What I did for Spring Break …

What I did for Spring Break …
Bit of Administration ....

- Reading
  - BSNV Chaps. 7 and 8

- Particularly important discussion section -
  don’t miss this week

- Additional observations for Lab 2, through April 5

- Washburn Observatory - 7 - 9 Monday, Tuesday
  - Drop in for Venus, Mars, Saturn, Jupiter, Orion ...

- Honors - 4:30 this afternoon, Astronomy Library
The Physics of Light

• Spectroscopy and Atomic Physics

• Types of Spectra

Continuous - No spectral lines

Absorption - Dark lines superimposed on continuous spectrum

Emission - Isolated bright lines
The Physics of Light

- Spectroscopy and Atomic Physics
- Graphical Spectra
The Physics of Light

- Spectroscopy and Atomic Physics
- Kirchoff’s Laws
The Physics of Light

- Spectroscopy
- Thermal Radiation
The Physics of Light

- Spectroscopy
  - Thermal Radiation
The Physics of Light

• Spectroscopy

• Thermal Radiation
• Wien Law

\[ \lambda_{\text{max}} = \frac{3 \times 10^6}{T} \]

\[ \lambda_{\text{max}} \text{ in nm} \]

\[ T \text{ in } ^\circ\text{K} \]
The Physics of Light

- Spectroscopy
- Thermal Radiation
- Wien Law
- Stefan-Boltzmann Law

\[ E_{\text{flux}} = \text{energy emitted from square meter in one second} \]

\[ E_{\text{flux}} = \sigma T^4 \]

\( \sigma = \text{Stefan-Boltzmann constant} \)
The Physics of Light

- Spectroscopy and Atomic Physics
- Kirchoff’s Laws
The Physics of Light

- Spectroscopy and Atomic Physics

- Quantum Mechanics - Electron can only be in certain specific orbits $\Leftrightarrow$ can only have certain specific energies

Quantum Numbers

Hydrogen Atom
The Physics of Light

• Spectroscopy and Atomic Physics

• Quantum Mechanics - Electron energy changes can only have certain values corresponding to energy changes between orbits

  $\Rightarrow$ only certain energies of photons can be absorbed or emitted

![Diagram showing absorption and emission with different energy levels](image)
The Physics of Light

- Spectroscopy and Atomic Physics

- Shine “white” light onto hydrogen atom; for simplicity, consider all electrons to be in level 2 (highly unrealistic!)
The Physics of Light

- **Spectroscopy and Atomic Physics**

  - Only photons with energy equal to energy difference between orbits 2 and 3 are absorbed. This energy corresponds to a wavelength of 660 nm.
The Physics of Light

• Spectroscopy and Atomic Physics

• Photons with energy equal to energy difference between orbits 2 and 3 are emitted. These photons are emitted in all directions.
The Physics of Light

- Spectroscopy and Atomic Physics
- Kirchoff’s Laws
The Physics of Light

- Spectroscopy and Atomic Physics

- Energy Level Diagrams
The circled arrows ("electron transitions") represent

A) emission lines
B) continuous emission
C) absorption lines
You would expect these emission lines to be found in what part of the electromagnetic spectrum?

A) Ultraviolet
B) Optical
C) Infrared
D) Radio
The Physics of Light

- Hydrogen Spectrum

![Diagram showing the hydrogen spectrum with Balmer and Lyman series wavelengths.]
Telescopes

• **Fundamental Purpose - To Collect Light**
Telescopes

- Fundamental Purpose - To Collect Light

Collecting Area = \( \pi R^2 = \pi \times 1 \text{ cm}^2 \)

Collecting Area = \( \pi R^2 = \pi \times 25 \text{ cm}^2 \)

Collecting Area = \( \pi R^2 = \pi \times 100 \text{ cm}^2 \)

“0.2m Telescope”
Telescopes

• Design

Objective Lens

Light Detector

Focus (Image)

Refractor
Telescopes

• Examples
40” Refractor
Yerkes Observatory
Williams Bay, WI
Telescopes

• Design

![Diagram of a refracting telescope and a reflecting telescope](image)

**Refractor**

Objective Lens → Light Detector

**Reflector**

Objective Mirror → Light Detector
Telescopes

• Design

Objective Lens

Light Detector

Focus (Image)

Objective Mirror

Refractor

Reflector
Telescopes

• Light Detectors - Charge-Coupled Devices (CCDs)
Telescopes

• Light Detectors - Charge-Coupled Devices (CCDs)
Telescopes
Telescopes

- Electromagnetic Spectrum
Telescopes

Beyond Visible Light
Telescopes

Telescopes in Space

Optical

Infrared
Crab Nebula

X-ray

Optical