PHTN1300 Lab #5: Gas Laser Cavity Optics (2013F)

_____ / 35 Total (+ separate prelab mark)

__ **/3 Abstract**
- __ Summary of experiment and intent
  - __ MODES and GAIN mentioned
- __ How it was done
  - __ Introduction of intra-cavity loss by a tilted glass slide
  - __ Equating total loss to gain
- __ Summary of results
  - __ Numerical results (parameters, gain)

__ **/6 Background (Intro)**
- __ Cavity optics of the HeNe Laser incl. typical values
- __ Description of TE Modes
  - __ Where they originate – chapter 6 of the text
- [2] __ Alignment procedure
  - __ Autocollimation procedure
  - __ Diagram (required) … could show a commercial unit
- [2] __ Brewster window
  - __ Loss vs. plane window, polarizations
  - __ diagram showing angle
  - __ relevant formulae for loss vs. angle – Fresnel equation

__ **/3 Procedure**
- __ Enough detail to reproduce the experiment precisely
  - __ Optics alignment procedure, both methods covered
  - __ Production of modes (and power measurement)
  - __ Introduction of loss and experiment to determine gain

__ **/15 Observations**
- [1] __ Output power for various modes
  - __ Drawings of the modes
- [4] __ Output power vs. insertion **loss**
  - __ Graph of power vs. loss (NOT just angle)
  - __ Angles (TWO required) at which lasing ceases identified
  - __ Error estimates provided for measurements (+/-) – Angle, and then loss
  - __ Insertion losses calculated properly (Snell's law, Rp)
    - __ **Finally** losses where laser ceases reported as xxx +/y yyy %
- [8] __ Gain Estimate
  - [3] __ **Parameters** for OC, HR, Windows, Attenuation. loss stated
    - __ HR loss calculated from $P_{intra\text{-}cavity}$ & measured OC (same method as lab #4)
    - __ Sources **cited** explicitly (e.g. Window loss from CVI Melles Griot)
    - __ Attenuation assumed and stated
  - __ Length of gain element explained (actual length of plasma, not entire tube)
  - [2] __ Gain Formula used is shown
    - __ Rearranged as per in lectures, incorporate all losses, x_a/x_g, Windows
  - [2] __ Gain, numerically
    - __ Two loss figures computed at two angles
    - __ **Error estimate** (+/-) based on angle measurement error
    - __ **Finally** gain is expressed as xxx +/- yyy m^{-1}
- [2] __ Output power predicted (Might be in Conclusion section)
  - __ Normal g_{th} calculated for system (with **no** glass slide inserted)
  - __ Saturation power calculated (similar to procedure in class notes)

__ **/8 Conclusion**
- [3] __ Report calculated gain (**recap** key data from observations)
  - __ Two gain figures reported
    - __ If significantly different, discuss possible reasons why
  - __ Estimated parameters (loss at windows, atten.) explained
  - __ Error estimate (+/-) provided
  - __ Links/Sources included for estimated parameters
- [2] __ Explain when a Brewster window is required
  - __ Can other lasers use flat windows like ours?
  - __ Outline A/R coatings on our tube windows
  - __ Mention POLARIZATION of the output beam caused by Brewster windows
- [1] __ Power output estimate (Might be just recapped from the Observation section)
  - __ All parameters reiterated (g_{th}, g_0, P_{sat}, P_{output})
- [2] __ Effect of TE Modes on output power
  - __ When is maximum power achieved?
  - __ When should TEM_{00} be used?

__ /-2 References

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