3.3 Diffraction, Interference, and Polarization

PRE-LECTURE READING 3.3

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

VIDEO LECTURE

- Diffraction, Interference, and Polarization[1] (24:13)

SUPPLEMENTARY NOTES

Diffraction

- See Diffraction[2].
- Particles pass by sharp edges.
- Waves bend around sharp edges, if within about one wavelength of the edge.

Interference

- See Interference[3].
- Particles can interfere with each other, due to intermolecular forces, but they cannot interfere with themselves.
- Waves can interfere with themselves, constructively and destructively.
- The single-particle version of Young's double-slit experiment[4] shows that light, as well as electrons, protons, neutrons, atoms, molecules, etc., although emitted and detected as particles, travel as waves.
    - In other words, particles travel as waves when we are not looking, but become particles again when we try to observe them!
    - This very nonintuitive—even disturbing—result tells us something fundamental about the nature of the universe, at least on very small scales.
    - Given this, this experiment is arguably the most important of the 20th century, if not of all time.

[1] http://youtu.be/xFrvL2r-YB8
[2] http://en.wikipedia.org/wiki/Diffraction
[3] http://en.wikipedia.org/wiki/Interference_(wave_propagation)
[4] http://en.wikipedia.org/wiki/Double-slit_experiment

- This phenomenon is called wave-particle duality[5], and serves as the foundation of quantum mechanics[6].

Polarization

- See Polarization[7].
- Particles can pass through perpendicular polarizers.
- Waves cannot.

ASSIGNMENT 3

- Do Question 1.

[5] http://en.wikipedia.org/wiki/Wave%E2%80%93particle_duality
[6] http://en.wikipedia.org/wiki/Quantum_mechanics
[7] http://en.wikipedia.org/wiki/Polarization_(waves)