The Cosmic Engine

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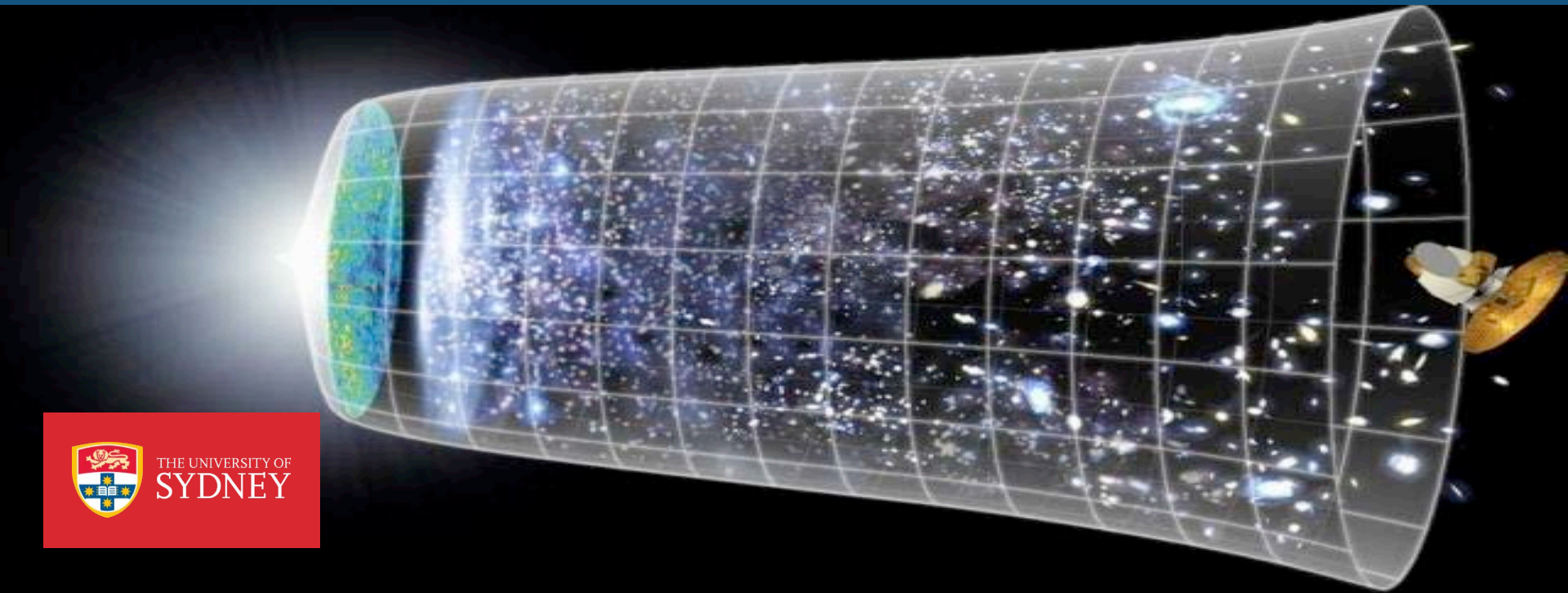
Super Science Fellow

University of Sydney



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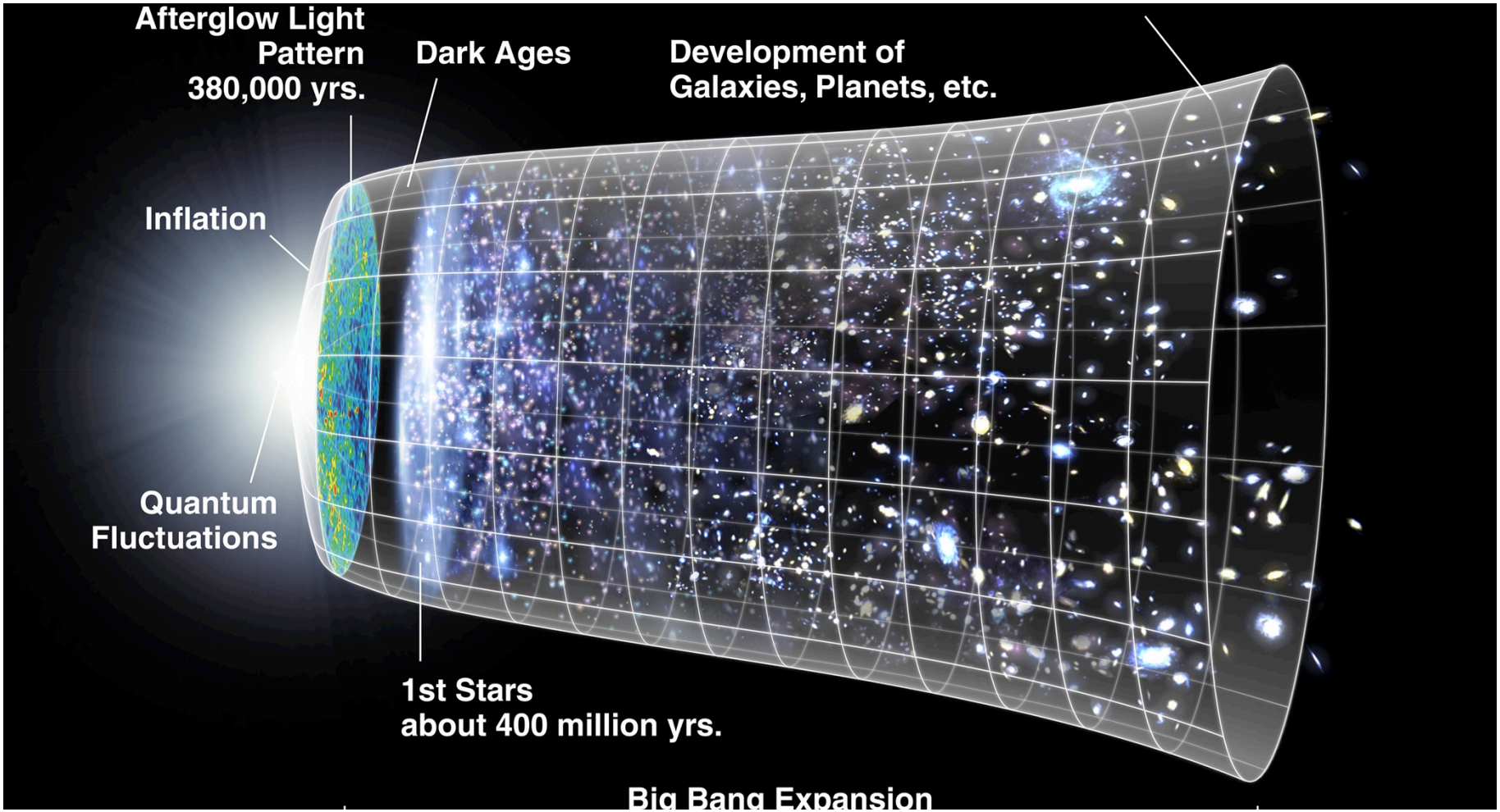
Our Universe



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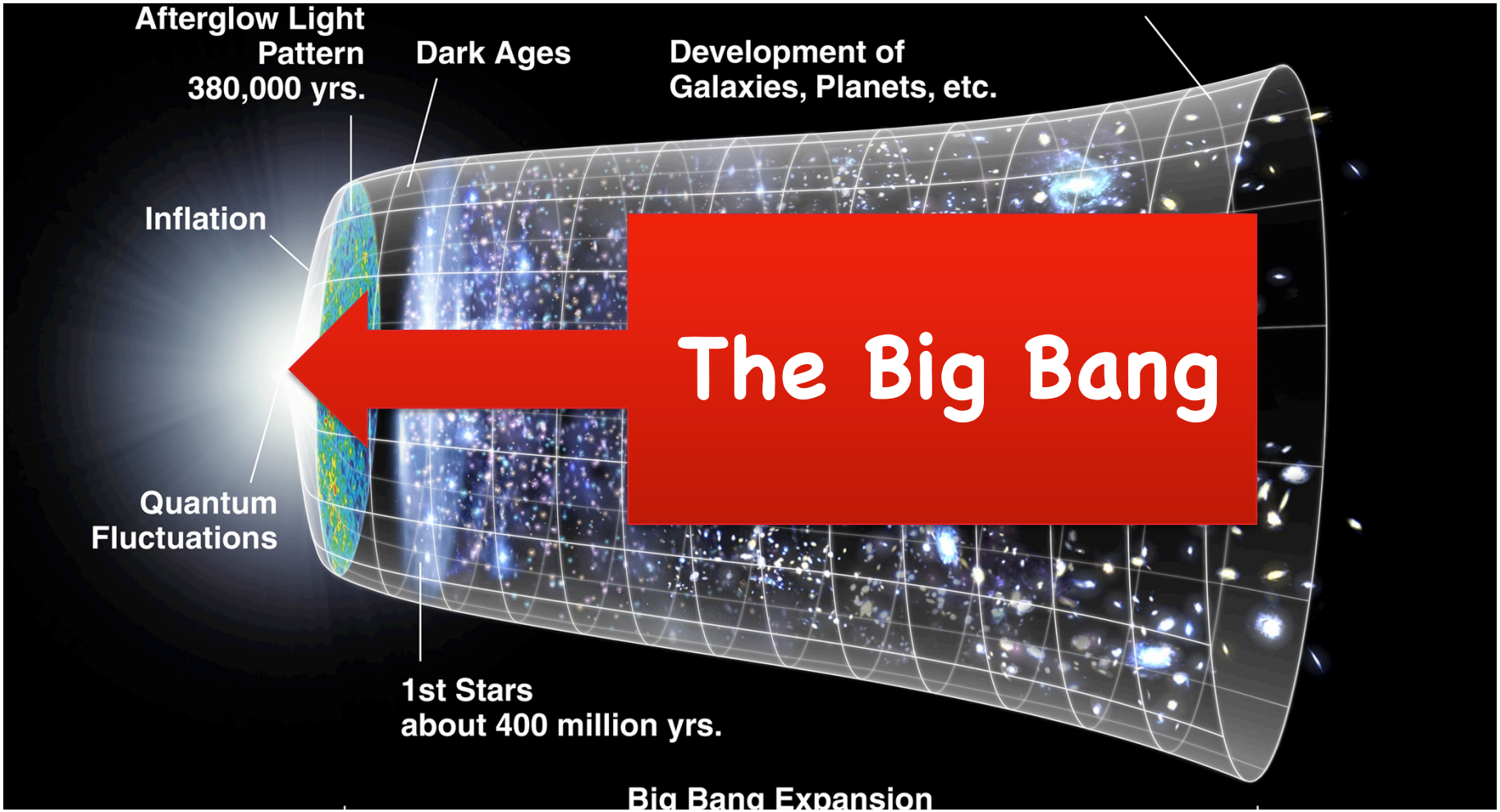
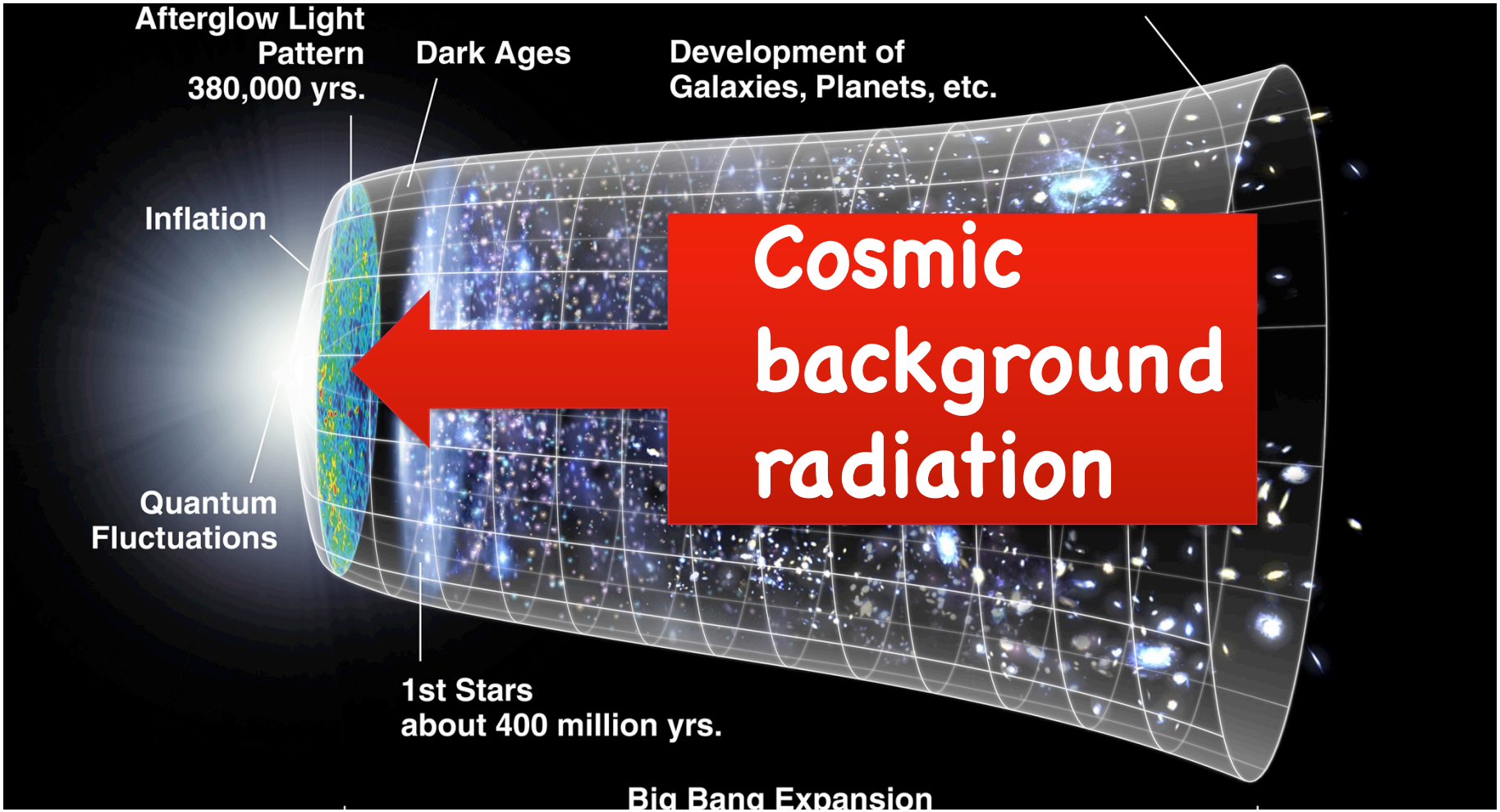


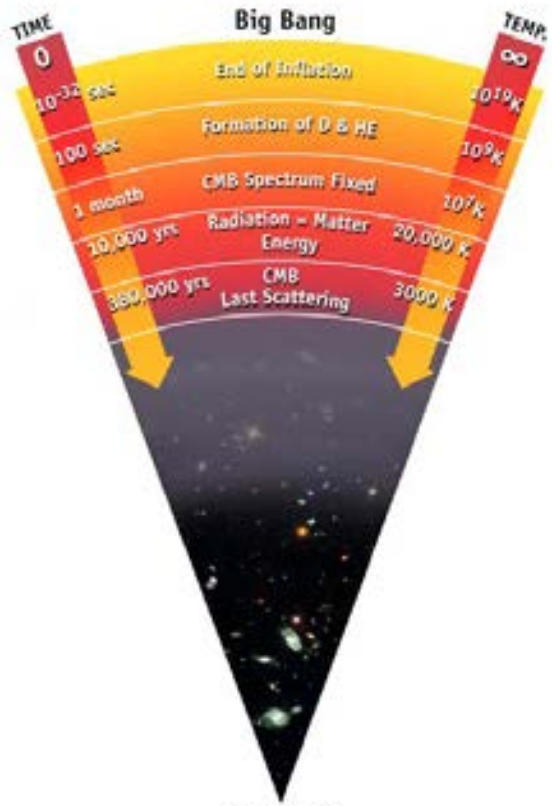
The Big Bang

- Just after the big bang (13.7 billion yrs ago), the Universe was very hot and dense
- Began to expand extremely rapidly (Inflation) but expansion slowed down again very quickly
- Universe began to cool down and form the first sub-atomic particles (e-, p, etc.)

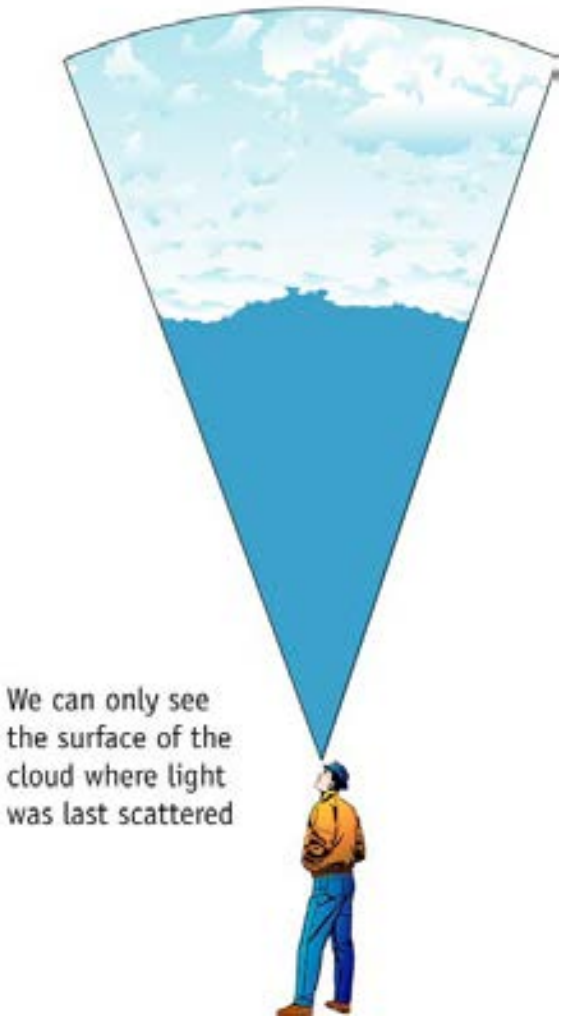
Our Universe



Cosmic Microwave Background

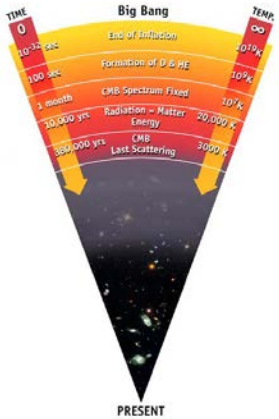


The cosmic microwave background Radiation's "surface of last scatter" is analogous to the light coming through the clouds to our eye on a cloudy day.



Cosmic Microwave Background

- Faint, all-pervasive radiation field, ~3 K (-270° C) blackbody radiation)
- Nobel Prize for its discovery by Arno Penzias and Robert Wilson
- Signal can be detected in old TVs!



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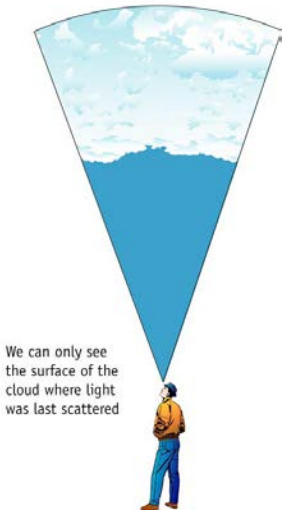
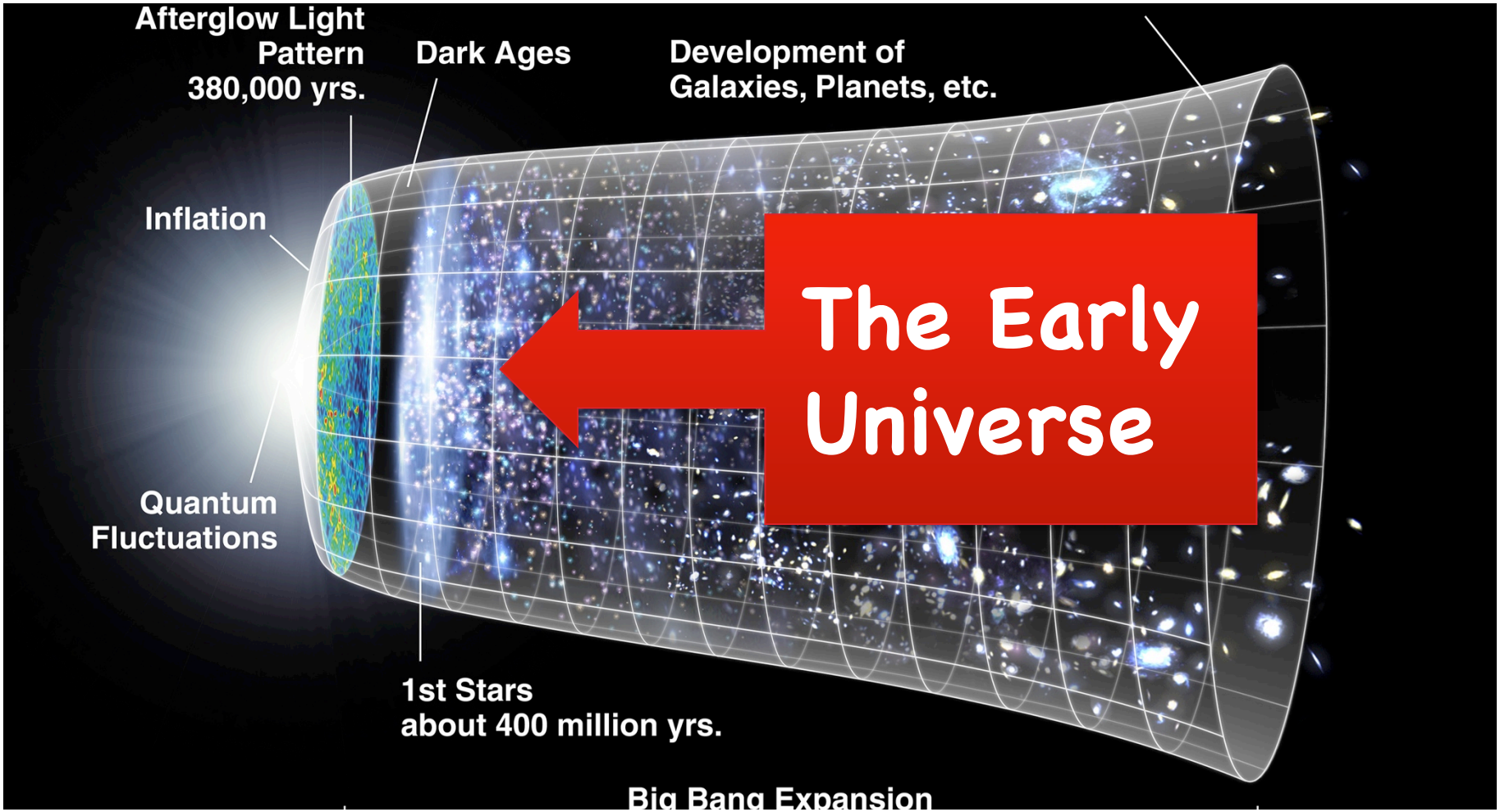


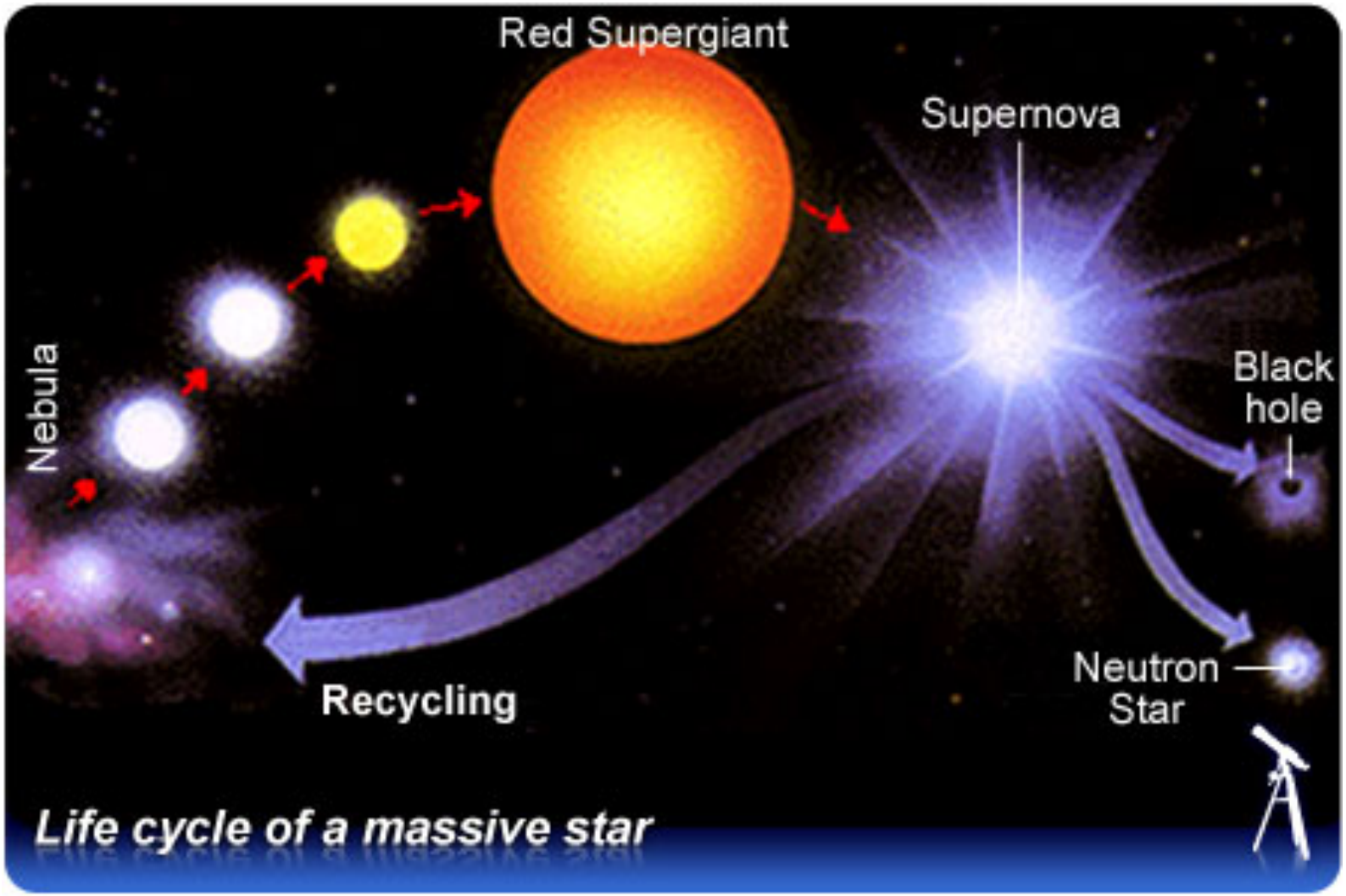
Our Universe



The Early Universe

- The Universe was almost entirely Hydrogen (with a small number of other slightly heavier elements)
- The first Stars were formed from giant clouds of Hydrogen
- The nuclear fusion process inside stars created heavier elements and even heavier elements when they exploded (Supernovae)

The Early Universe

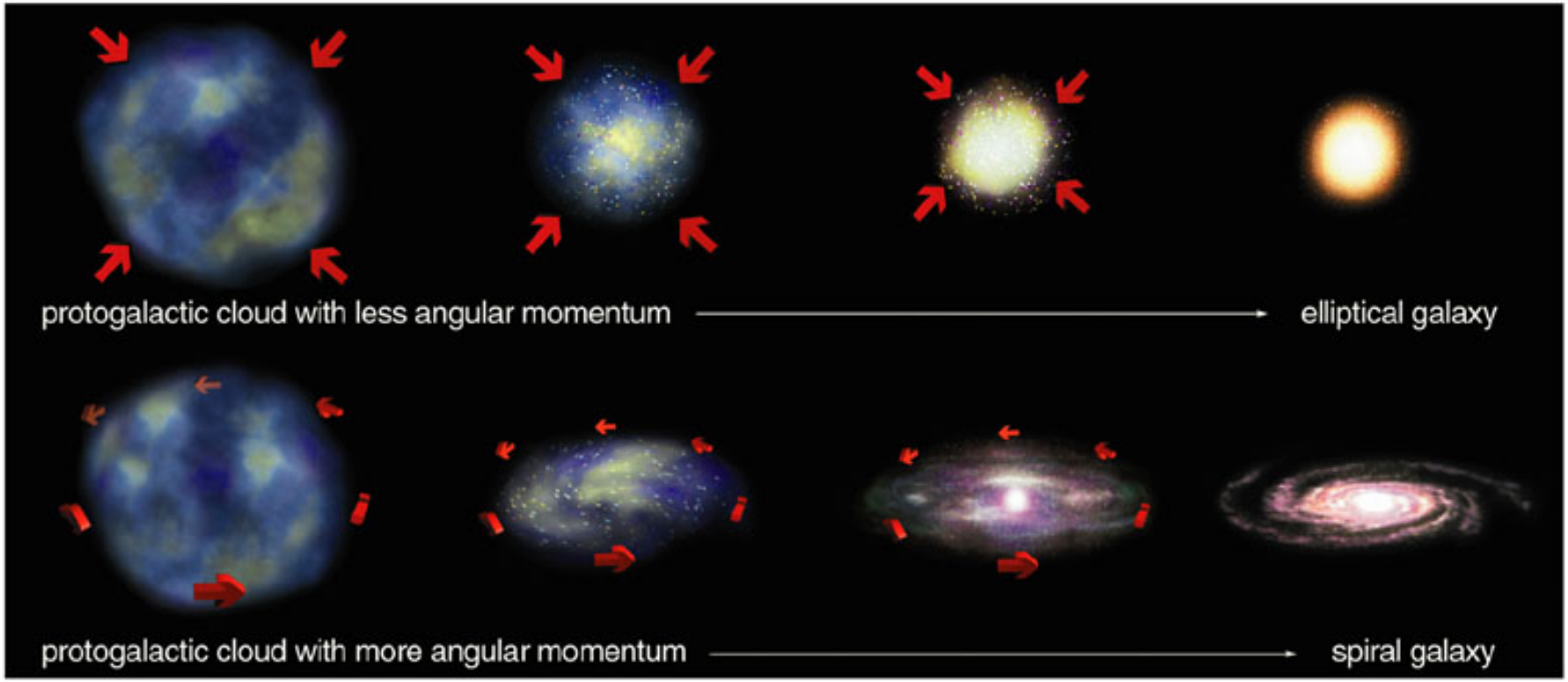


The Early Universe

Proto-galaxy example:

The Early Universe

Proto-galaxy evolution:



Cosmic Engine

- How old is our Universe?
- What temperature is the CMB radiation?
- How are the heavy elements made (other than in the big bang)?

Cosmic Engine

- How old is our Universe?

13.7 billion years

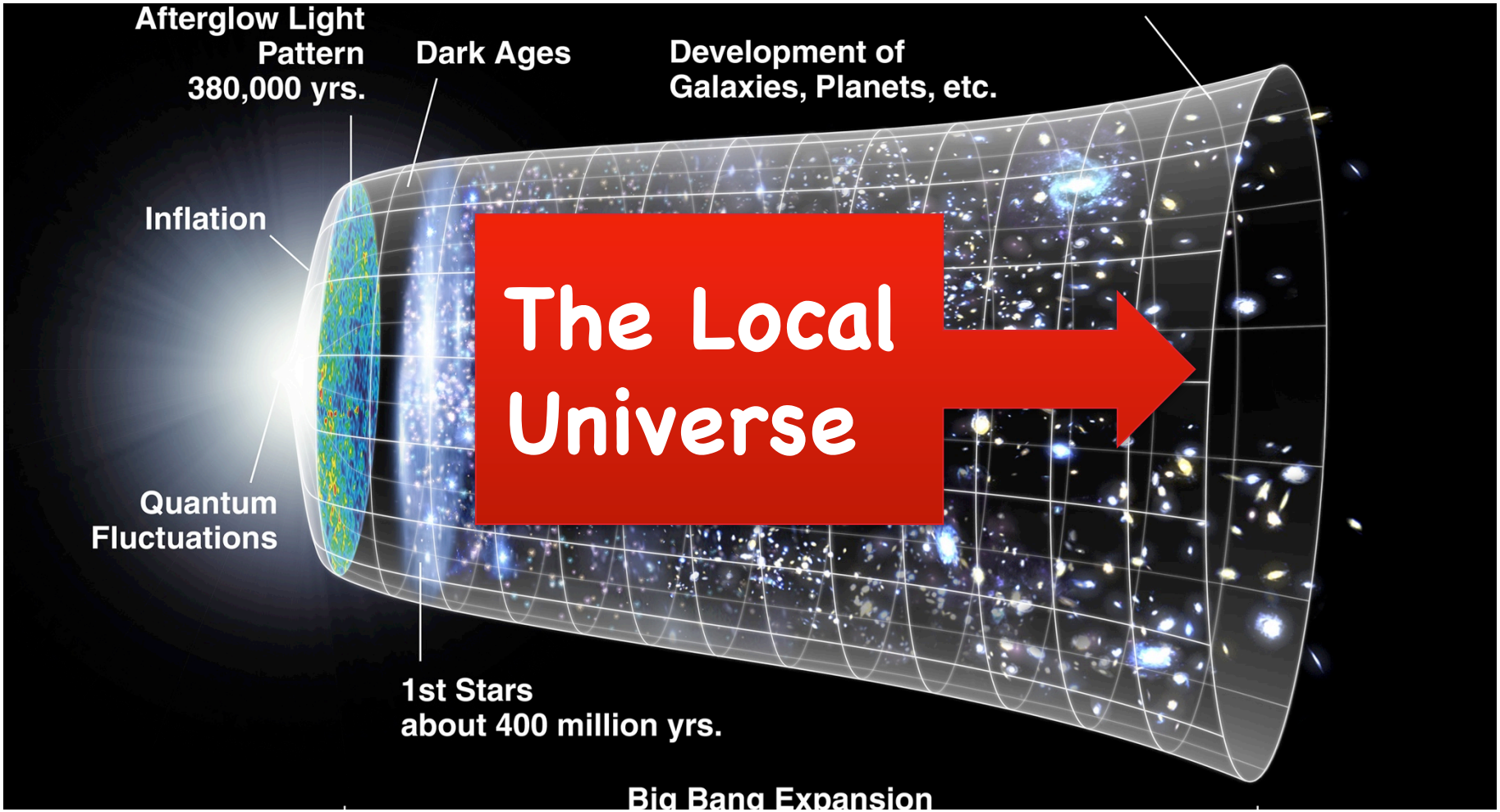
- What temperature is the CMB radiation?

3 K (-270° C)

- How are the heavy elements made (other than in the big bang)?

Nuclear fusion in stars and Supernovae

Our Universe



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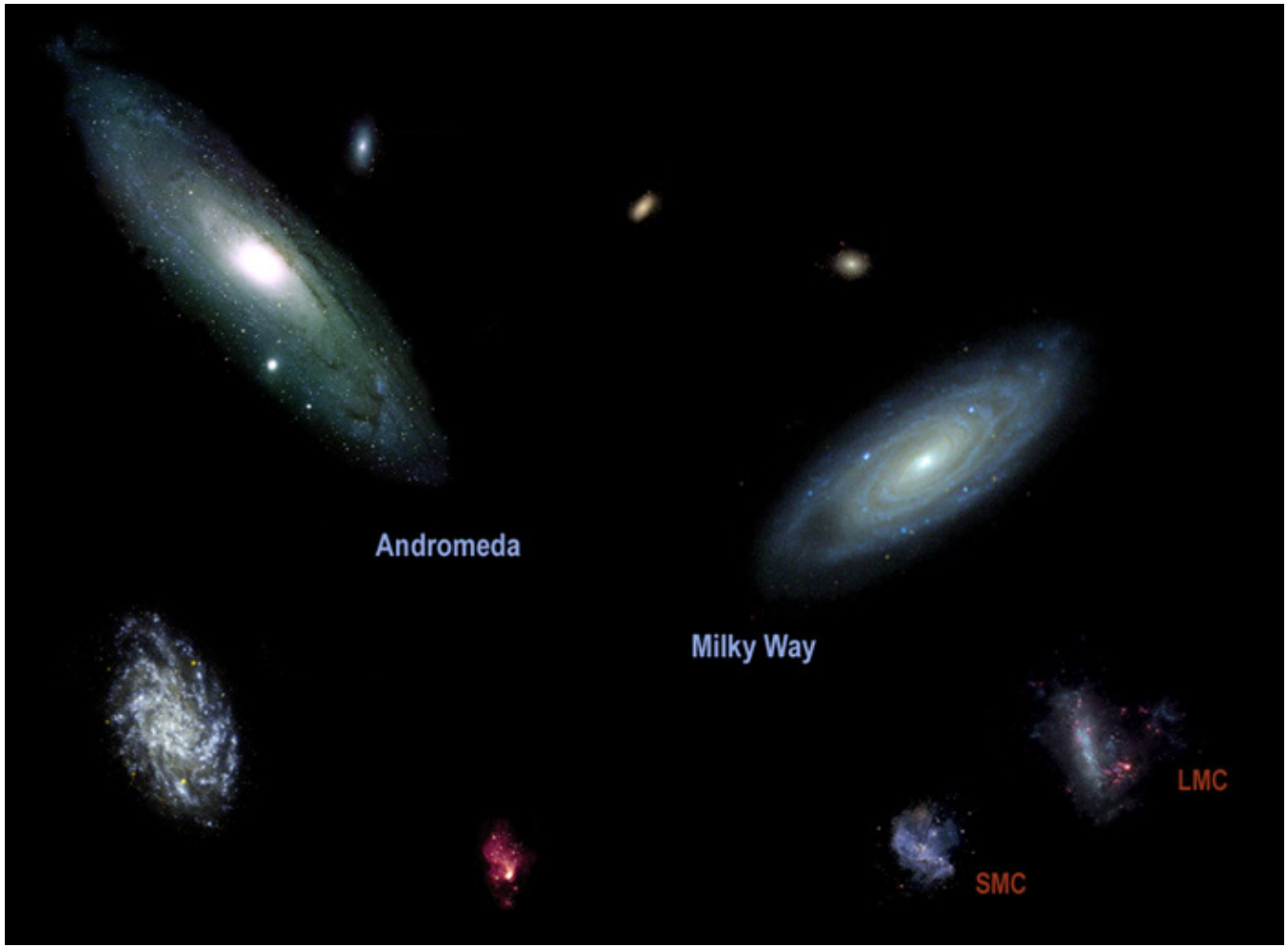
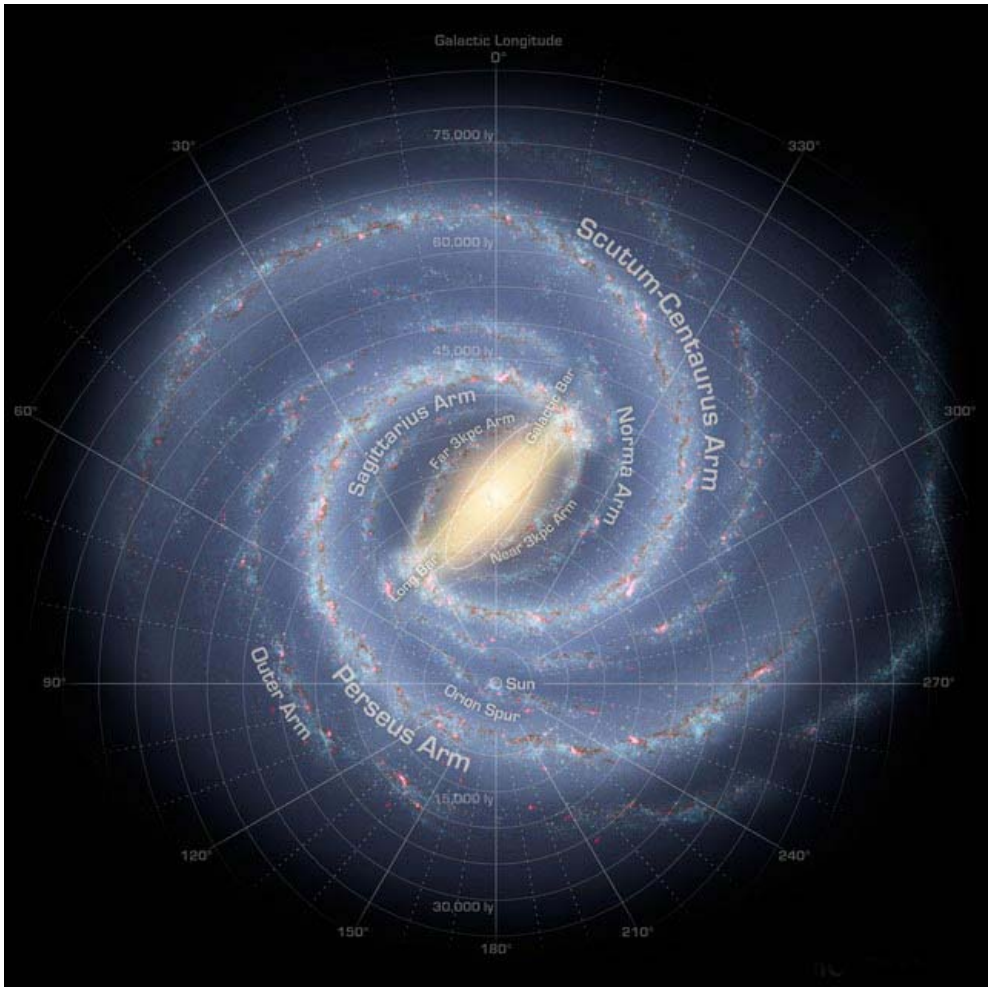
The Local Group



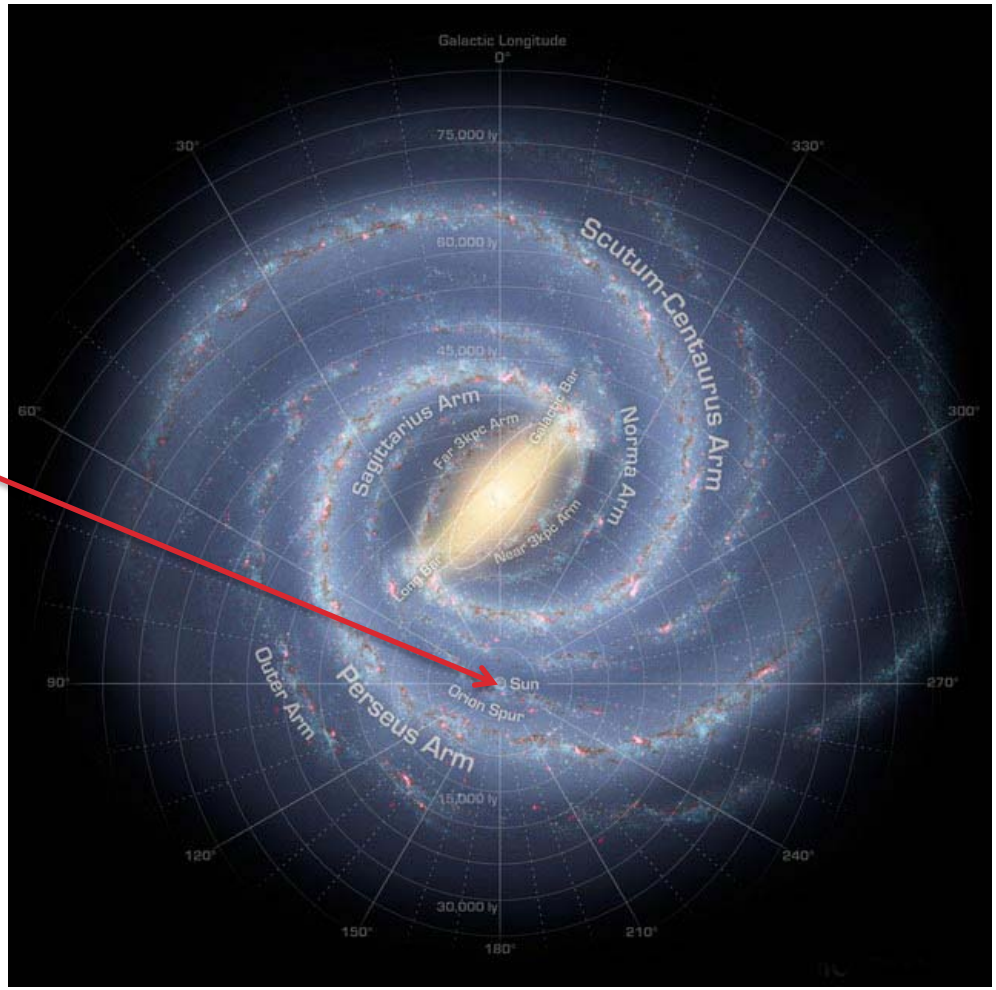
The Milky Way

- 100,000 light-years in diameter
- 1,000 light-years thick
- Gas, dust, black holes
- 300 billion stars
- How many planets?

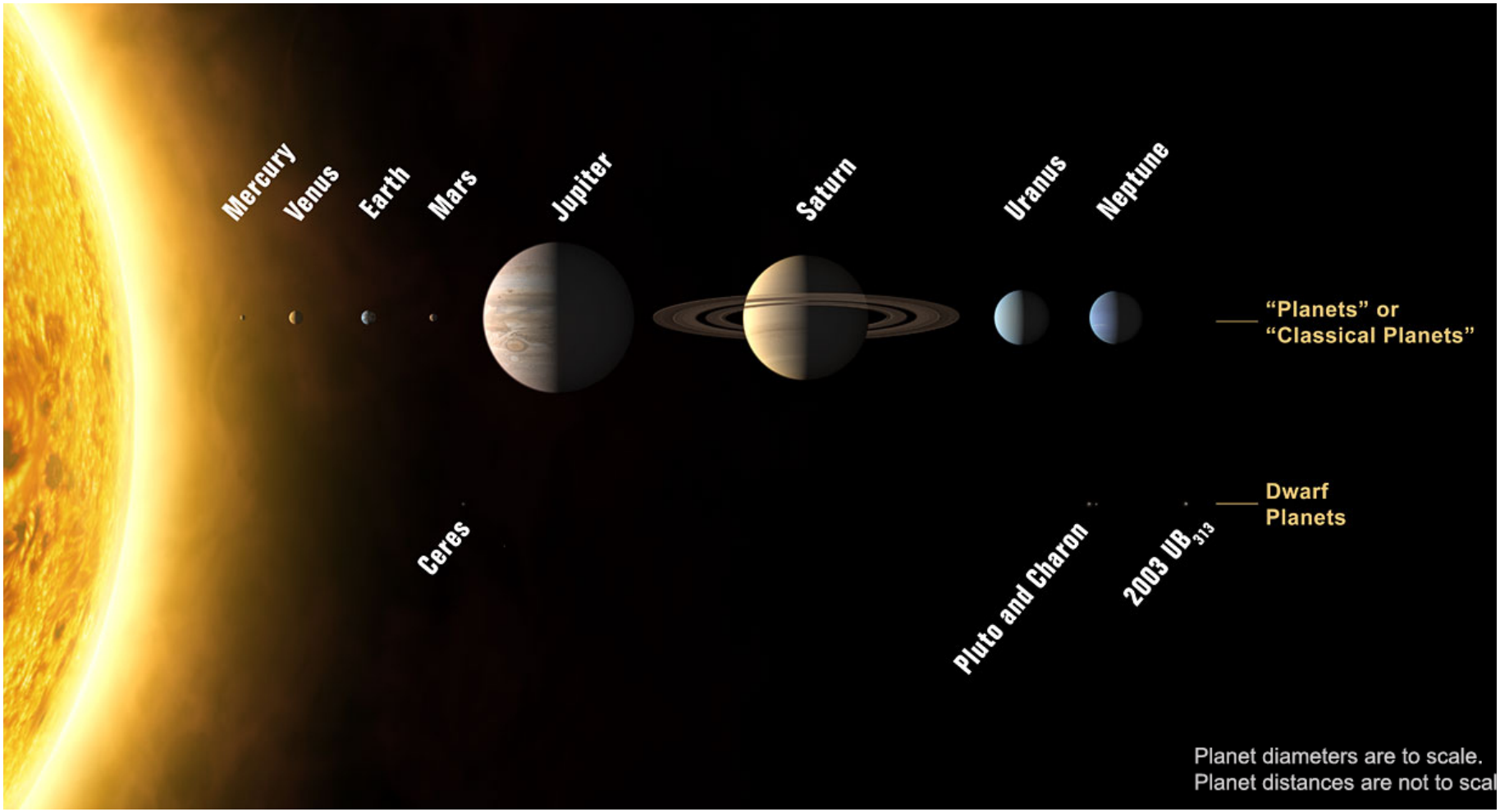


The Milky Way

Our solar system



Our Solar System



Cosmic Engine

- Roughly how many stars are in the Milky Way?
- What galaxy will collide with ours in 4 billion years?
- How long does it take light from the Sun to reach us?

Cosmic Engine

- Roughly how many stars are in the Milky Way?

~300 billion

- What galaxy will collide with ours in 4 billion years?

Andromeda (M31)

- How long does it take light from the Sun to reach us?

8 minutes

Thank You

Questions???

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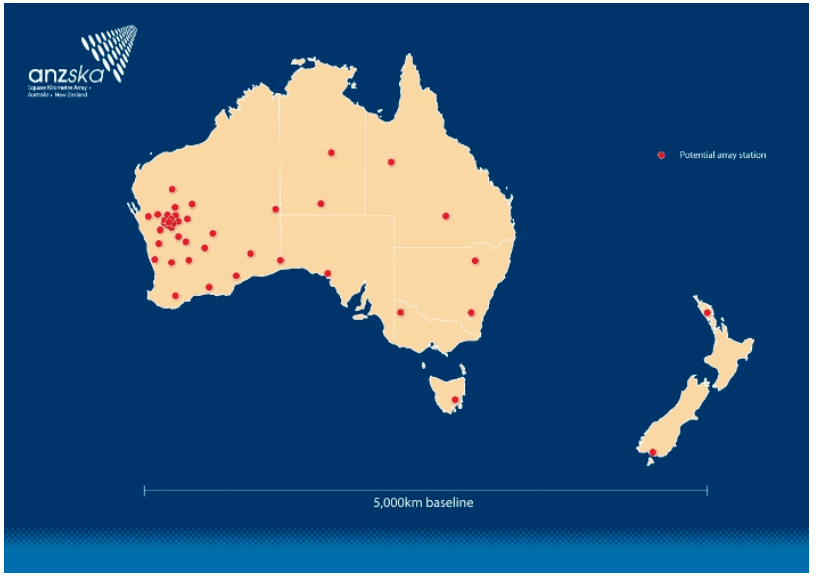
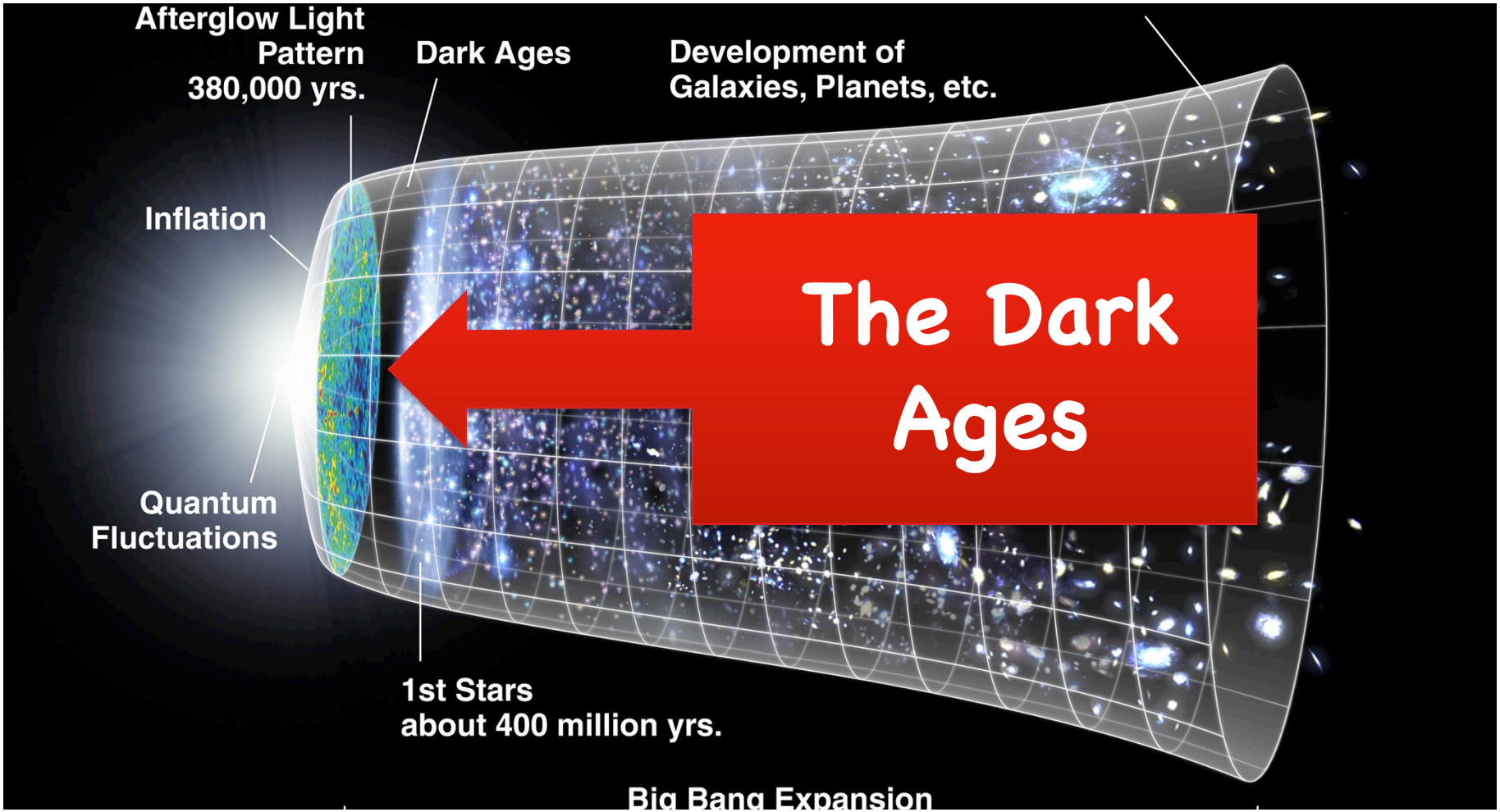
Extra Slides

The Square Kilometer Array

- 1,000,000 m^2 of collecting area
- Will be able to detect an airport radar on a planet 50 light years away
- Ready by 2020+



The Square Kilometer Array



The Square Kilometer Array

- Produce 100 times the global internet traffic
- Generate data that will fill 15 million 64 GB IPods every day!
- And take 2 million years to playback on IPhone