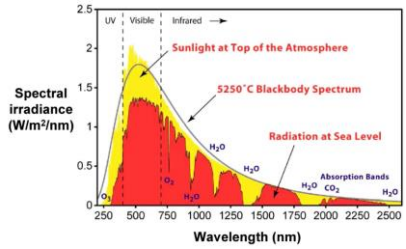
## Today's Class: Space Telescopes – Imagers and Spectrographs

- Reading: Section 6.3 in Cosmic Perspective.
- Homework #3 due on Monday.






1

## Last Class

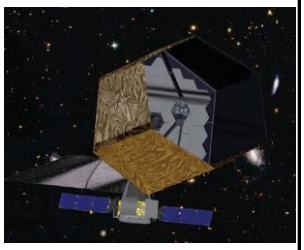
- **Refraction**
  - Focusing light
  - Image formation
- **Fundamental Properties of Telescopes**
  - Light Collection Area
  - Angular Resolution
- **Designs of Telescopes**
  - Refracting telescope
  - Reflecting telescope



2

## Class Exercise: The Next Large Space Telescope

You have been tasked to design the next Large Space Telescope to study signs of life in the atmospheres of Earth-like exoplanets. Describe your design & why. What do you require for angular resolution and light collecting area?





3

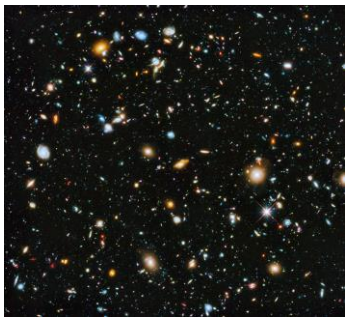
## Today's Class

- **Astronomical Imaging**
  - Colors
  - What do we learn from images?
- **Spectroscopy**
  - Design of spectrographs
  - What do we learn from spectra?



4

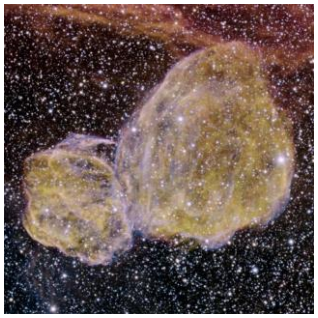
## Telescopic Images





5

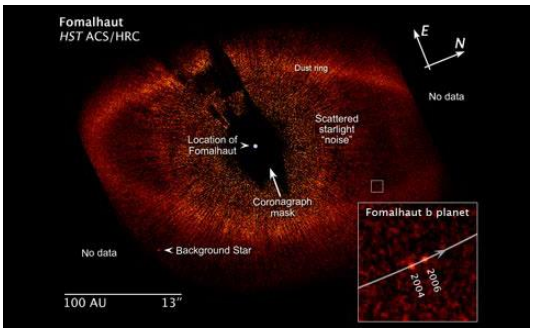
## Telescopic Images





6

# Telescopic Images





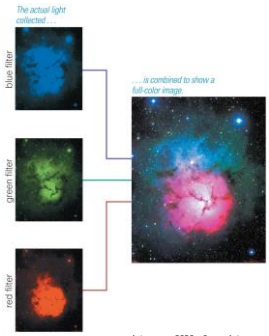

7

# Telescopic Images



8

# Imaging



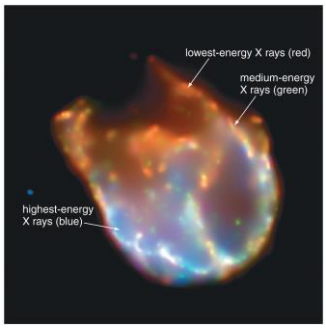

- An image is an array, or a matrix, of square pixels (picture elements) arranged in columns and rows.
- Astronomical detectors generally record only one color of light at a time.
- Several images must be combined to make full-color pictures.



9

# Imaging

- Astronomical detectors can record forms of light our eyes can't see.
- Color is sometimes used to represent different energies of non-visible light.



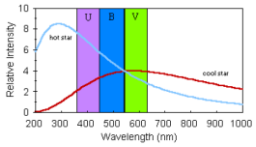



10

# Colors

Stars of different temperature will put differing amounts of light in the different filters, allowing a temperature measurement of stars by comparing their bright nesses in various filters.

**UBV Passbands**

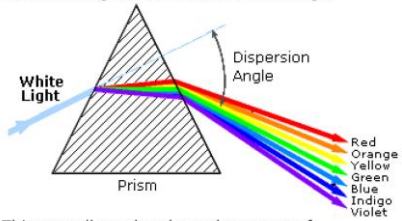





11

# Spectroscopy

Spectroscopy is breaking light up and measuring how much light comes at each wavelength

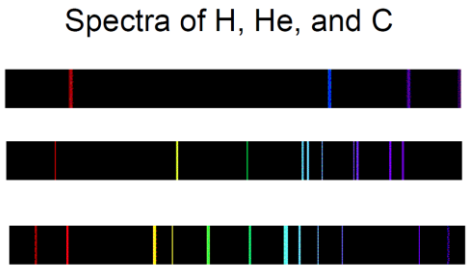



This can tell us a lot about the nature of object emitting the light



12

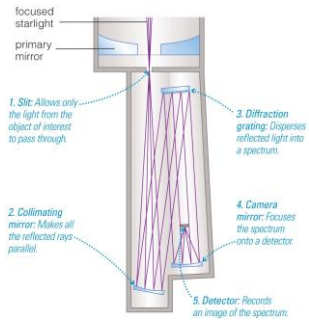
## Each Element has a unique spectrum due to its atomic structure






13

## Spectrograph

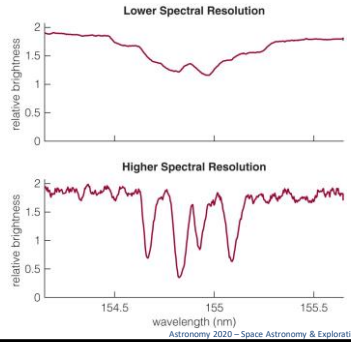



- A spectrograph separates the different wavelengths of light before they hit the detector.



15

## Spectroscopy

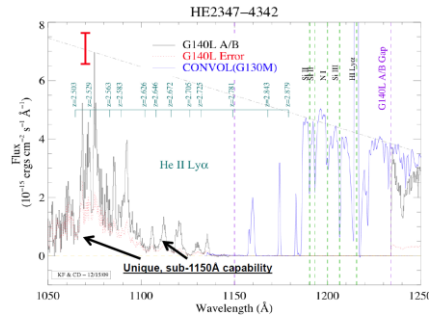



- Plotting relative brightness of light at each wavelength shows the details in a spectrum.



16

## Spectrum from HST Cosmic Origin Spectrograph (COS)






17

## What did we learn today?

- **Astronomical Imaging**
  - Colors
  - What do we learn from images?
- **Spectroscopy**
  - Design of spectrographs
  - What do we learn from spectra?



18