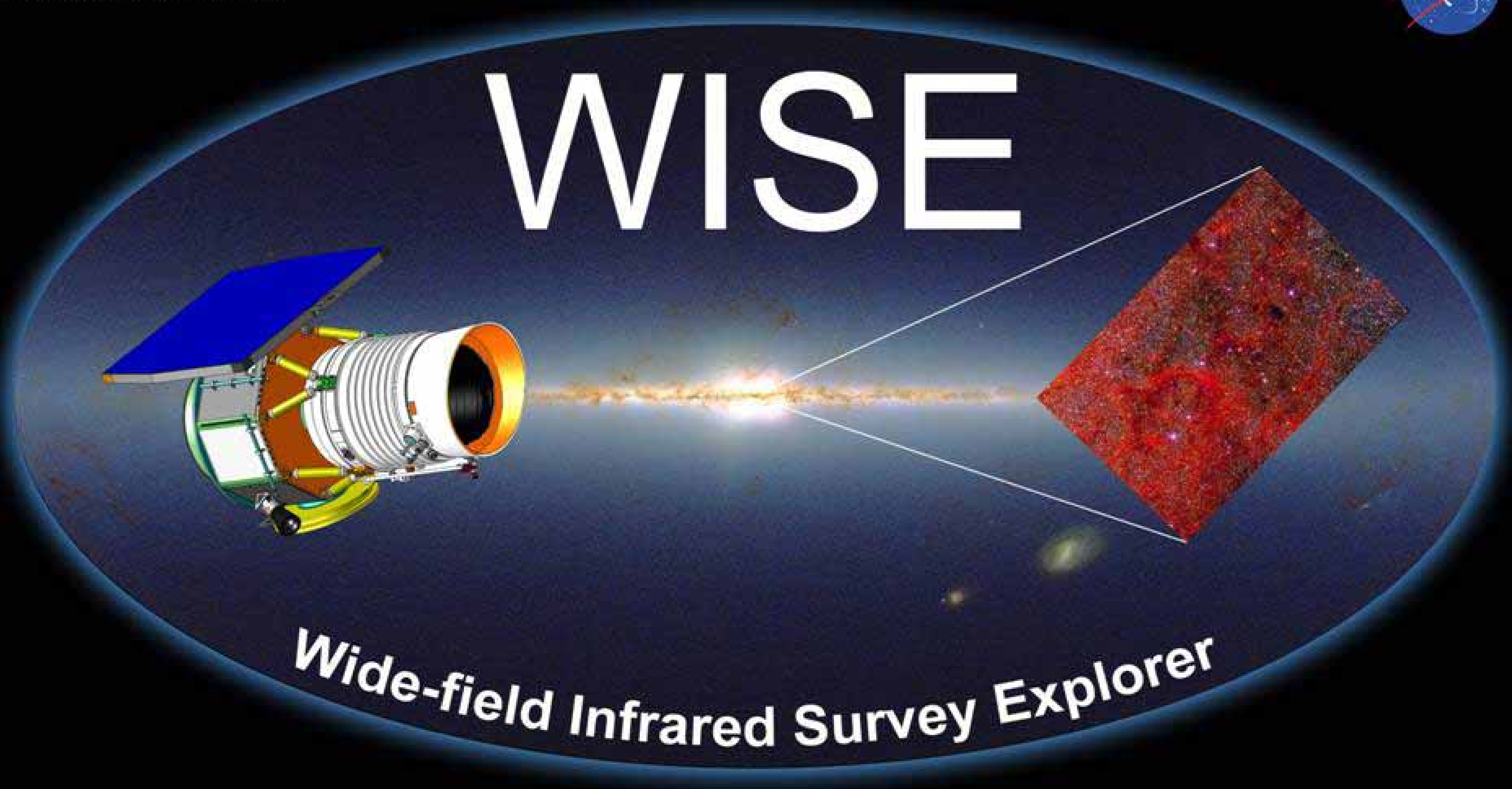
National Aeronautics and Space Administration



http://wise.astro.ucla.edu

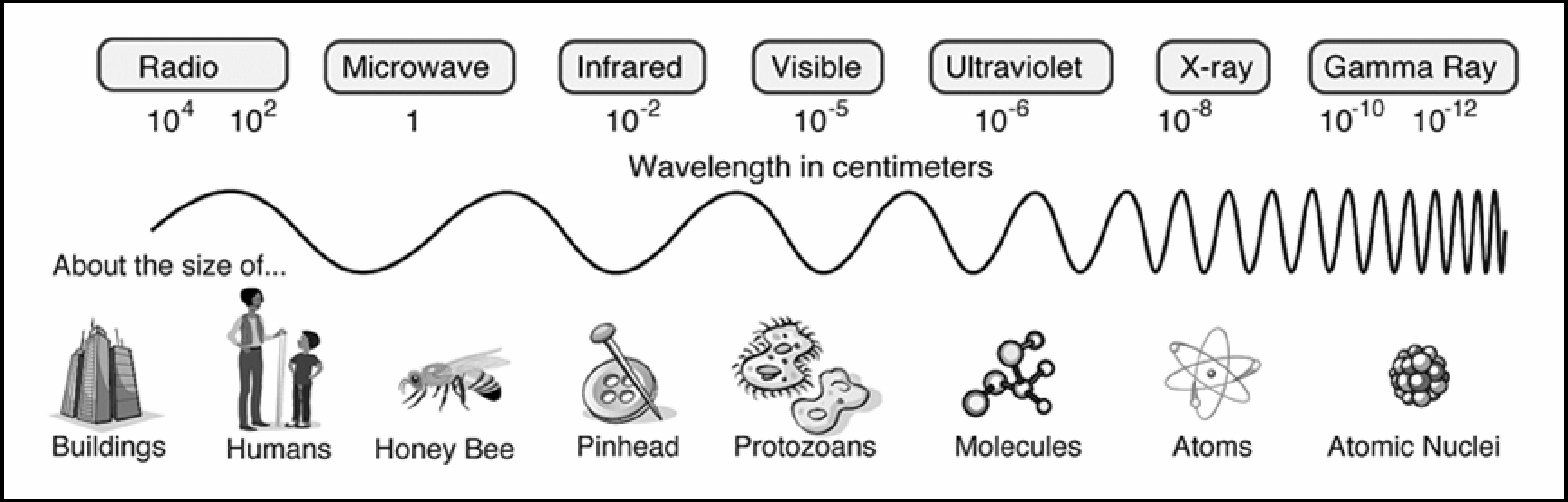
UCLA • JPL • BALL • SDL • IPAC • UCB

Infrared Light

- In 1800 William Herschel discovered “invisible light”
- It’s energy with all the same characteristics as visible light, but is not sensed by the human eye
- The light Herschel discovered was just beyond the red part of the spectrum. So it was named “infrared”

The Spectrum of Light

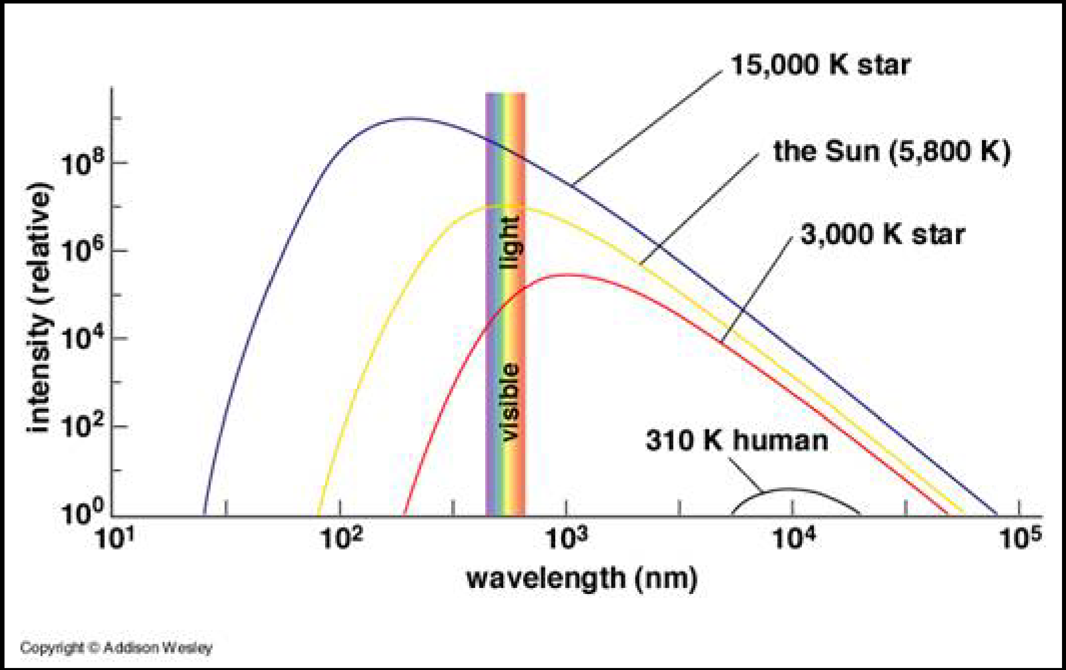
- "Visible light" is a tiny fraction of the *Electromagnetic Spectrum*
- Gamma rays--billions of waves per inch
- Radio waves--up to miles-long wavelengths

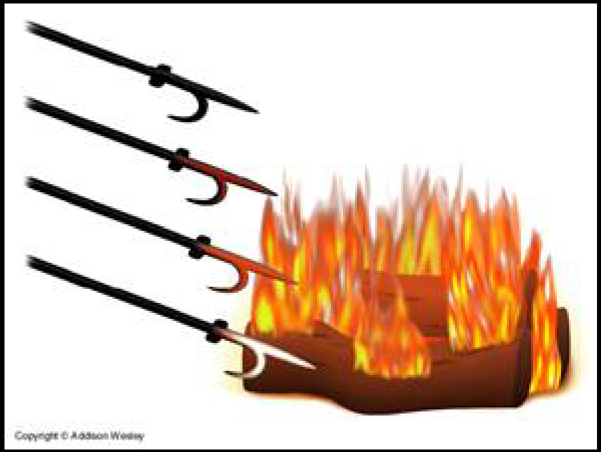


Low Energy Waves

High Energy Waves

The Physics of Light



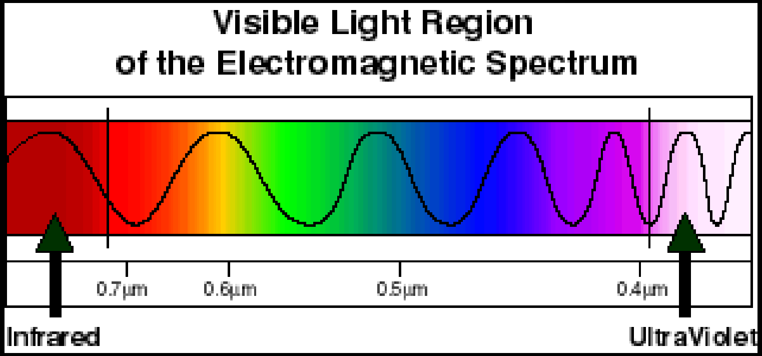


- All objects in the Universe emit light depending on their temperature.
- Cool objects emit primarily long wavelength light
- Hot objects emit primarily short wavelength waves

The Range of Infrared Light

Infrared light lies just beyond the red portion of the visible spectrum ("below red“). Infrared wavelengths are about 0.7 to 350 microns.

(a micron is one-millionth of one meter, or about 1/50th the width of a human hair).



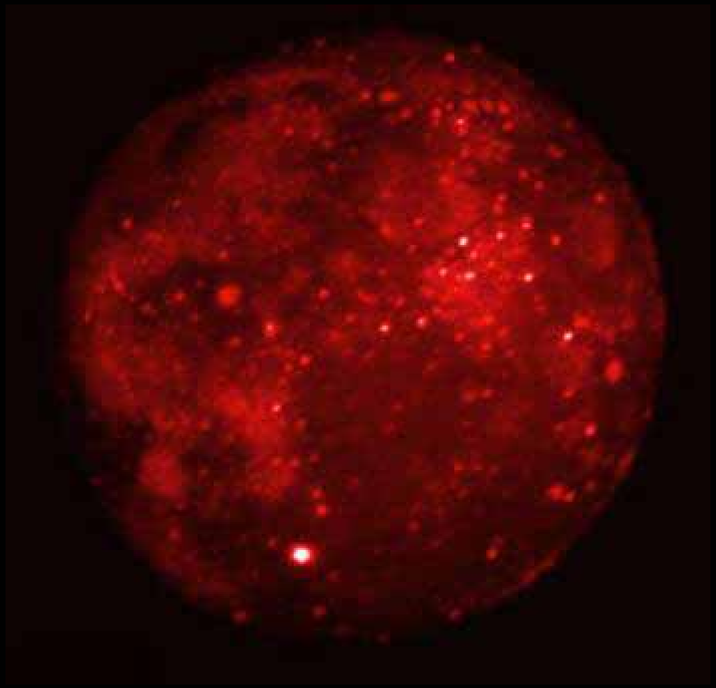
SPECTRAL REGION	WAVELENGTH RANGE (microns)	TEMPERATURE RANGE (degrees Kelvin)	WHAT WE SEE
Near-Infrared	0.7 – 5	740 – 5,200	Cooler red stars Red giants Dust is transparent
Mid-Infrared	5 – 40	93 – 740	Planets, comets and asteroids Dust warmed by starlight Protoplanetary disks
Far-Infrared	40 – 350	11 – 93	Emission from cold dust Central regions of galaxies Very cold molecular clouds

Getting the WHOLE picture

An object can look radically different depending on the type of light collected from it:

Since shortly after Herschel discovered infrared light astronomers have been observing astronomical objects in Infrared Light to get a more complete picture

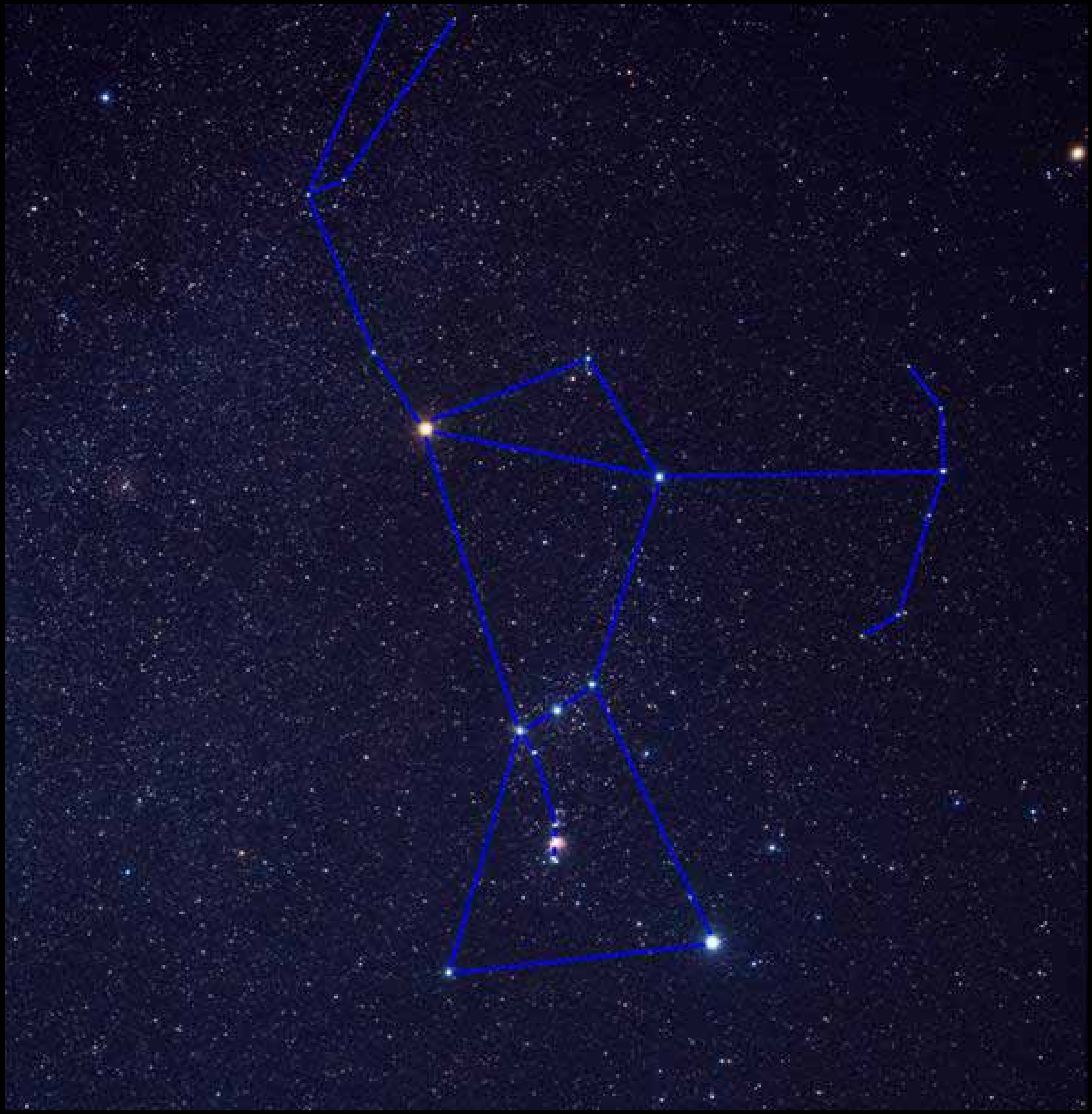
Visible Light Image



Mid-Infrared Light Image

Constellation Orion

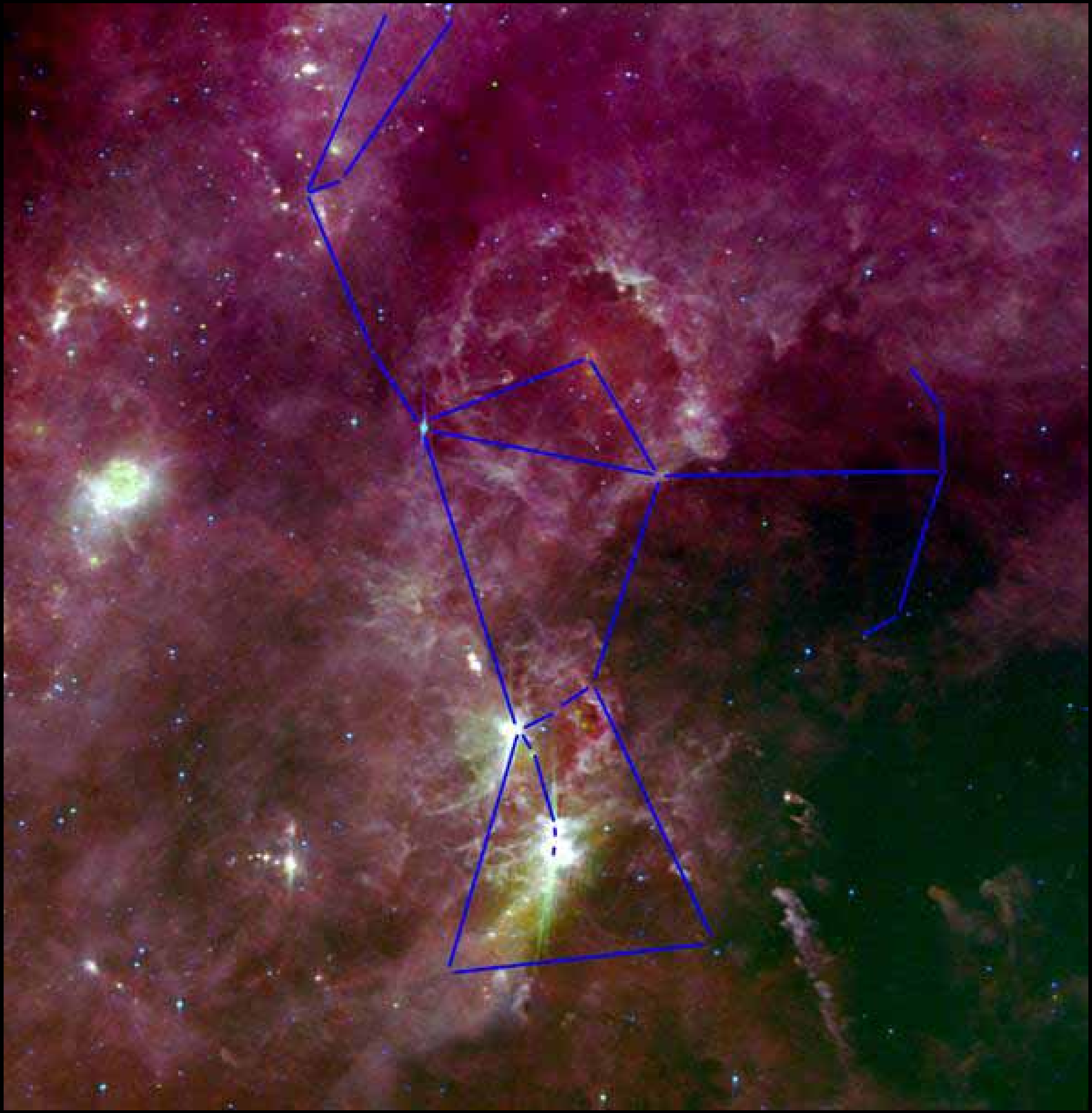
Visible Light



Constellation Orion

Mid Infrared Light

IRAS



Trifid Nebula

Visible Light

NOAO

Trifid Nebula

Infrared Light

Spitzer

Orion Nebula

Visible
Light

Orion Nebula

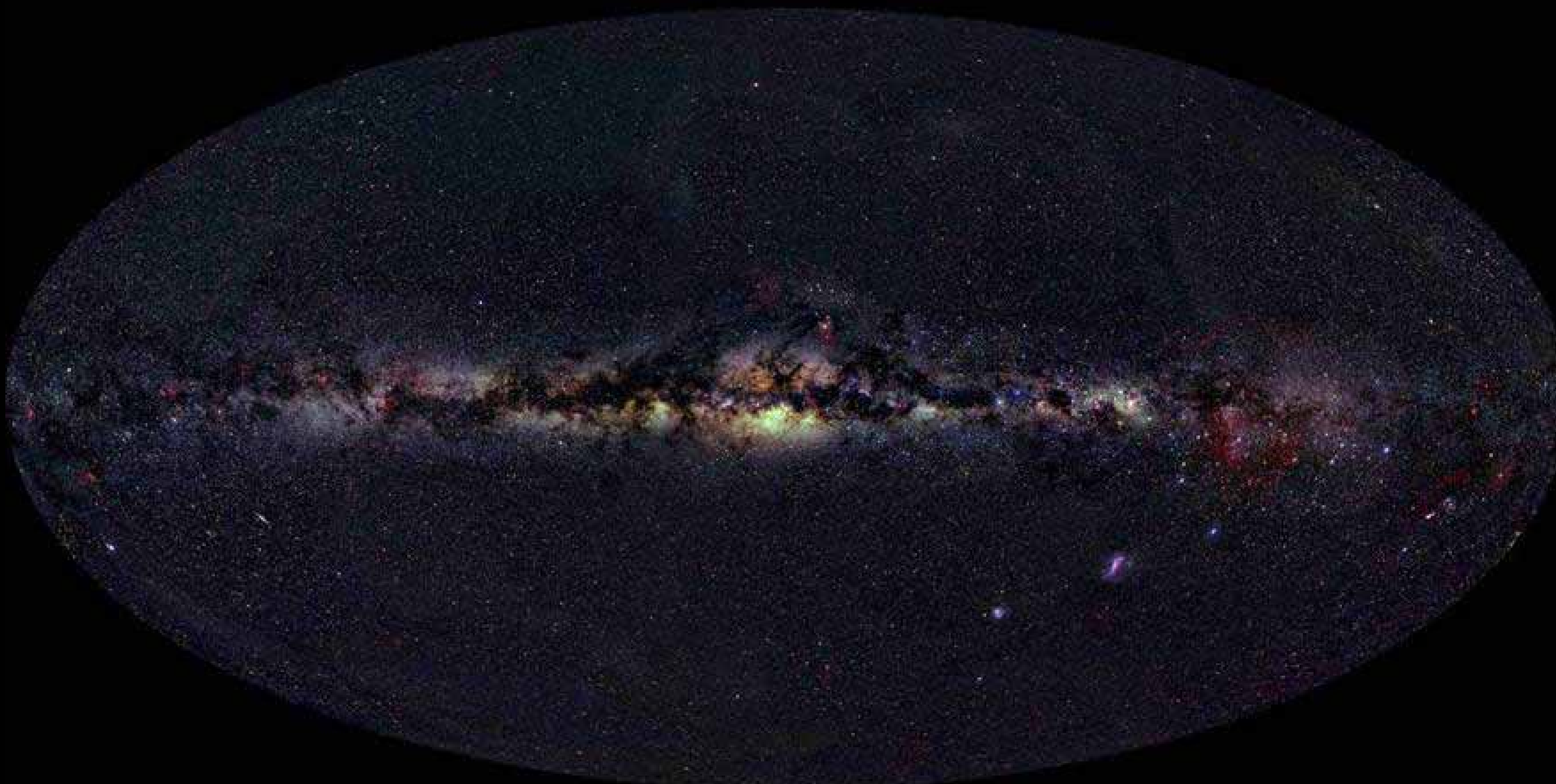
Infrared
Light

Spitzer

Sombrero Galaxy

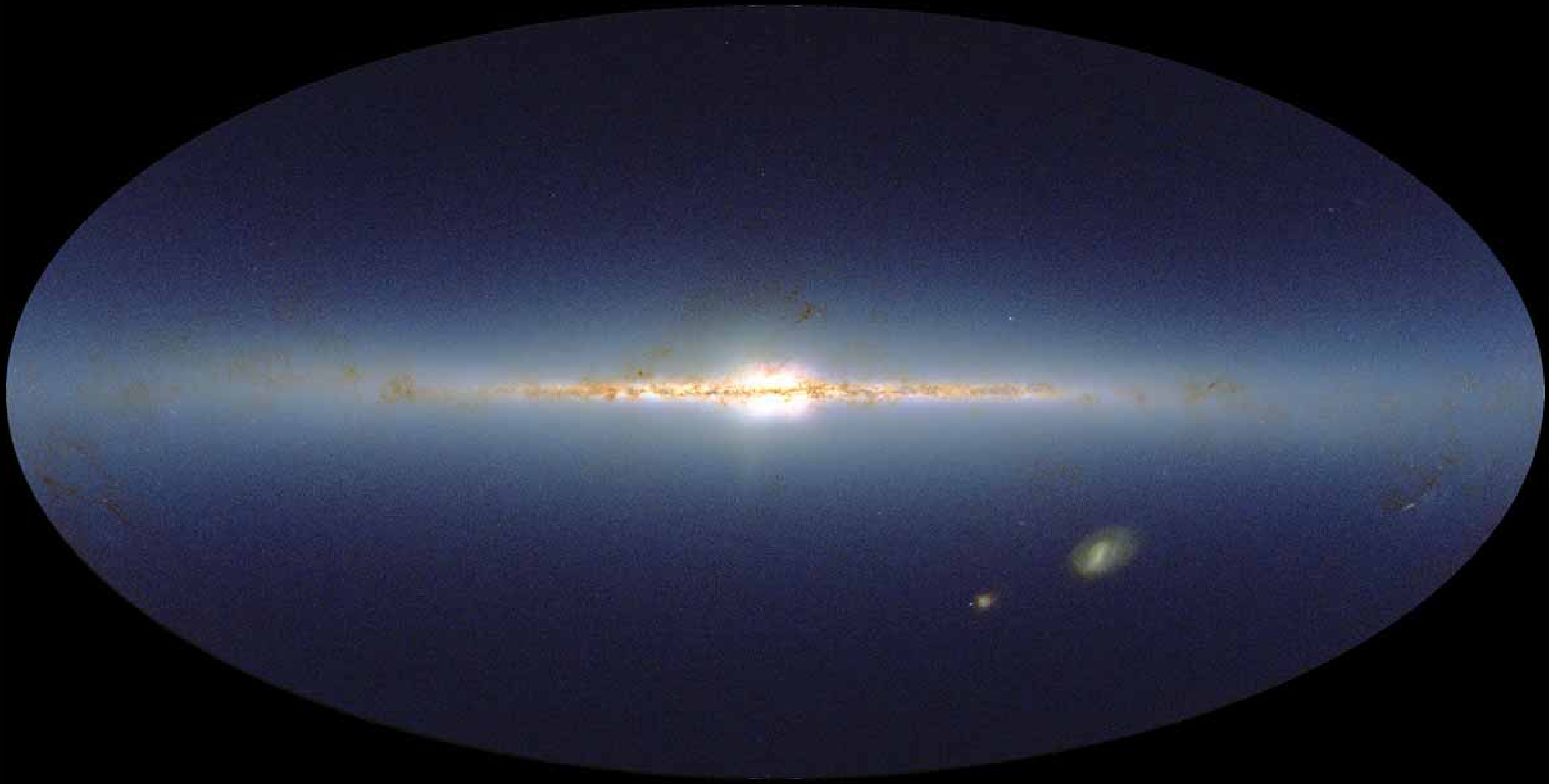
Sombrero Galaxy

The Whole Sky



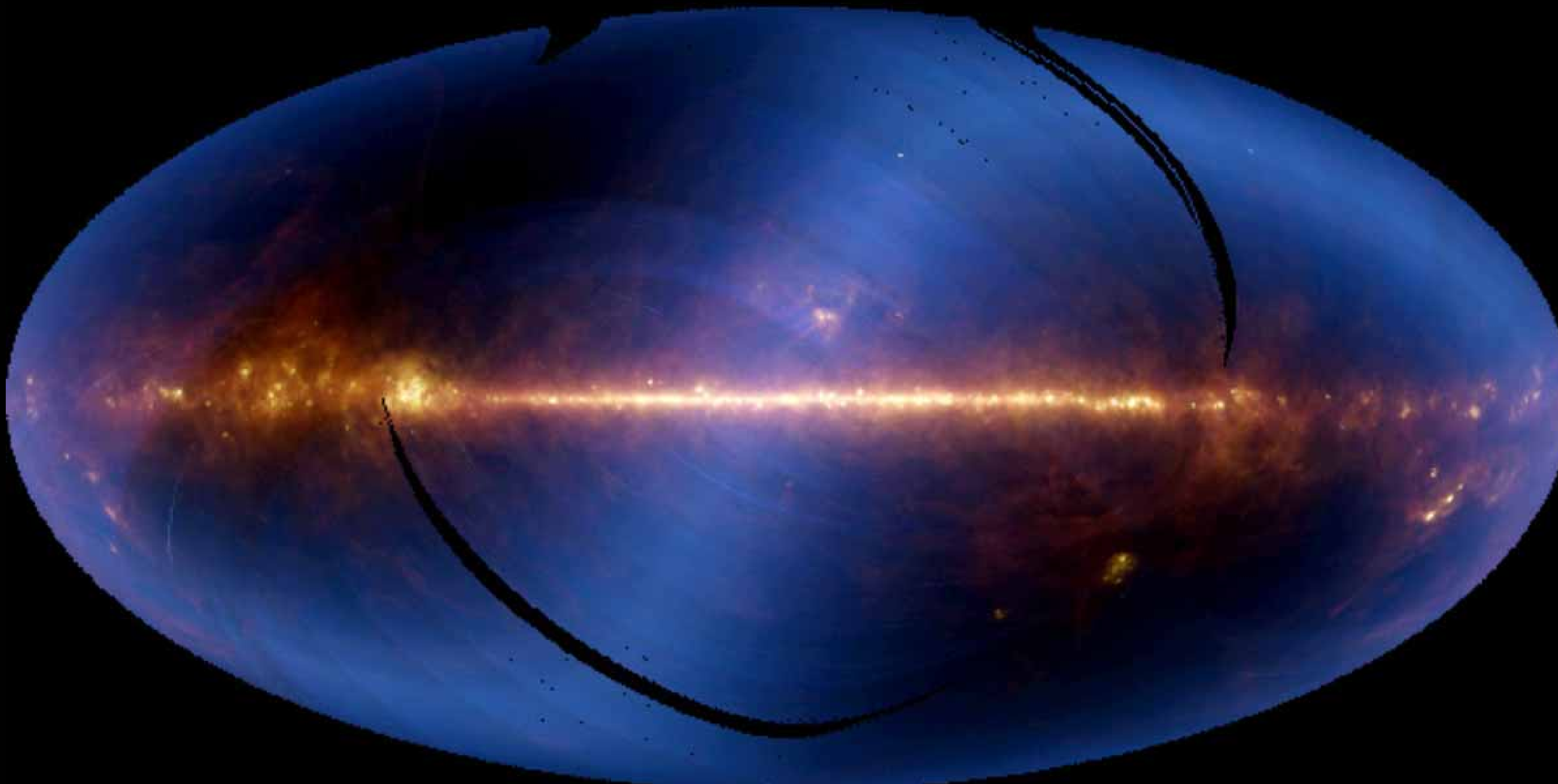
Visible Light - Axel Mellinger

The Whole Sky



Near Infrared Light - 2MASS Survey

The Whole Sky



Mid/Far Infrared Light - IRAS Survey

Why Study Infrared?

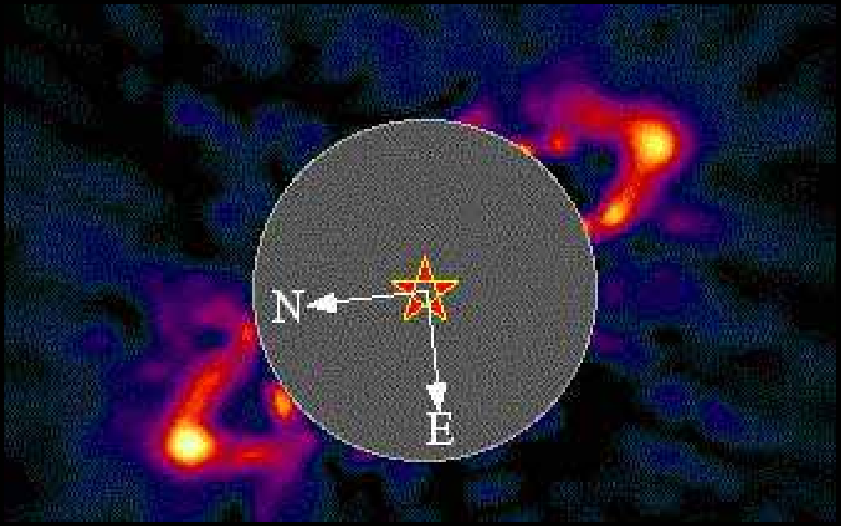
- Visible: dark nebula, heavily obscured by interstellar dust ("Horsehead Nebula")
- Near-Infrared: dust is nearly transparent, embedded stars can be observed forming
- Mid- and Far-Infrared: glow from cool dust is directly observable

Visible

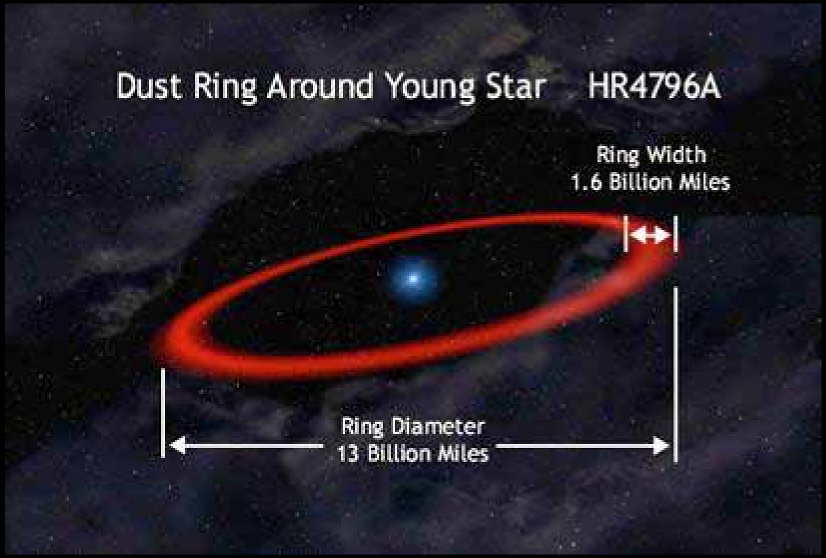
Near Infrared

Mid-Infrared

Why Study Infrared?

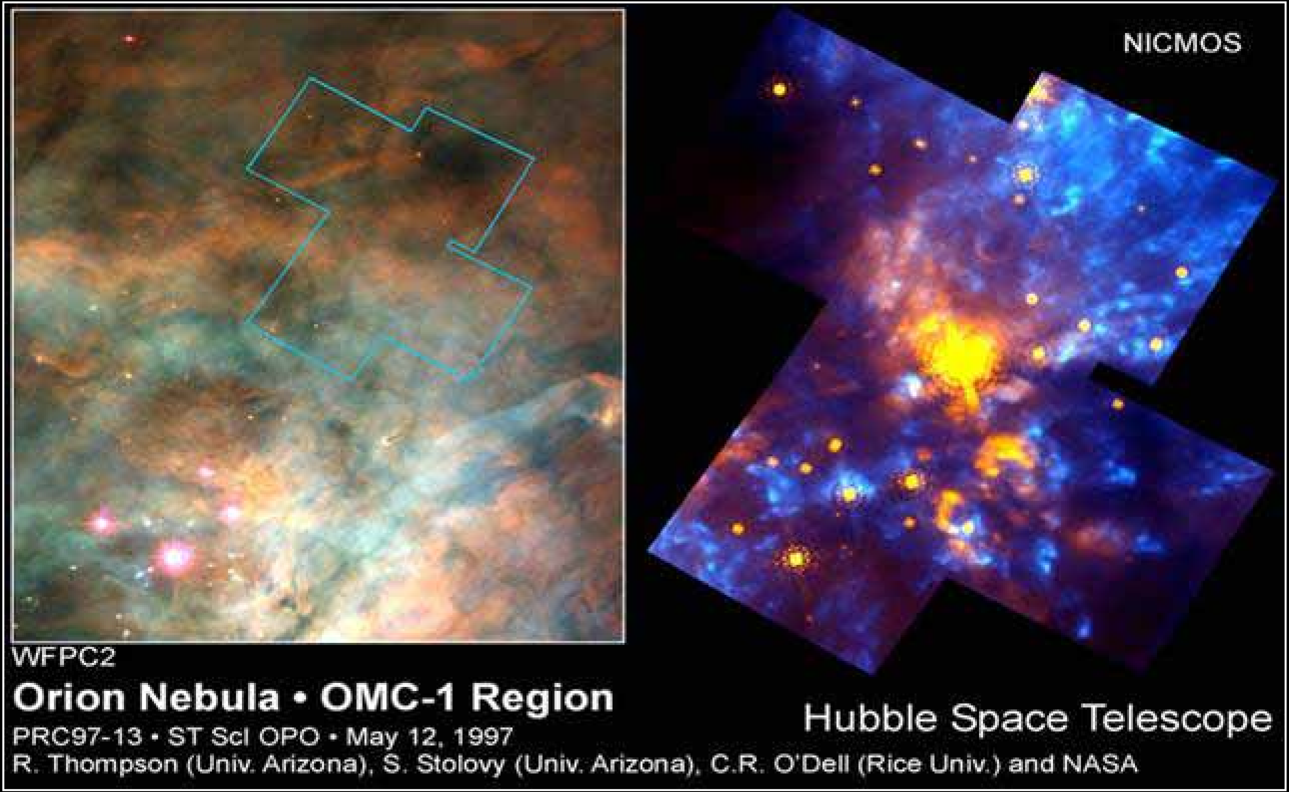


- **Cool objects--like newly forming stars and solar systems--emit almost exclusively in the Infrared**

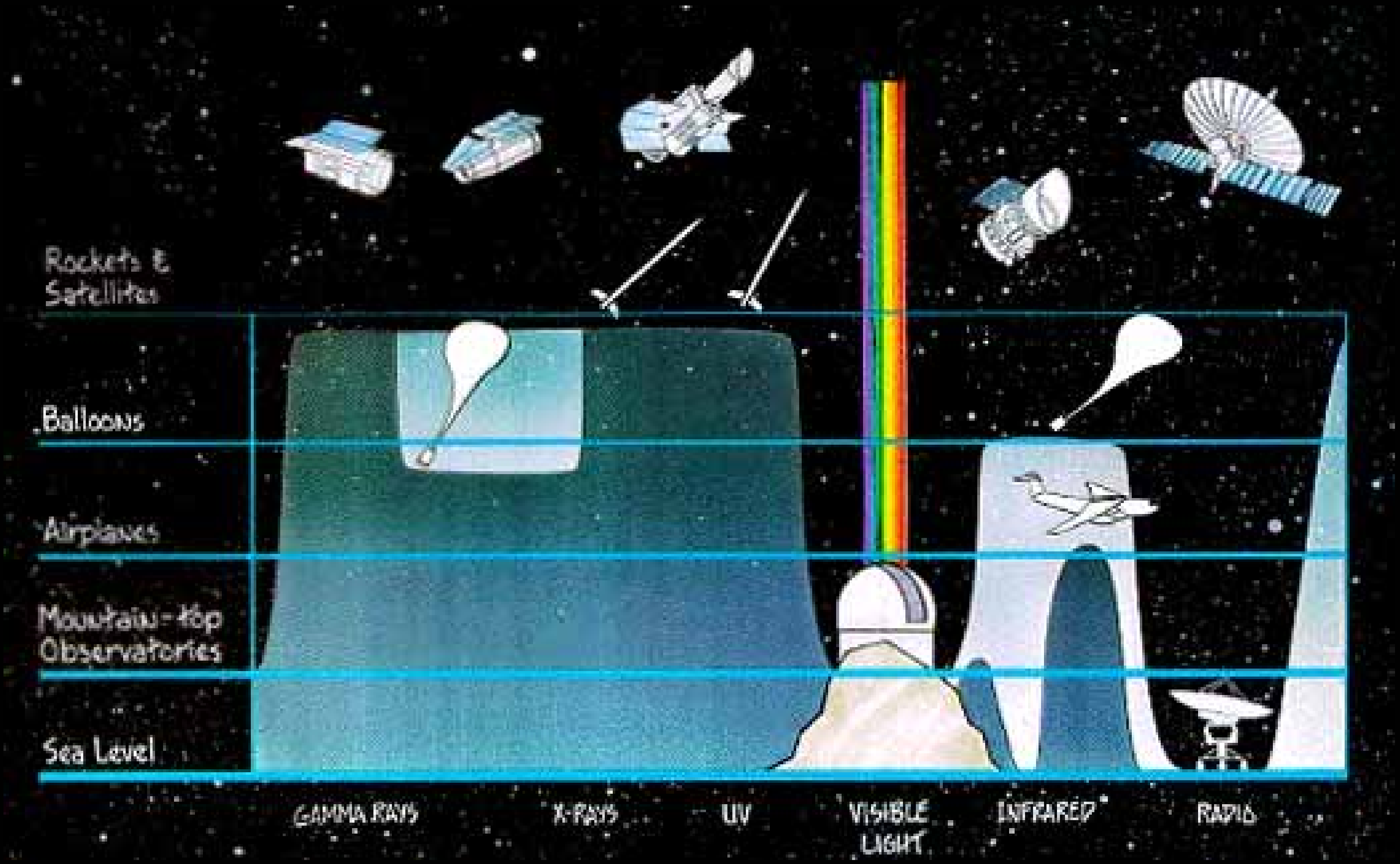


Why Study Infrared?

Infrared penetrates intervening dust clouds, allowing us to see through or into them



But there’s a Challenge…



- Earth’s atmospheric water vapor absorbs almost all incoming infrared radiation
- Even mountain-top observatories get a limited view of the infrared universe

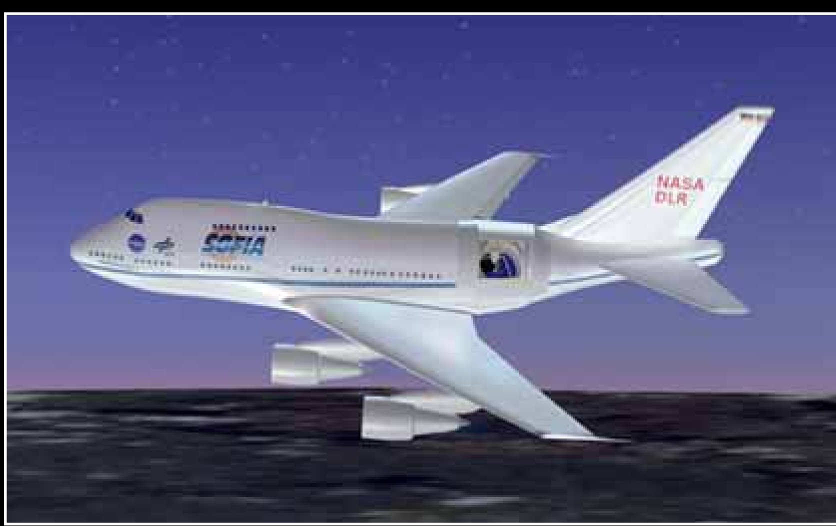
Infrared telescopes need to observe from high altitude or in space

NASA's Infrared Missions

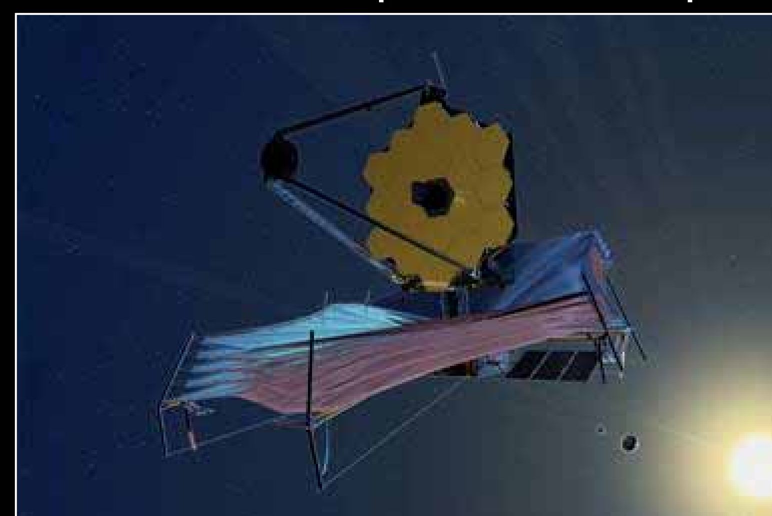
Spitzer Space Telescope

WISE

SOFIA



James Webb Space Telescope



WISE Wide-field Infrared Survey Explorer

NASA

WISE will map the sky in infrared light,
searching for the nearest and coolest stars,
the origins of stellar and planetary systems,
and the most luminous galaxies in the Universe.

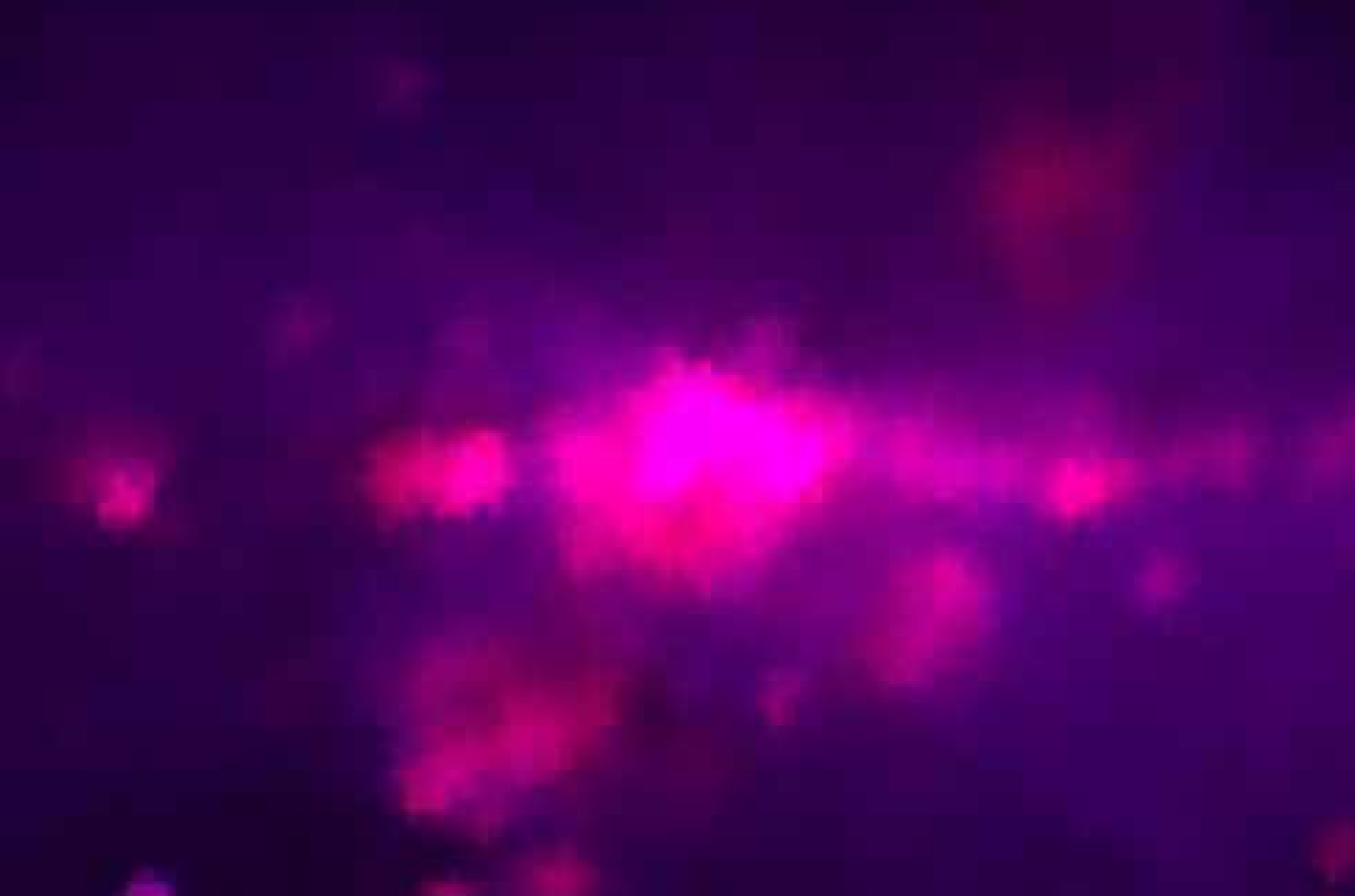
WISE will deliver to the scientific community:

Over 1 million images covering the whole sky in 4 infrared wavelengths

Catalogs of ≈ 500 million objects seen in these 4 wavelengths

wise.astro.ucla.edu

Two decades ago IRAS gave us what is still our best view of the mid–infrared sky.



WISE will map the entire sky with resolution comparable to the view shown here.

WISE Mission: Orbit

WISE will be launched in late 2009

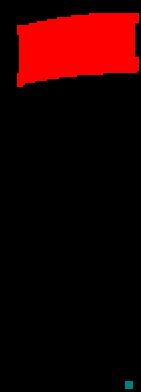
It will orbit Earth cart-wheeling once per orbit to always stay pointing straight up and will always keep its solar panels to the Sun.

As Earth orbits the Sun, WISE's orbit also rotates to maintain the spacecraft's orientation to Earth and Sun

WISE Mission: Surveying

Each image exposure will last 11-sec and is matched to the orbit.

Each orbit, a circular strip of the sky is imaged.



As the orbit itself rotates, a slightly different strip is imaged.

In 6 months, the entire sky is imaged

There will be 8 or more exposures at each position over more than 99% of the sky.

WISE Mission: Wavelengths

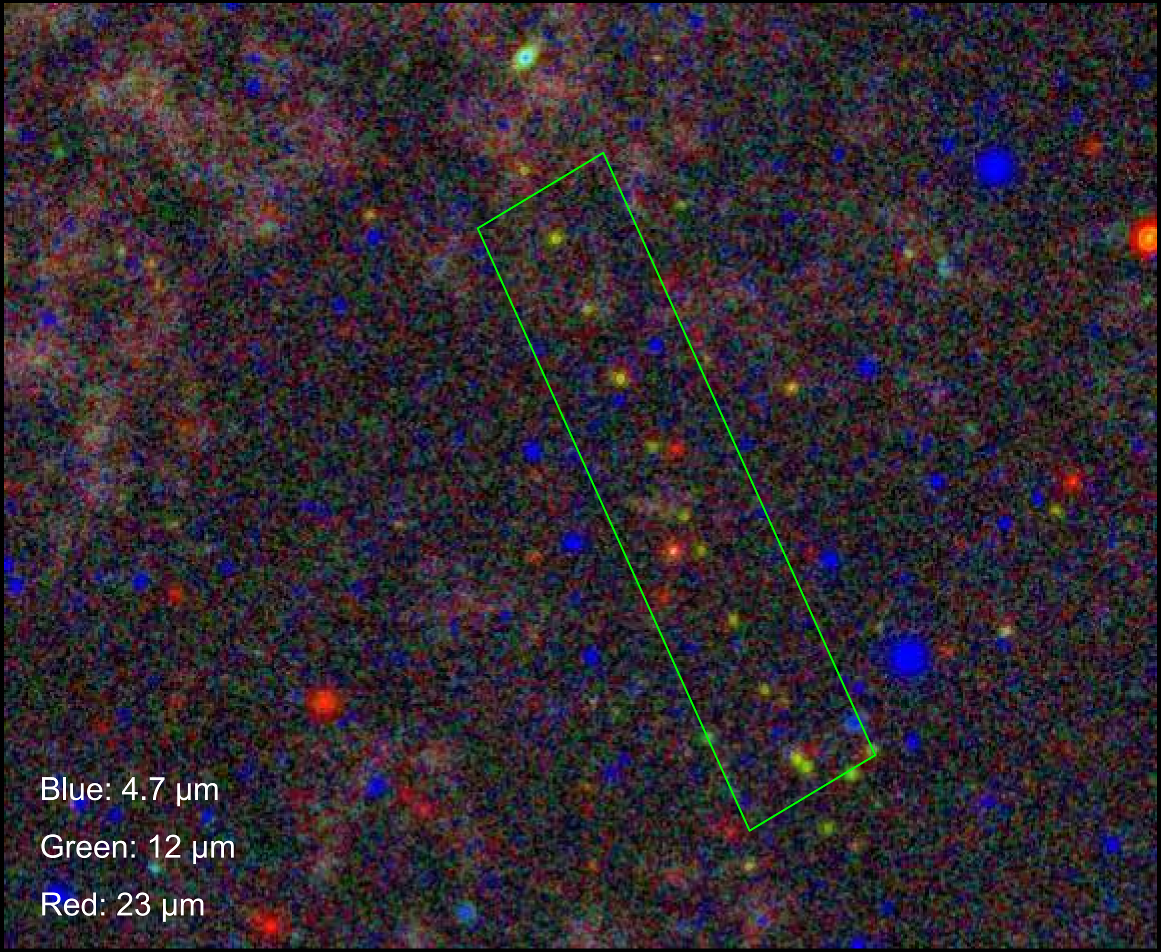
WISE will survey the sky in two near infrared channels:
3.3 and 4.7 μm

WISE will survey the sky in two mid-infrared channels:
12 and 23 μm

WISE Science: Asteroids

WISE will detect most of the Main Belt asteroids larger than 3 km, providing reliable diameters for them.

WISE Science: Asteroids

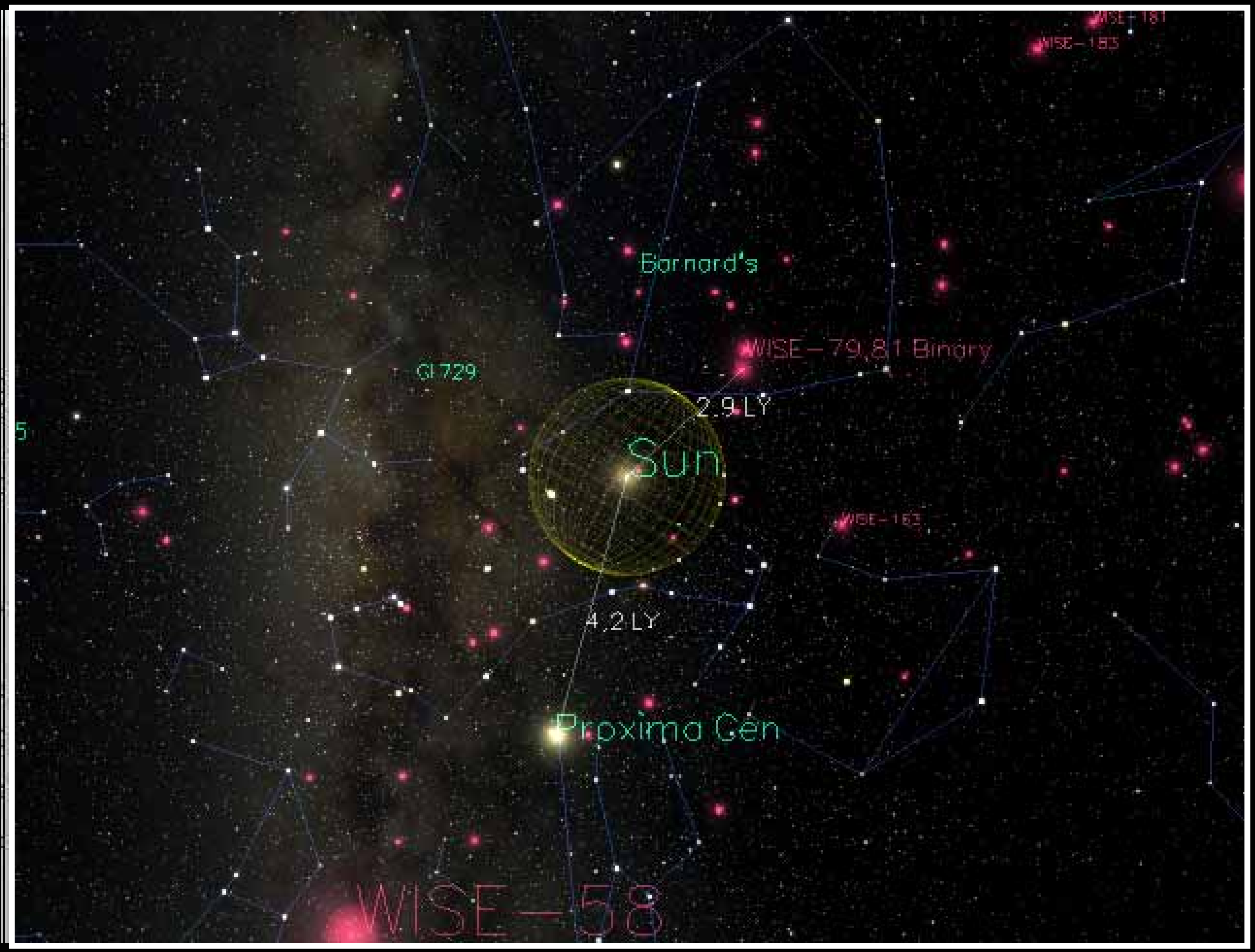


A simulated composite WISE image demonstrates how the motion of an asteroid will be easily detected

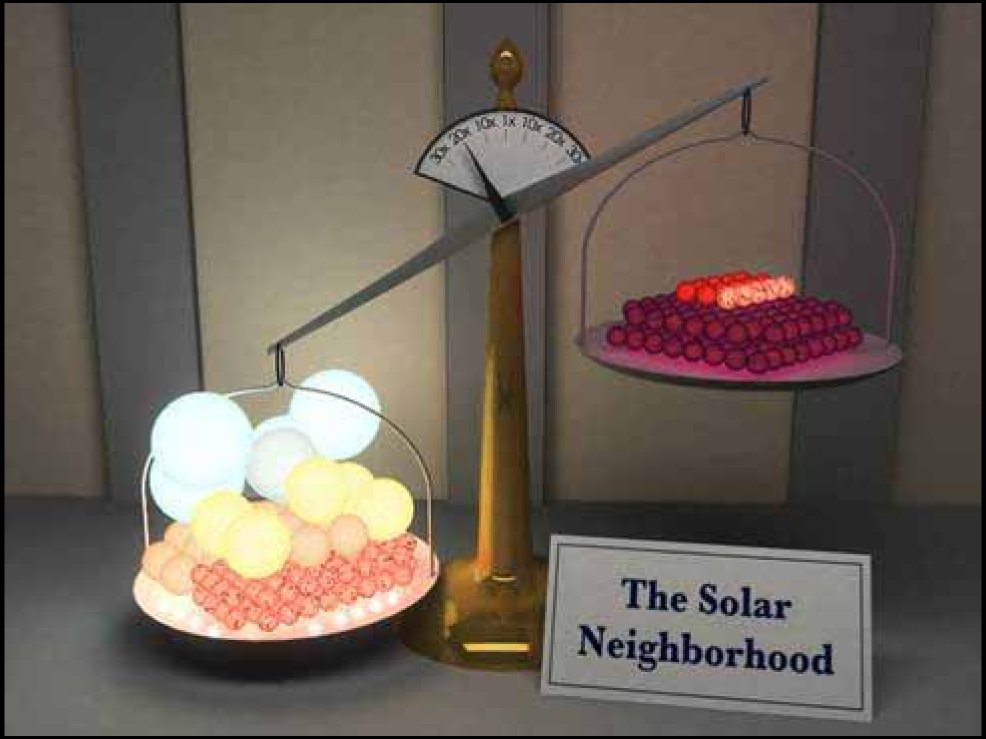
WISE's Education Program will allow students to search for asteroids themselves

WISE Science: Cool Stars

WISE will find the coolest and closest stars to the Sun



WISE Science: Cool Stars

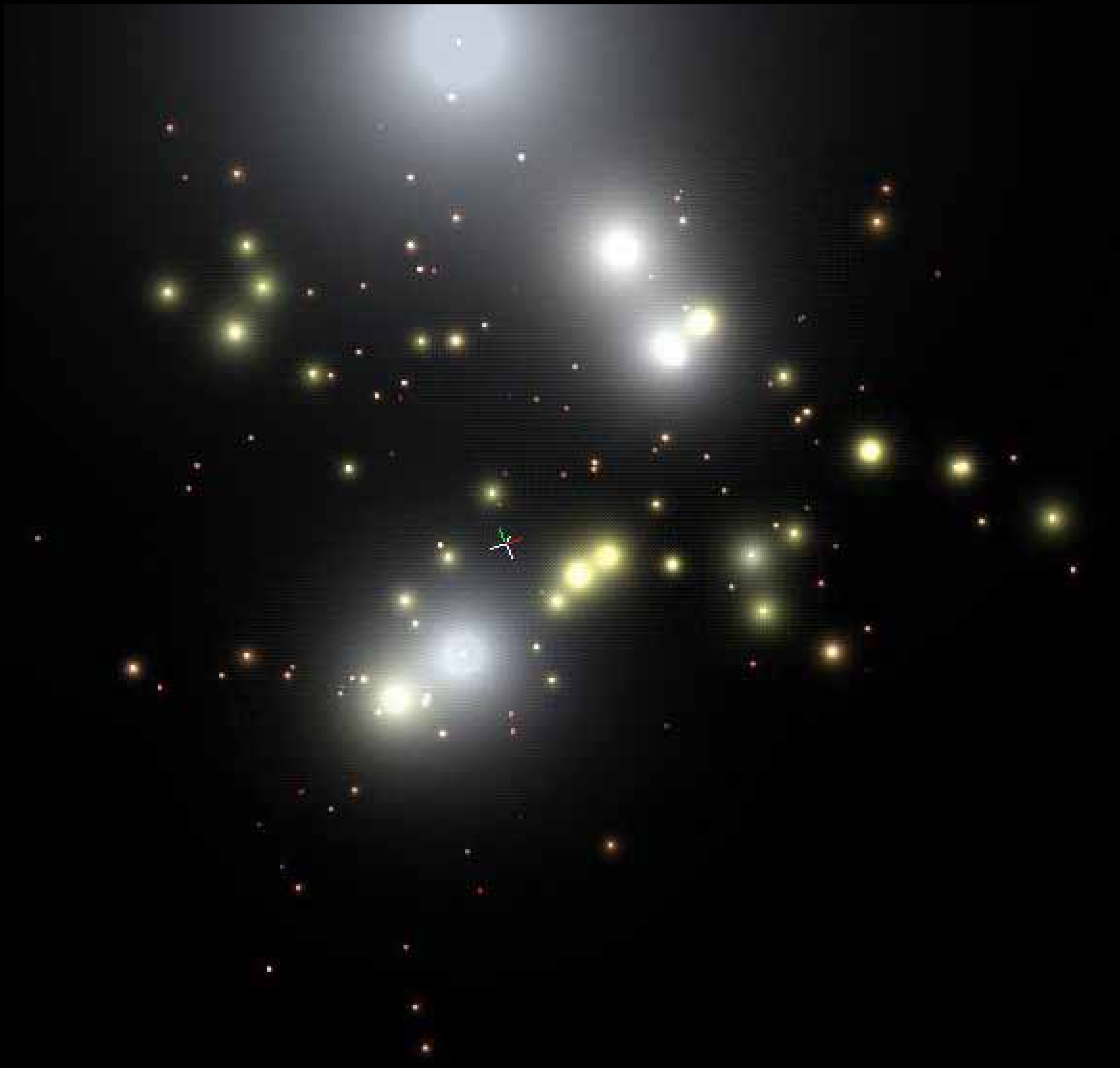


Red and Brown Dwarf stars are the most common type of star.

They have lowest masses and are the coolest stars.

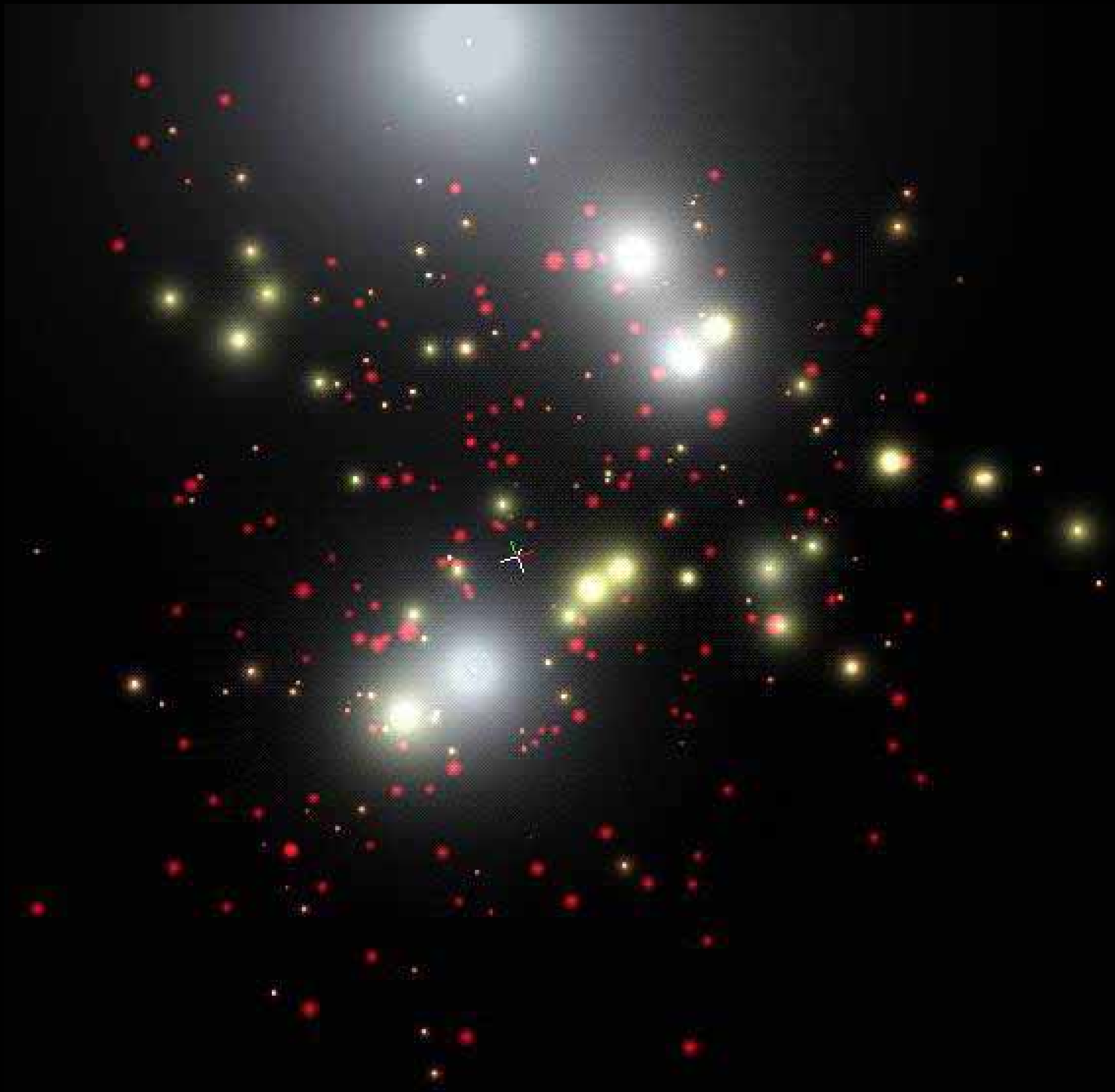
They emit most of their energy in infrared light and are faint.

WISE Science: Cool Stars



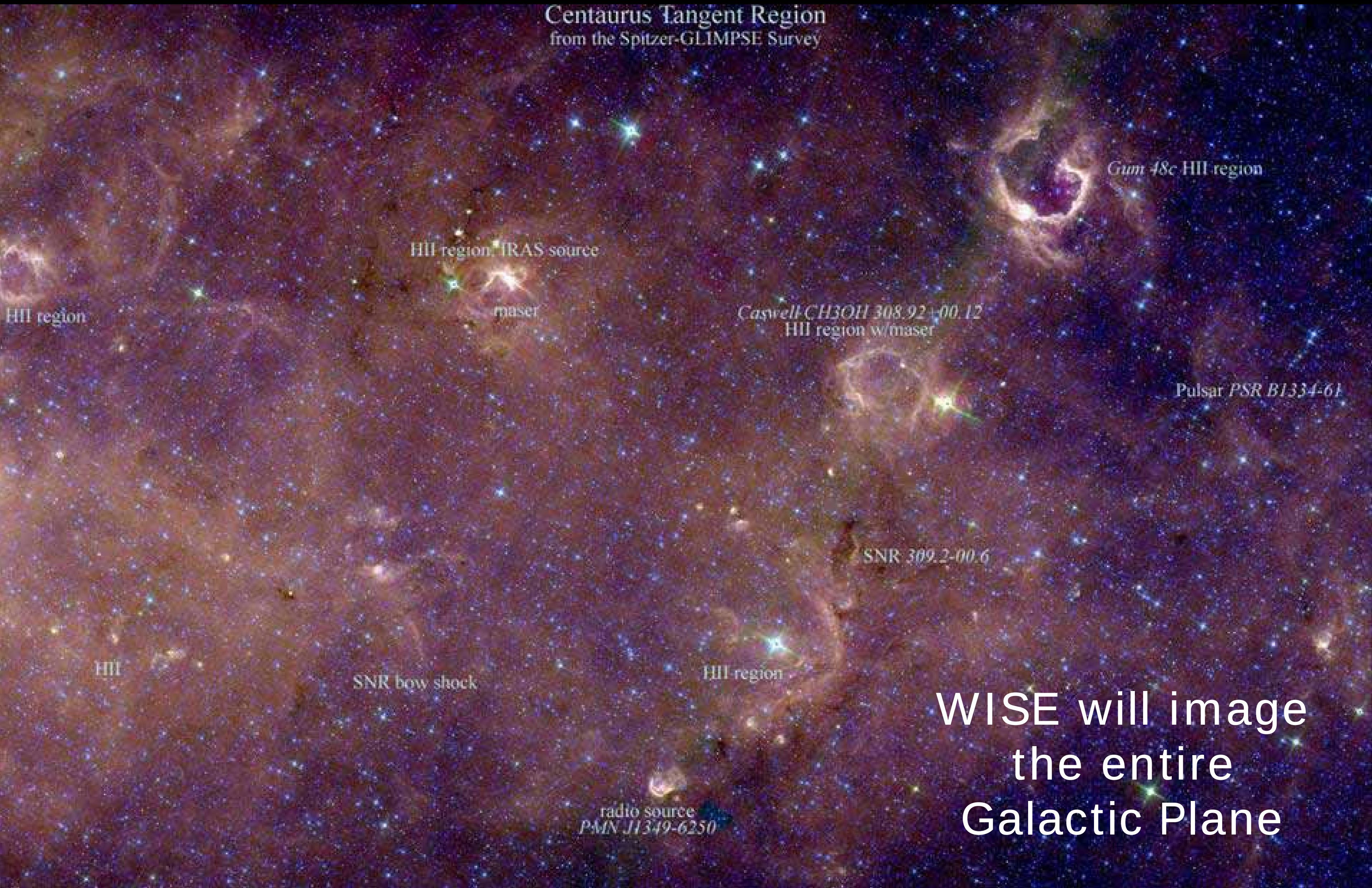
Known Stars within 25 light-years

WISE Science: Cool Stars



WISE Stars within 25 light-years

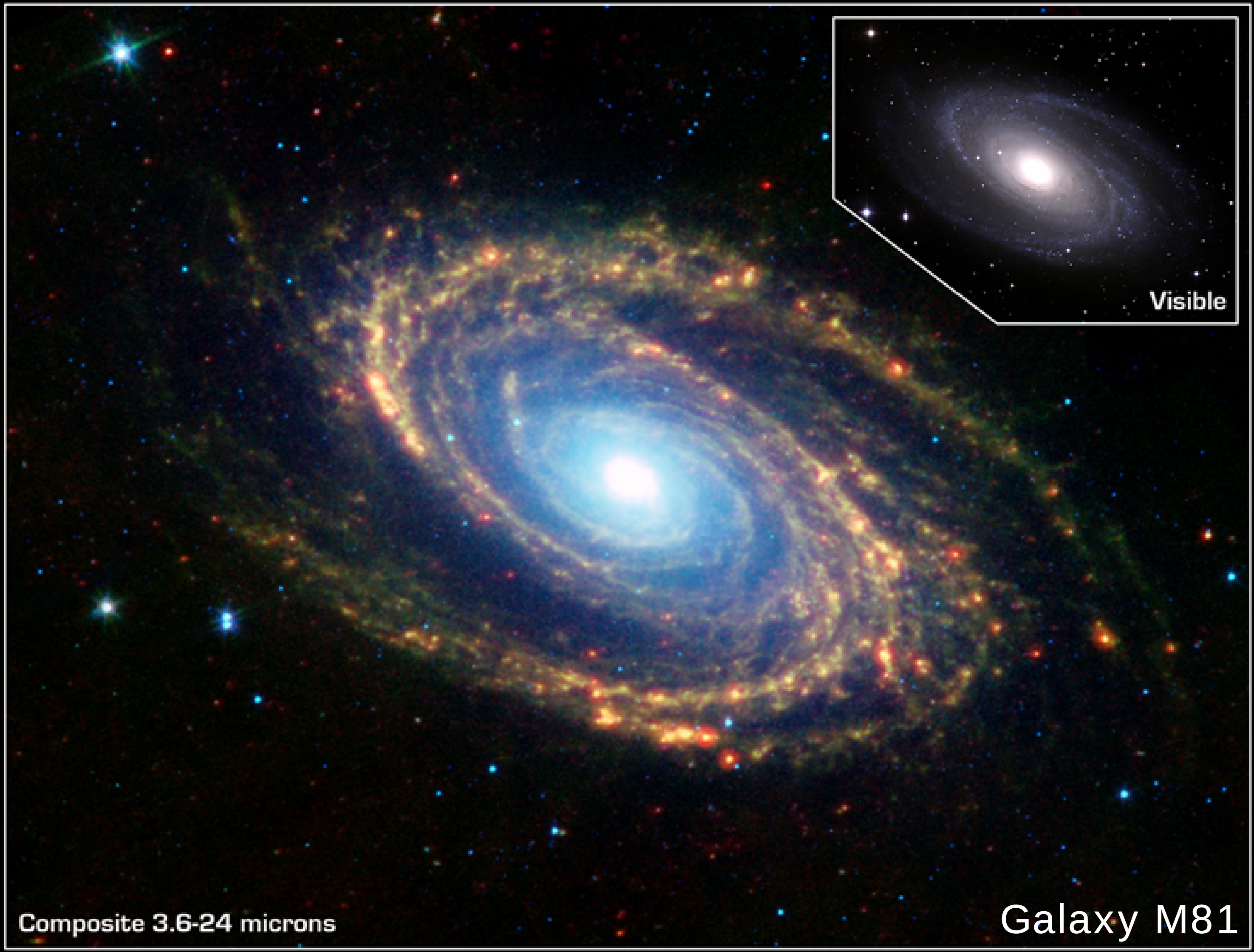
WISE Science: The Milky Way



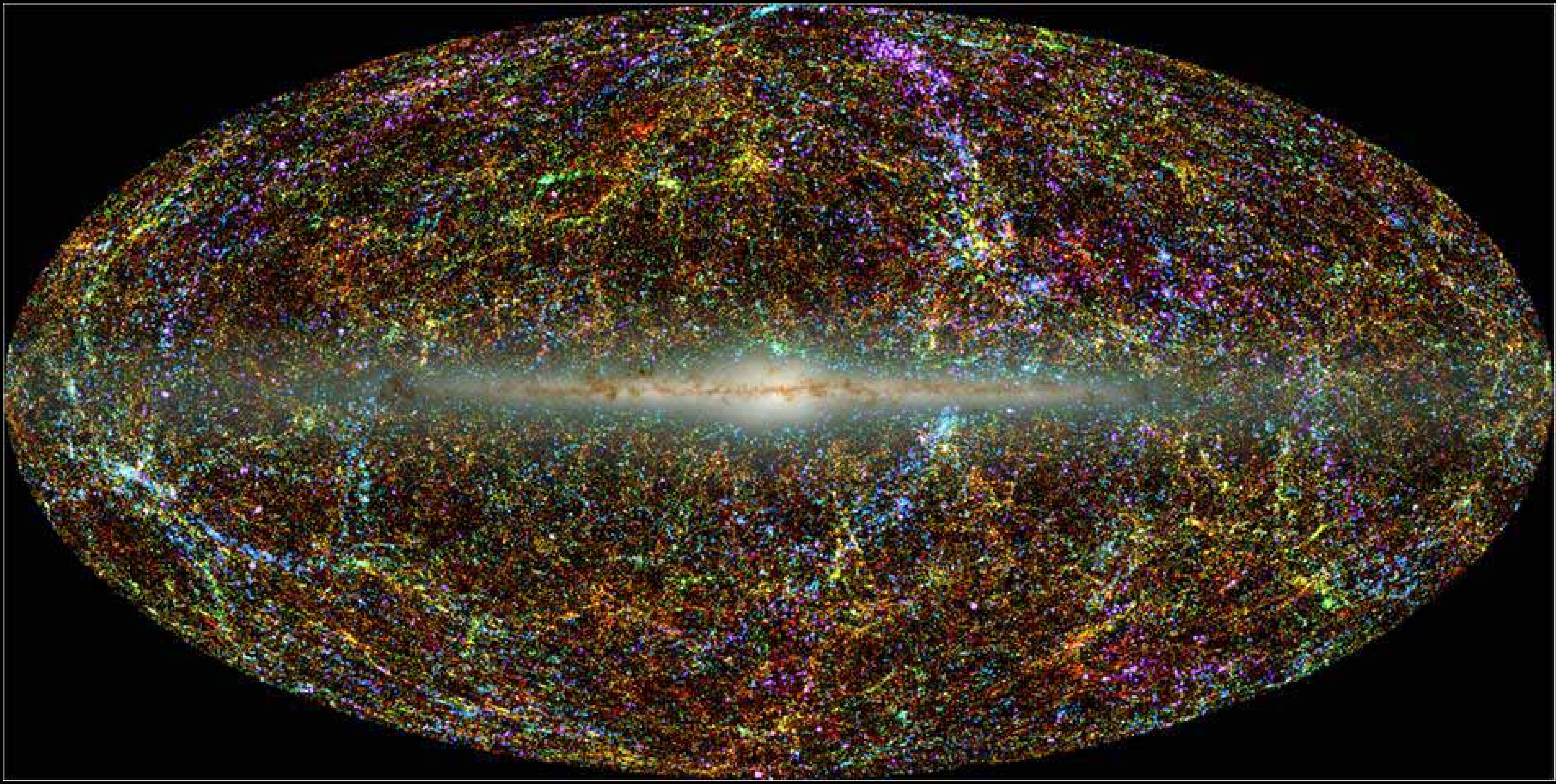
WISE will image the entire Galactic Plane

WISE Science: Extragalactic

WISE will image all nearby galaxies



WISE Science: Cosmology

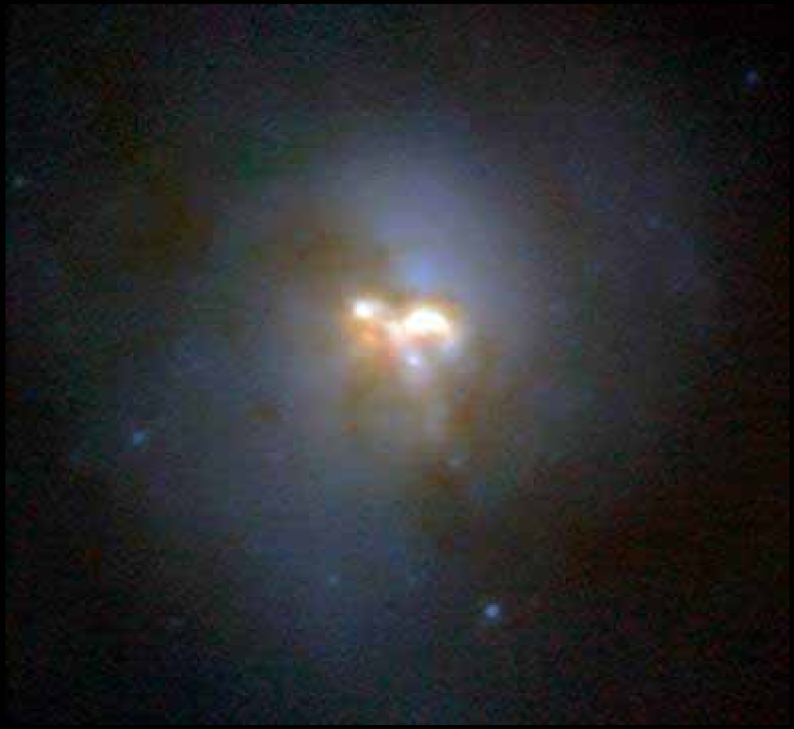


2MASS Surveyed Large Scale Structure out to 1.3 Billion Light-years (z ~ 0.1)

WISE will survey out to 6.7 Billion Light-years (z ~ 0.5)

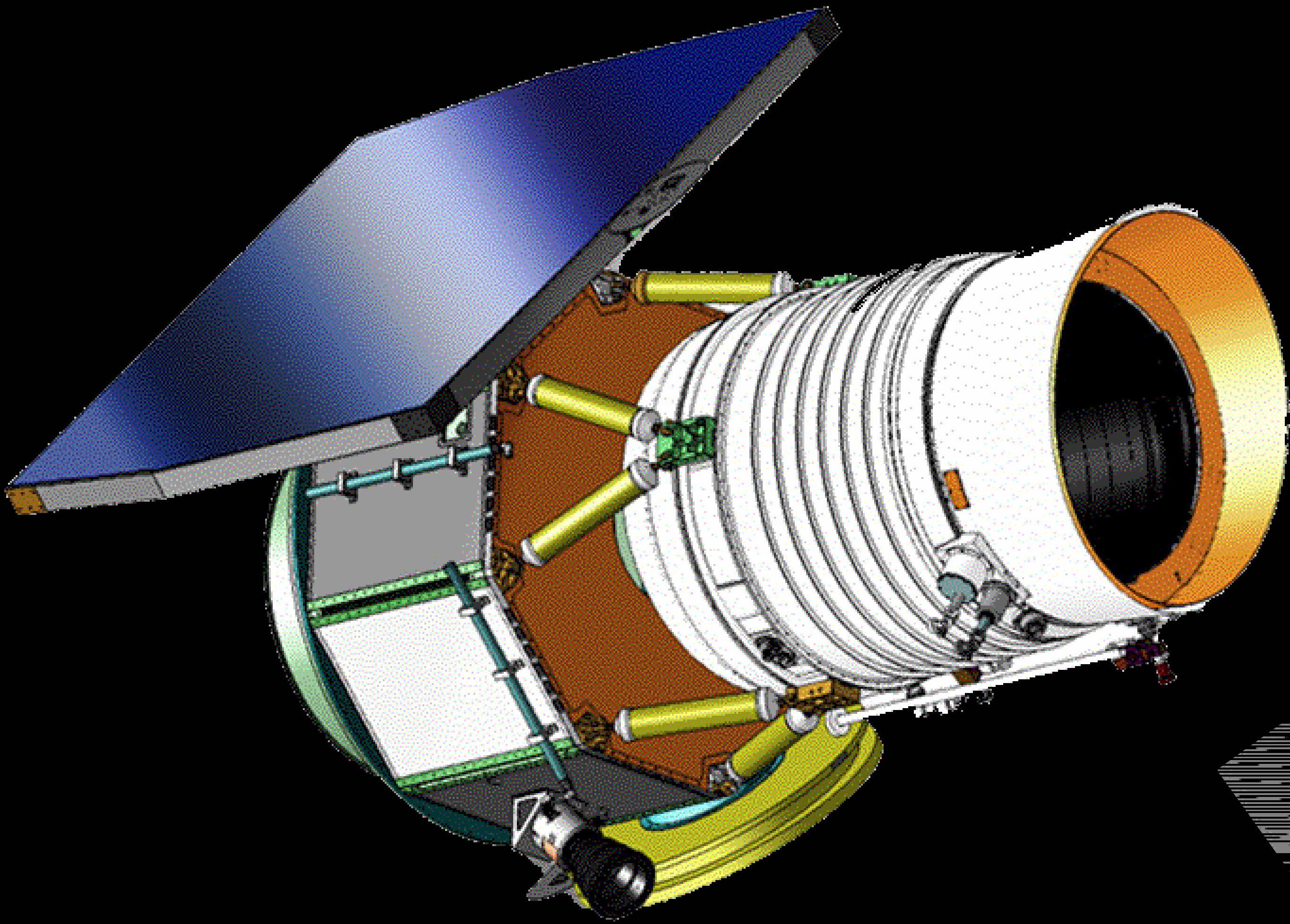
WISE Science: Extragalactic

WISE will find the most luminous galaxies in the Universe:
Ultra-luminous Infrared Galaxies (ULIRGs)



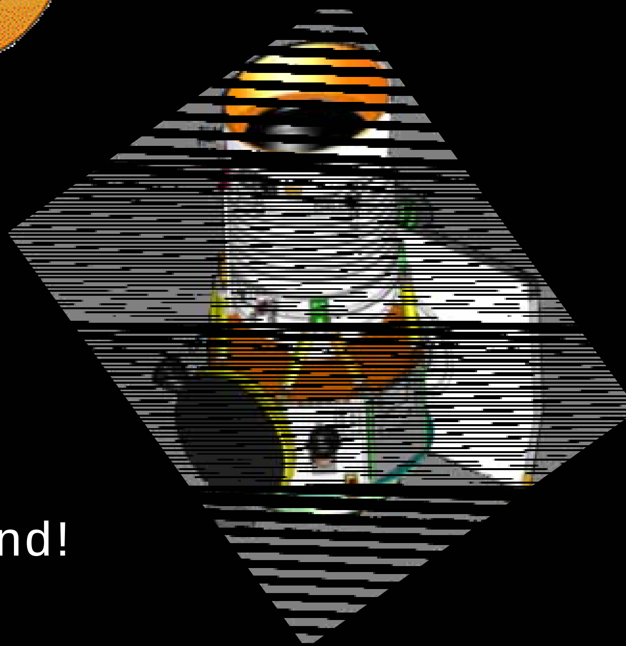
ULIRGs are merging galaxies whose collisions lead to dust-enshrouded bursts of star formation.

WISE Mission: Spacecraft



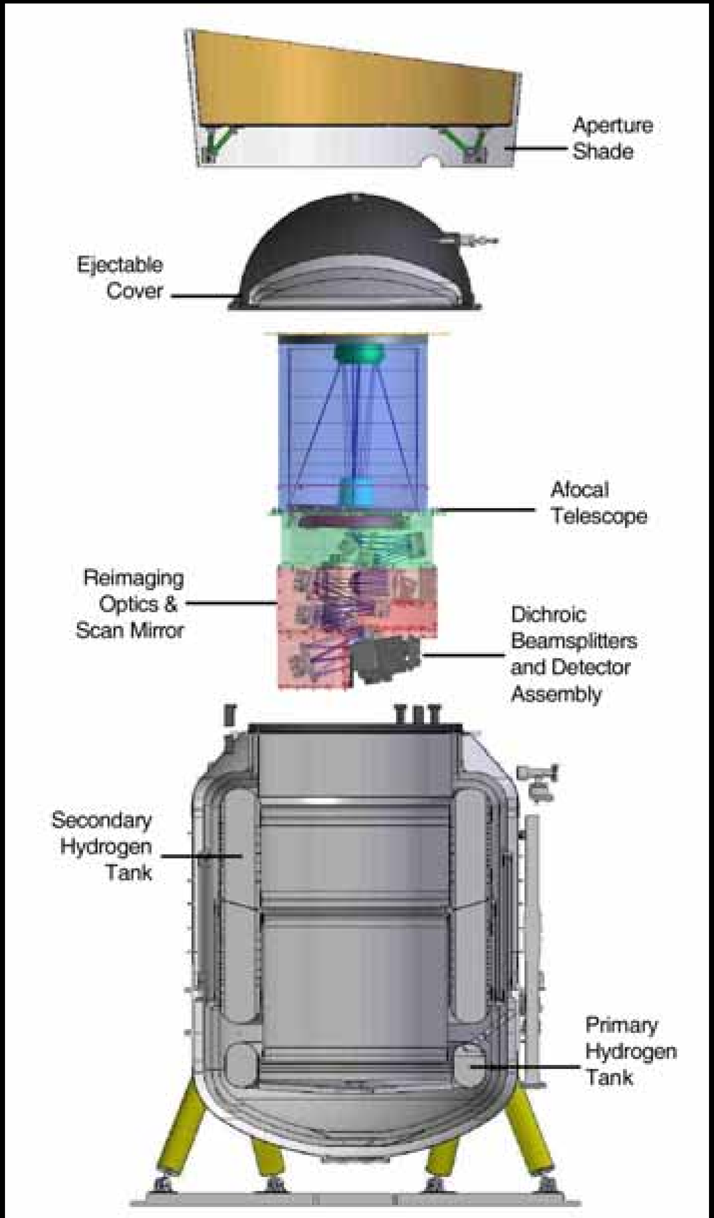
A cold 40 cm telescope in Earth orbit

Enabled by new megapixel infrared detector arrays

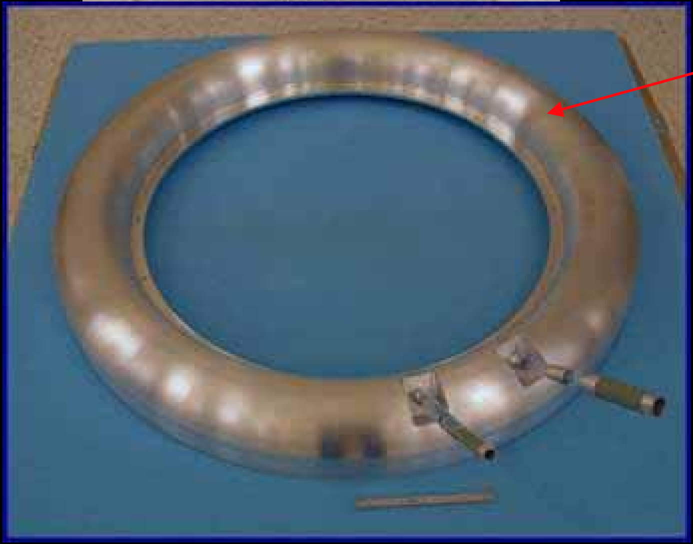


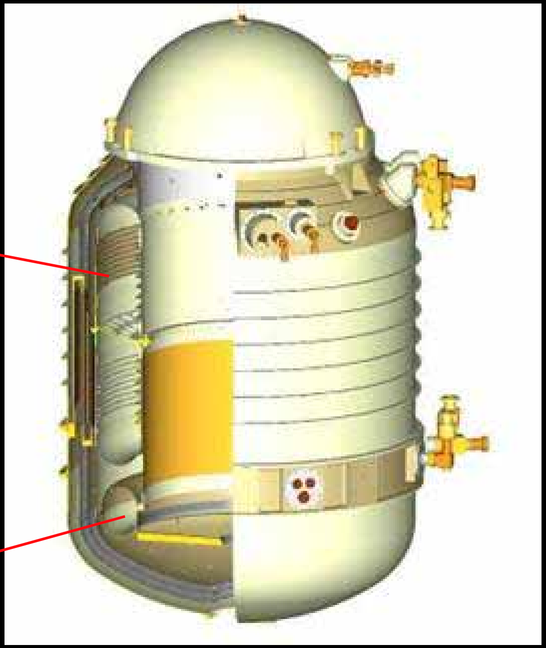
By being in space, the 40 cm WISE telescope is as powerful as 6,000 8-meter telescopes on the ground!

WISE Mission: Payload



WISE Mission: Cryostat

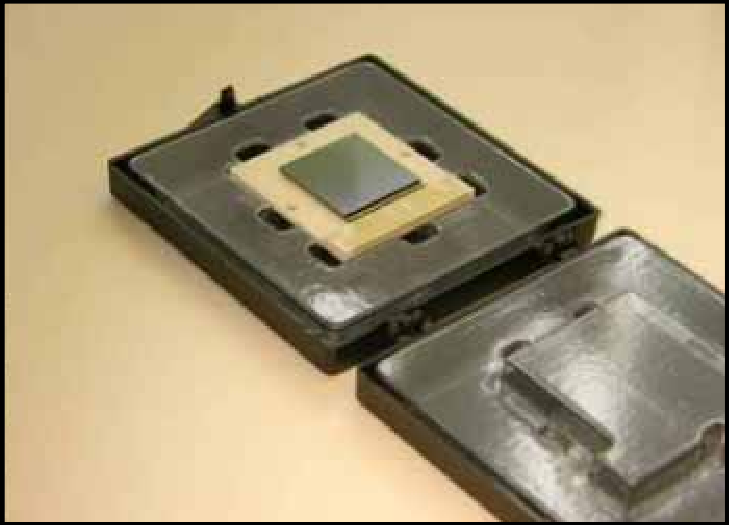




Uses solid hydrogen to cool optics and detectors down to near absolute zero.

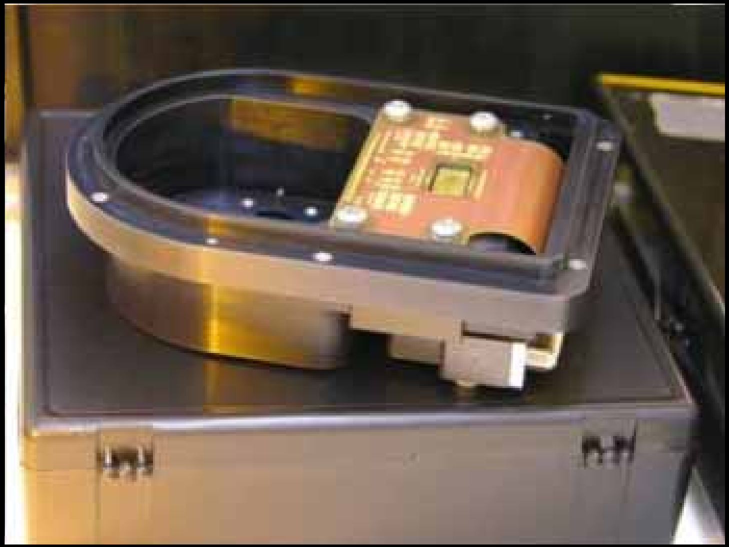
WISE Mission: Detectors

Mid Infrared Detector Array



1024^2 Si:As Detector

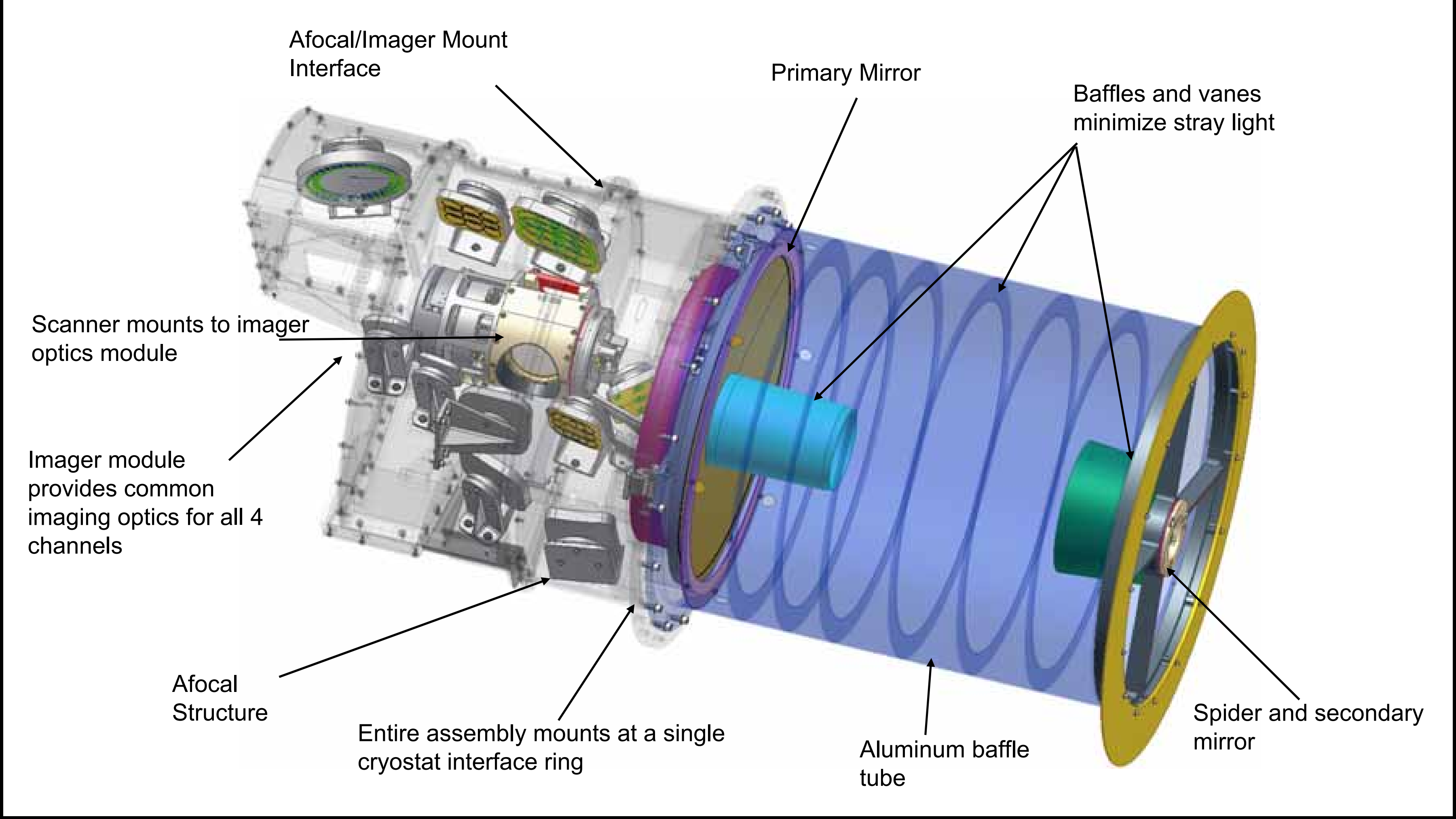
Near Infrared Detector Array



1024^2 HgCdTe Detector in Focal Plane Mount Assembly

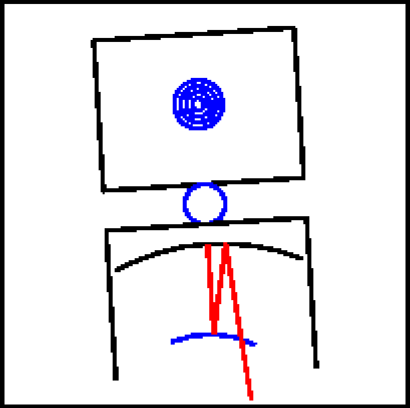
WISE Mission: Optics

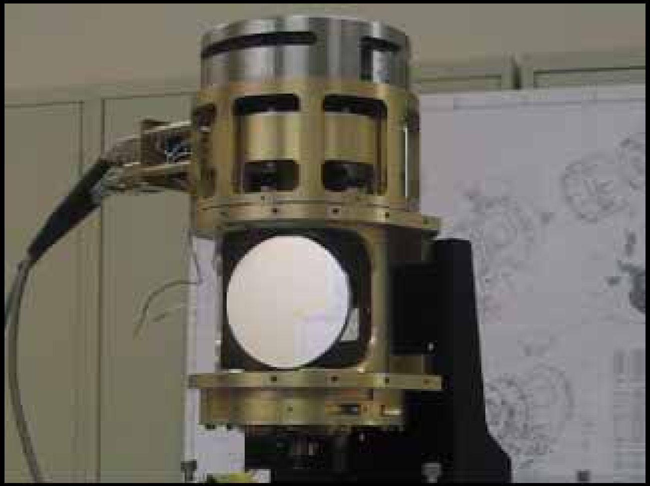
The WISE End-to-End Optical System with Embedded Scanner



WISE Mission: Scan Mirror

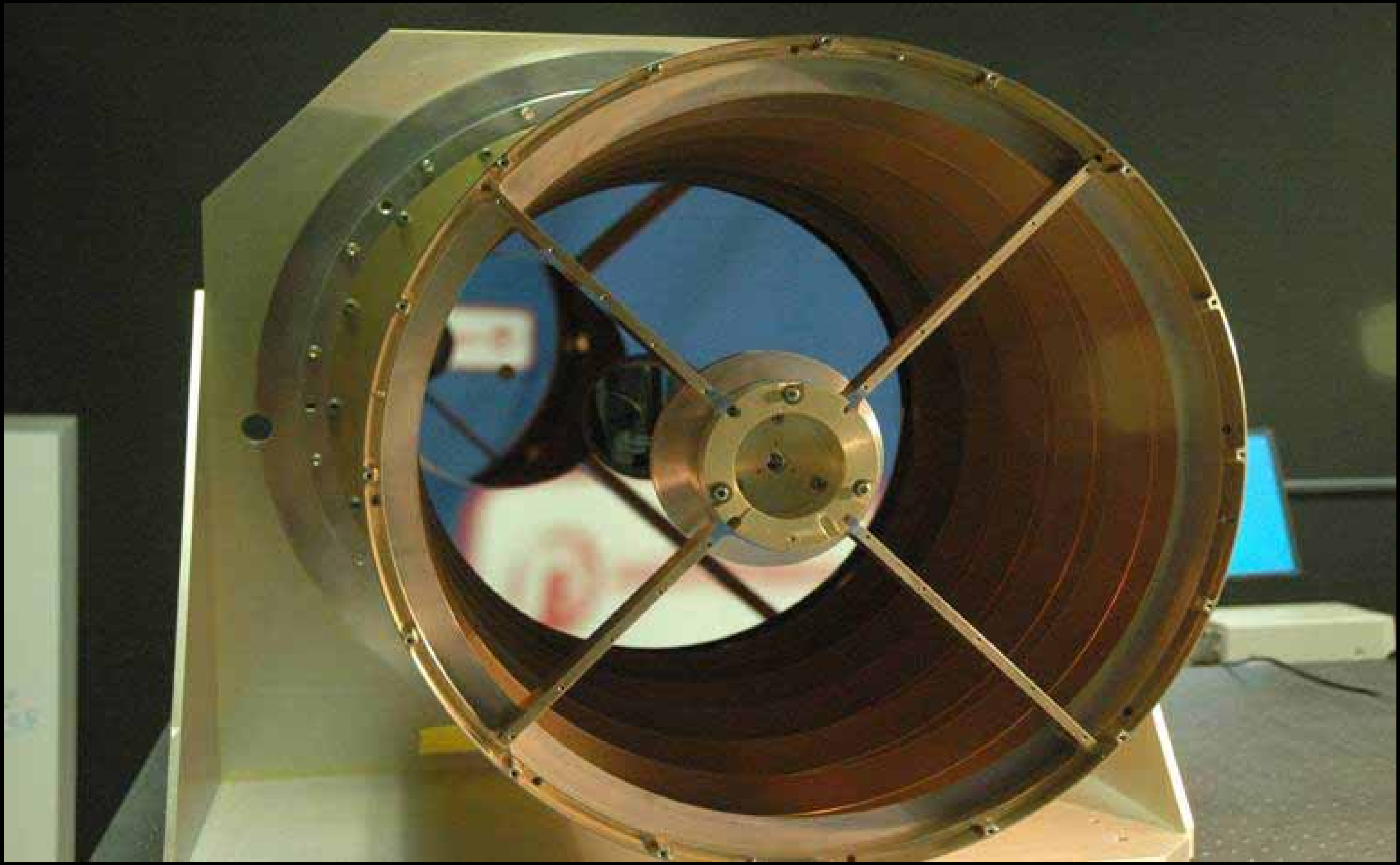
WISE will use a scan mirror to stabilize the line-of-sight while the spacecraft scans the sky.





WISE Mission: Telescope

WISE Mission: Telescope

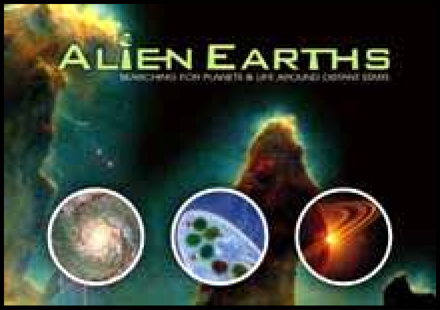


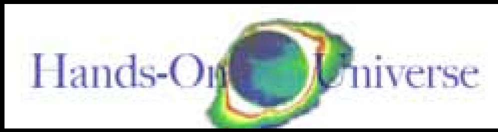
Note: the M2 and M1 baffle cones were not installed at time of photo

WISE Education & Outreach

The WISE E/PO Program is a multifaceted enterprise bringing together a veritable who's who of professionals in formal and informal astronomy education.

The WISE E/PO program will inspire students, teachers, and the public at large to appreciate, understand, and take part in the WISE mission.





WISE