



CAASTRO
ARC CENTRE OF EXCELLENCE
FOR ALL-SKY ASTROPHYSICS

What is the Big Bang?



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The Big Bang

What is the evidence for the big bang?



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Hubble's Law

Velocity



distance

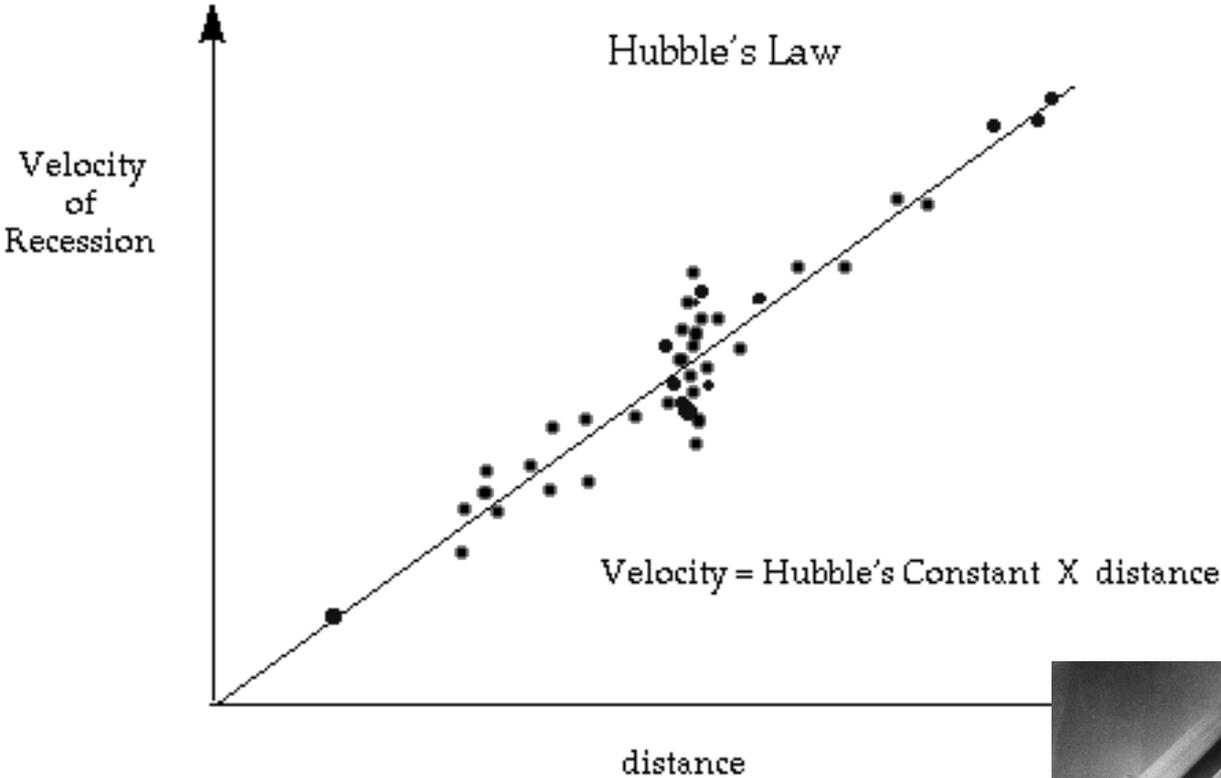


Edwin Hubble

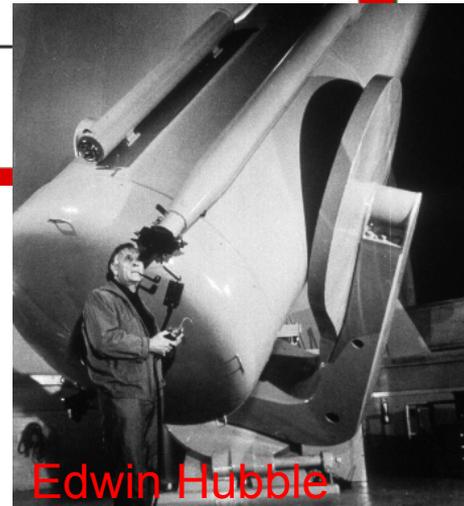


Hubble's Law

Velocity



distance

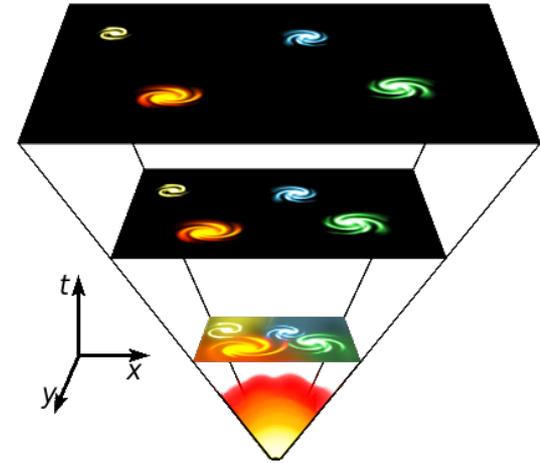


Edwin Hubble



Some predictions

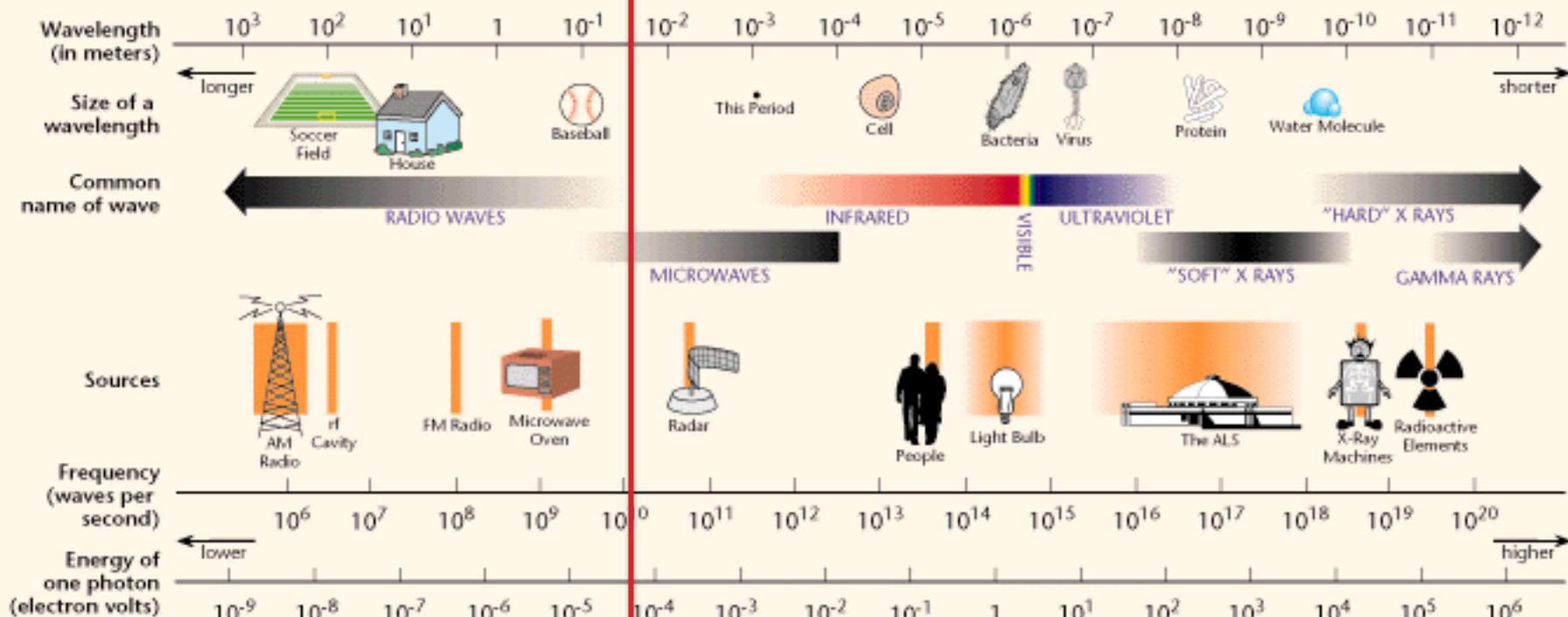
- › If the Galaxies in the Universe are expanding away from each other - at some point in the past they must have been close together. 
- › If the Universe started with an explosion it must have generated an enormous amount of photons or “light”.
- › PREDICTION:
- › **We should be able to detect the left over “light” that was created at the start of the Universe.**
- › But where do we look for itWE NEED RADIO TELESCOPES





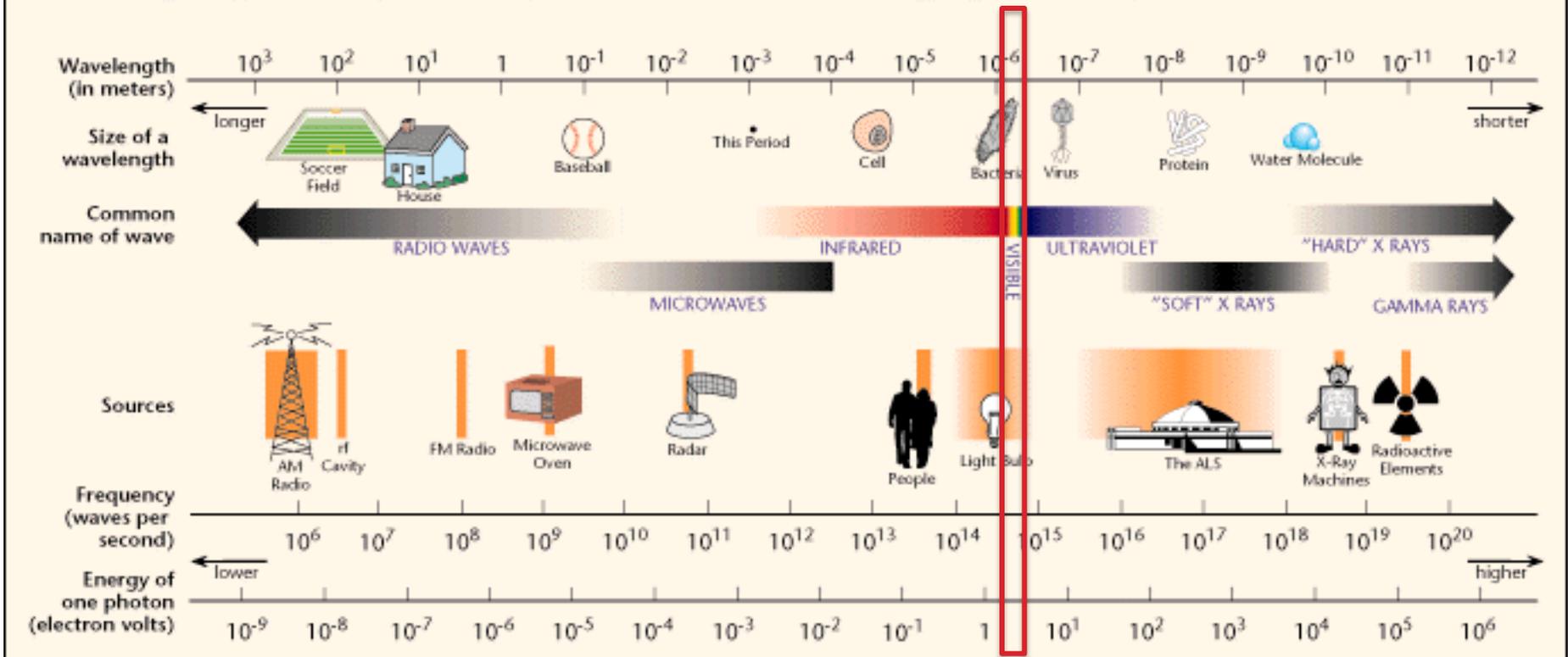
What is radio astronomy?

THE ELECTROMAGNETIC SPECTRUM





THE ELECTROMAGNETIC SPECTRUM



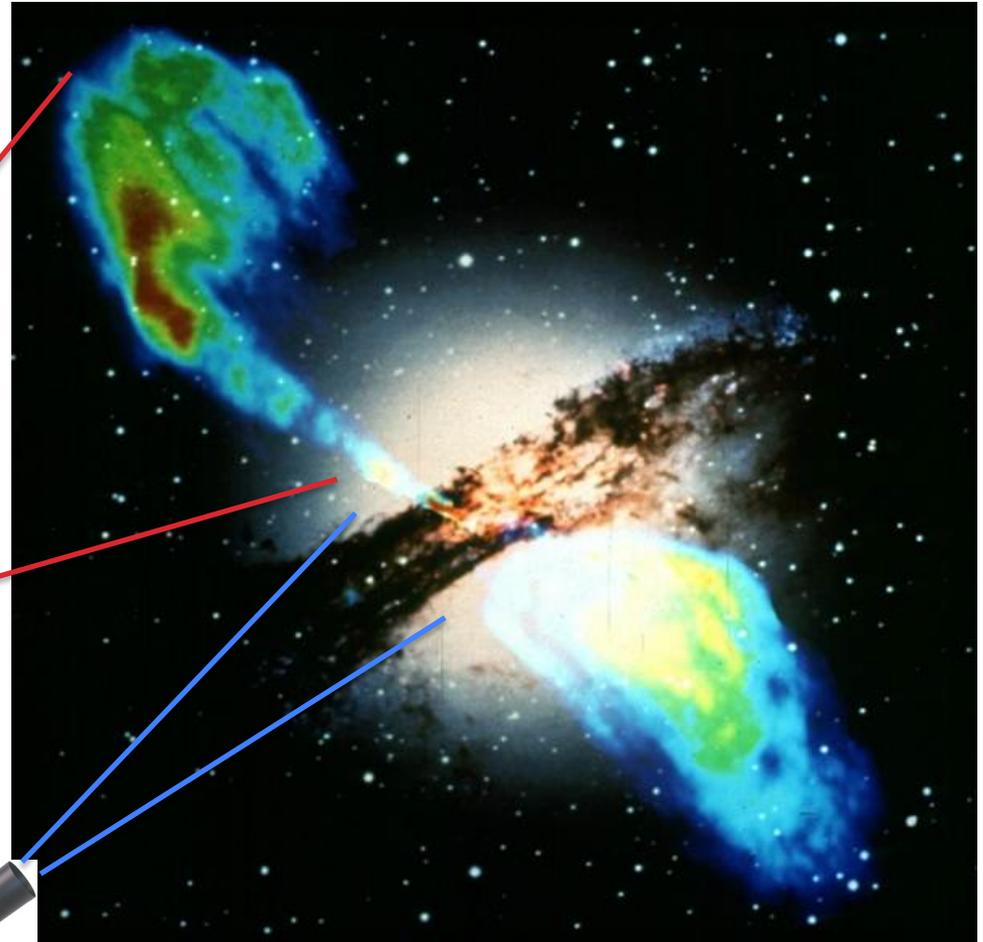
↔
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↔
= One trillionth of the available information



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What do we “see” in the radio waves?

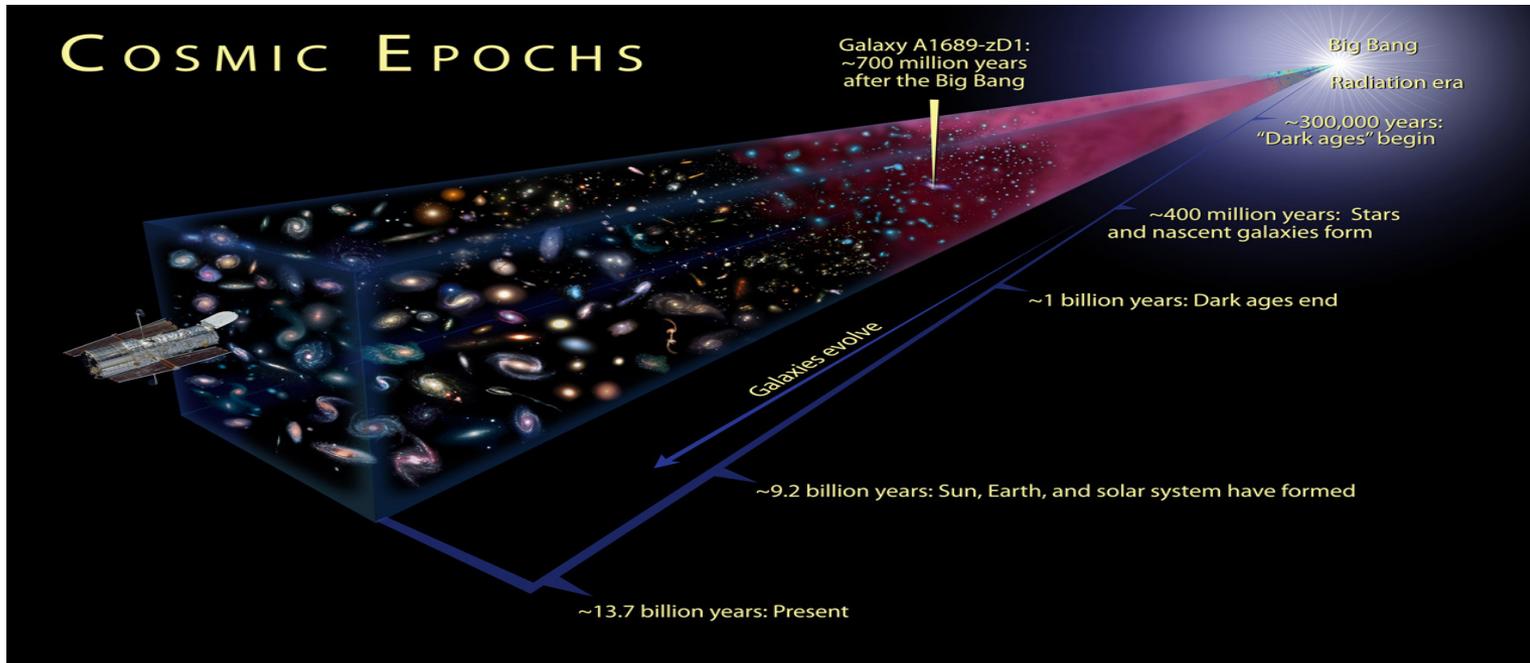
- › **Radio waves** trace the colder quieter photons ($E=hf$).
- › **Optical light** traces stars and dust.





What is the cosmic microwave background radiation?

- › The cosmic microwave background radiation is the relic afterglow of the initial big bang fireball (predicted in the late 1940s)
- › It is the radiation that was released in the Big Bang and has now “cooled”.
- › It emits at radio wavelengths (microwaves).

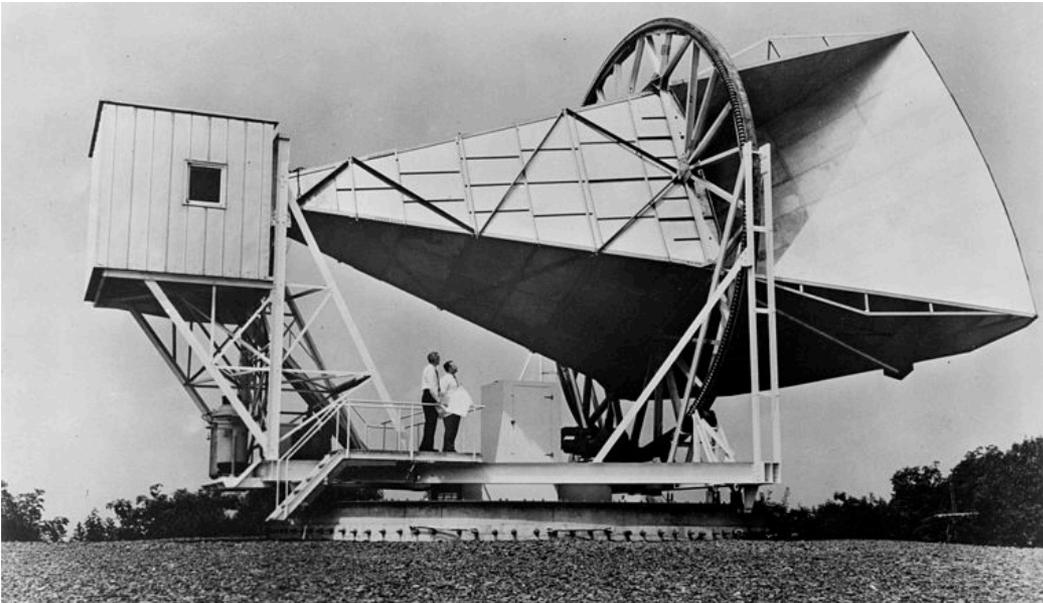
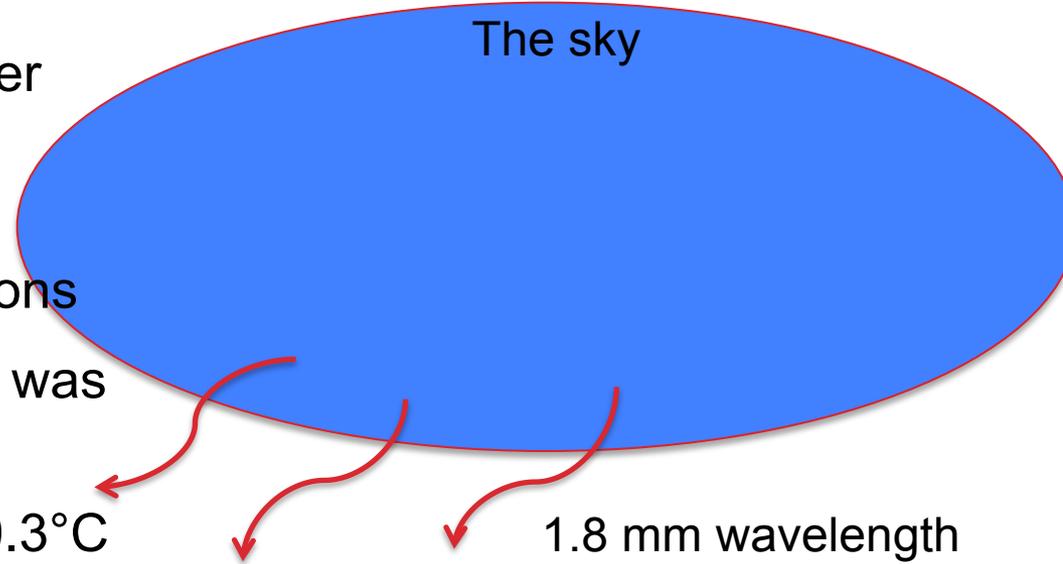




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The discovery of the cosmic microwave background radiation

- › Penzias and Wilson 1978 discover the CMB and win Noble prize
- › They discovered that space was emitting radio waves in all directions
- › The temperature of this radiation was very cold but NOT zero.
- › Temperature = 2.7 Kelvin or -270.3°C

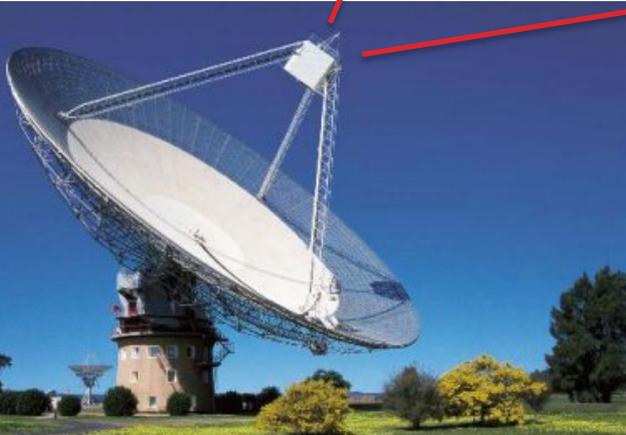
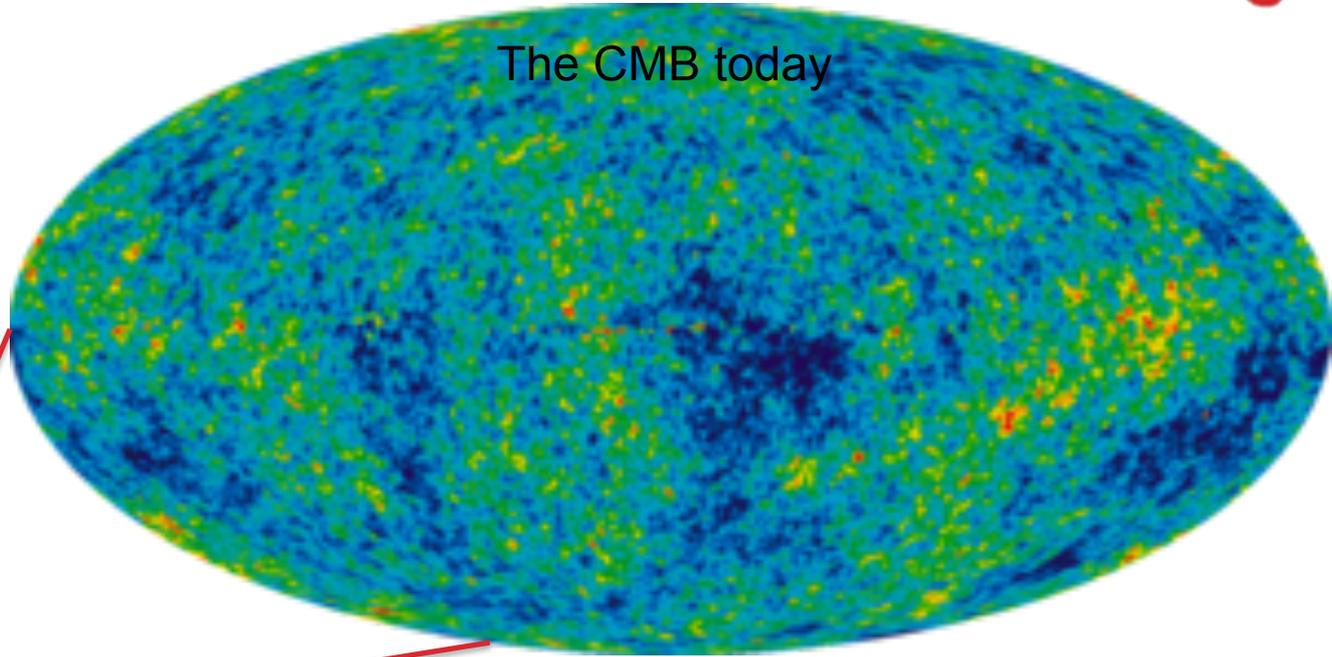




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What we see with our new telescopes today

The CMB today



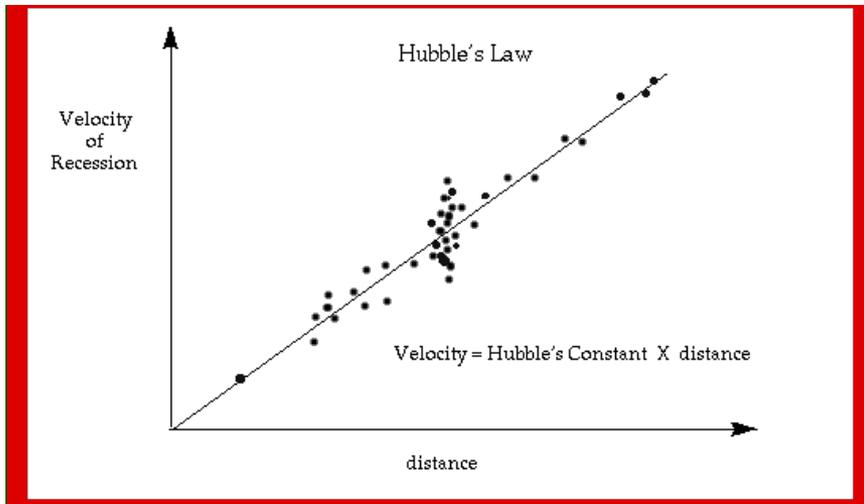
- › With our best telescopes today we see slight peaks and troughs in the CMB temperature which help us to study the early structure in the Universe



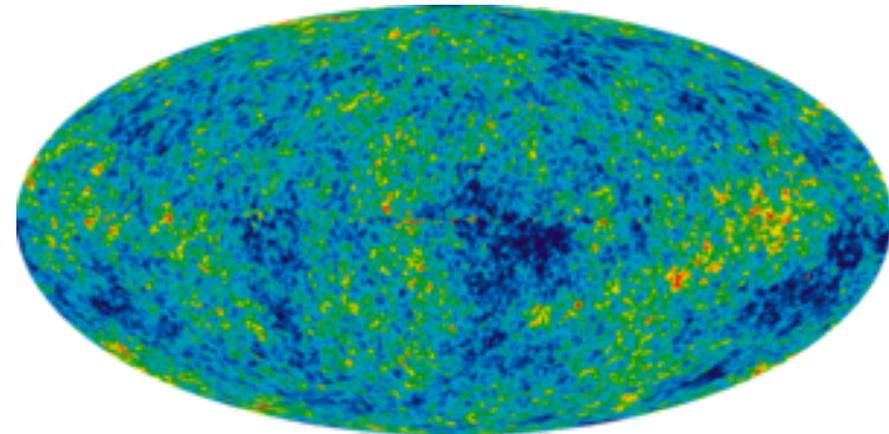
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Two pieces of evidence for the Big Bang

Hubble's Law



The Cosmic Microwave Background Radiation



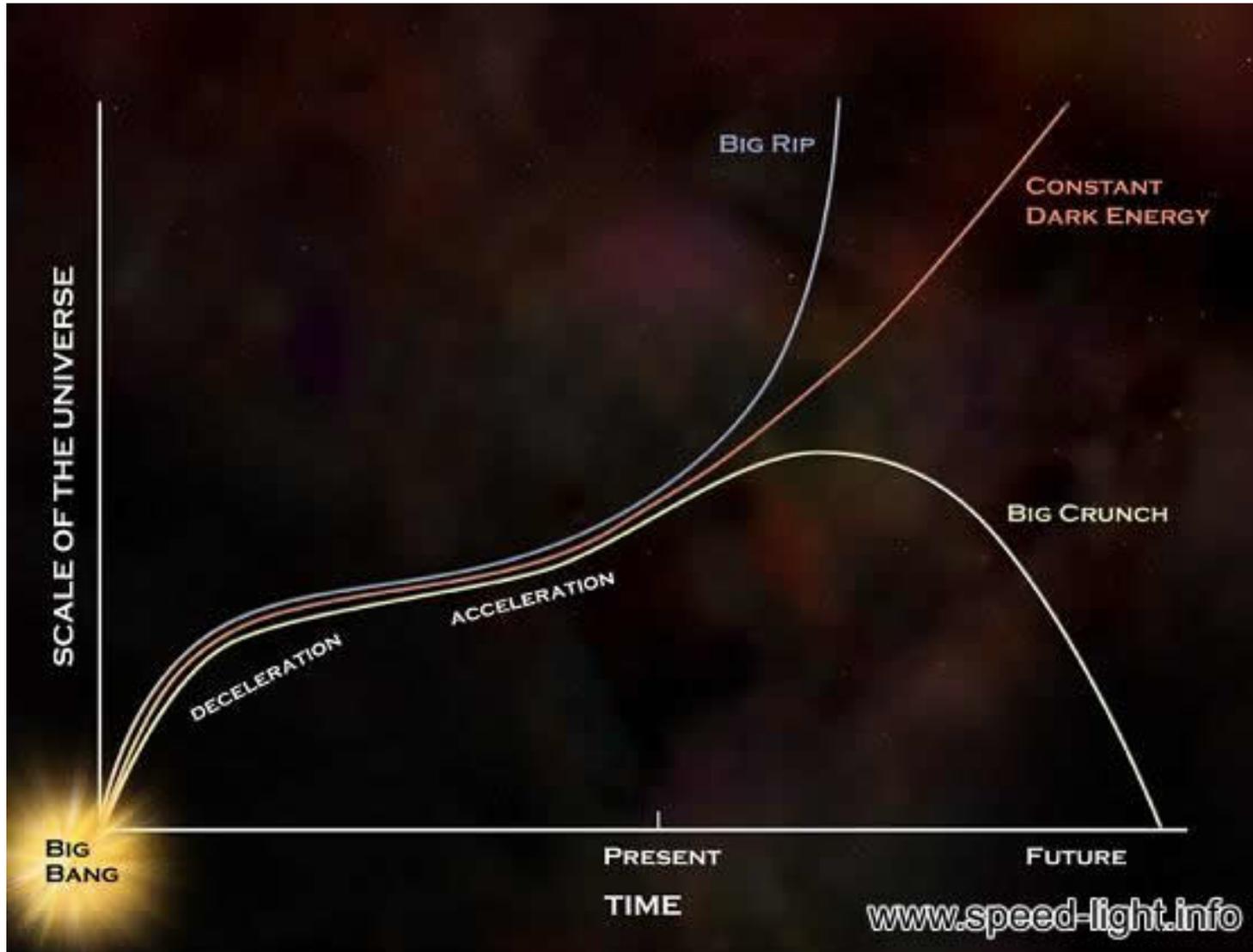


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What happens next?



What is the big rip?

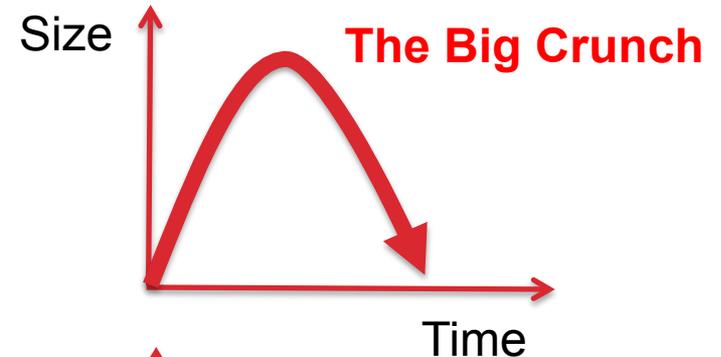




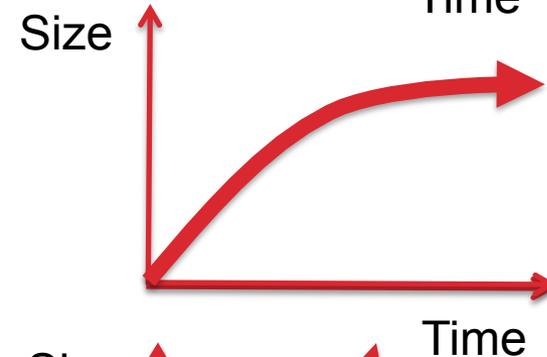
The fate of the Universe

› Possible outcomes for the fate of the Universe.

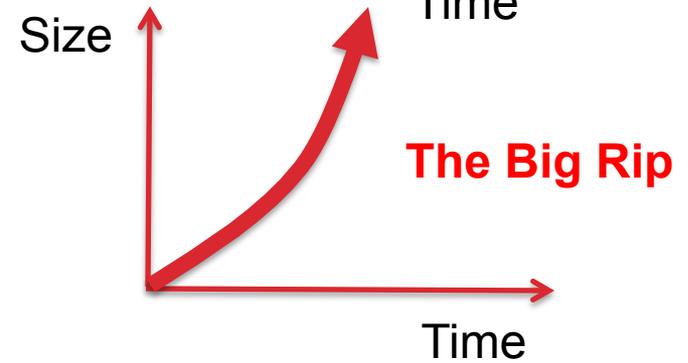
› The Universe collapses back in on itself



› The Universe expands to a constant size



› The Universe starts to expand more rapidly

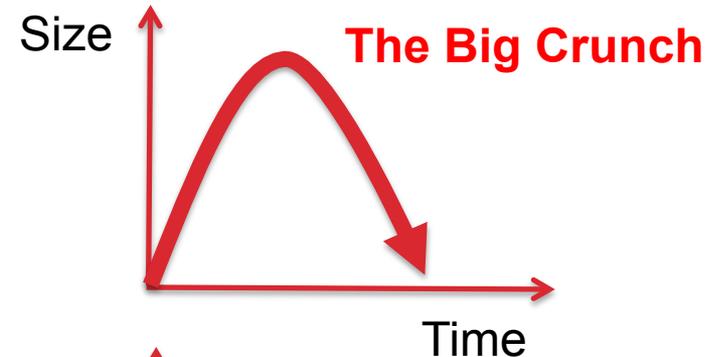




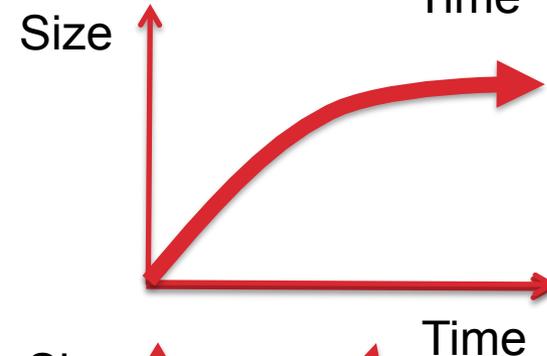
The fate of the Universe

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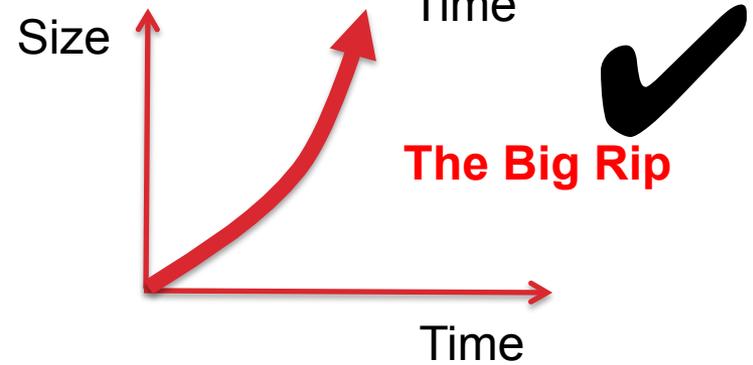
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What is the evidence for the Big Rip



Distant Supernovae

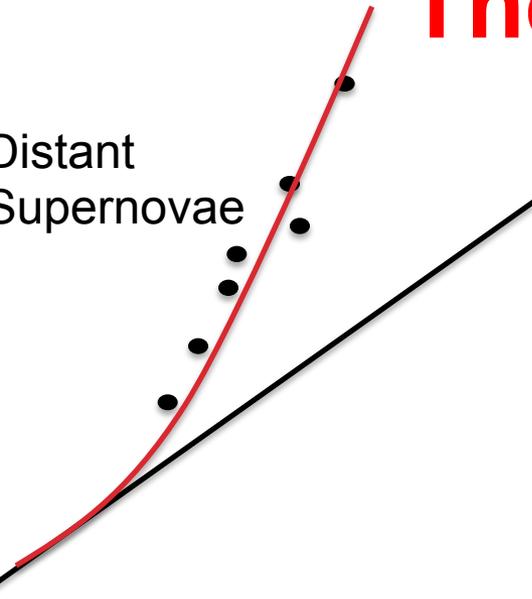
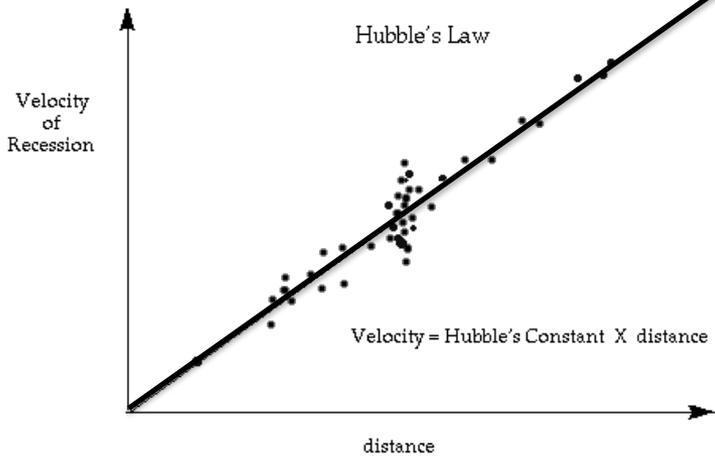




What is the evidence for the Big Rip

The Big Rip

Distant
Supernovae

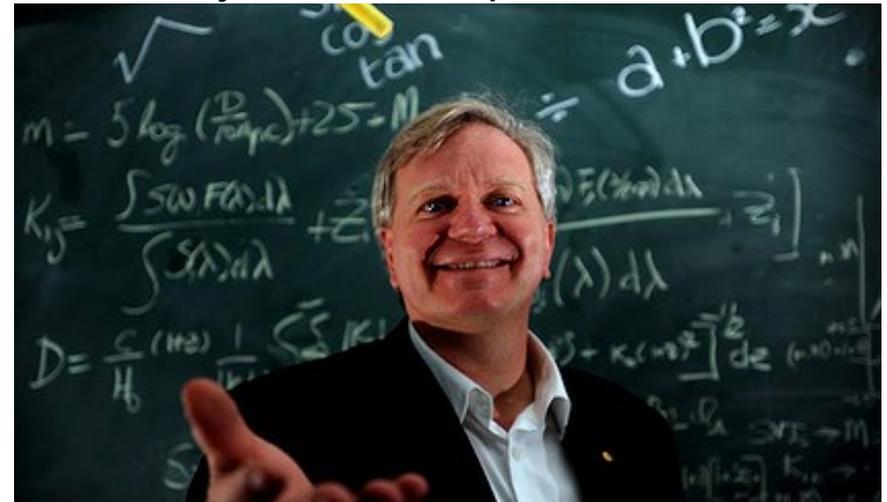
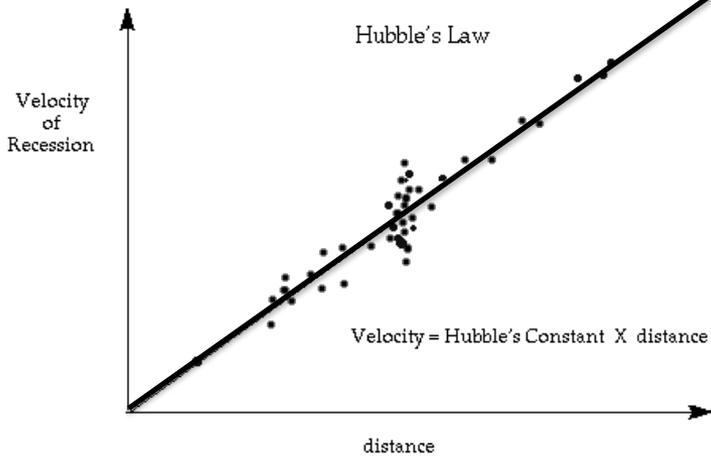




The Big Rip

Distant
Supernovae

CAASTRO team leader Brian Schmidt wins this years Noble prize.





- › The Universe is expanding and the two pieces of evidence are:
 - › Hubble's Law
 - › The Cosmic Microwave Background Radiation
- › Radio astronomy allows us to probe the Universe in ways we cannot using optical light alone.
- › The fate of the Universe is uncertain however it appears that the Big Rip scenario might be correct