies—are formed within stars and released into space when stars die.

**INTERSTELLAR DIAMOND DUST**

These tiny diamond crystals were forged in the explosion of a dying star and much later were mixed into the cloud that gave birth to our Solar System over 4.6 billion years ago. The crystals were found in the Allende Meteorite, which fell to Earth in 1969.



Small informational card on the right wall.



# Our Galaxy: The Milky Way

## Star Death

### STAR DEATH

When a star runs out of fuel, it can explode as a supernova, leaving behind a black hole or a neutron star. The remnants of a star can also form a nebula, a cloud of gas and dust that can eventually form new stars.



**Ring Nebula**  
M57



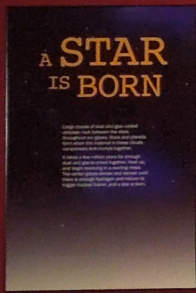
**Helix Nebula**  
M45



**Supernova Remnant**  
Crab Nebula  
M1

# Our Galaxy: The Milk

A star is born





Galaxies Far, Far Away

Galaxies Far, Far Away

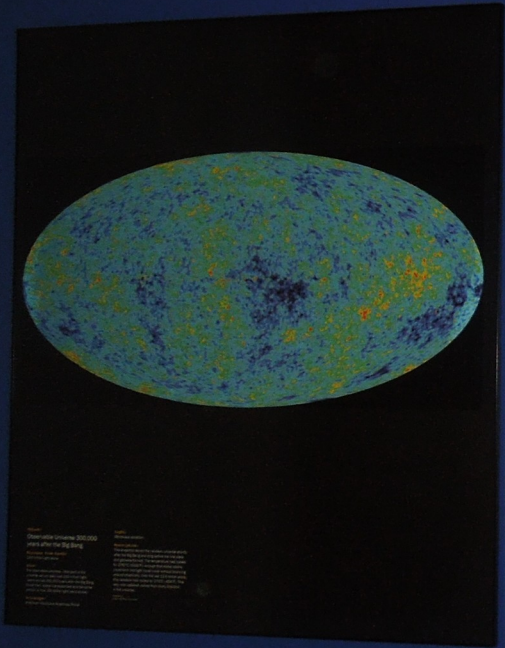
Our galaxy  
is what it is



EXIT

r Away

GA



**THE EVER-EXPANDING UNIVERSE**

Approximately 13.8 billion years ago, the universe began with a massive explosion known as the Big Bang. The universe has been expanding ever since, and the space between galaxies is stretching. This expansion is what causes the universe to appear to be getting larger and larger over time.

The map above shows the Cosmic Microwave Background (CMB), the afterglow of the Big Bang. The colors represent tiny temperature fluctuations in the early universe, which are the seeds of all the galaxies and structures we see today.

Source: NASA/ESA/Planck Collaboration





# Galaxies Far, Far Away



## GALAXIES FAR, FAR AWAY

**D**istant galaxies (G1) are shown in the center of each galaxy in a representative field. In all, they are densely packed matter with the cores of some having blue or red light. Some of these dark holes may not be as dense as they appear to be.



Rest Rooms  
Escalator

OCEAN HALL

2nd Floor  
Dinosaurs  
Restroom

Ancient Seas  
Ice Age

CAFE

The Scientist is In  
Meet the scientist who is currently working on the project. He will be available for a Q&A session on the 1st floor of the museum. He will be available from 10:00 AM to 12:00 PM. He will be available for a Q&A session on the 1st floor of the museum. He will be available from 10:00 AM to 12:00 PM.

Live Butterfly Pavilion  
Hours of Operation: 10:00 AM - 5:00 PM

See the scientist who is currently working on the project. He will be available for a Q&A session on the 1st floor of the museum. He will be available from 10:00 AM to 12:00 PM.

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CHOOSE  
GIVE

I'm Making a World  
With A New