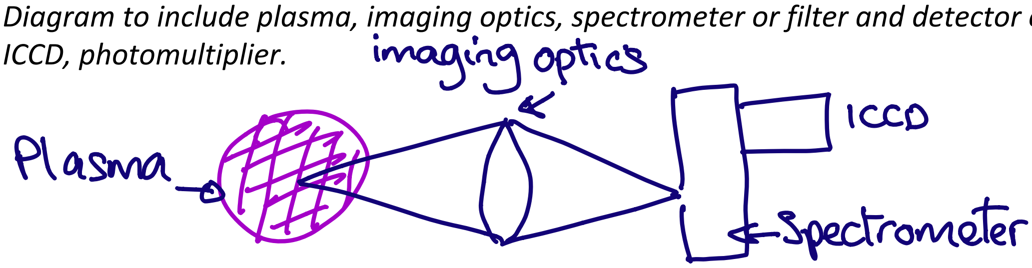
Plasma Diagnostic Techniques Practical Class 1

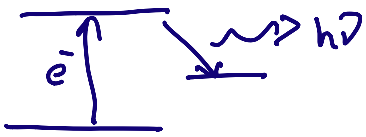
1. For applying optical emission spectroscopy to a plasma:
   (a) Briefly discuss the basic underlying principles.
   Emission from the plasma can be observed and from the intensities, intensity ratios and line shapes various plasma parameters can be derived.
   (b) Outline which plasma parameters the technique can measure.
   Species densities – including neutrals, ions and electrons. Species temperatures. Electric fields.
   (c) Draw a diagram clearly detailing how you could implement OES in a plasma reactor. *Highlight the necessary components of the setup.*
   Diagram to include plasma, imaging optics, spectrometer or filter and detector e.g. ICCD, photomultiplier.



   (d) Outline challenges and limitations with implementing OES.
   Not a direct technique, therefore many assumptions used. Reliable data for all processes can be an issue.

2. For a weakly ionised plasma not in thermodynamic equilibrium name a suitable model to describe the emission from a plasma reactor.
   - *Corona model.*

   (a) Using a simple diagram explain the main processes for such as system.



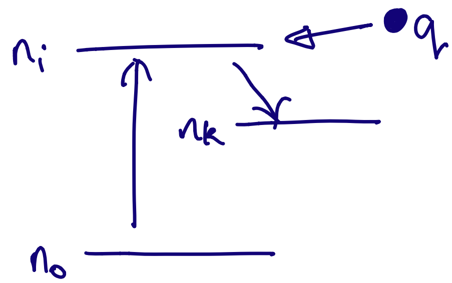
- Excitation/population through electron impact.
- Depopulation through radiation.

   (b) If the collisionality of the plasma increases describe a more suitable model, including how any additional processes, may be taken into account.
   Need to take quenching into account.

Collisional radiative model.

   (c) For the situation of high collisionality derive a steady state equation for the number density in a level *i.* Discuss the parameters this depends on.
   Quenching will depend on quenching partners – their densities and quenching coefficients.

$$\frac{dn_i}{dt} = n_0 E_i - n_i \sum_k A_{ik} - n_i \sum_q n_q k_q$$



$$\frac{dn_i}{dt} = n_0 E_i - n_i \sum_k A_{ik} - n_i \sum_q n_q k_q \quad = 0$$

$$n_i = \frac{n_0 E_i}{\sum_k A_{ik} + \sum_q n_q k_q}$$