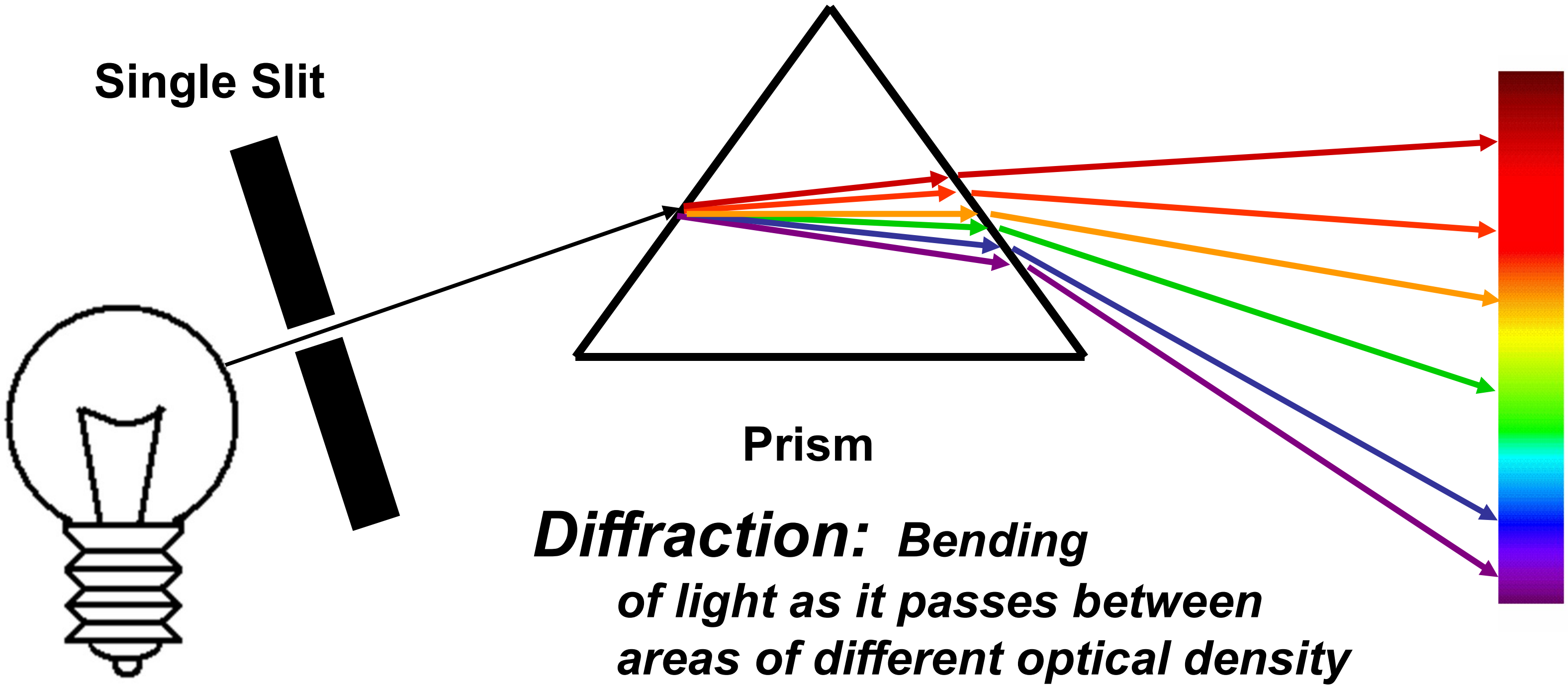
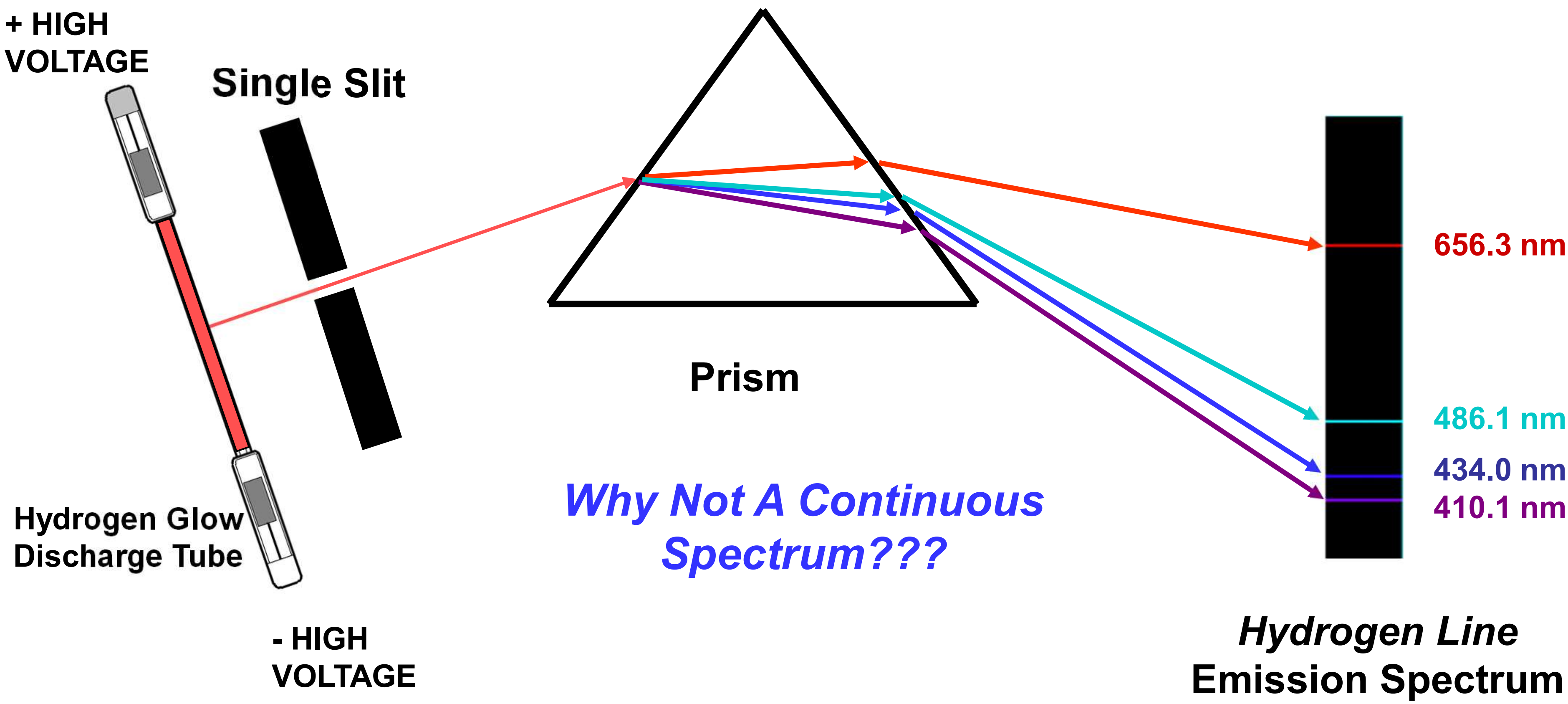
Spectroscopy and Stationary States

Spectroscopy



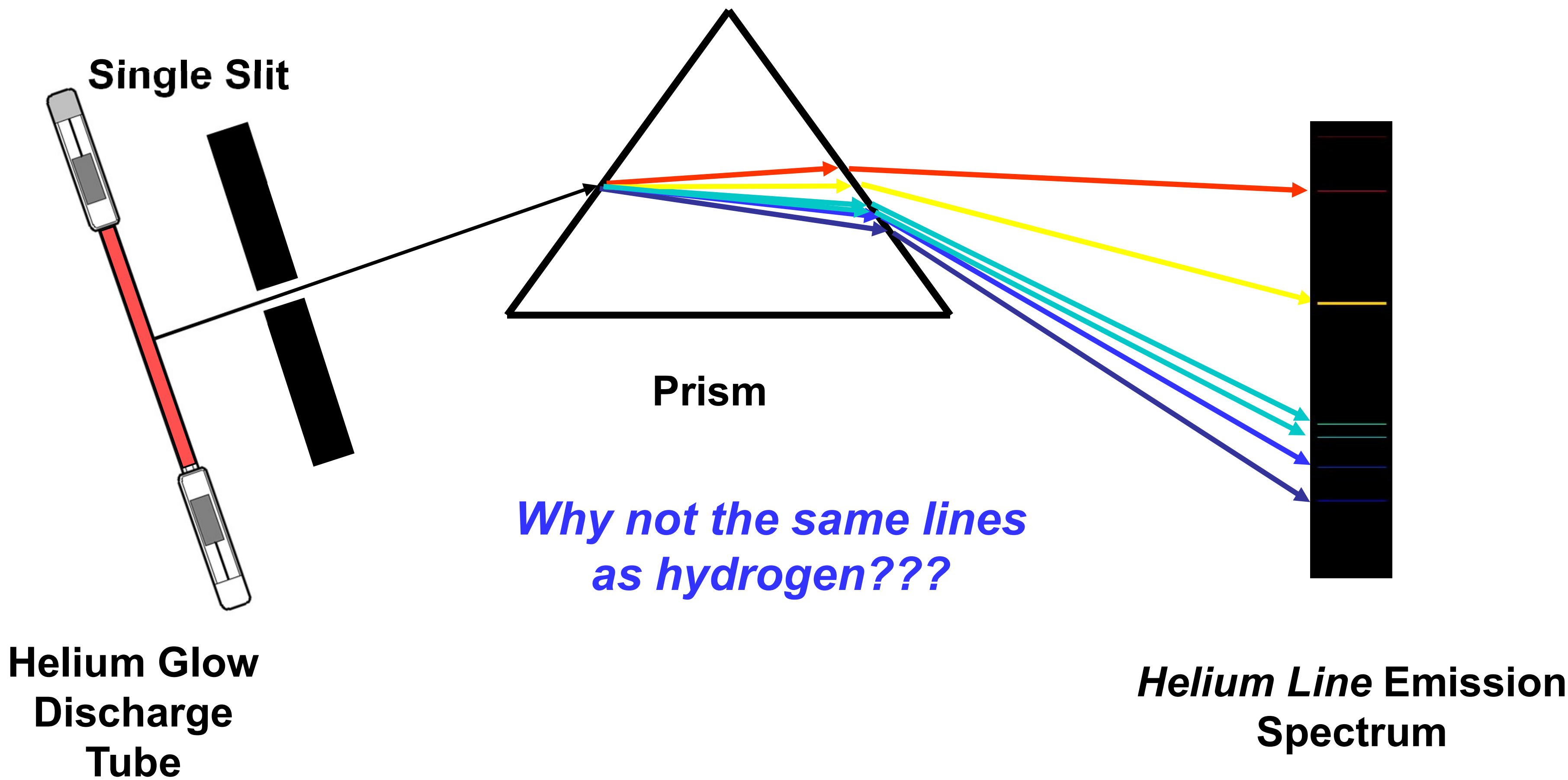
Diffraction: ***Bending of light as it passes between areas of different optical density***

Hydrogen Spectroscopy



Emission Spectra: Bright lines of color separated by regions of *total darkness.*

Spectroscopy



Emission Spectra: Bright lines of color separated by regions of *total darkness.*

Line Spectrum: Identifying a Pattern

Rydberg Equation:

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

R: Rydberg Constant.

$R = 1.096766 \times 10^7\ m^{-1}$

...n_1 and n_2 are integers

...$n_2 > n_1$.

Johannes Rydberg
(1845 – 1919)

Found a mathematical pattern in the hydrogen emission line spectrum.

Rydberg Equation: Hydrogen Atom

Calculate the wavelength in nanometers of the line having $n_1=2$ and $n_2=4$.

Rydberg Equation:

$$\frac{1}{\lambda} = R\left(\frac{1}{n_1^2} - \frac{1}{n_2^2}\right)$$

For Hydrogen Visible Spectrum:

$n_1 = 2$

$n_2 = 3, 4, 5, 6, \text{etc}$

$$\frac{1}{\lambda} = 1.096766 \times 10^{7} m^{-1}\left(\frac{1}{2^2} - \frac{1}{4^2}\right)$$

$$\frac{1}{\lambda} = 1.096766 \times 10^{7} m^{-1} \times (0.1875)$$

$$\frac{1}{\lambda} = 2056436.25 \ m^{-1}$$

$$\lambda = 4.86278 \times 10^{-7} m = 486.278 \ nm$$