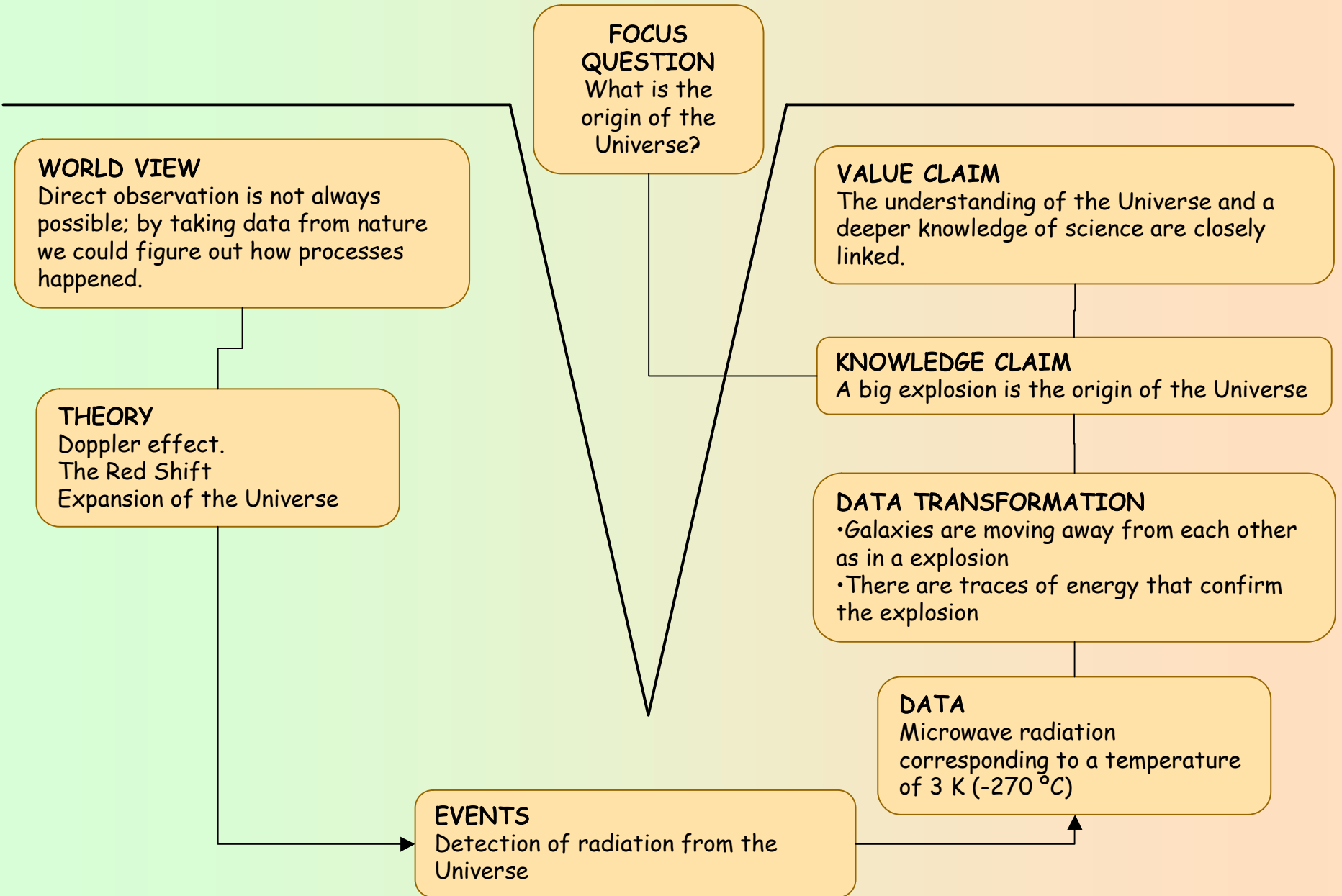


# The Big Bang: a V diagram



**FOCUS QUESTION**  
What is the origin of the Universe?

**WORLD VIEW**  
Direct observation is not always possible; by taking data from nature we could figure out how processes happened.

**THEORY**  
Doppler effect.  
The Red Shift  
Expansion of the Universe

**EVENTS**  
Detection of radiation from the Universe

**VALUE CLAIM**  
The understanding of the Universe and a deeper knowledge of science are closely linked.

**KNOWLEDGE CLAIM**  
A big explosion is the origin of the Universe

**DATA TRANSFORMATION**  
•Galaxies are moving away from each other as in an explosion  
•There are traces of energy that confirm the explosion

**DATA**  
Microwave radiation corresponding to a temperature of 3 K (-270 °C)

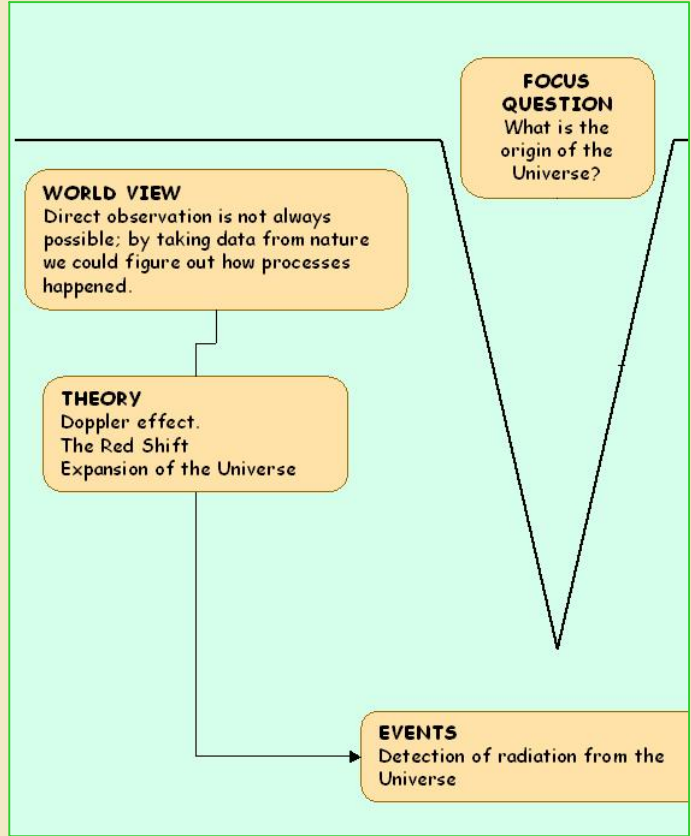
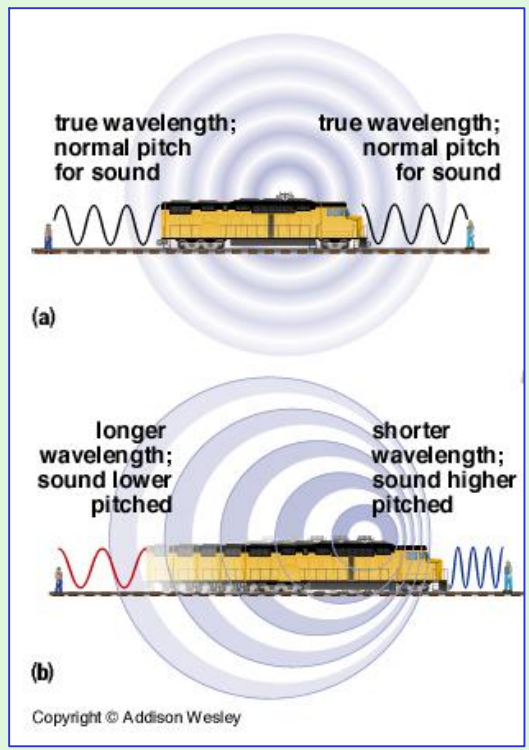
# The Big Bang: a V diagram

## World View

To know how the Universe was created, scientist have to rely on data found by observation; no direct evidence is possible.

## Theory: The Doppler Effect

We can measure the velocity of an object by analyzing the apparent wavelengths of spectral lines from it.

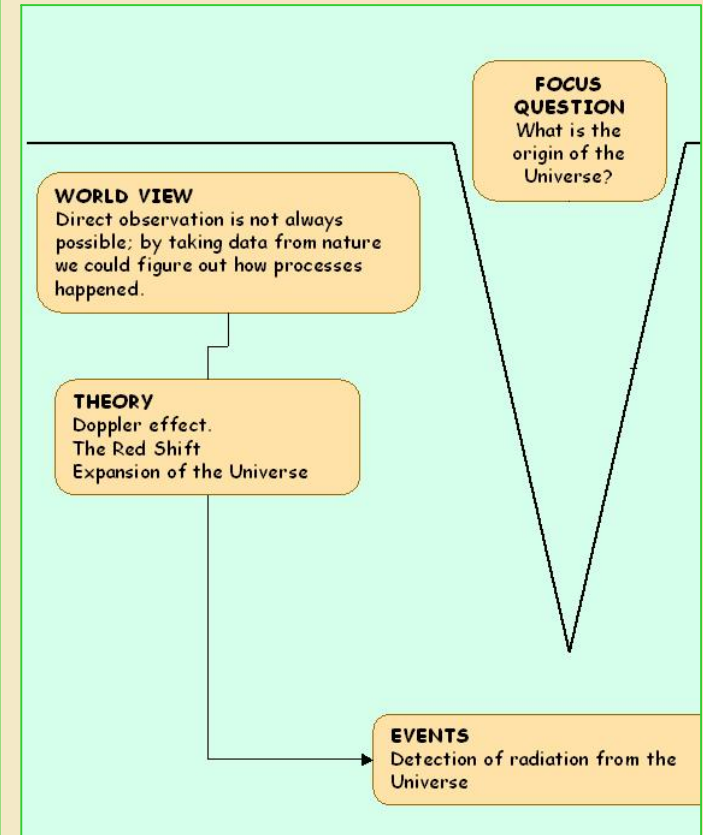
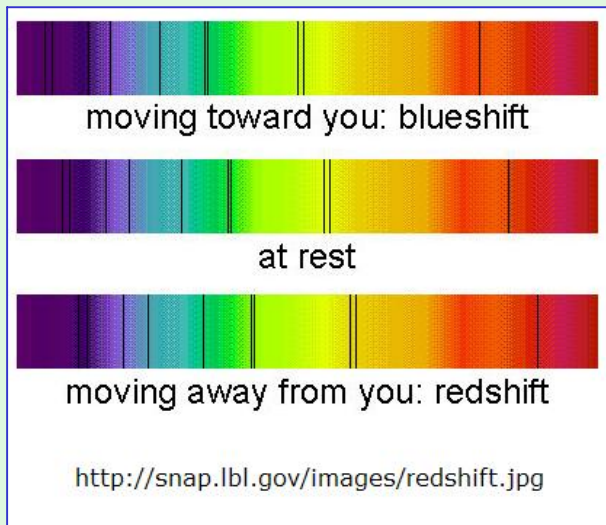


# The Big Bang: a V diagram

## Theory: The Red Shift

Objects in motion compress the light waves in front of them making them appear more blue (blue shift), the light waves behind are stretched out and appear more red (red shift).

Amount of shift of wavelength is proportional to the component of velocity along the line of sight.

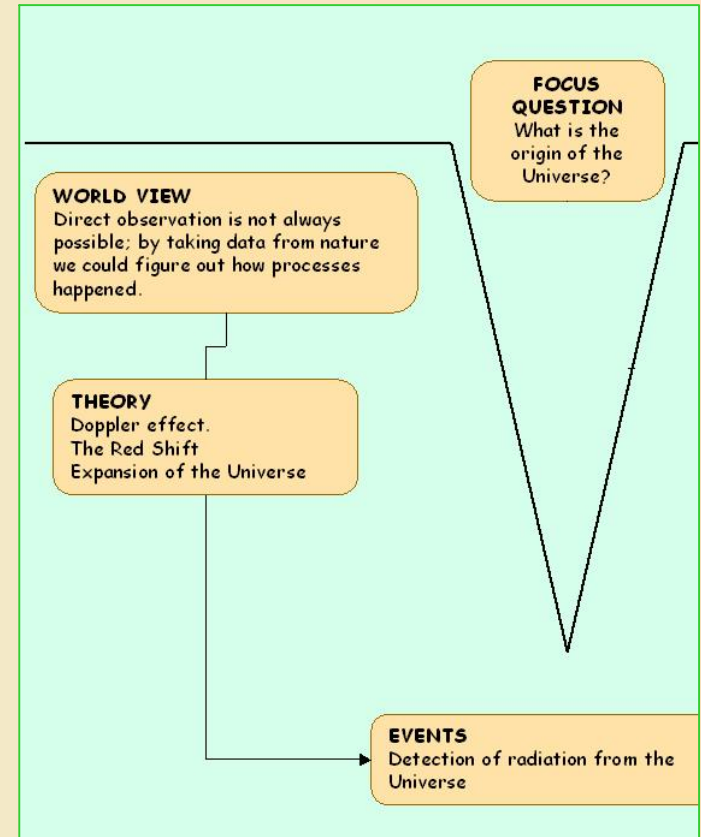
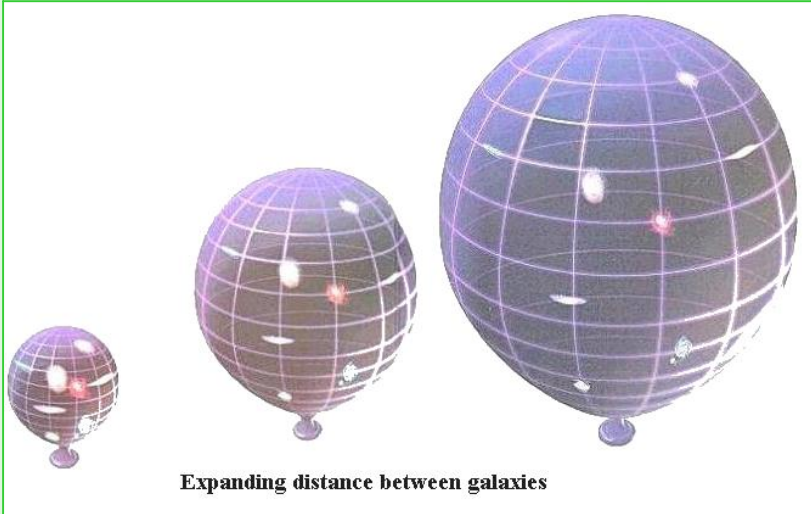


# The Big Bang: a V diagram

## Theory: Expansion of the Universe

Hubble's work showed that the Universe is expanding.

The further a galaxy was, the faster it was moving away from us.

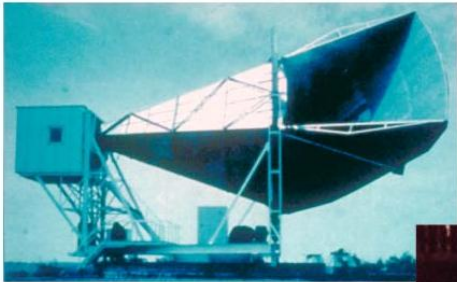


# The Big Bang: a V diagram

## Event: Detection of Background Microwave Radiation

In 1964, two radioastronomers (Robert Wilson and Arno Penzias) discovered that in the universe there was a background microwave radiation.

### DISCOVERY OF COSMIC BACKGROUND



Microwave Receiver



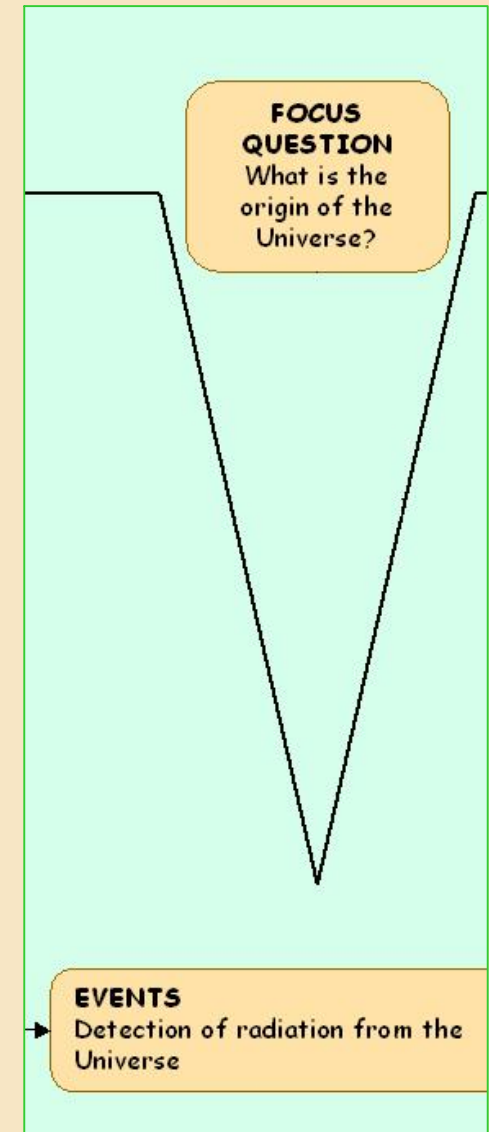
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Robert Wilson



Arno Penzias

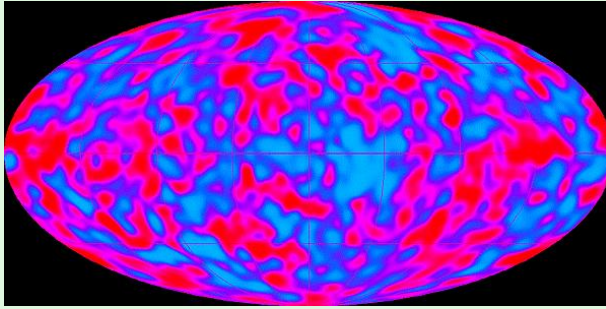
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# The Big Bang: a V diagram

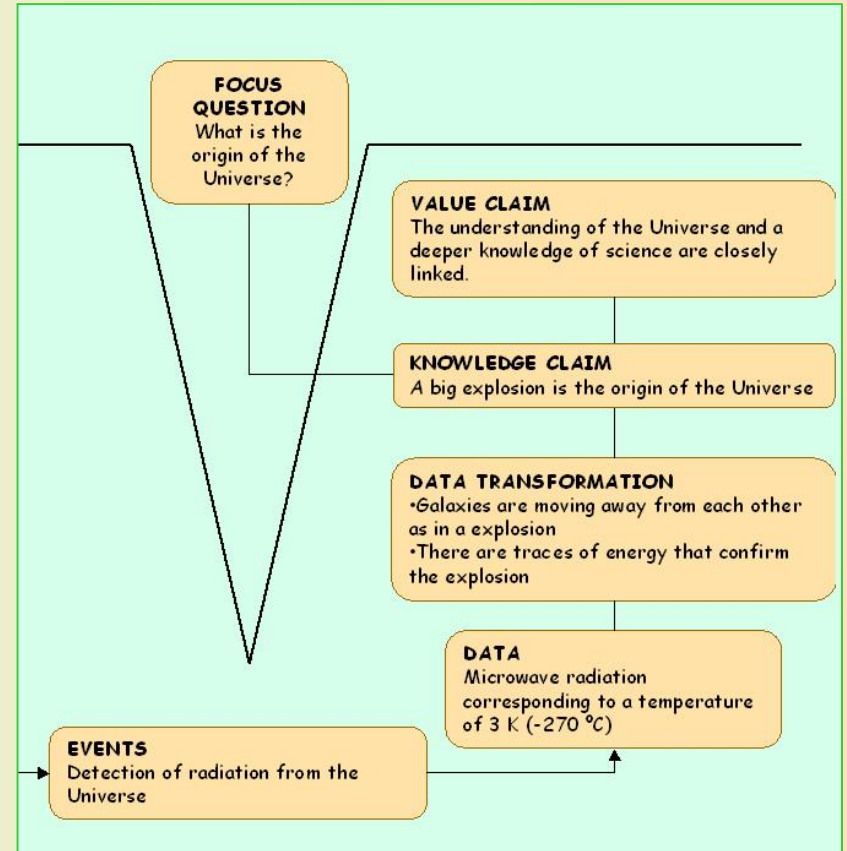
## Data: Background Microwave Radiation

The background microwave radiation corresponds to a temperature of 3 K (-270 °C).



## Data Transformation: Evidence of a big explosion

The background radiation (energy) and galaxies moving away indicate the possibility of a big explosion.



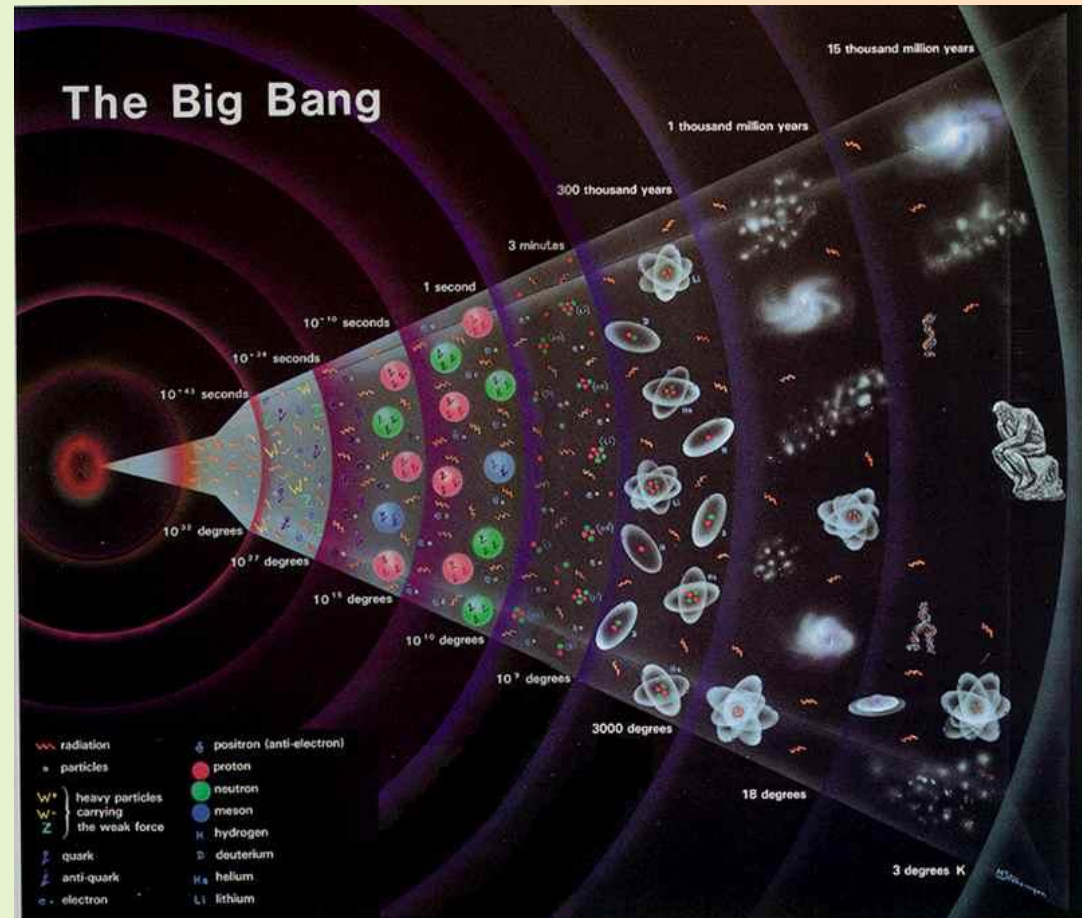
# The Big Bang: a V diagram

## Knowledge Claim

The essential idea is that the universe has expanded from a primordial hot and dense initial condition (singularity) in the past and continues to expand to this day

It postulates that 12 to 14 billion years ago, the portion of the universe we can see today was only a few millimeters across.

It has since expanded from this hot dense state into the vast and much cooler cosmos we currently inhabit.



# The Big Bang: a V diagram

## Value Claim

A better understanding of the Universe and science

## The Top Problems of the Big Bang

The Big Bang theory is our current and widely accepted theory. But that doesn't mean that there are no problems within that theory.

Here we have some objections:

- Is a singularity acceptable?
- Is the microwave background's proof strong enough to consider it as a proof of the big bang?

