Physics 2700H: Lab III

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Abstract

1 Introduction

Spectroscopy is a useful tool in many fields. A visible light spectrometer—such as the one employed in this experiment—can be used to determine the composition of an object by measuring emission or absorption of specific wavelengths of photons by that object.

This experiment seeks to employ a digital visible light spectrometer to verify calculated values for electron energy level transitions in a helium atom, determine the active "ingredient" **REPHRASE** in unknown visible light emitters, and determine a method to resolve merged spectral lines for energy level transitions with similar emitted photons.

2 Theory

Electrons in orbit around atomic nuclei exist in specific, quantized, energy levels and may only move between these levels when a "hole" **REWORK** is available for them to do so. In order to "jump" up to a higher energy level an electron must be given energy, usually by a photon, who's energy is given by

$$E = \frac{hc}{\lambda}$$

where h is Planck's constant [1], c the speed of light in the medium through which the photon moves, and λ the wavelength of the photon. Electrons may also decay to a lower energy level, emitting the energy lost in that process as a photon of energy given by the difference in energy between the final and initial energy levels.

The spectrometer employed in this experiment records the number of these emitted photons for a given wavelength by separating. . .

3 Methods

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4 Discussion

4.1 Helium Spectrum

4.2 Sources of error

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Assigned Transition	Pred. wave-length, λ_p(nm)	Obs. wave-length, λ_o(nm)	% Diff	Comments
$1s0s^1S$ $1s3p^1P$	392	0	0	‘’
$1s0s^3S$ $1s3p^3P$	412	0	0	‘’
$1s1s^1S$ $1s3p^1P$	505	505 ± 1.7	0.337	Extremely faint
$1s1s^3S$ $1s3p^3P$	471	471 ± 0.6	0.127	‘’
$1s2s^1S$ $1s1p^1P$	397	0	0	‘’
$1s2s^1S$ $1s2p^1P$	502	502 ± 1.6	0.319	‘’
$1s2s^3S$ $1s3p^3P$	707	707 ± 1.5	0.212	‘’
$1s3s^1P$ $1s0p^1D$	439	0	0	‘’
$1s3s^1P$ $1s1p^1D$	492	492 ± 1.6	0.325	‘’
$1s3s^1P$ $1s2p^1D$	668	668 ± 1.8	0.269	‘’
$1s3s^1S$ $1s3p^1P$	728	728 ± 1.5	0.206	‘’
$1s3s^3P$ $1s0p^3D$	403	0	0	‘’
$1s3s^3P$ $1s1p^3D$	447	447 ± 1.6	0.358	‘’
$1s3s^3P$ $1s2p^3D$	588	588 ± 1.5	0.255	‘’
$1s3s^3S$ $1s2p^3P$	389	389 ± 1.4	0.360	‘’

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5 Conclusion

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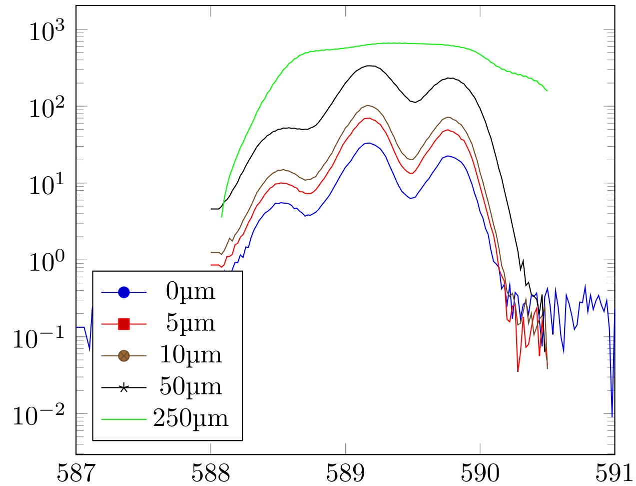

Figure 1: ψ lamp spectrum focused on yellow doublet. Note significantly decreased intensity for a 0µm slit width requiring semilog scale. See appendix for full size.

6 Bibliography

References

[1] Eite Tiesinga, Peter J. Mohr, David B. Newell, and Barry N. Taylor. The 2022 codata recommended values of the fundamental physical constants, 2024.

7 Appendix

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7.1 Figures

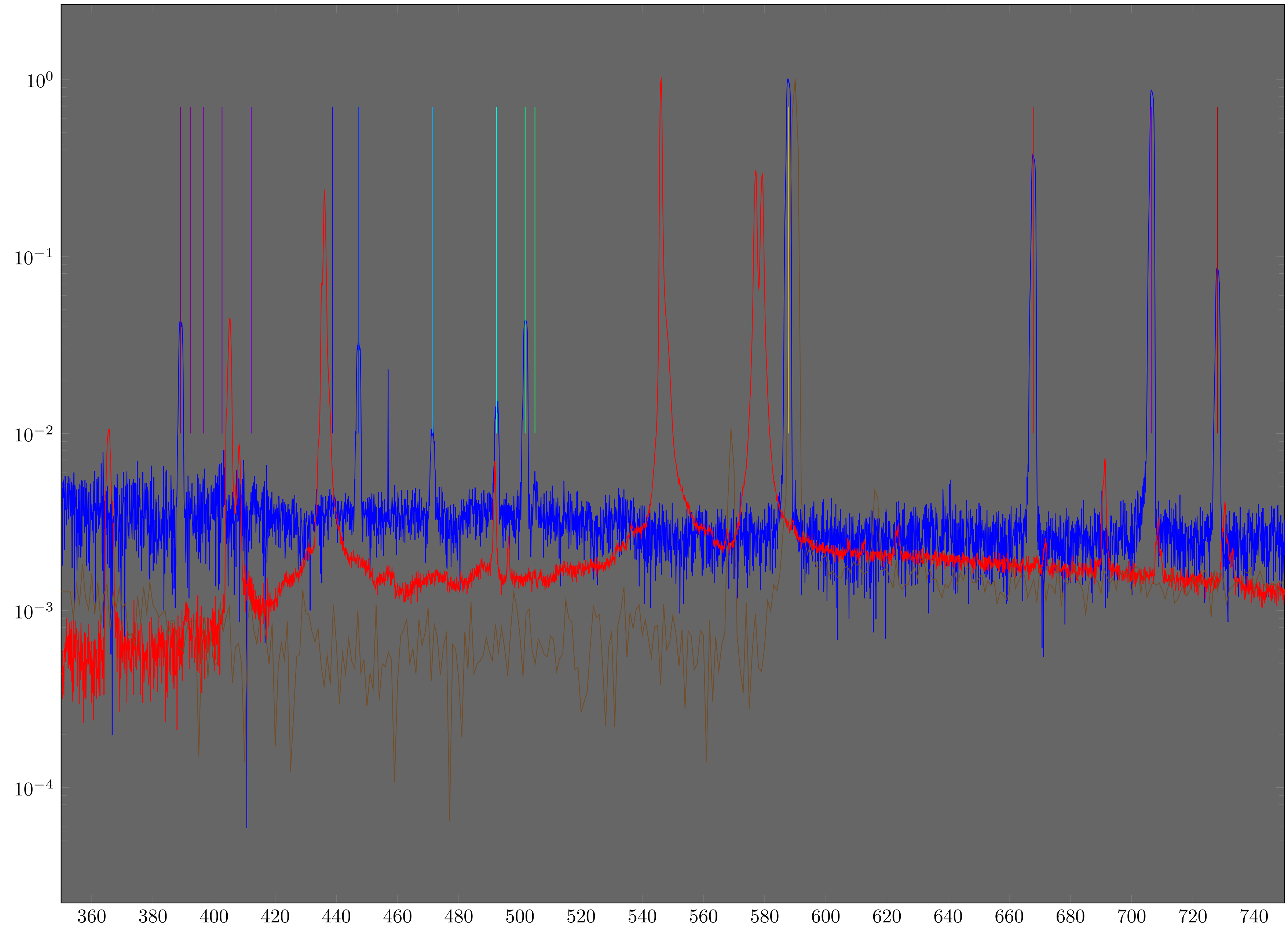

Figure 2: Helium spectrum. Coloured lines denote predicted values. See appendix for full size. Generated with TikZ

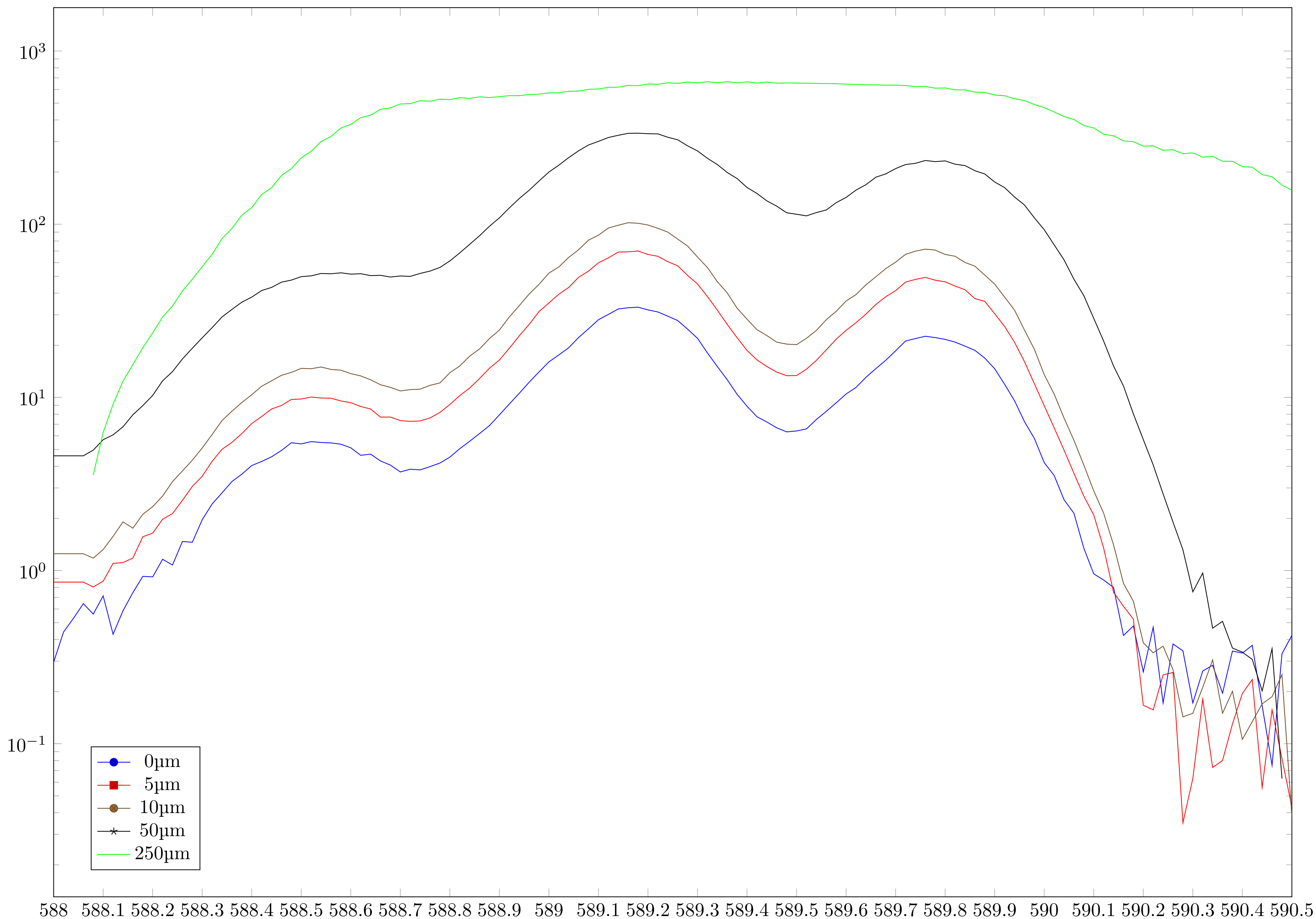

Figure 3: ψ lamp spectrum focused on yellow doublet. Note significantly decreased intensity for a 0µm slit width requiring semilog scale. See appendix for full size.