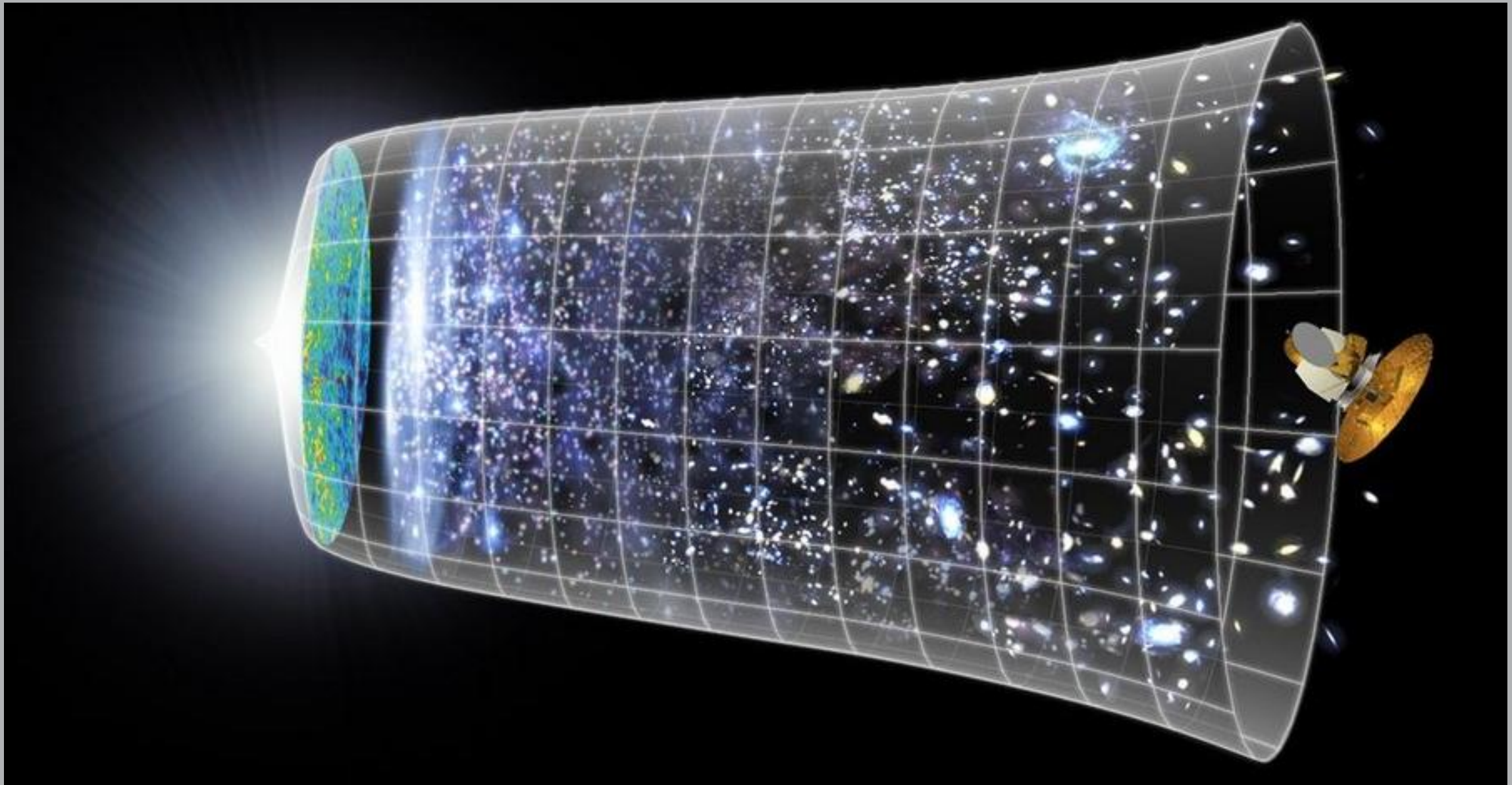


# The Big Bang

Christopher Berry





# The Universe





# Expanding Universe

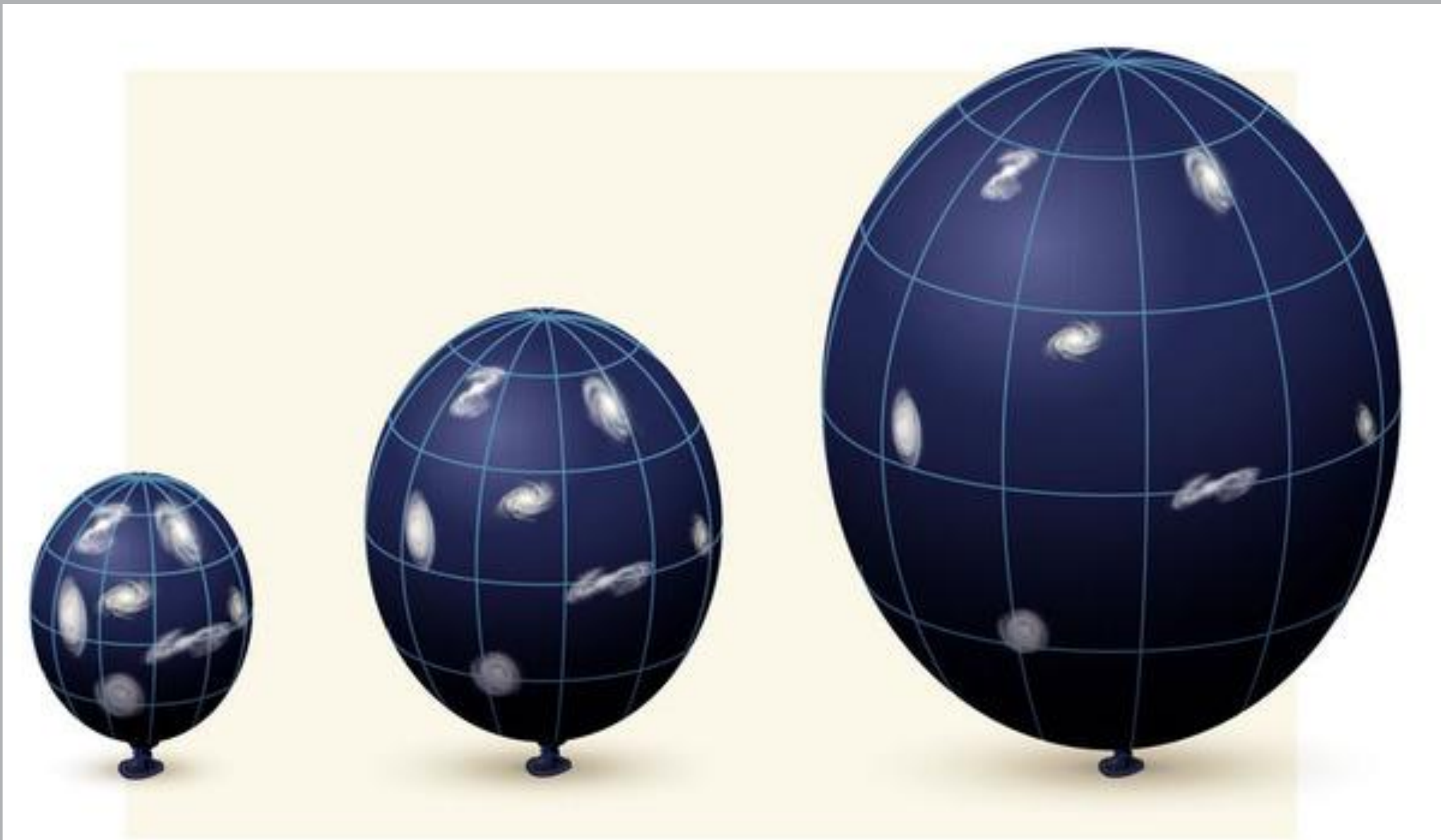


Credit:  
NASA

Hubble's Law:

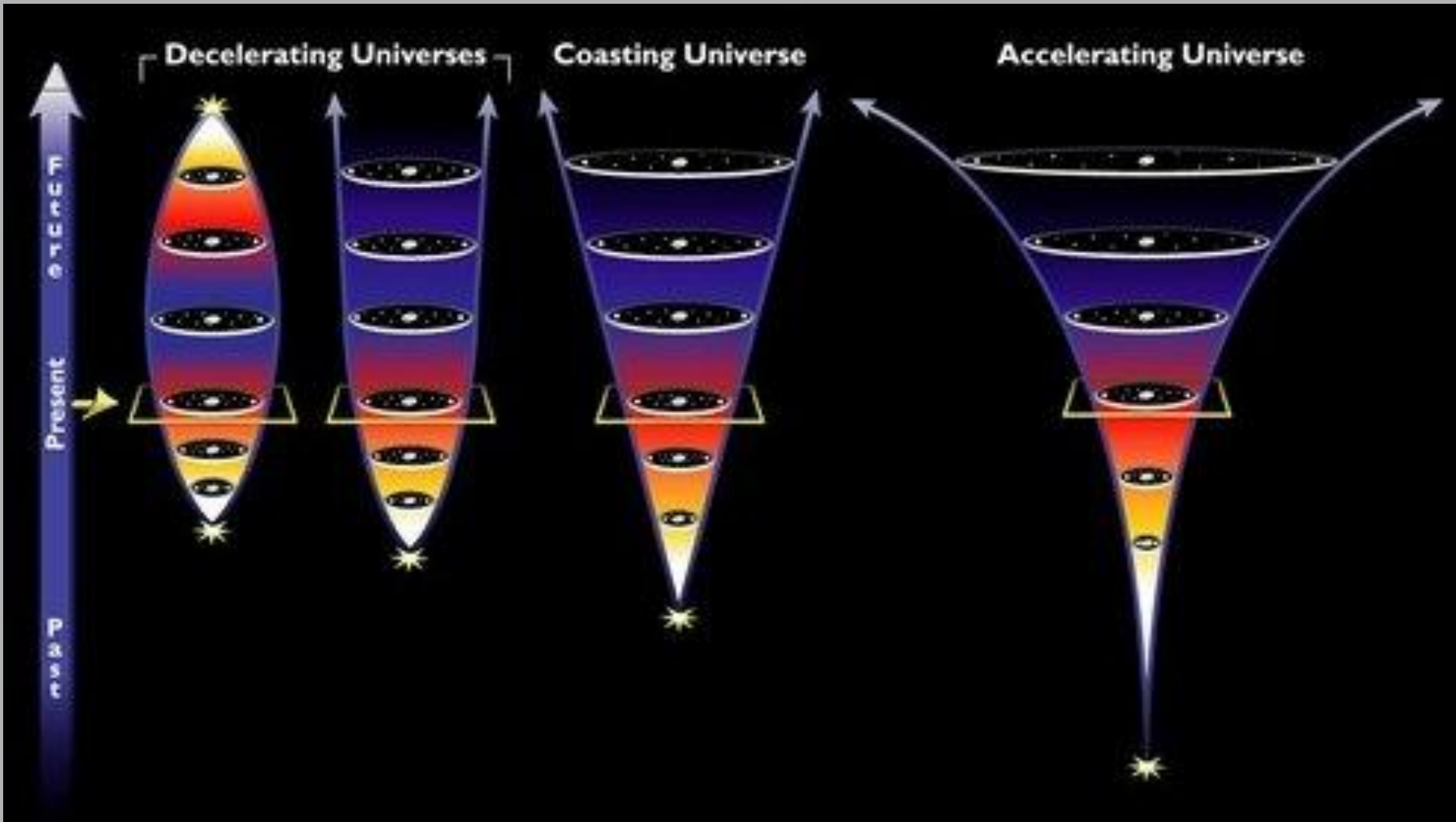
$$v = H_0 D$$

# Stretching space



Credit:  
One-Minute  
Astronomer

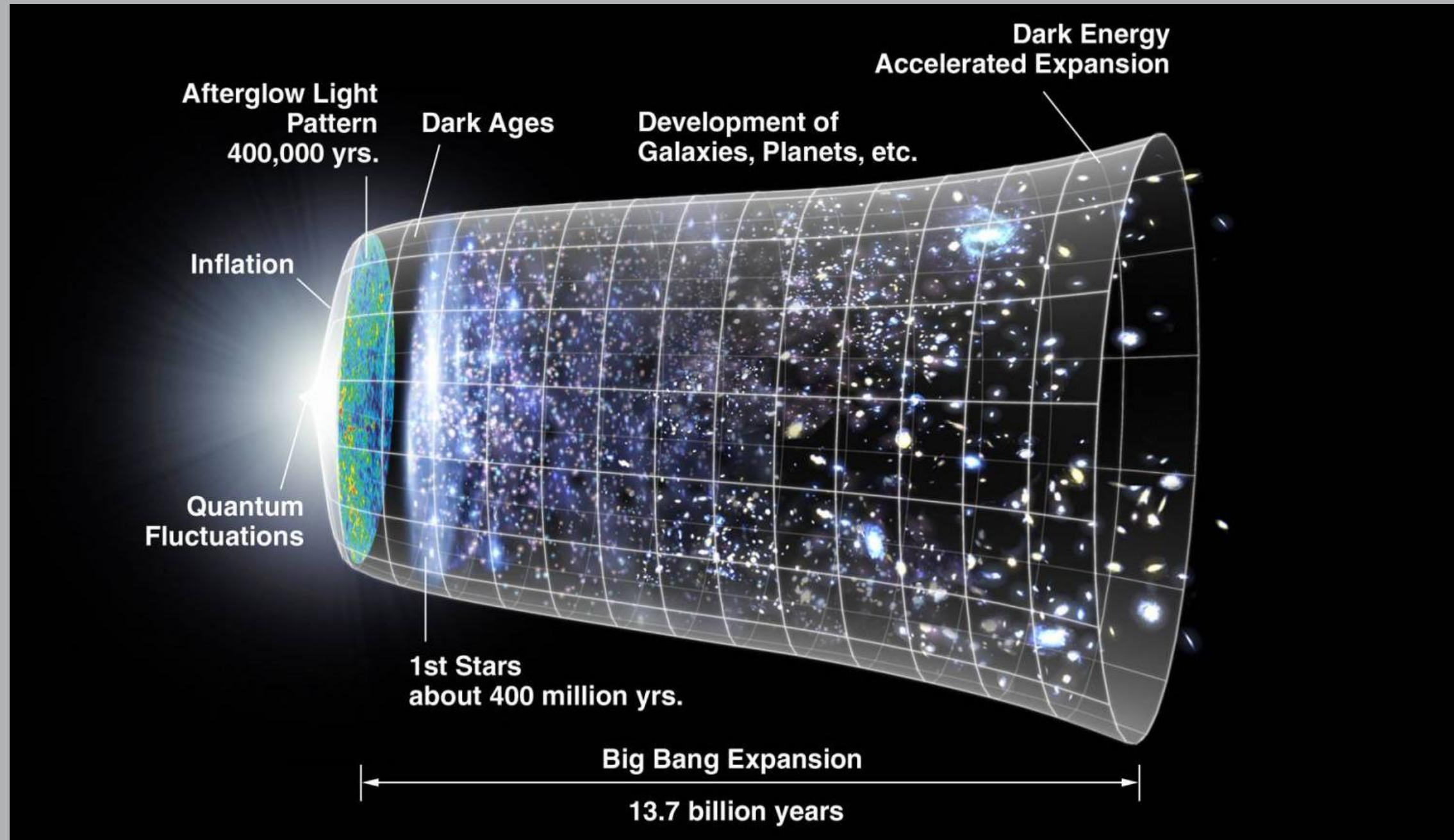
# Acceleration



Credit:  
Ethan  
Siegel

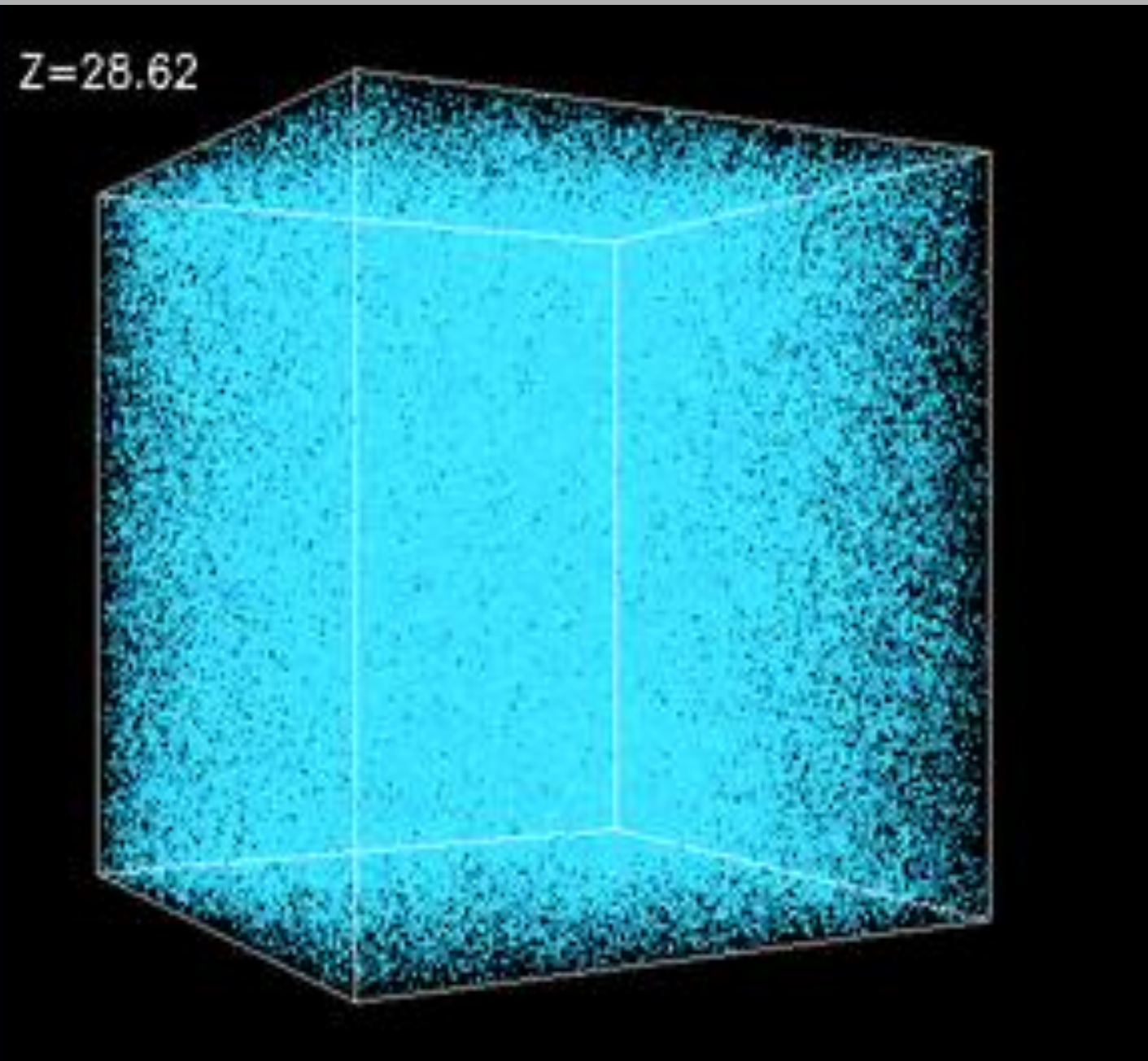


# History of the Universe



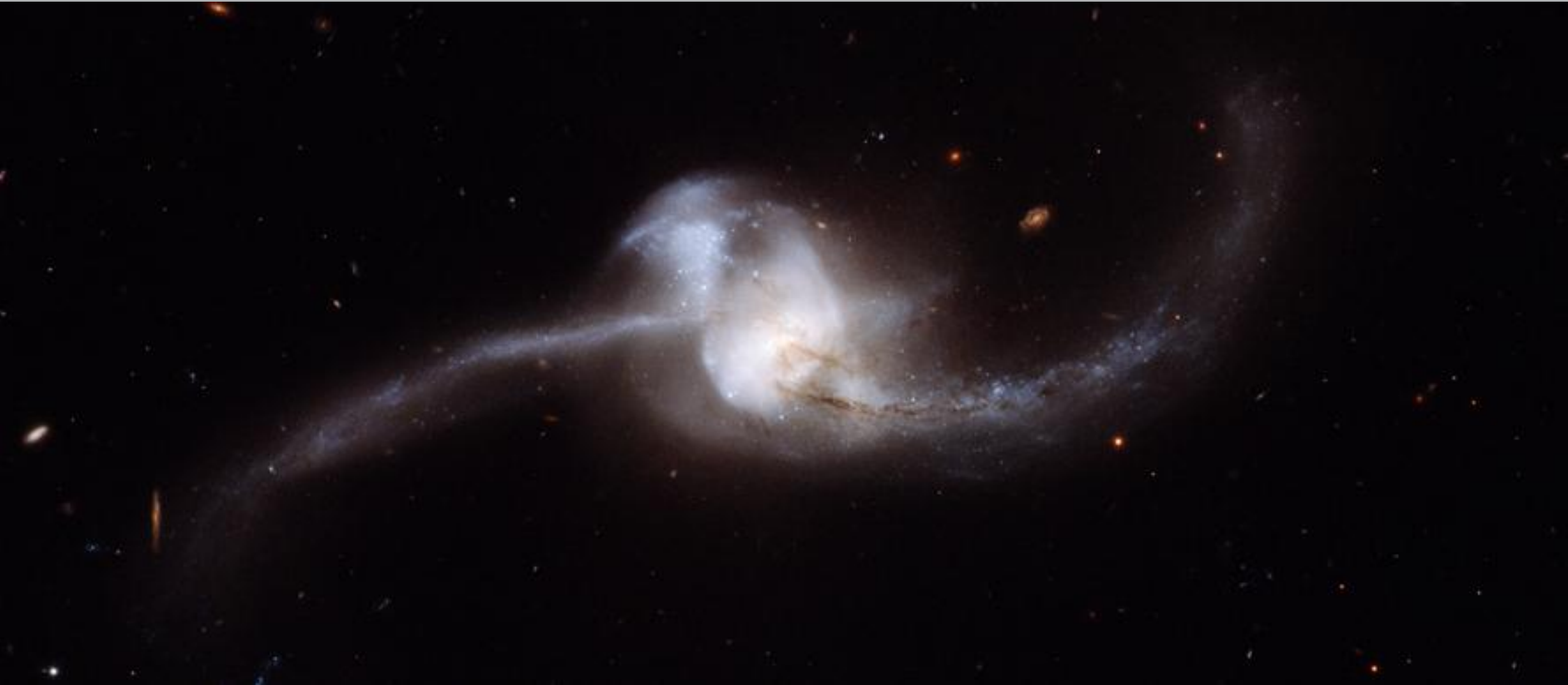
Credit:  
NASA

# Structure formation



Credit:  
University  
of Chicago

# Galaxy formation



Credit: NASA, ESA

Christopher Berry

The Big Bang

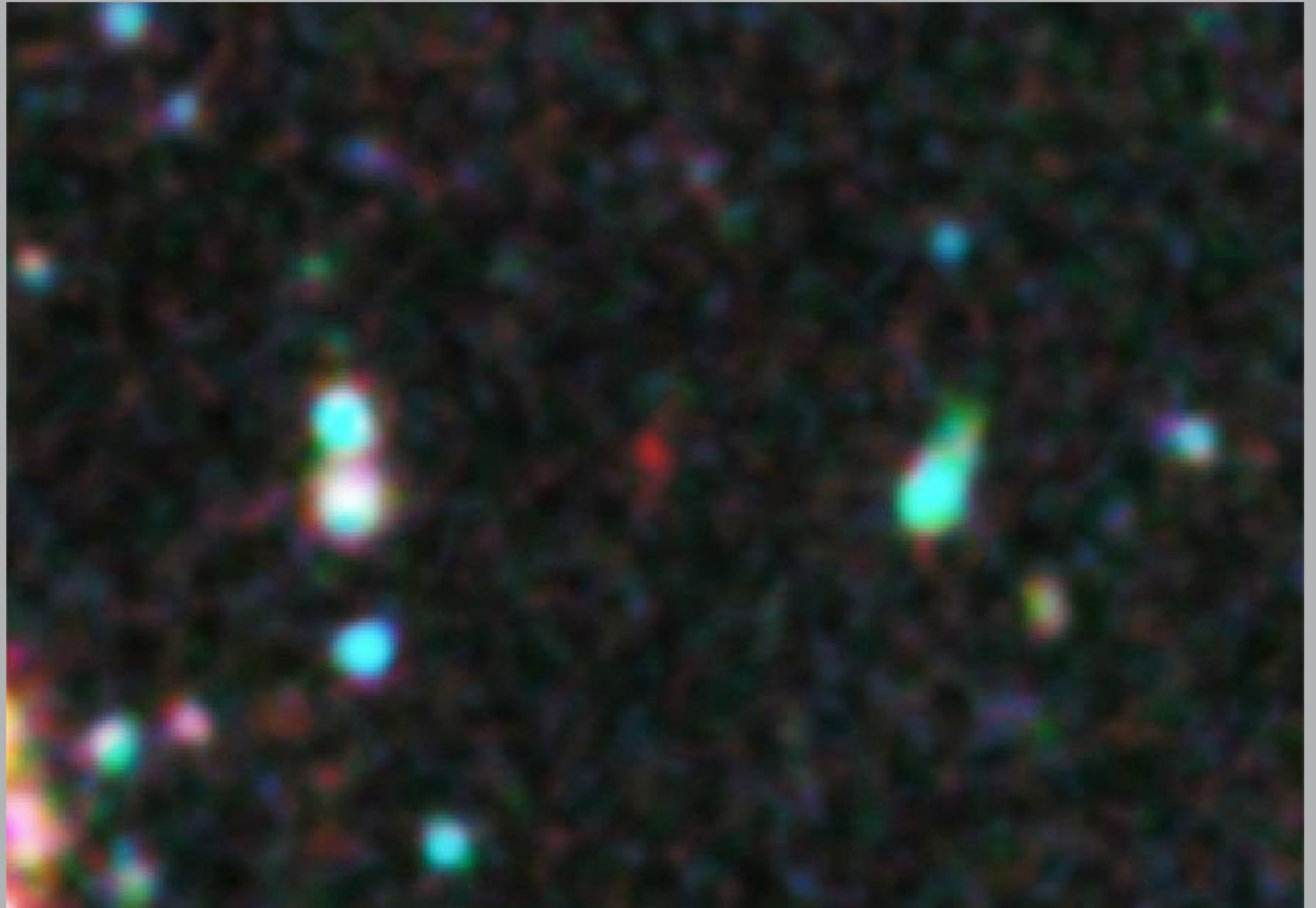
Wednesday 9 January 2013



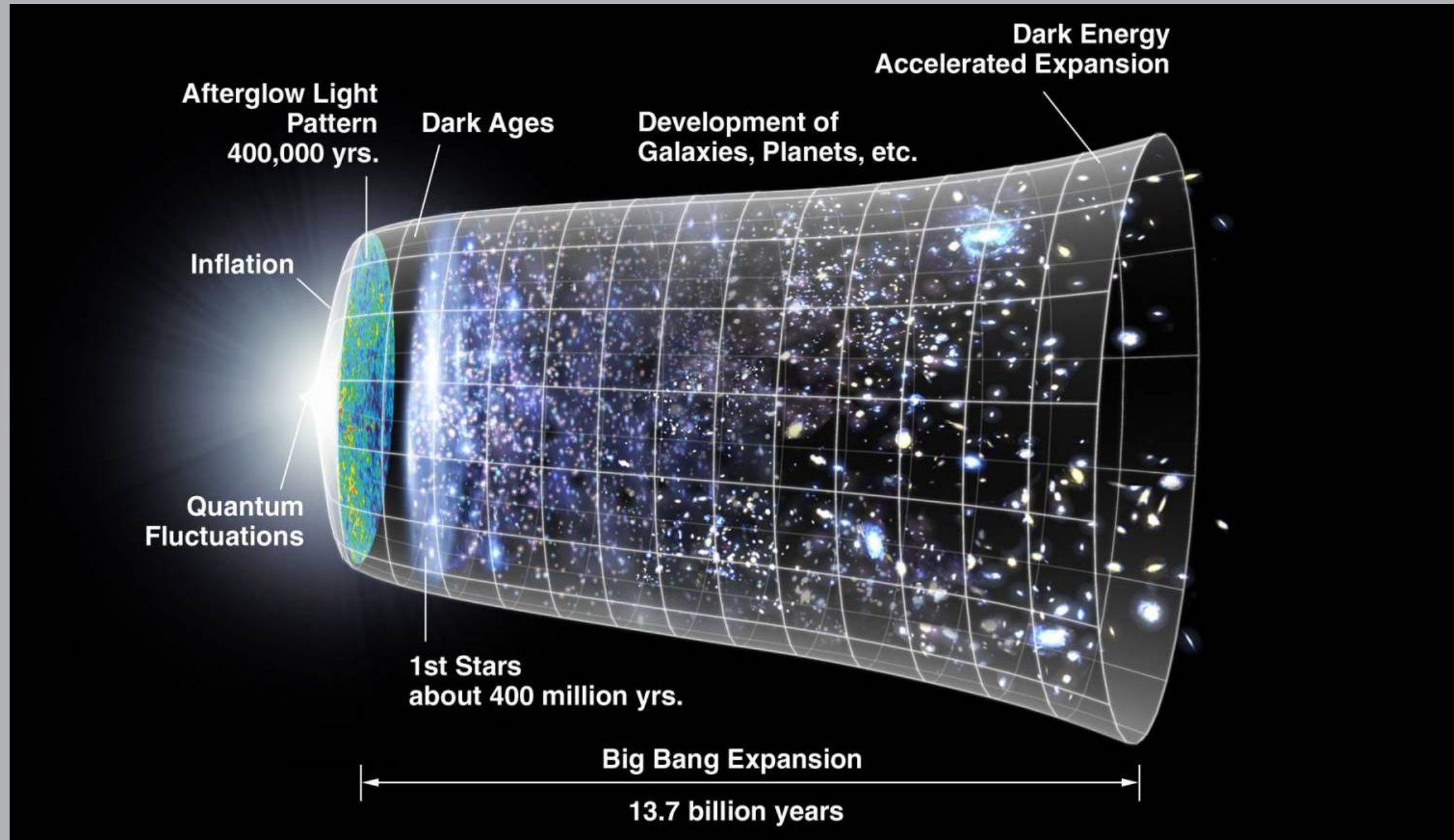
# Most distant galaxy?

UDFj-39546284  
13.37 billion years old

Credit:  
NASA,  
HST



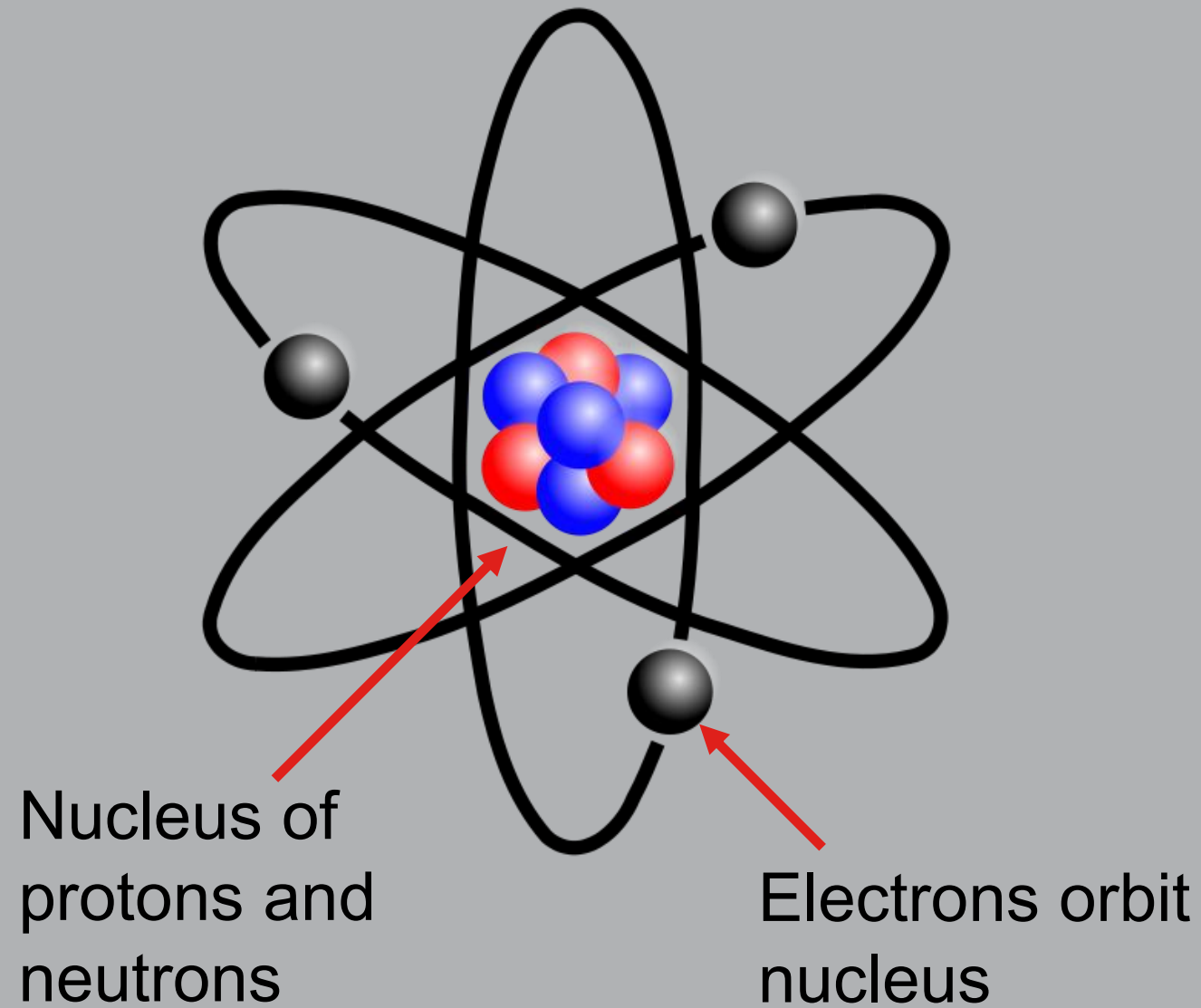
# History of the Universe



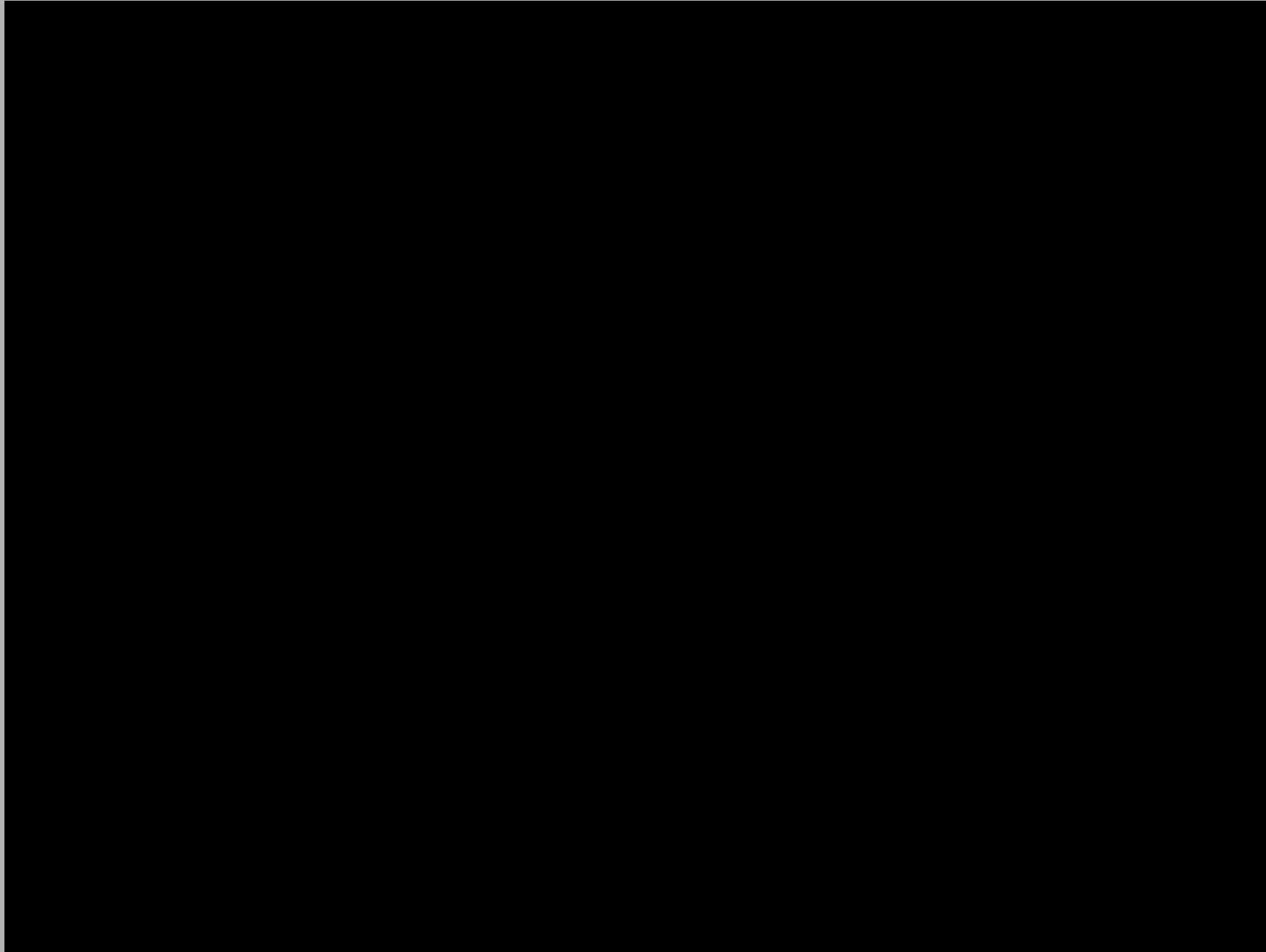
Credit:  
NASA



# Atoms



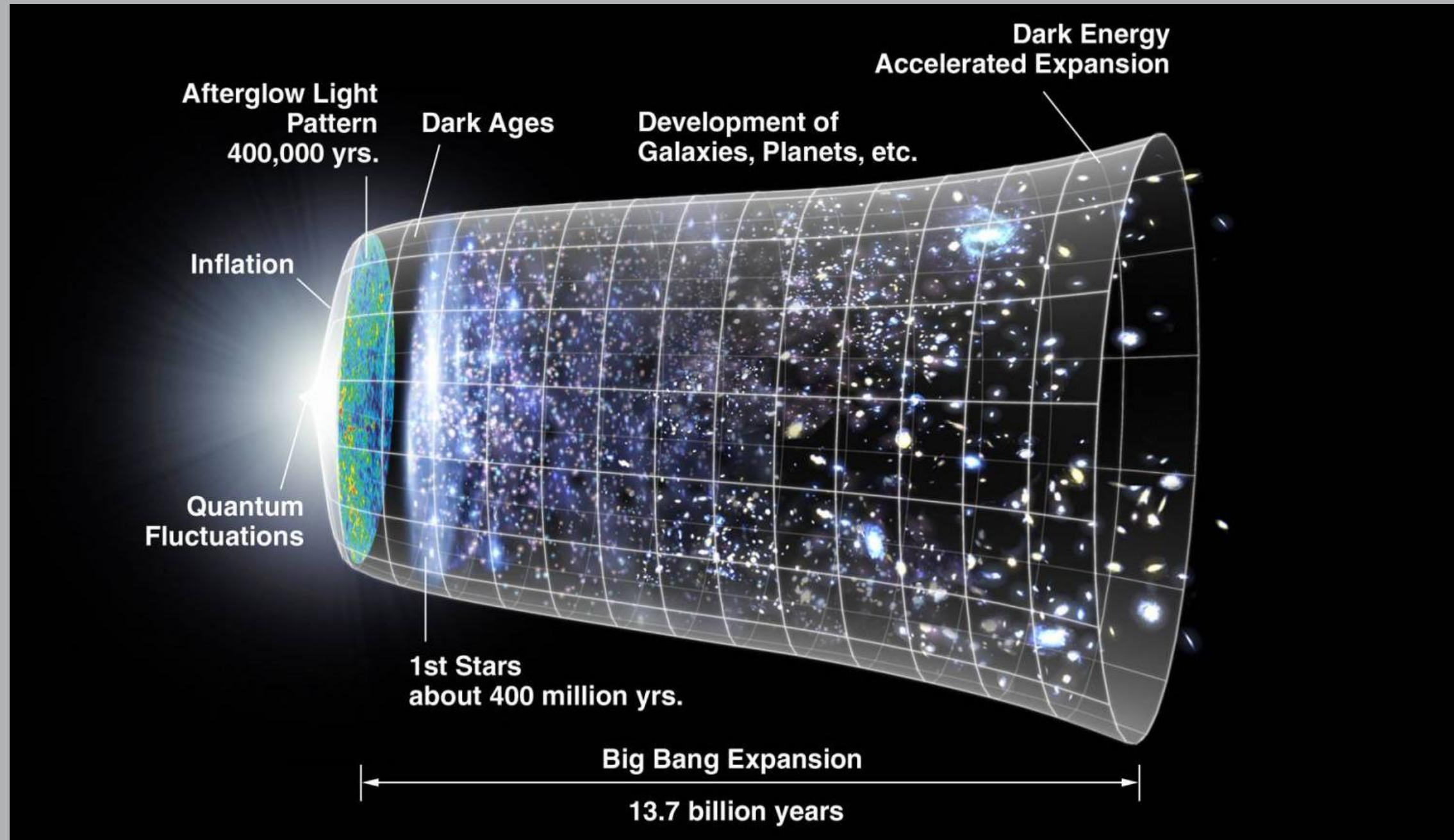
# Reionization



Credit: Alvarez  
and Kaehler



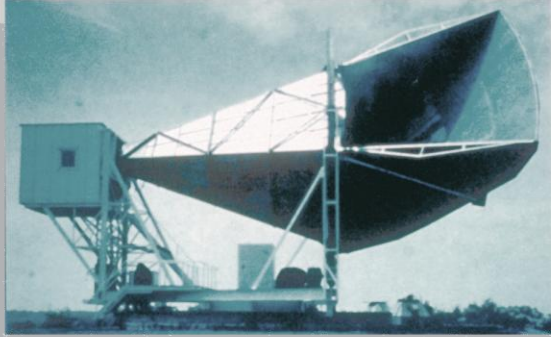
# History of the Universe



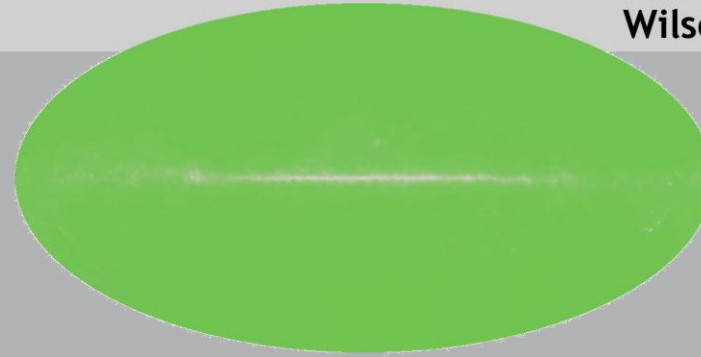
Credit:  
NASA

# Cosmic microwave background

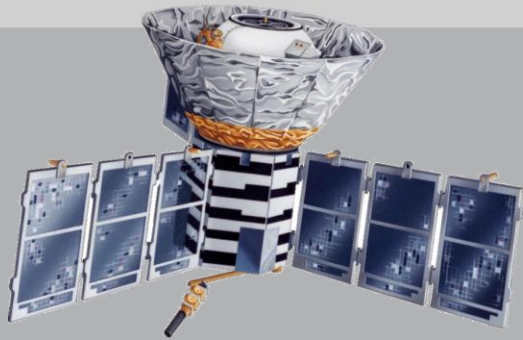
1965



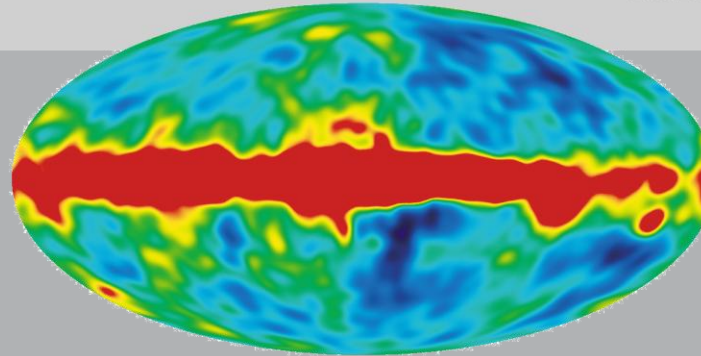
Penzias and  
Wilson



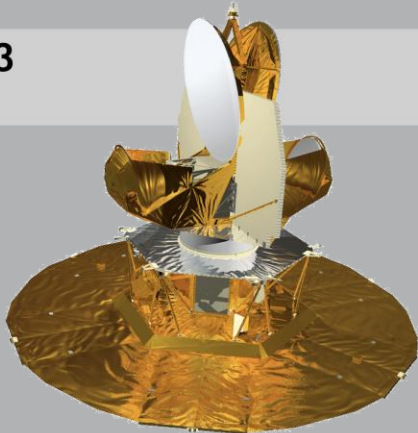
1992



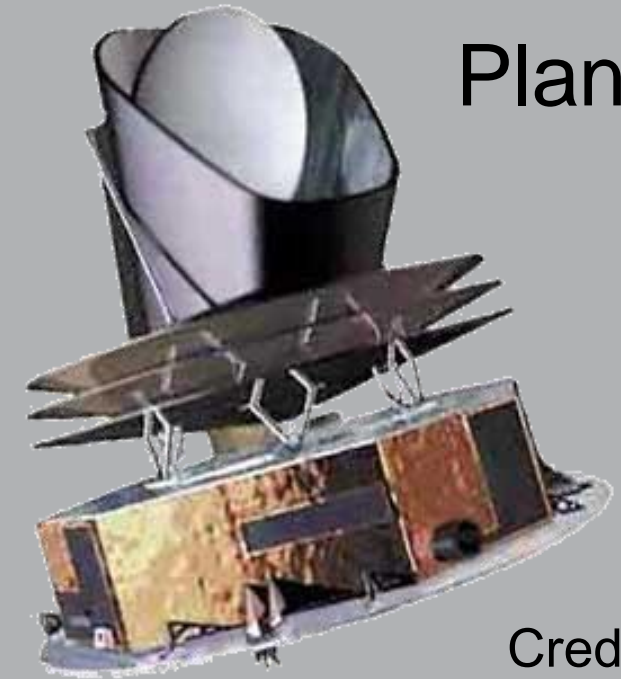
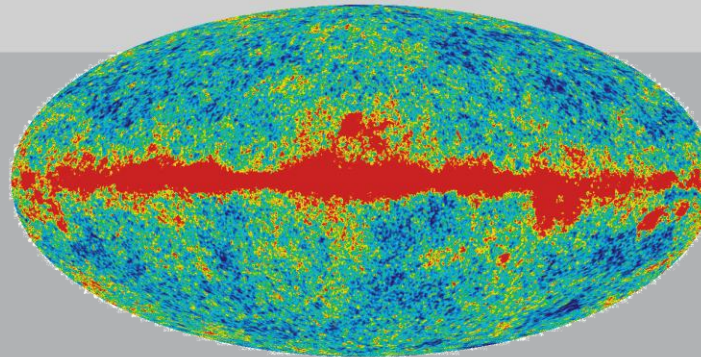
COBE



2003



WMAP



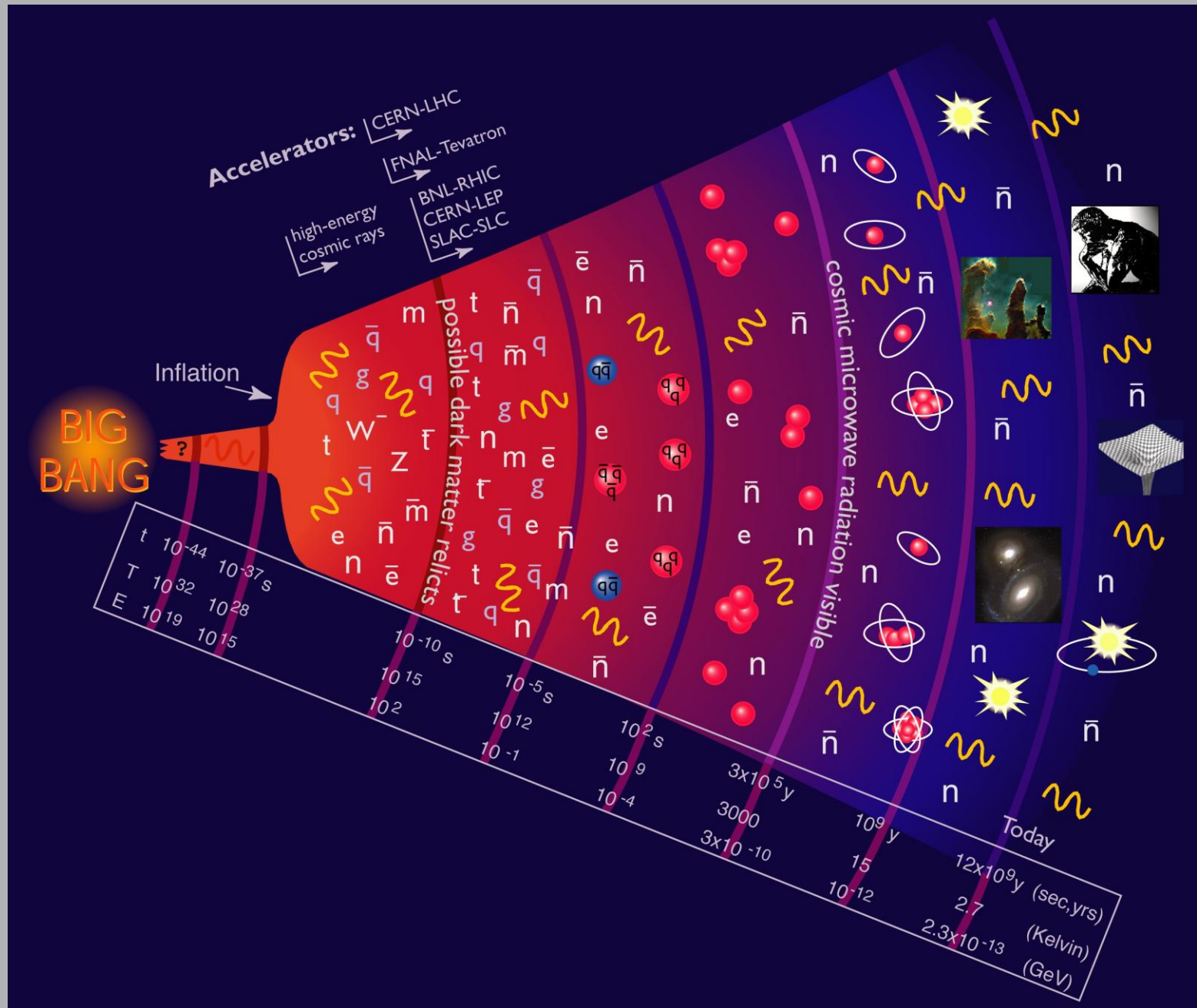
Planck

Credit: ESA

Credit: NASA, WMAP



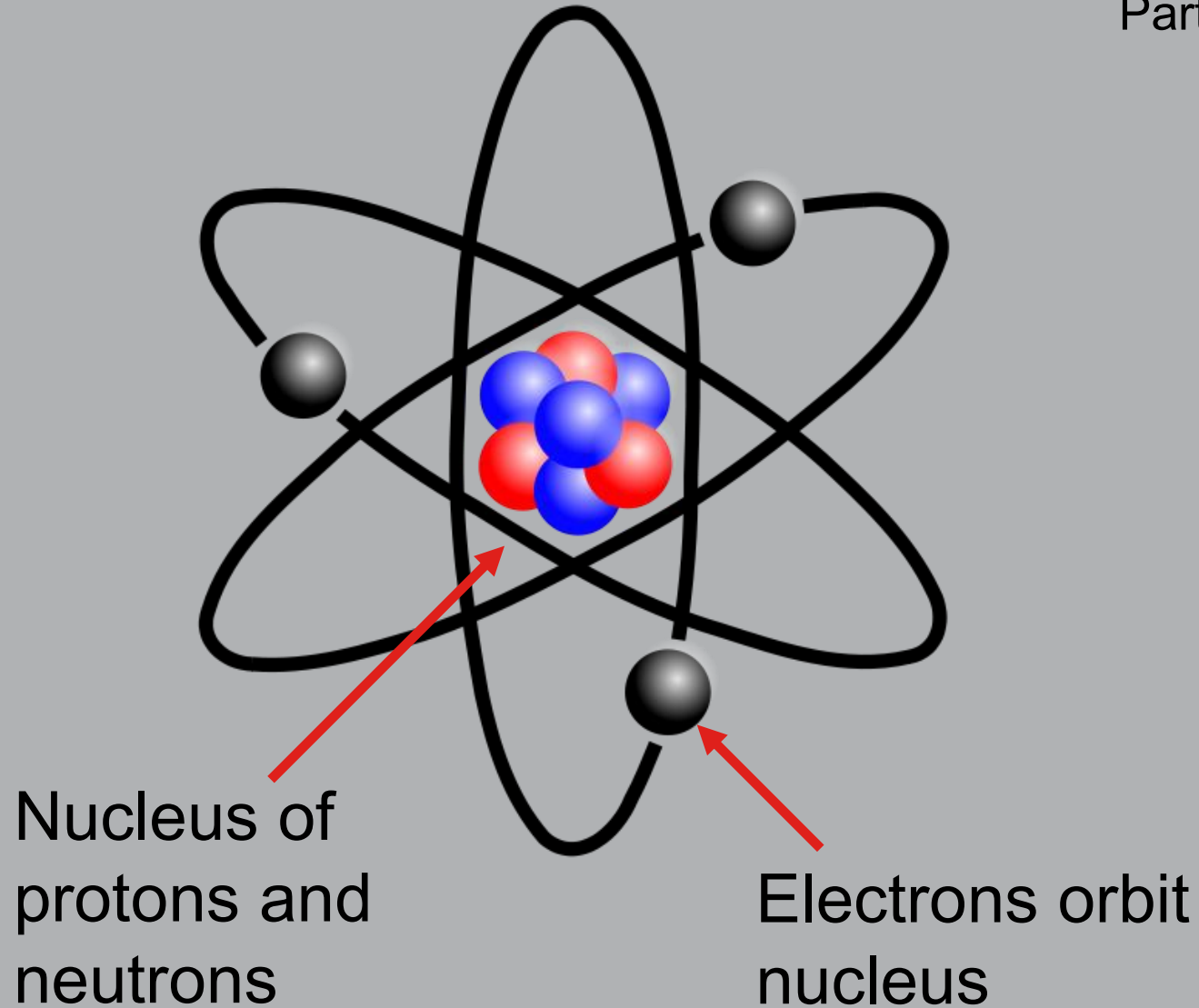
# The early Universe



Credit:  
Particle  
Data Group

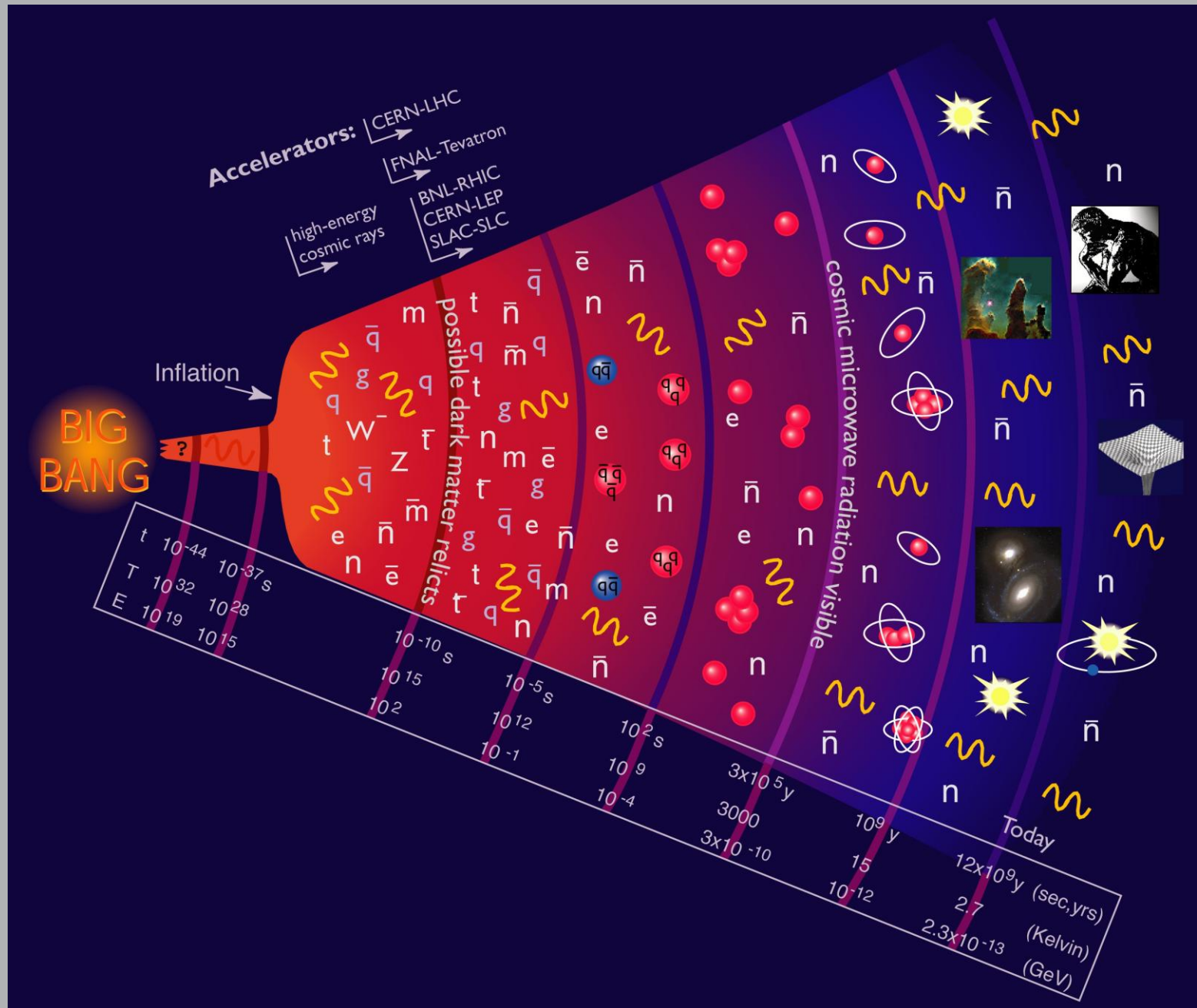
# Particle soup

Credit:  
Particle Zoo



The <b>PARTICLE ZOO</b> <small>Sewing the fabric of spacetime</small>						
ELEMENTARY PARTICLES of THE STANDARD MODEL:						
QUARKS	I	II	III	FERMIONS		
	 $u$ UP QUARK	 $c$ CHARM QUARK	 $t$ TOP QUARK	BOSONS		
	 $d$ DOWN QUARK	 $s$ STRANGE QUARK	 $b$ BOTTOM QUARK	 $\gamma$ PHOTON	FORCE CARRIERS	
	 $\nu_e$ ELECTRON-NEUTRINO	 $\nu_\mu$ MUON-NEUTRINO	 $\nu_\tau$ TAU-NEUTRINO	 $g$ GLUON		
	 $e^-$ ELECTRON	 $\mu$ MUON	 $\tau$ TAU	 $Z$ Z BOSON		
				 $W$ W BOSON		

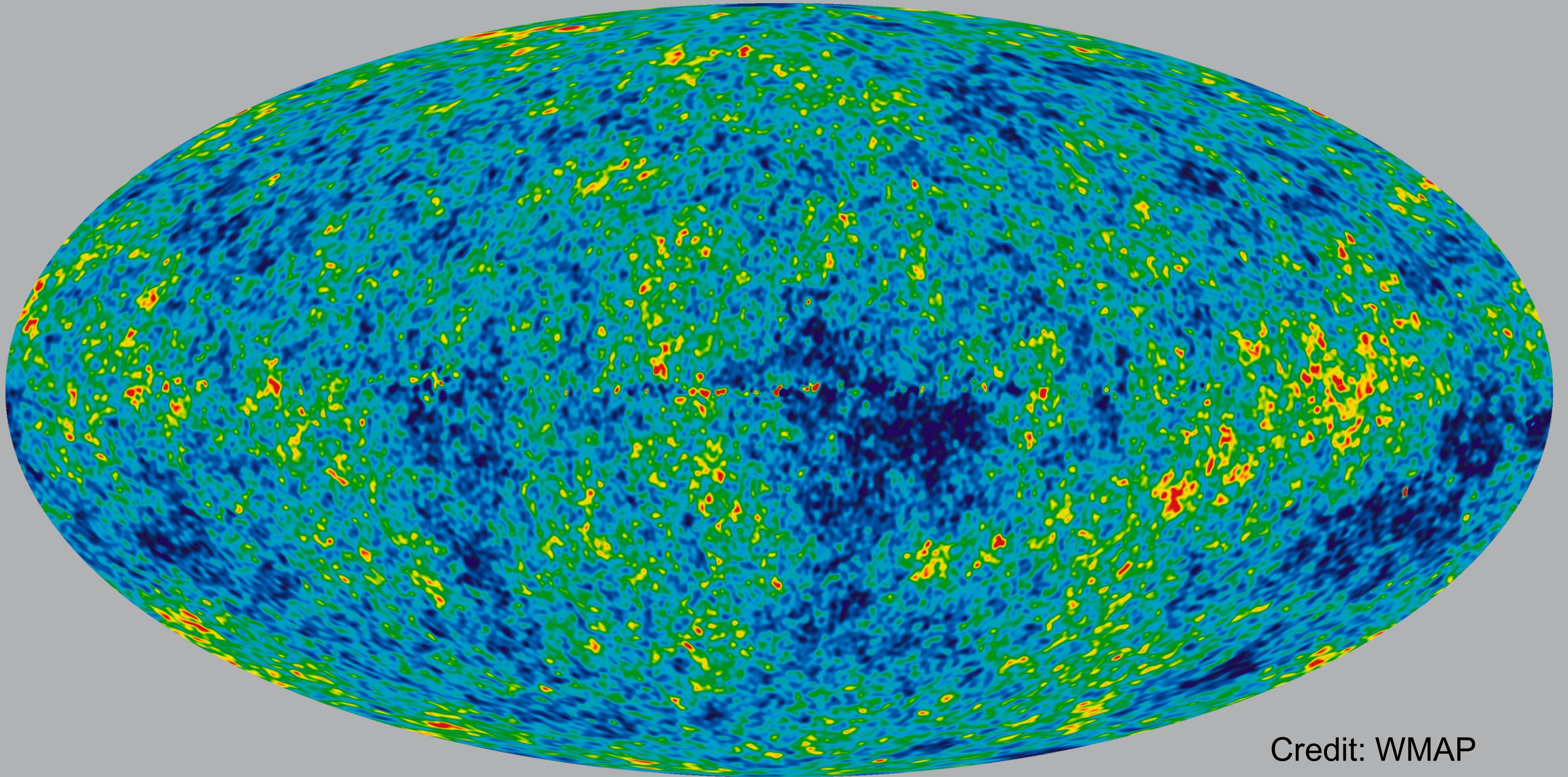
# The early Universe



Credit:  
Particle  
Data Group



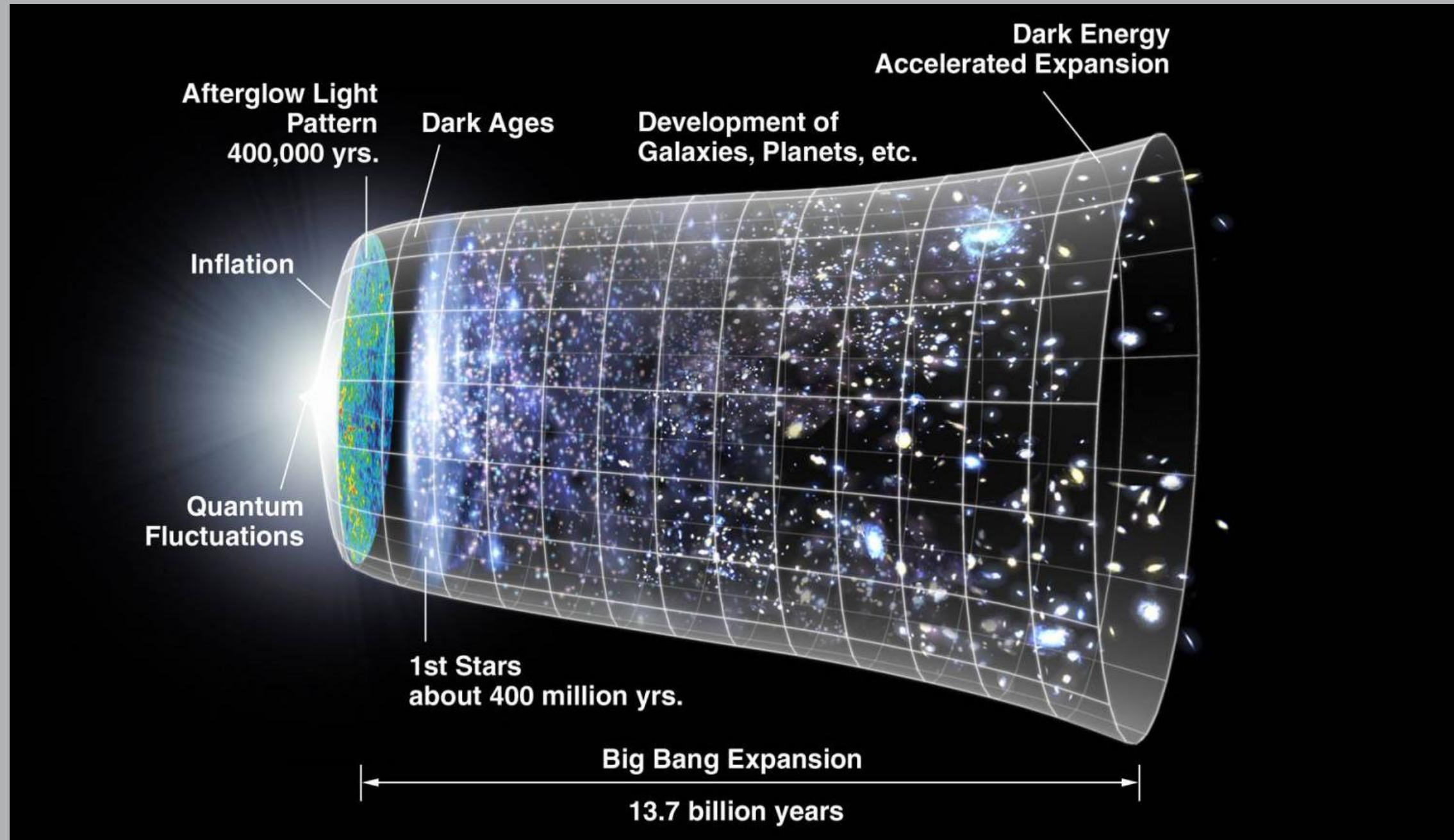
# Cosmic microwave sky



Credit: WMAP



# History of the Universe



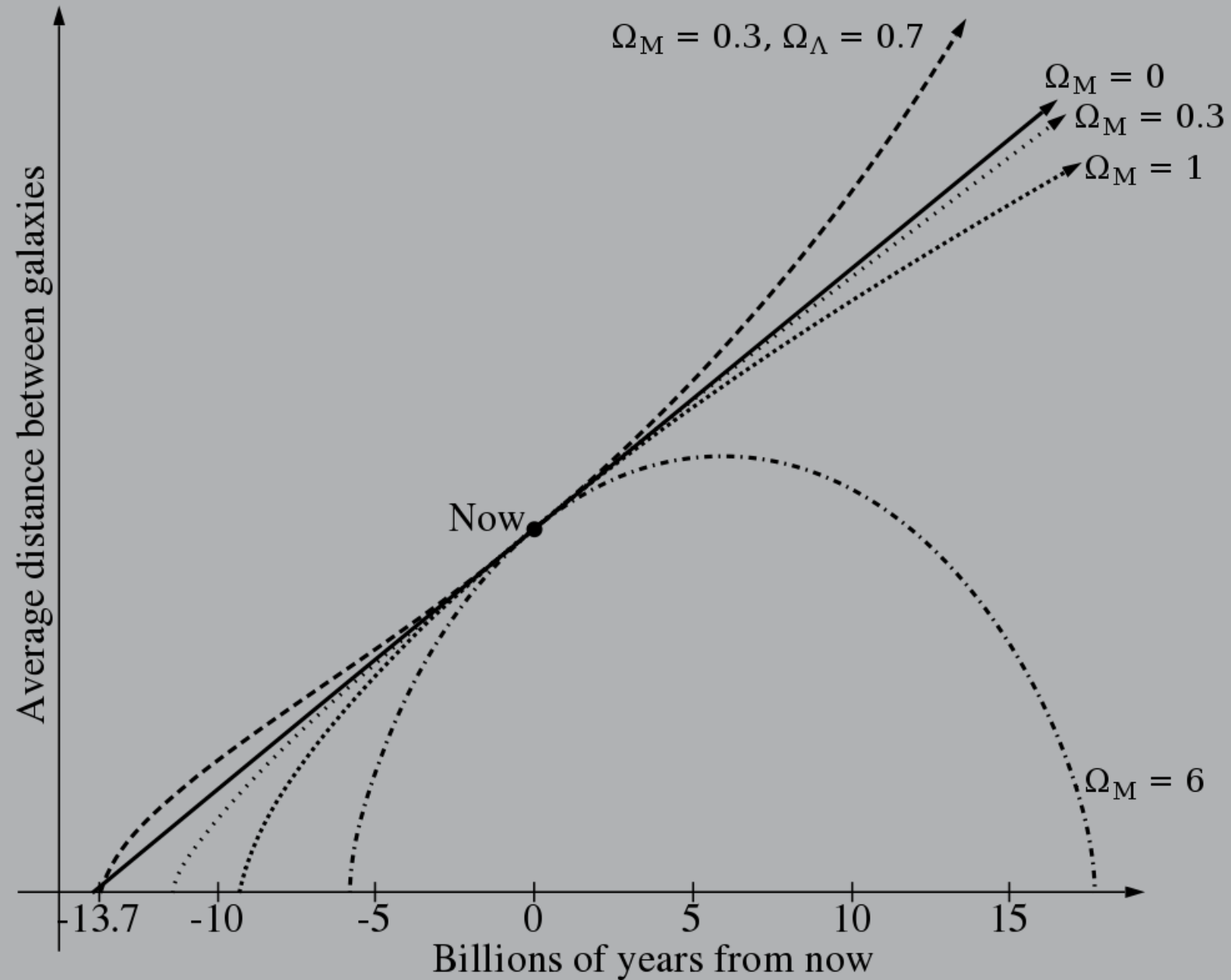
Credit:  
NASA

# Before that

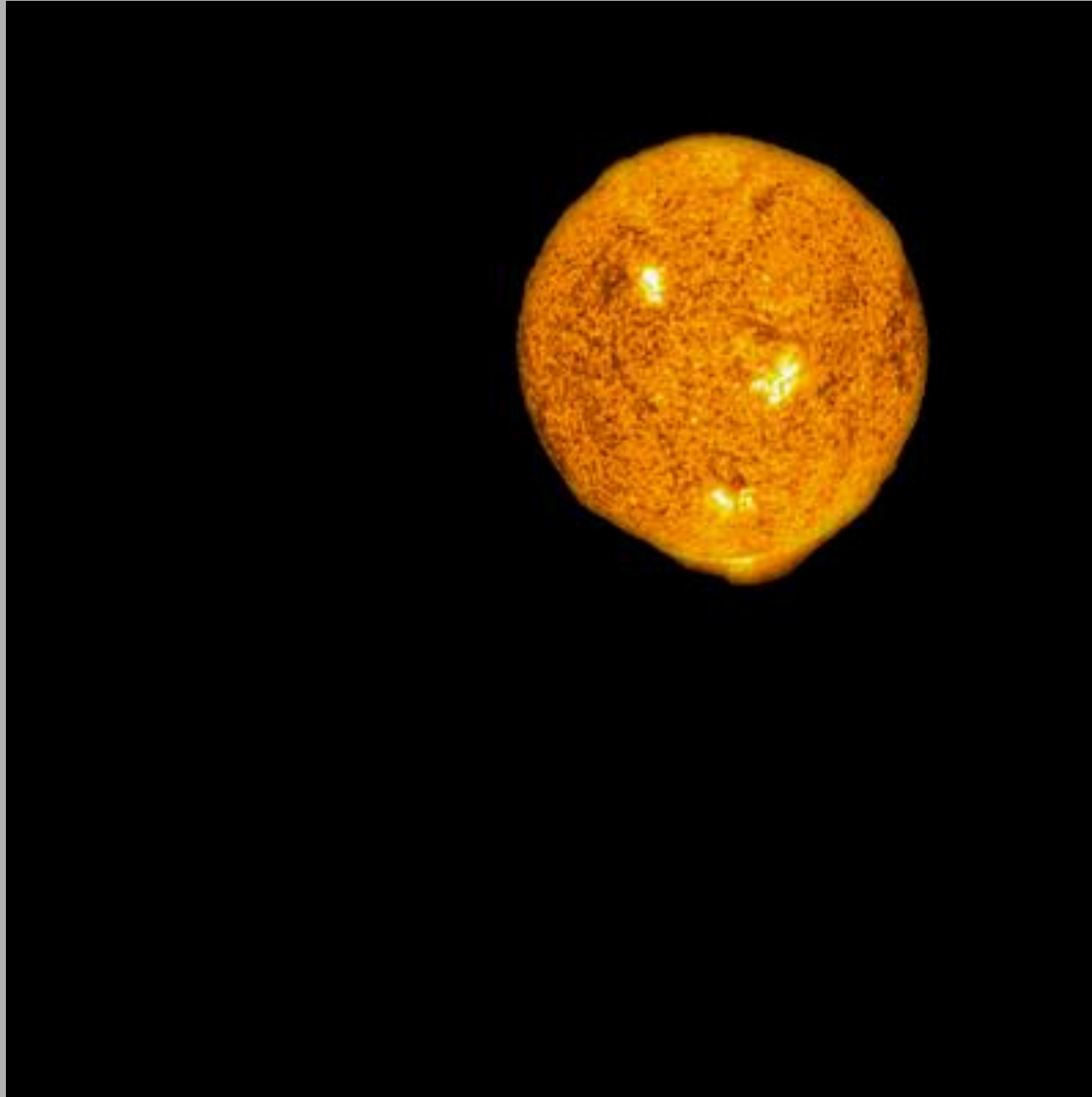




# Scale of the Universe

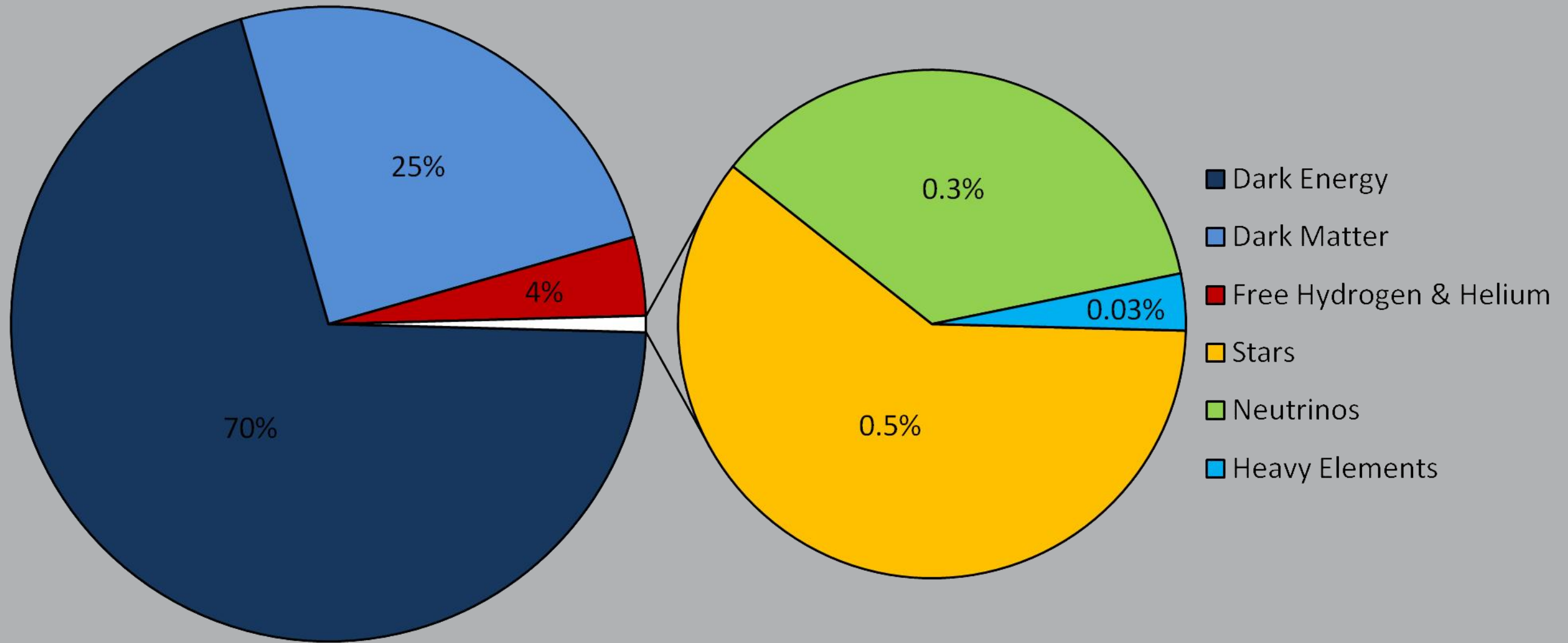


# Olber's paradox





# Contents of the Universe



# Higgs boson



Credit:  
Particle Zoo