# 3.1 Light, Cosmic Rays, Neutrinos, and Gravitational Waves

## PRE-LECTURE READING 3.1

- *Astronomy Today*, 8th Edition (Chaisson & McMillan)
- *Astronomy Today*, 7th Edition (Chaisson & McMillan)
- *Astronomy Today*, 6th Edition (Chaisson & McMillan)

## VIDEO LECTURE

- Light, Cosmic Rays, Neutrinos, Gravitational Waves[1] (6:49)

## SUPPLEMENTARY NOTES

### Information from the Universe

#### Waves

- Light (electromagnetic waves)
    - See Light[2].
    - The vast majority of the information that we receive from the universe we receive from light.
- Gravitational waves
    - See Gravitational Waves[3].
    - Waves in the space-time continuum
    - Not yet detected, but will probably be detected this decade
    - We will return to this topic in Astronomy 102.

#### Particles

- Cosmic rays
    - See Cosmic Rays[4].
    - High-speed, high-energy particles that produce showers of other particles when they strike our atmosphere
- Neutrinos

[1] http://www.youtube.com/watch?v=kkGStNAAd_g&feature=youtu.be
[2] http://en.wikipedia.org/wiki/Light
[3] http://en.wikipedia.org/wiki/Gravitational_wave
[4] http://en.wikipedia.org/wiki/Cosmic_ray

- See Neutrinos[5].
- Very-weakly-interacting, very-low-mass particles that mostly pass through Earth
- Roughly 30 trillion pass through your skull every second.
- A very small fraction can be detected.
- We will return to this topic in Astronomy 102.

[5] http://en.wikipedia.org/wiki/Neutrinos