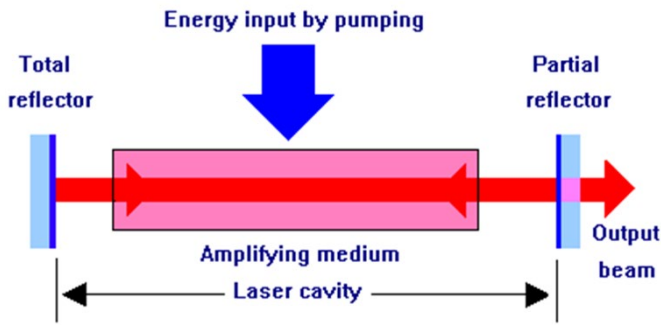


Laser Principals

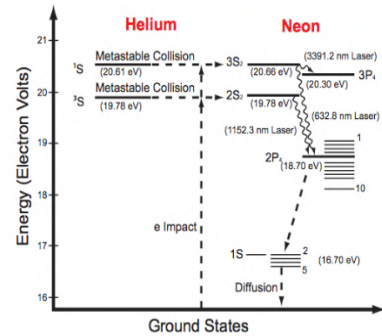


Laser

- "Light Amplification by **Stimulated Emission of Radiation**"
- Every laser needs three components
 - Pump – provides power
 - Gain Medium – amplifies electromagnetic radiation
 - Resonator – stores the coherent electromagnetic field

HeNe Gas Laser

- Special gas laser which uses electric current as a **pump** to excite the HeNe gas which is used as the **gain medium**
- Electrical current first excites Helium atoms from the ground state into the excited state and collide with ground Neon atoms which become excited
- Decay of Neon atoms from higher energy bands to lower, leads to the production of a photon of light at **632.8 nm**



Problem

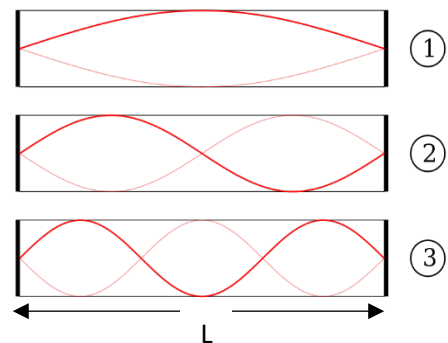
- Although we have the three things a laser needs, why do we not see laser light from our setup?



Answer

- Laser cavity length (**L**) matters to create a resonating cavity
- Light is a wave that can interfere with itself when bouncing in the cavity and in order to get laser light, we need these waves to constructively interfere with each other
- This happens at cavity length only at exact multiple of half the wavelength in the cavity, creating standing wave **longitudinal modes (q)** in the cavity

Longitudinal Modes



q	L (cm)
1	0.0003164
10	0.003164
100	0.03164
1000	0.3164
10000	3.164
100000	31.64

Equation

- The equation for the cavity length in air is: $L = q \frac{\lambda}{2}$
- We know the confined wavelength is: **632.8 nm**
- We can then calculate all the possible cavity lengths for all longitudinal modes
 - **q** must be an integral
 - most times we must go to very large modes to be able to physically set the laser up