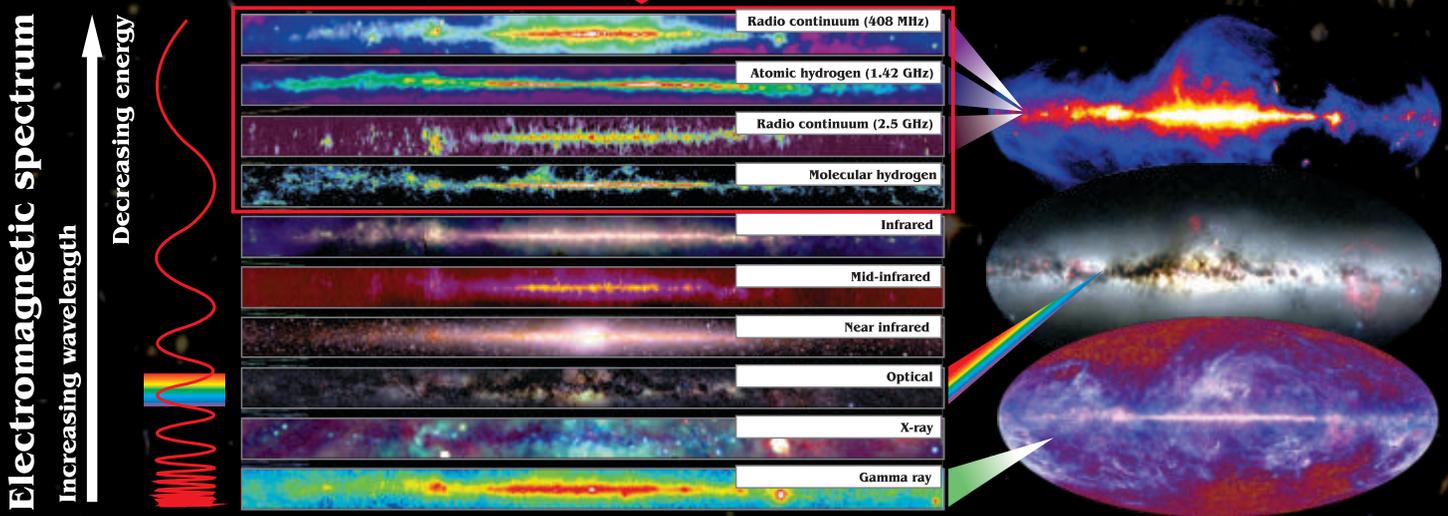


# What is RADIO ASTRONOMY?

Astronomy is one of the oldest sciences. It is concerned with the evolution, physics, chemistry, meteorology and motion of celestial objects. It also deals with the formation and development of the universe. Celestial objects studied include planets, comets, stars, star clusters, nebulae and galaxies. Radio astronomy studies the part of the electromagnetic spectrum with wavelengths between approximately one millimeter and 30 meters. A wide variety of objects are observable at radio wavelengths, including supernovae, interstellar gas, pulsars, active galactic nuclei and spectral lines produced by interstellar gas (eg. the hydrogen spectral line at 21 cm wavelength).



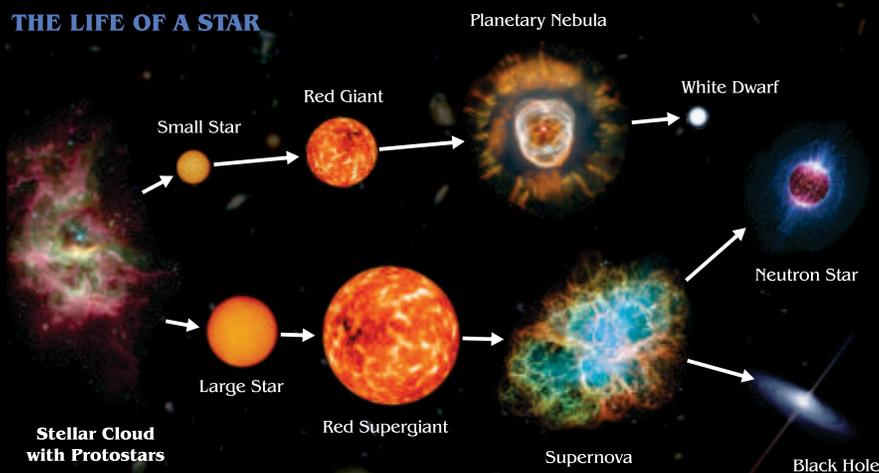
## THE BIG PICTURE Where does radio astronomy fit



## WHY WE DO IT

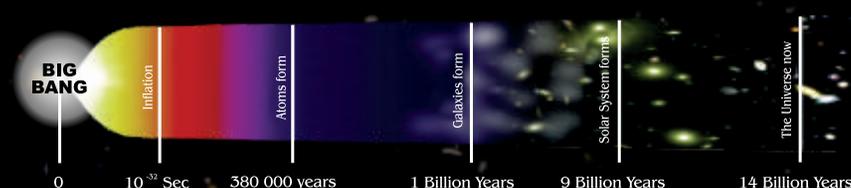
Helping to answer big questions in physics

### THE LIFE OF A STAR



The lifepath a star will follow is determined mainly by 2 factors: the star's initial mass as well as the mass gain or loss during different stages of it's life. Since most stars take billions of years from birth to death, it is impossible for us to observe the entire lifecycle of any one star. Rather one observes as many different stars as one can by keeping in mind that differences are mainly due to mass differences, one can then build accurate models of stellar evolution. Star birth and death are particularly interesting because observations of these events can teach one about physics at high masses and energies, things we cannot reproduce on Earth. From this we can better understand the four fundamental forces: Electromagnetism, Gravity, the Strong and Weak Nuclear forces.

### AGE OF THE UNIVERSE

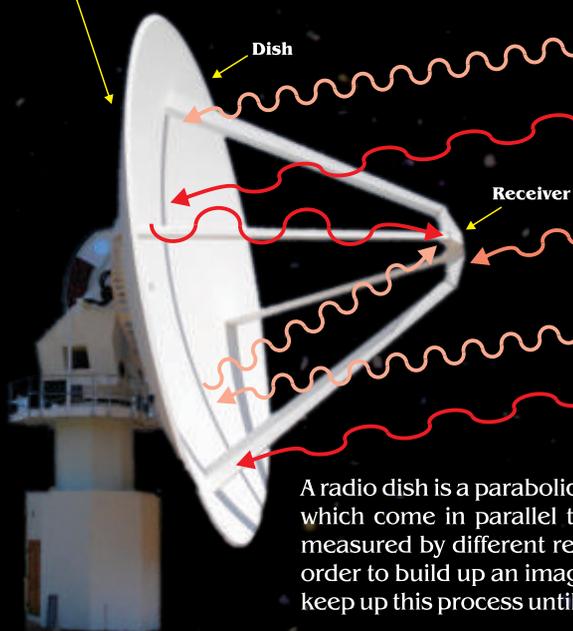


Because light travels at a fixed speed through the vacuum of space, we only observe events that are already in the past. Light from our own sun takes 8 minutes to reach Earth, so we see the sun as it was 8 minutes ago. The same rule applies for all celestial objects: the further away they are, the further in the past the events we observe took place. Therefore observing objects from near to very far away helps us understand how the universe developed through time.

# DOING RADIO ASTRONOMY

Physics, mathematics, engineering...

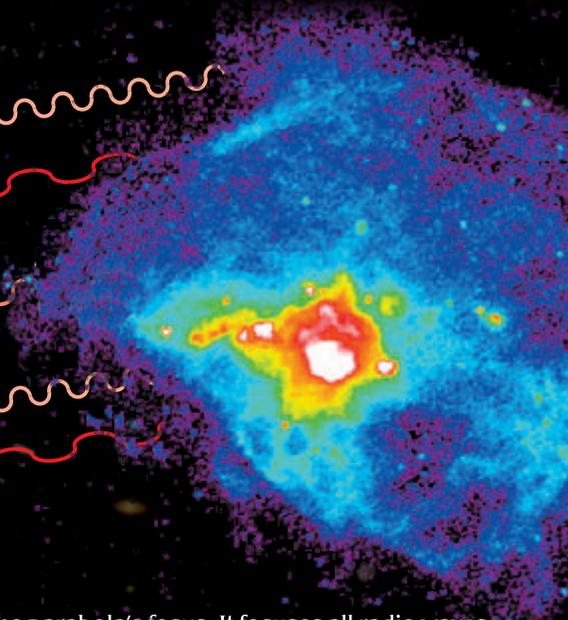
The dish of a radio telescope focuses the radio waves



Radio waves travel across space for millions of kilometers before arriving at earth

Radio Waves

A radio dish is a parabolic metal reflector with a receiver at the parabola's focus. It focuses all radio waves which come in parallel to the dish's axis onto the receiver. Different wavelengths of radio waves are measured by different receiver feedhorns. A radio telescope is effectively a single pixel instrument - in order to build up an image such as the one at the top right, one has to scan through the whole area and keep up this process until all relevant radio wavelengths have been measured for each position.



## THINGS WE OBSERVE

Our eyes do not give the whole truth

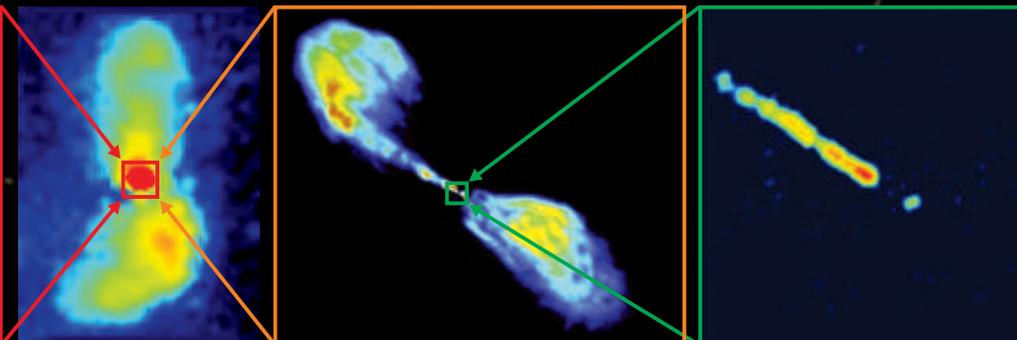
### OPTICAL IMAGE



**Left:** Galaxy NGC5128 (visible): Giant elliptical galaxies such as this are produced by the merger of smaller galaxies. They often contain a super-massive Black Hole spitting out jets of hot gas.

**Right:** The jets, seen in Radio emission, cover 10 degrees on the sky. (Map by the 26-m HartRAO telescope)

### RADIO IMAGES



**Left:** Radio emission from the inner part of the jets in NGC5128, mapped by the Very Large Array (VLA) which uses Very Long Baseline Interferometry (VLBI) to produce images.

**Right:** Radio emission from the jet as it leaves the Black Hole, mapped by a network of radio telescopes across the Earth (including the HartRAO 26-m dish) using VLBI.

## DR SHARMILA GOEDHART

Profile

Sharmila Goedhart completed her PhD in 2004 through Potchefstroom University while based at HartRAO. Her research focused on the formation of the most massive stars in our Galaxy, using radiation from methanol masers to investigate the changing conditions around young massive stars. She stayed on at HartRAO as staff astronomer after her PhD. In 2008 she joined the SKA SA project to help test the newly constructed XDM telescope (the prototype for the KAT-7 array). She is now a senior commissioning scientist for the Karoo Array Telescope (MeerKAT). Her work involves testing all aspects of the telescope performance, giving feedback to the engineering team and verifying the quality of the scientific data taken.

