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What's All the Fuss About? Day 1: Exploring the 2019 Nobel Prize Contributions in Chemistry, Physics, and Literature

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"FOR THE GREATEST
BENEFIT TO HUMANKIND"

ALFRED NOBEL

The 2019 Nobel Prizes in Chemistry, Physics and Literature

Dr. Denise Femia, Dr. Sean McClory, and Dr. Vincent Kling

2019 Nobel Prize in Chemistry

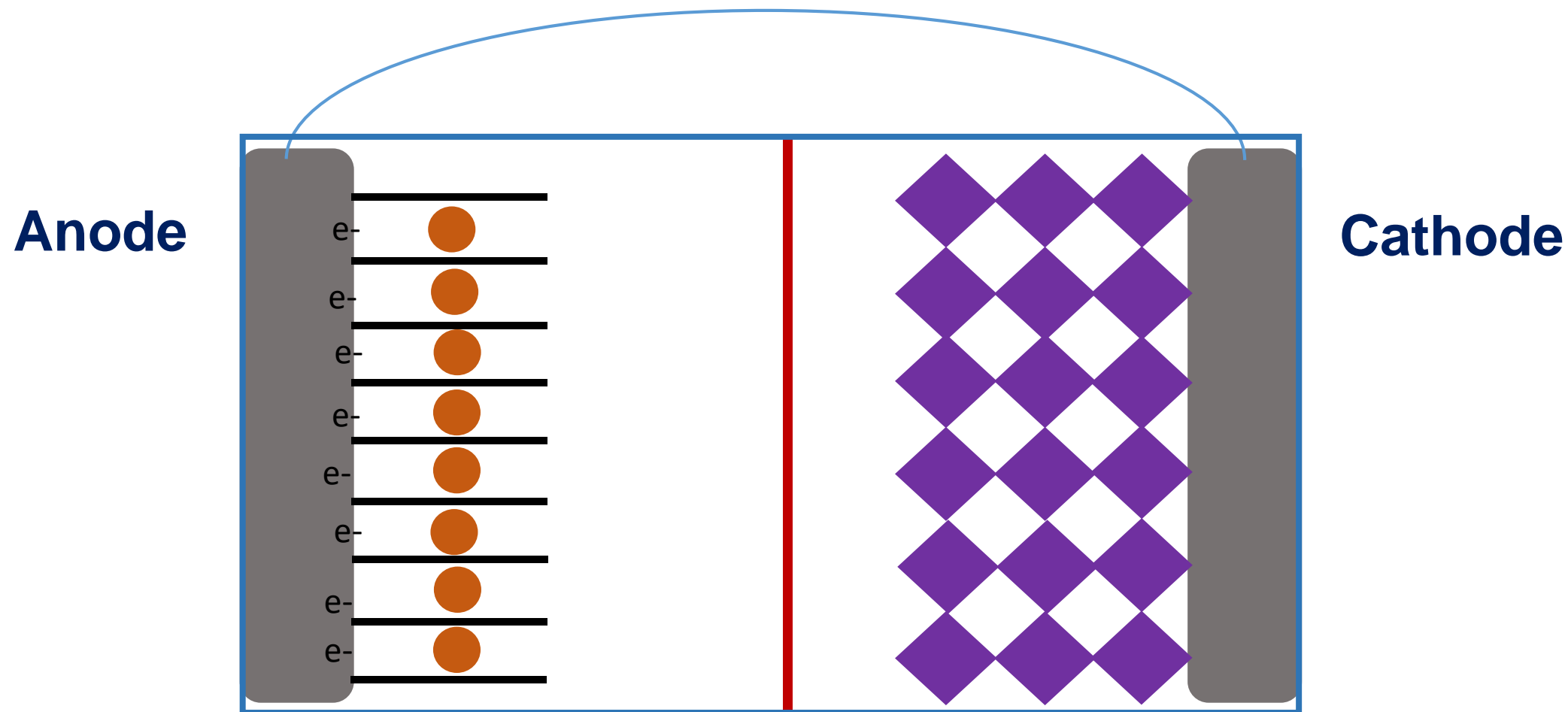
“for the development of lithium-ion batteries”

Nobel Prize in Chemistry



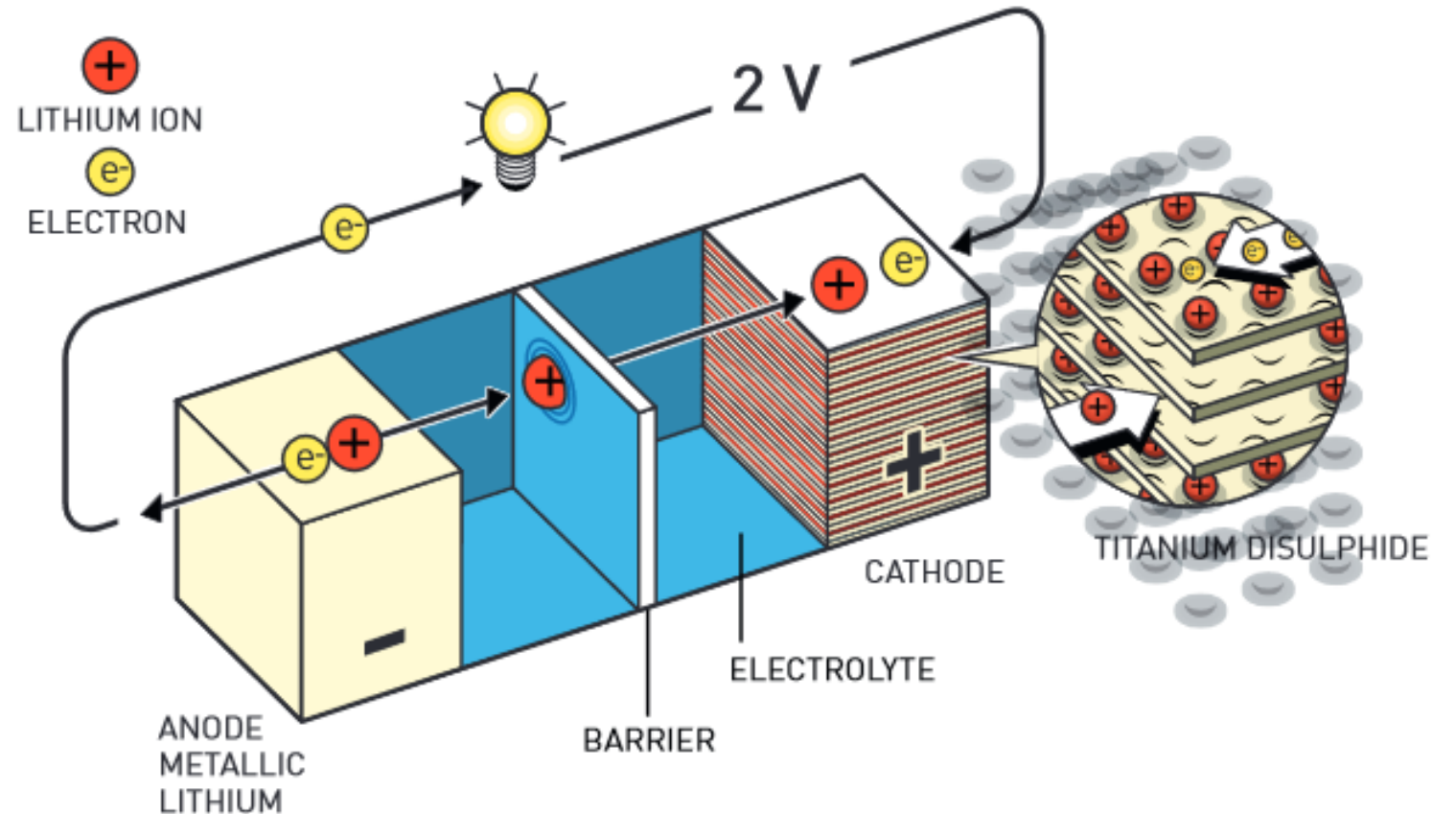
- John B. Goodenough, The University of Texas at Austin, USA
- M. Stanley Whittingham, Binghamton University, State University of New York, USA
- Akira Yoshino, Asahi Kasei Corporation, Tokyo, Japan Meijo University, Nagoya, Japan

How Does a Battery Work?



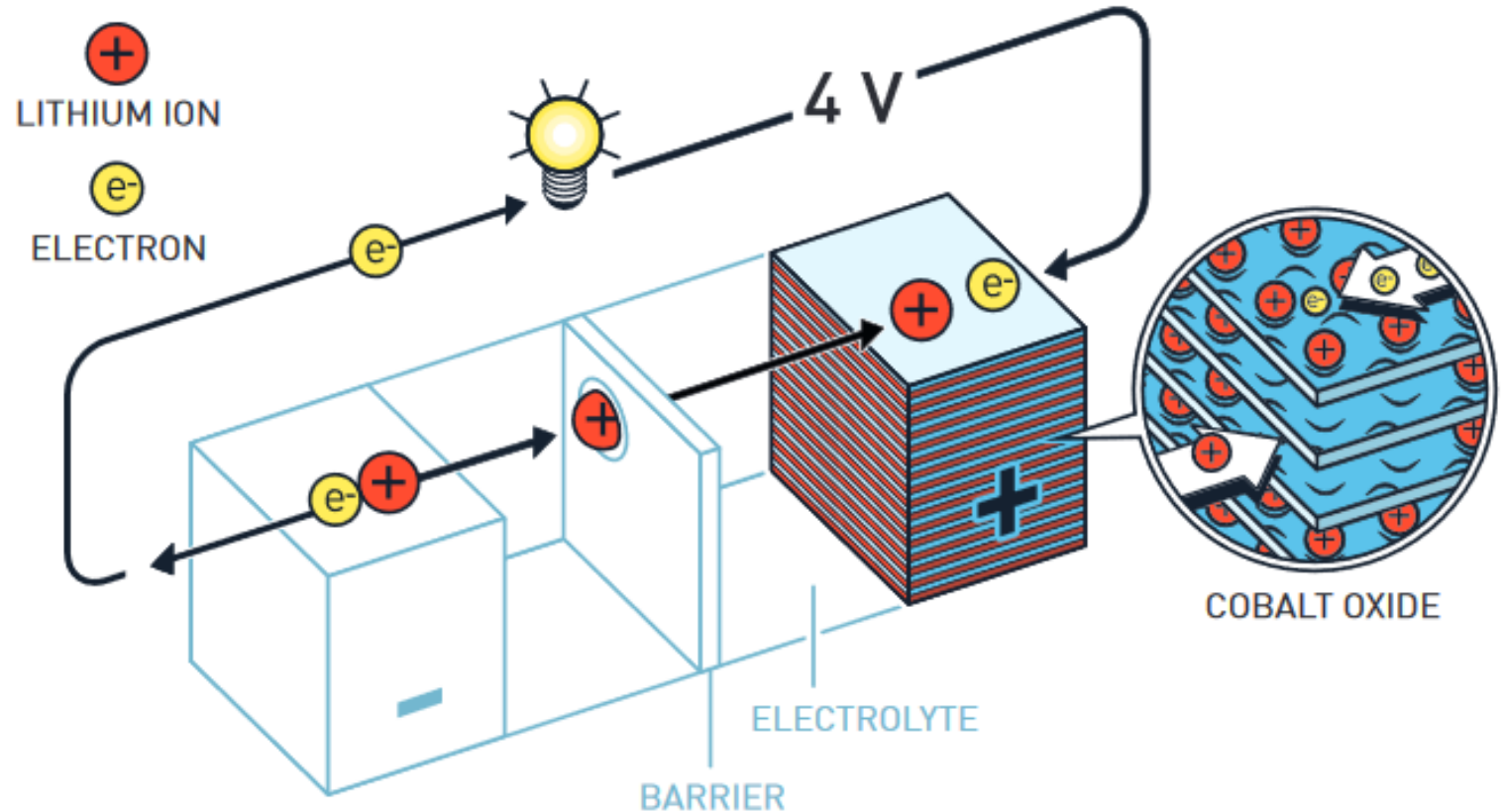
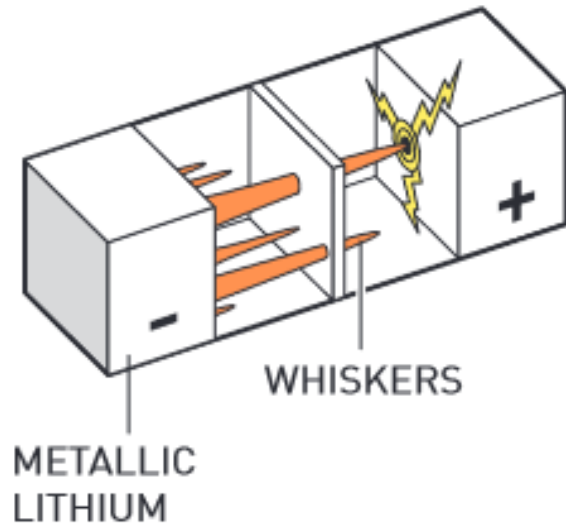
Development of Lithium Ion Batteries

- Whittingham's lithium ion battery



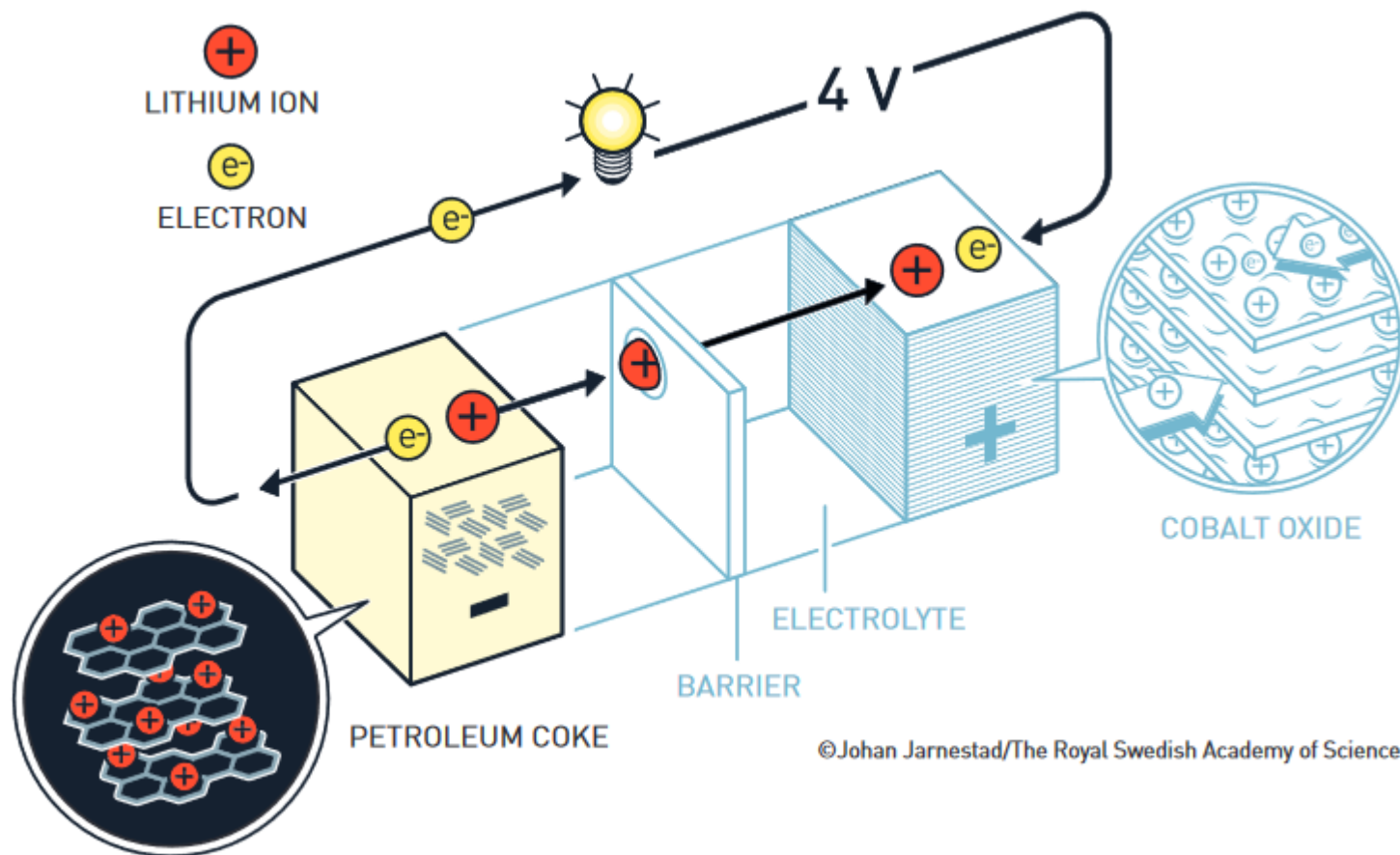
Development of Lithium Ion Batteries

- Goodenough's lithium ion battery

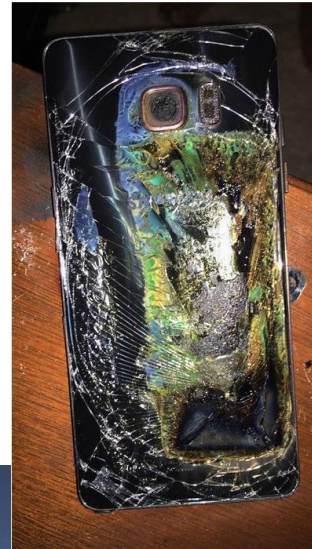
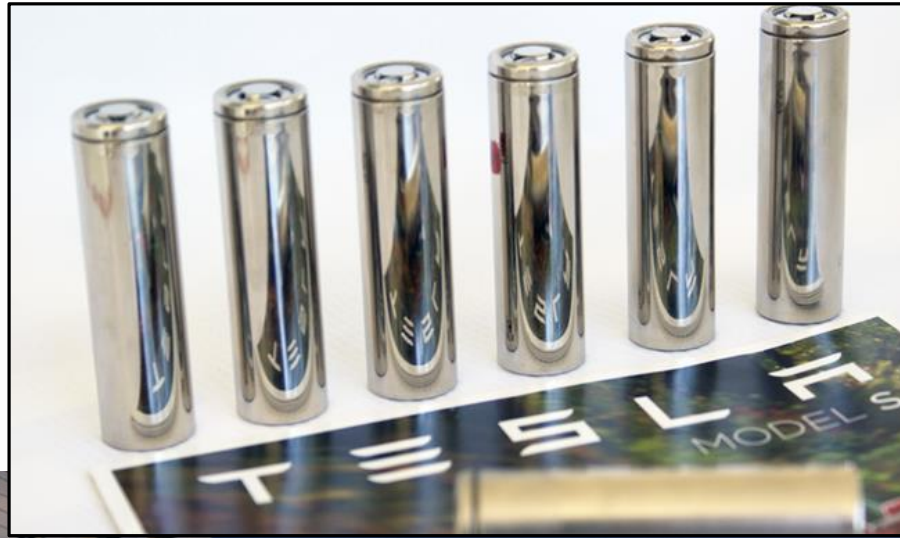


Development of Lithium Ion Batteries

- Yoshino's battery



The Future of Lithium Ion Batteries?



2019 Nobel Prize in Physics

“for contributions to our understanding of the evolution of the universe and Earth’s place in the cosmos”

2019 Prize in Physics

- Half: two Swiss astronomers who discovered the first planet orbiting a solar-type star – **exoplanet**
 - How can exoplanets be detected?
 - How many exoplanets are there?
 - Is there another Earth?
- Half: one US physicist for theories of how the universe came to be
 - How did the universe begin?
 - What evidence exists about the beginning of the universe?
 - What does mean for the future of the universe?

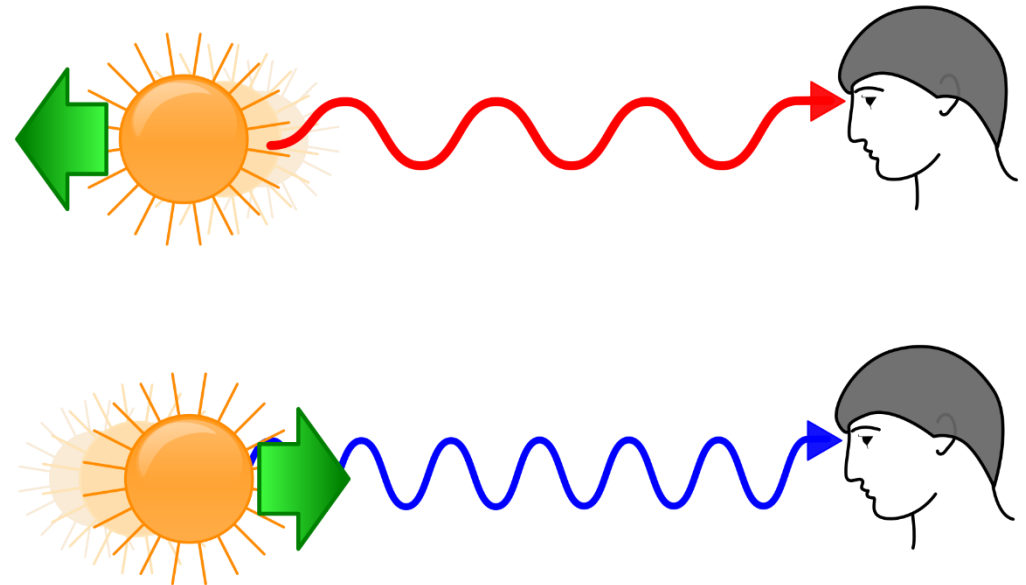
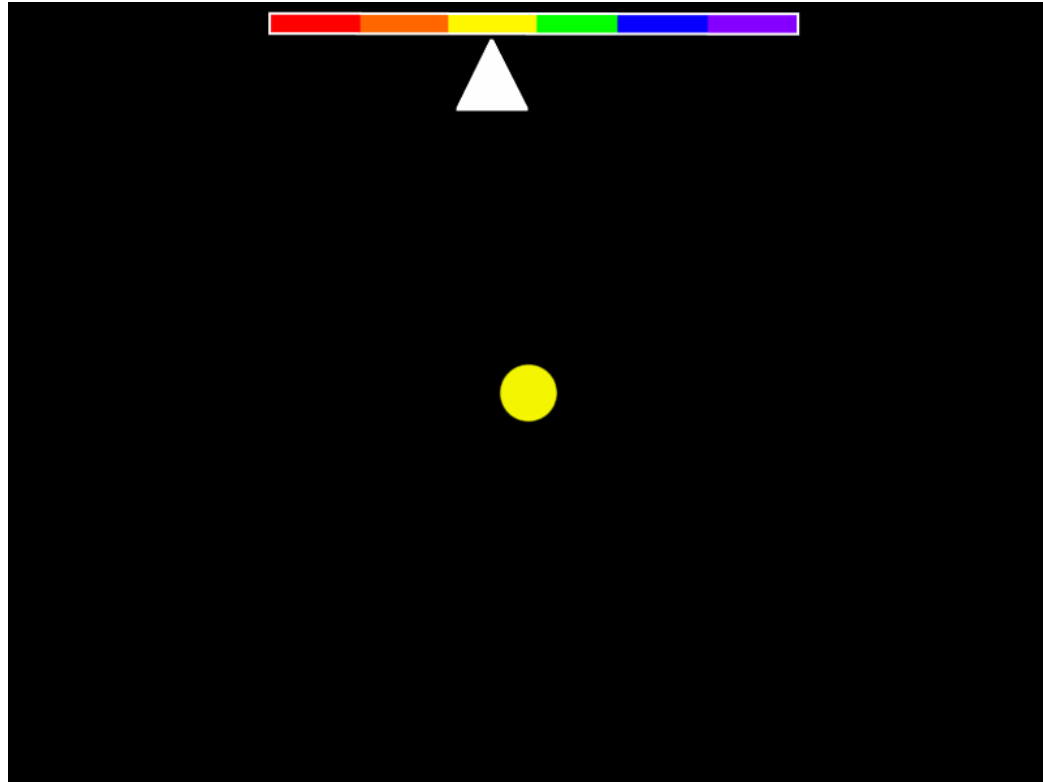
What is the Doppler Effect?

The Doppler Effect

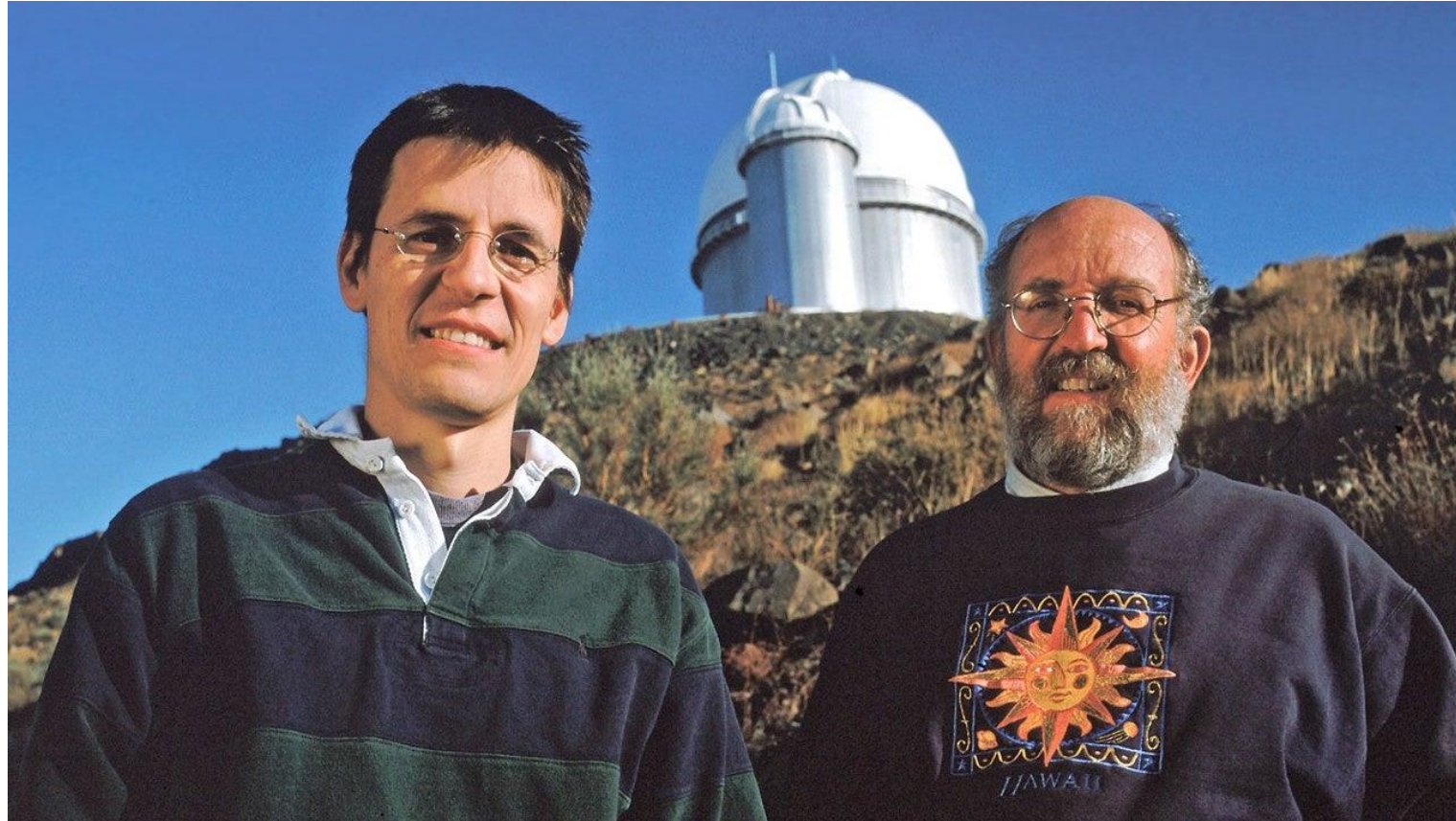
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- A wave's **frequency** is higher as the source of the wave moves toward an observer.
- Sound and light are both waves.

Doppler Blue/Redshift of light



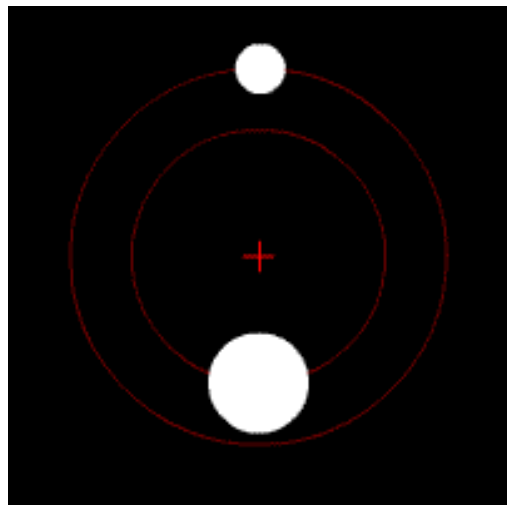
“for the discovery of an exoplanet orbiting a solar-type star”



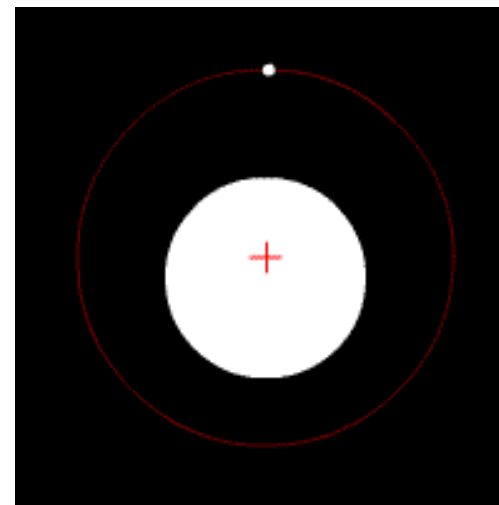
Dieder Queloz, University of Cambridge, UK

Michel Mayor, University of Geneva, Switzerland

Stars and planets orbit a center of mass



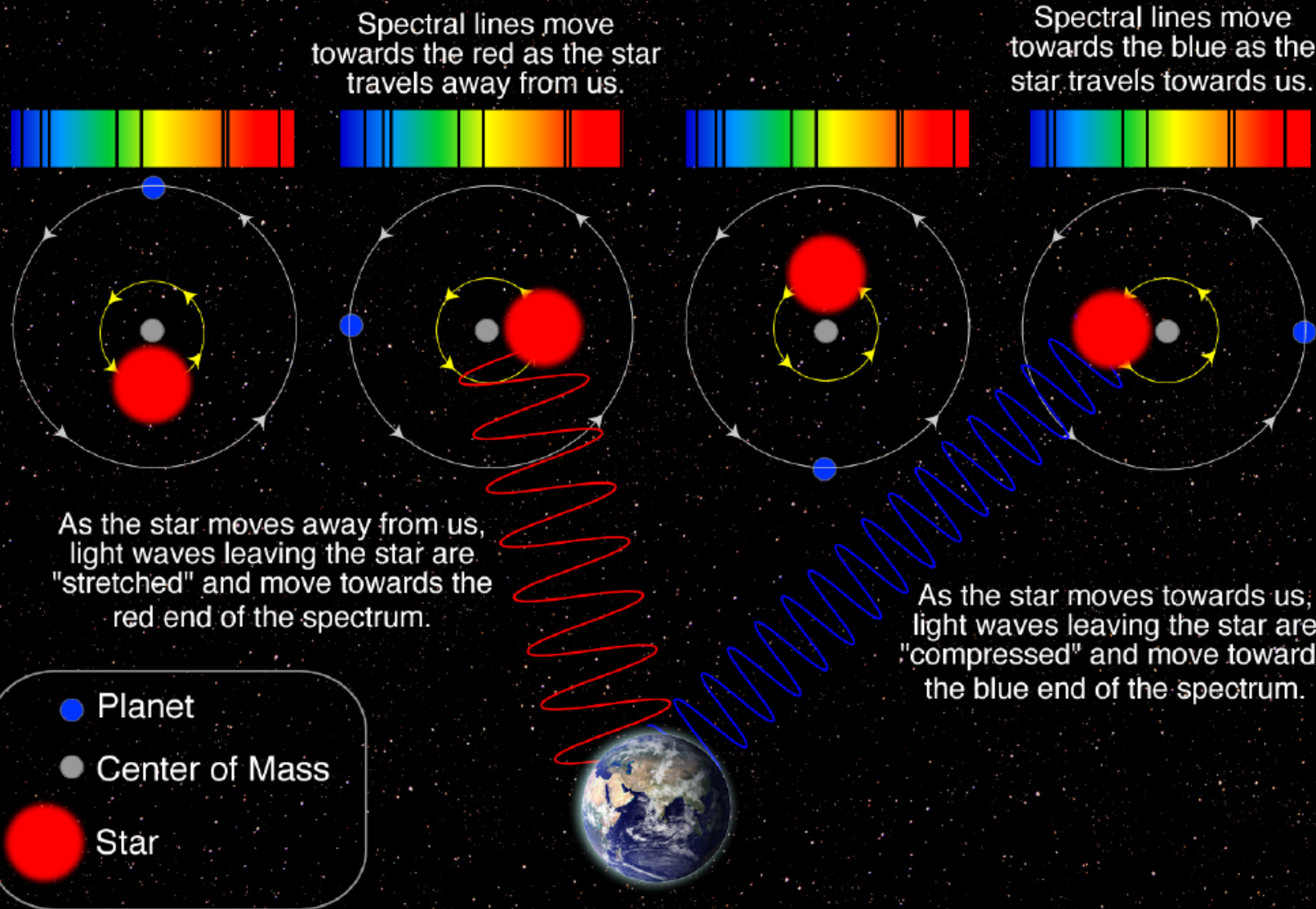
Orbits of objects similar in mass



Orbits of objects with different mass

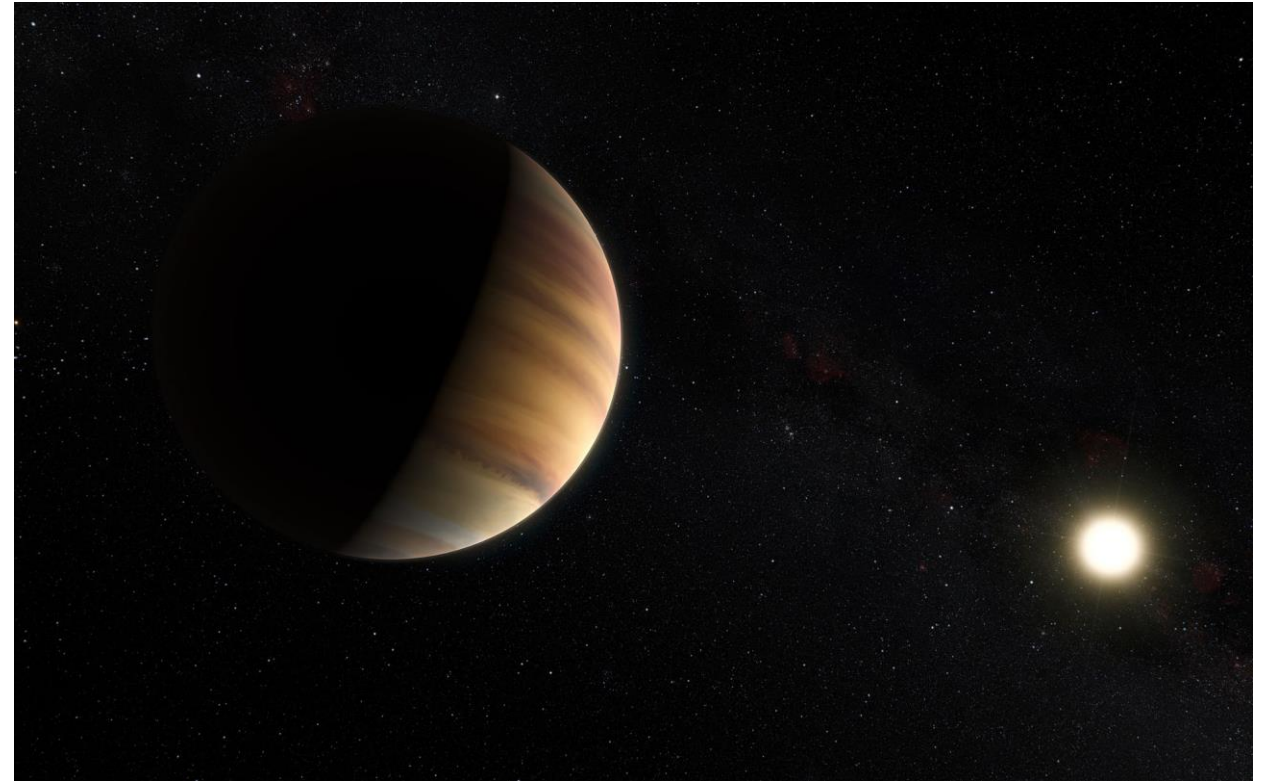
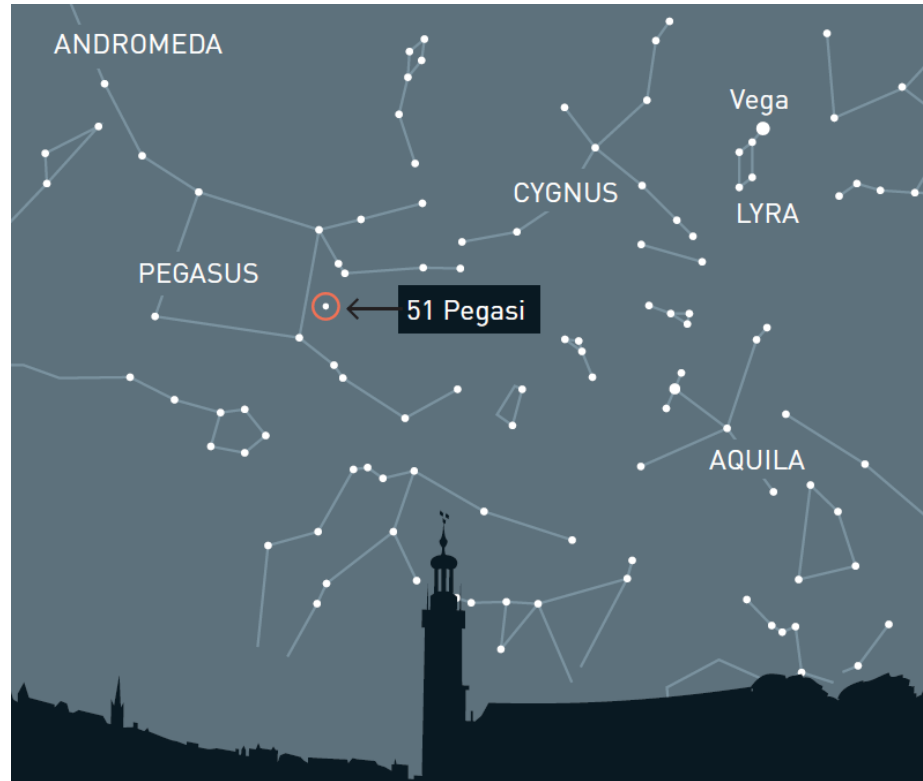
Radial Velocity Method

The star and planet orbit their common center of mass.

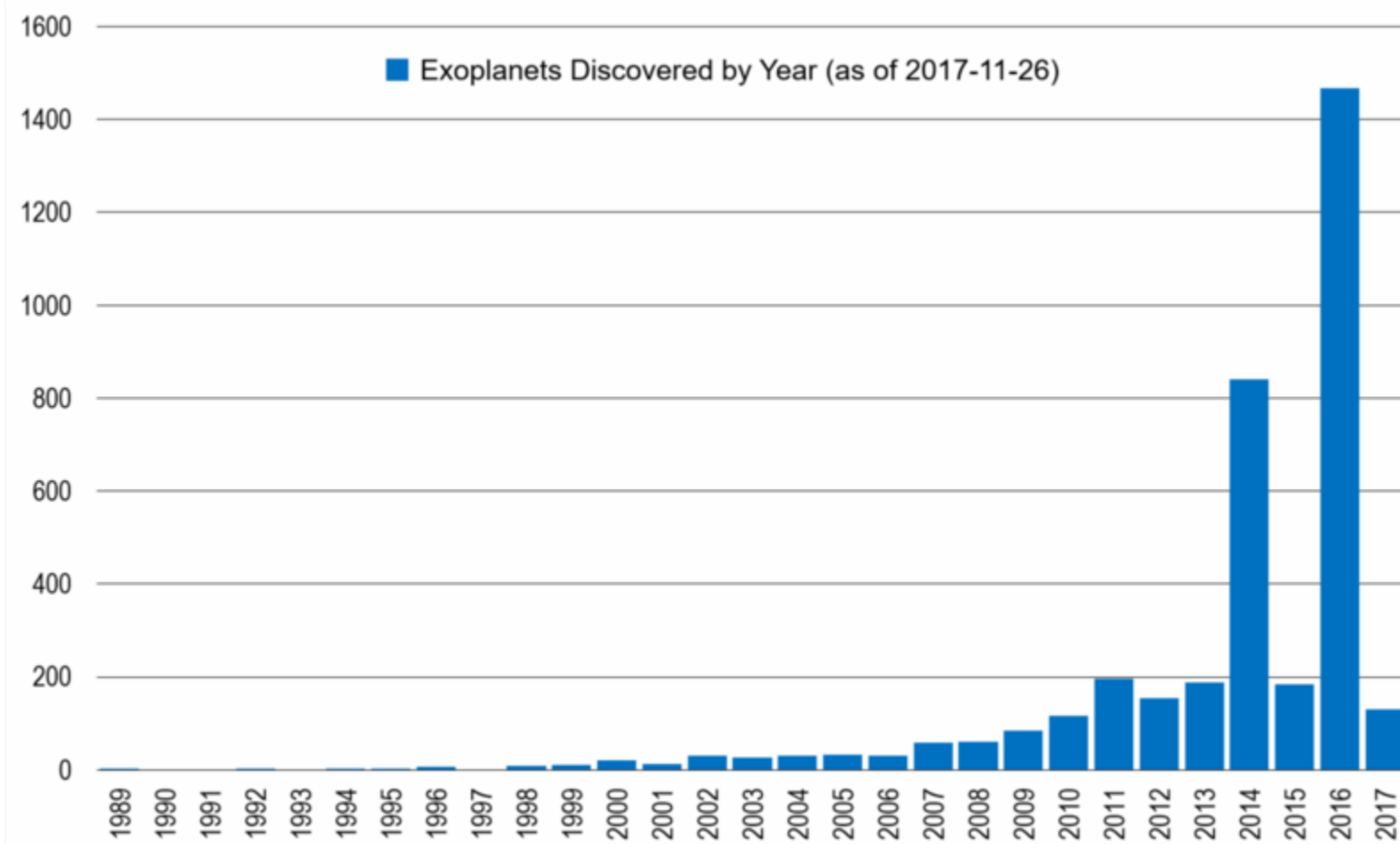


Not to scale

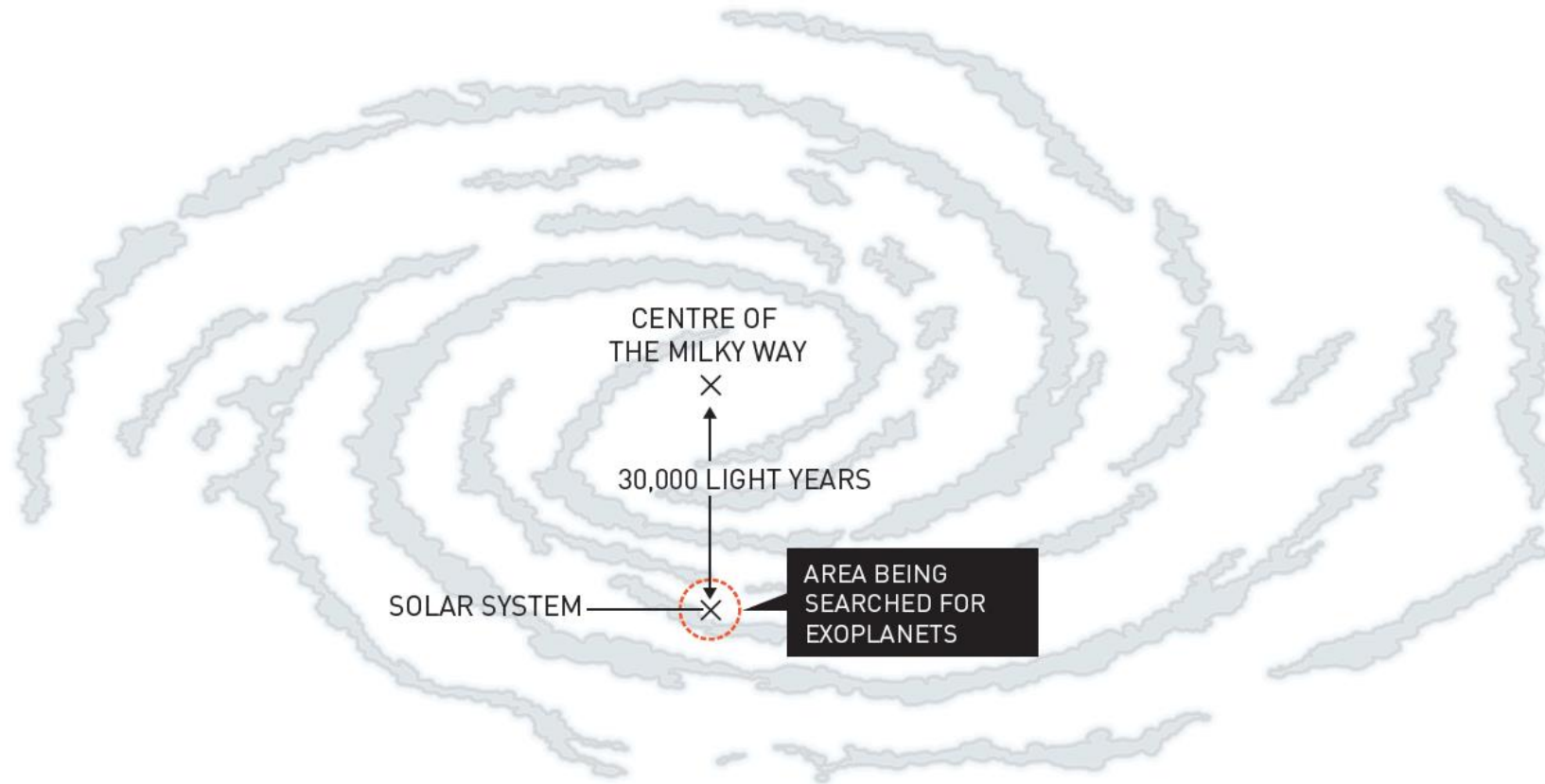
51 Pegasi B – the first planet discovered orbiting a sun-like star



There are now over 4000 confirmed exoplanets



Is there another Earth out there?



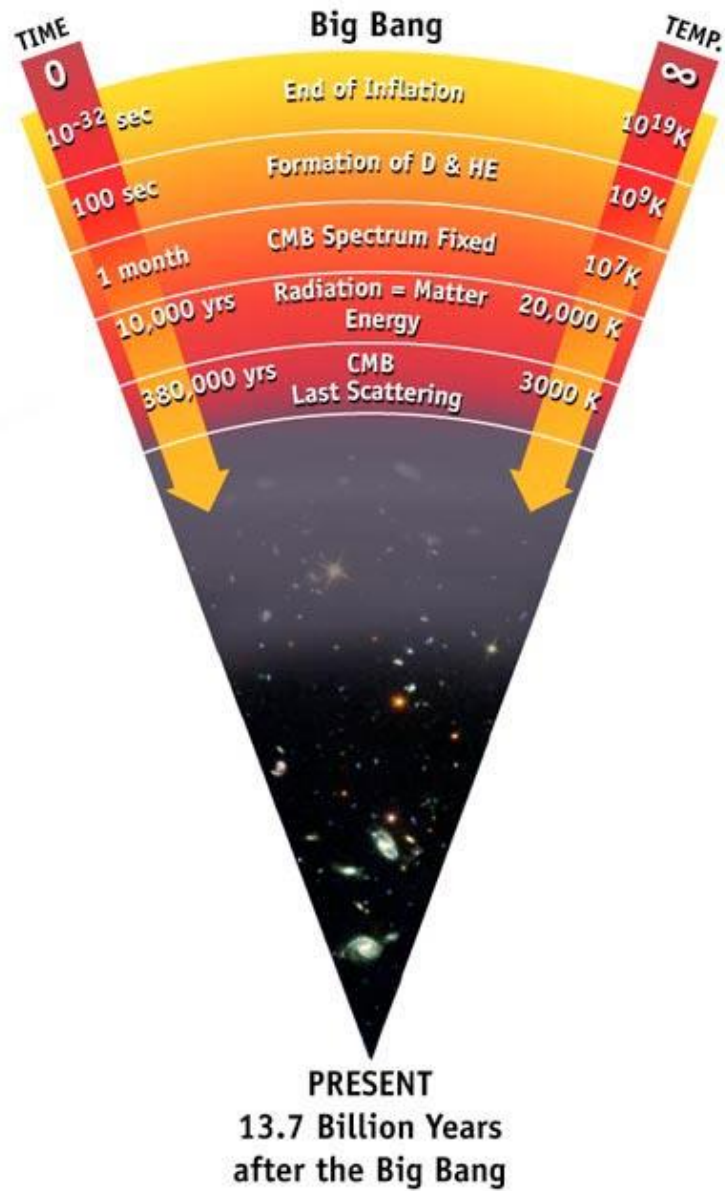
“for theoretical discoveries in physical cosmology”



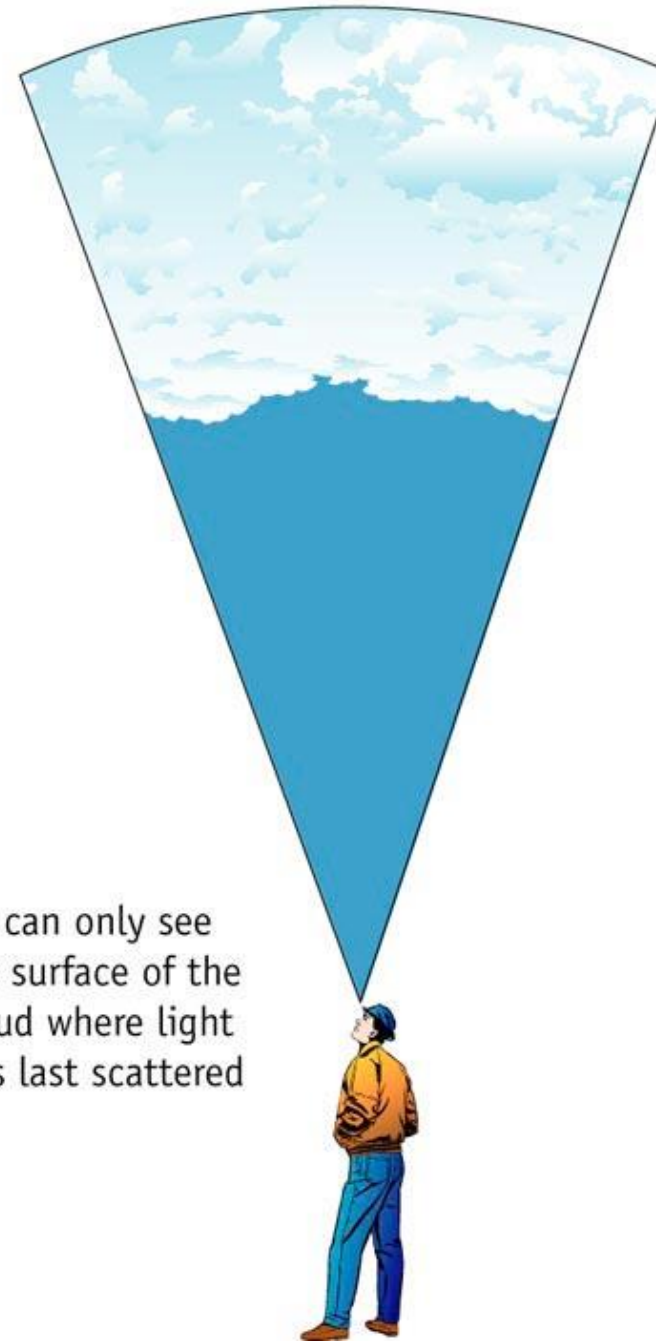
James Peebles, Princeton University, USA

Peebles theories predict incredible things

- The Big Bang left a Cosmic Microwave Background (CMB) radiation that could be detected
- The CMB would show that...
 - Only 5% of the universe is regular matter
 - 26% of the universe is “dark matter”
 - 69% of the universe is something else – “dark energy”
- Scientists still don't know what dark matter or dark energy is. Are they real? Can we know something exists that we don't understand?

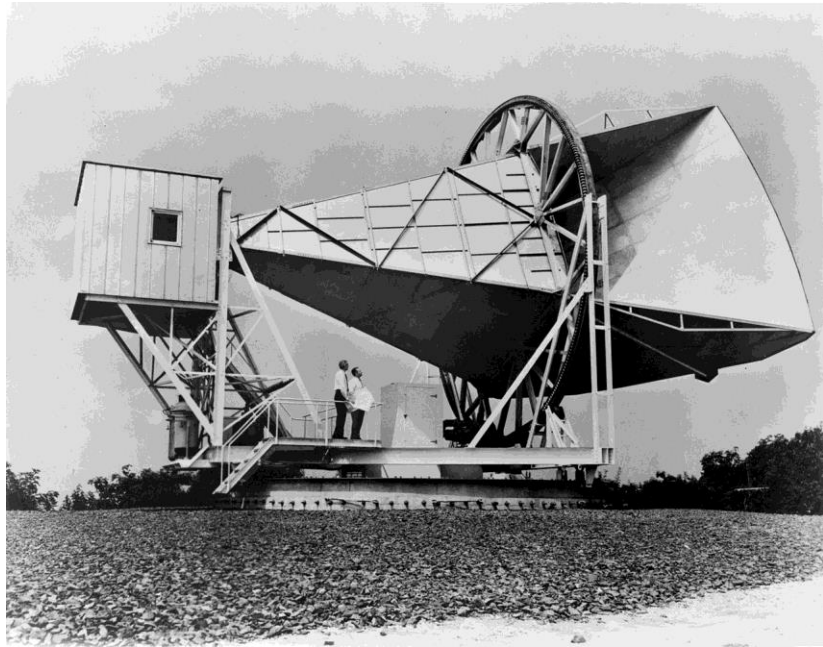


The cosmic microwave background Radiation's "surface of last scatterer" is analogous to the light coming through the clouds to our eye on a cloudy day.

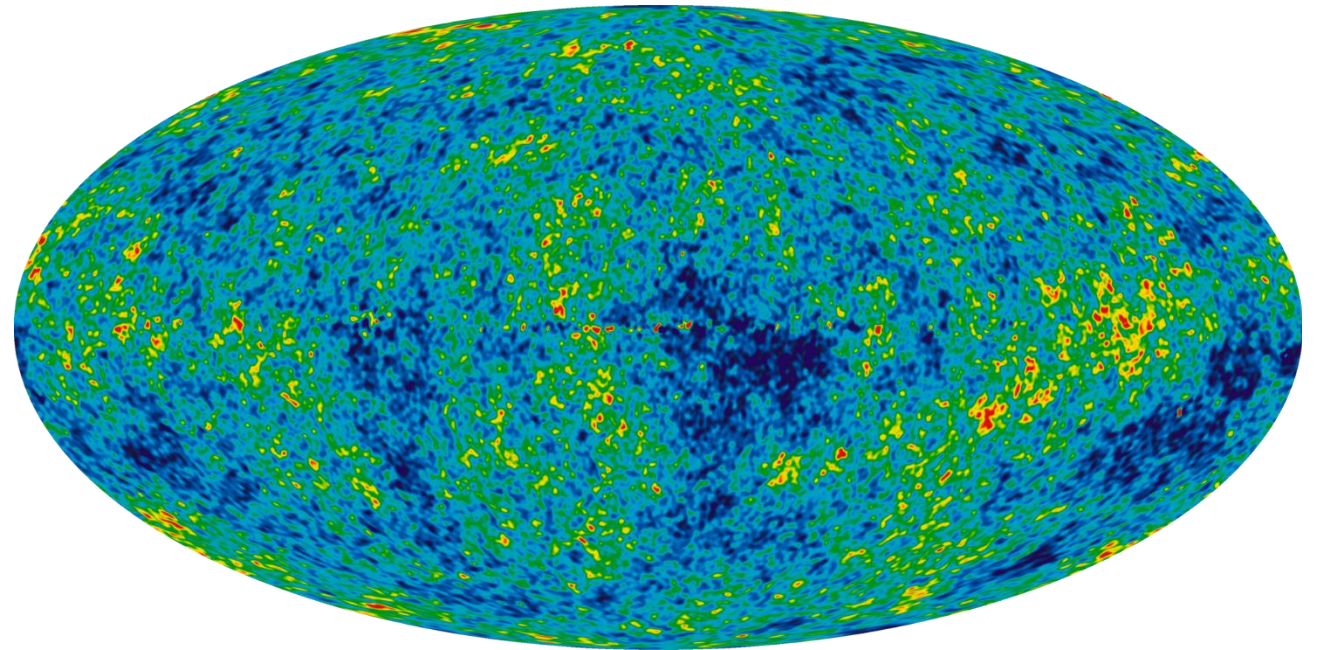


We can only see the surface of the cloud where light was last scattered

Detecting the CMB

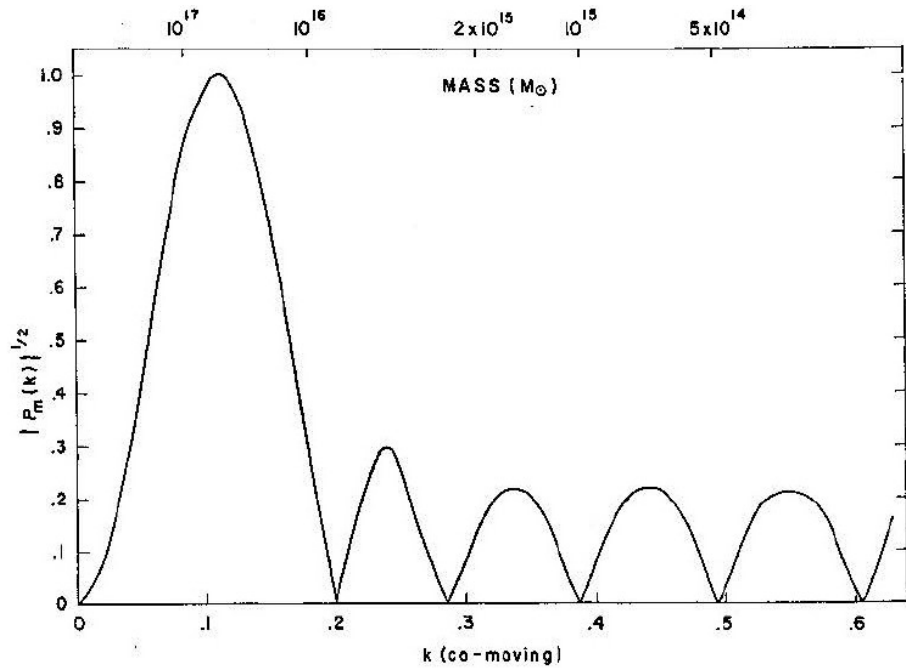


Penzias and Wilson first detected the CMB using this radio telescope
1978 Nobel Prize in Physics

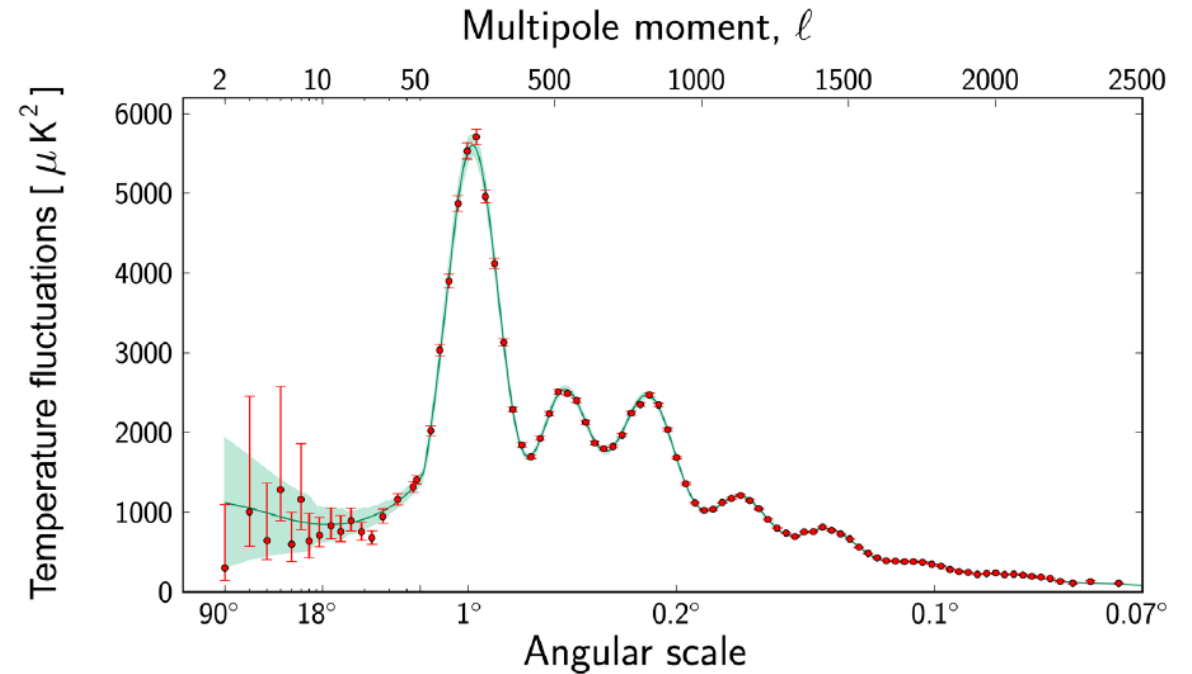


This is what the CMB looks like

Peebles predictions match new observations

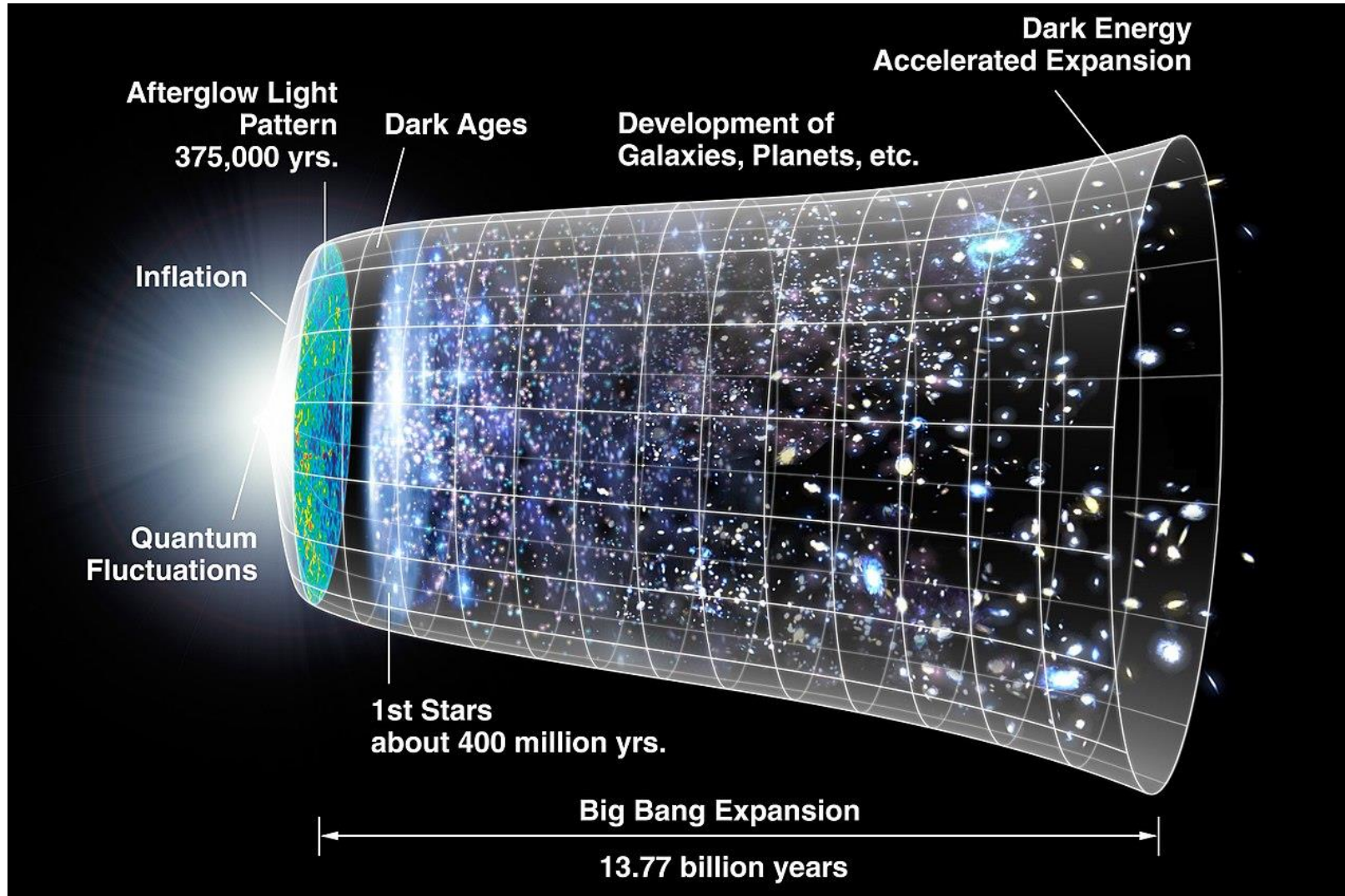


Peebles and Yu, 1970



Measurements from the Plank satellite, 2009-2014

Redshifted galaxies – Peebles' theories accurately describe what we now observe in the universe



2019 Prize in Physics

- Discovery of the first exoplanet around a sun-like star
 - Distant planets can be detected by the light from the stars they orbit – **Doppler** redshift and blueshift
 - We've only begun to detect planets in our galaxy
 - How long till we find the next Earth?
- Theory of how the universe developed
 - **Cosmic Microwave Background** radiation shows universe began with Big Bang
 - We don't understand Dark Matter and Dark Energy, but we can see the effects they have on the universe

2018 and 2019 Nobel Prizes in Literature

A “Political” Award