

# 18. Light Emitting Fluids

Thursday, October 27, 2016 4:11 PM

5 minutes  
Team Time

Admin:

High speed videos available for download from drive

Download software to convert to whatever format and extract stills:

<https://www.phantomhighspeed.com/Portals/0/Files/Software/PCC-2.8.761.0-Install.zip>

No, you won't need the 10Gb ethernet driver.

Team Second images/vids due 10/31 Monday. Don't be late!!

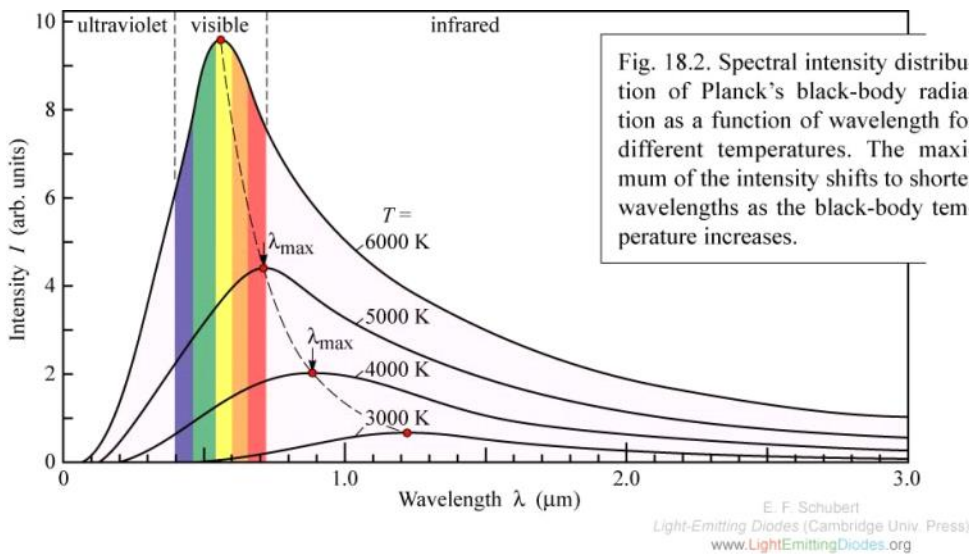
Last Team First critique: Team 10

Today: Light emitting fluids (last of dye/molecular techniques), then particles as seed.

### 3) Special Techniques

Light Emitting fluids: Photons are emitted for a range of reasons.

**Black Body Radiation** = yellow flame color, from BBR of soot particles. Random  $\lambda$  (wavelength) photons from thermal energy



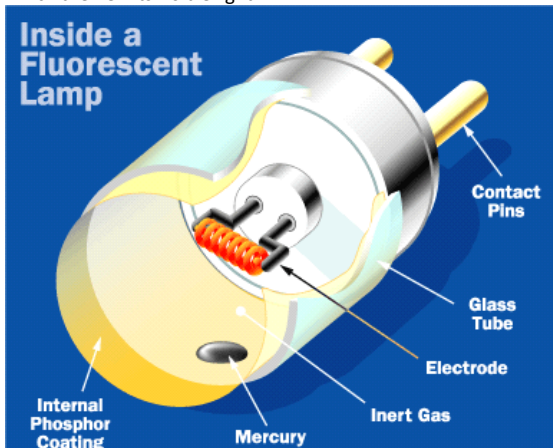
[https://www.phy.questru.ca/rknop/classes/enma/2010-10/wiki/images/8/84/Black\\_body.jpg](https://www.phy.questru.ca/rknop/classes/enma/2010-10/wiki/images/8/84/Black_body.jpg)

**Luminescence** = cold body emission, usually at specific  $\lambda$ .

**Fluorescence** = absorption of photons at a specific short  $\lambda$ , emits at a longer  $\lambda$ .

E.g. some laundry detergents and fabric softeners absorb in the UV, and emit blue or orange

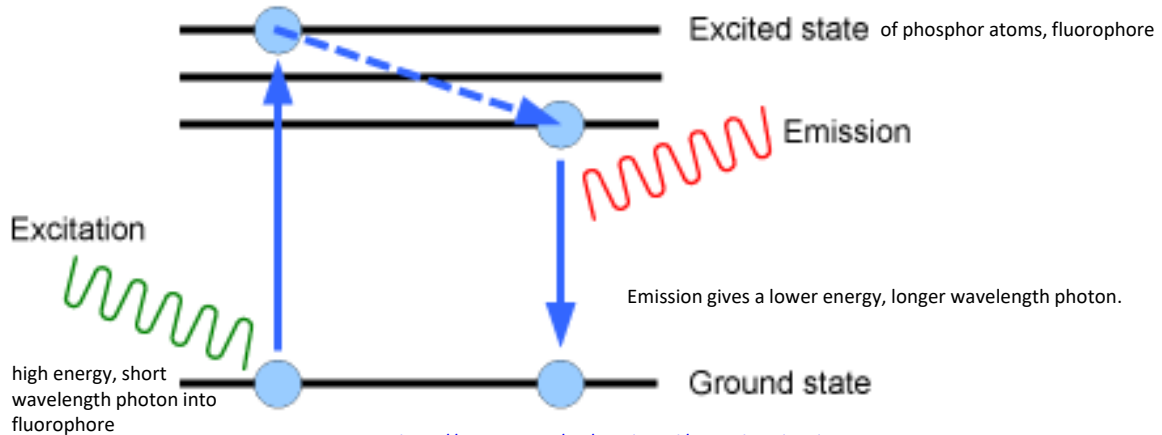
Fluorescent bulbs: Current is conducted through mercury vapor, energizes it to emit UV photons which hit a phosphor coating on the inside of the tube, which then emits visible light.



<http://home.howstuffworks.com/fluorescent-lamp.htm/>



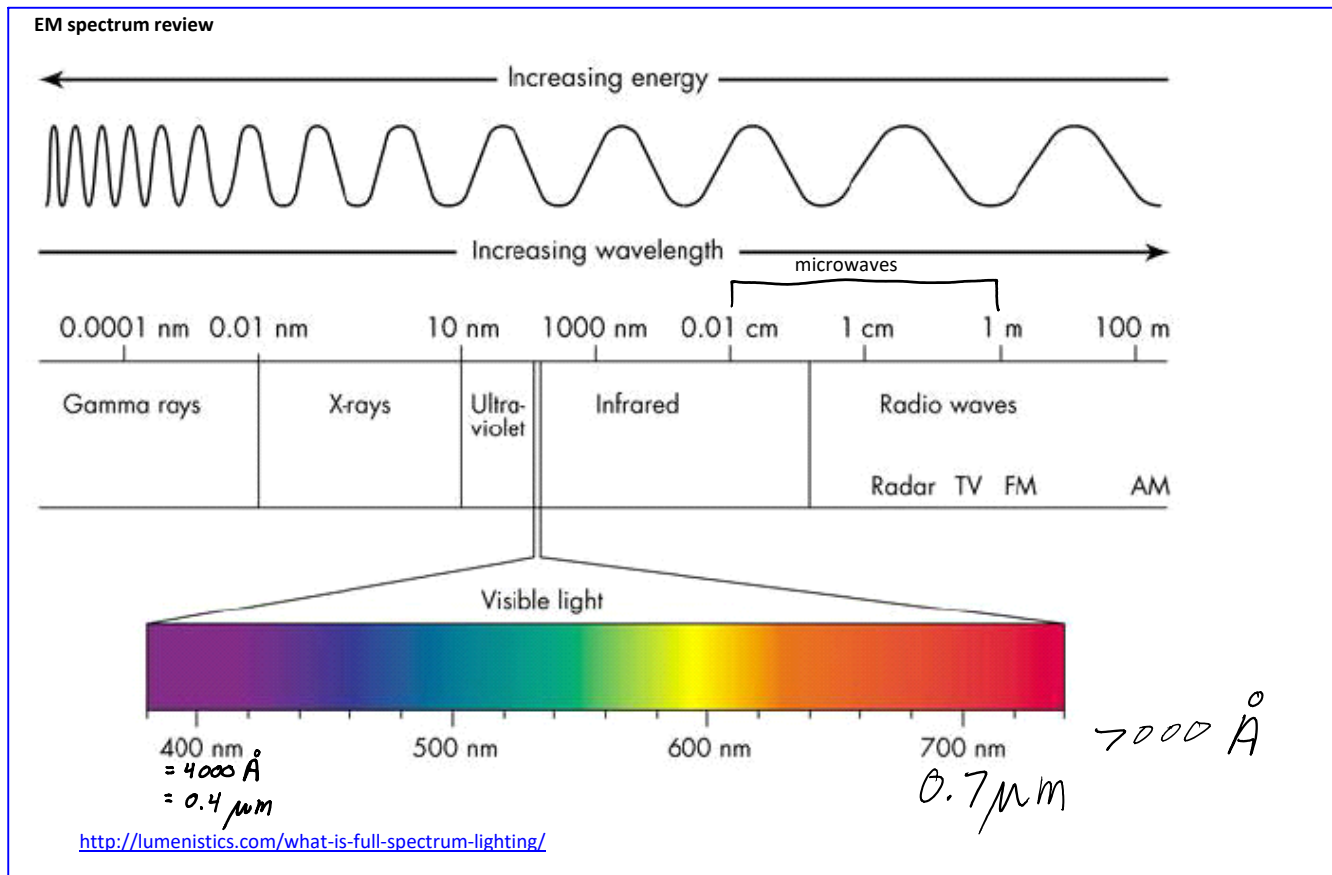
<http://home.howstuffworks.com/fluorescent-lamp.htm/>



<http://www.art.ca/en/preclinical/optical-molecular-imaging/fluorescence.php>

Wavelength change between absorption and emission = Stokes shift:

- some heat lost from excited state,
- and/or returns to ground state + highest vibrational mode, not all the way down.



**Chemoluminescence** - Cyalume, party bracelets: chemical reaction releases photon, which then drives fluorescence. Needs mix of chemicals for reaction, and choice of color.  
 Flames:  $C_2$ ,  $CH^+$ , radicals = highly reactive intermediate molecules (between reactant and product species) that only exist in the thin reaction zone. Excited by reactions, emit blue photons to get to lower energy state. Also, hot soot gives off black body radiation; yellow glow.

<http://www.sciencefriday.com/video/06/08/2012/what-is-a-flame.html>

**Bioluminescence** - Fireflies, deep sea fish, worms. Good for flow vis?

<https://www.youtube.com/watch?v=Fvob6L8q3I8> Red tide, blue waves off San Diego

*Ocean wakes plankton  
Life of pi*

**Electroluminescence** - LEDs, sodium vapor, mercury vapor lamps etc. Specific  $\lambda$ .

E.g. electric pickle <http://www.youtube.com/watch?v=tMhXCG6k6oA>

**Laser** : population inversion, specific  $\lambda$ , resonant cavity with mirrors. Gas dynamic laser: after supersonic expansion, lower vibrational states relax before higher ones = inversion. A type of 'chemical laser'