# Topic-Level learning goals for *Photons - Light as a Particle*
**UBC PHYS 250, *Introduction to Modern Physics*, Summer 2009**
**(updated July 30, 2009)**

**2. Light as a Particle- why believe idea that there are particle and wave like properties to objects, role of probability in this interpretation**

- Write down the mathematical description of a classical electromagnetic wave, and relate the terms in the expression to the velocity, wavelength, and frequency of the wave.
- Be able to describe how the energy in a classical EM wave depends on the amplitude of the field, and describe what happens when an EM wave is absorbed by a material if the wavelength is long enough that it behaves classically.
- Design an experiment to show that something behaves as a wave.
- Qualitatively describe what is measured in the photoelectric effect experiment and explain how this implies a quantum picture of light, including explaining what results the classical interpretation of light would predict for this experiment.
- Quantitatively analyze photoelectric data to deduce the relationship between energy of photons and frequency of light and predict how the emission of electrons will change if color of light, type of metal, or voltage of the metal is changed.
- Be able to design an experiment for determining the composition of an unknown pure metal based on the photoelectron effect.
- Be able to explain the essential role of the quantization of light as demonstrated by the photoelectric effect in the operation of a photomultiplier tube, a solid state photodector such as used in motion sensors, and the human eye. (Essentially all sensitive detectors of light.)
- In two slit interference pattern produced by light, relate the single particle detection of photons to the interference pattern from light beams.