COLLEGE OF ENGINEERING
THE UNIVERSITY OF ALABAMA IN HUNTSVILLE

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Optical Analysis of High Pressure Microplasma Discharges

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Overview/Introduction

- Rare gas microplasmas are being explored as a gain media for high power lasers. The laser uses certain electron configurations, called metastables, to release more energy.
- Plasmas allow for higher power output than other gain mediums, potentially achieving Megawatt class lasers.

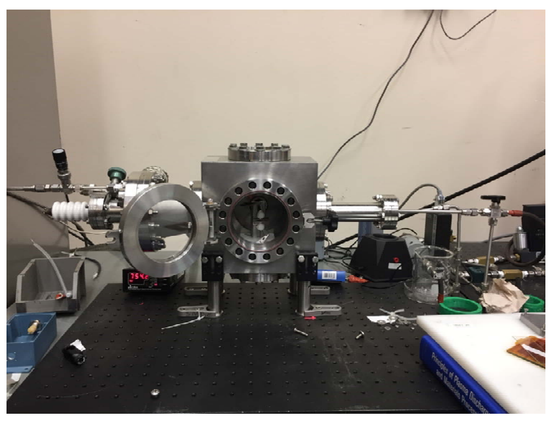

Figure 1 – Vacuum chamber used for experimentation

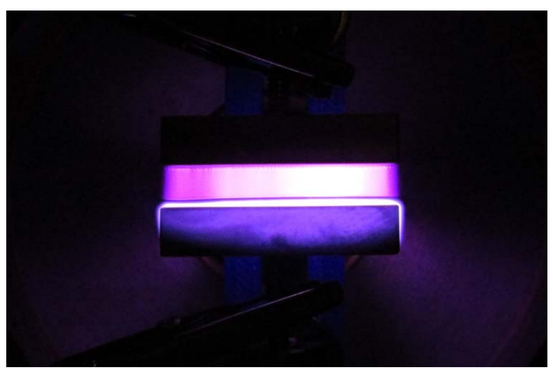

Figure 3 – Microplasma glow in a He-Ar atmosphere

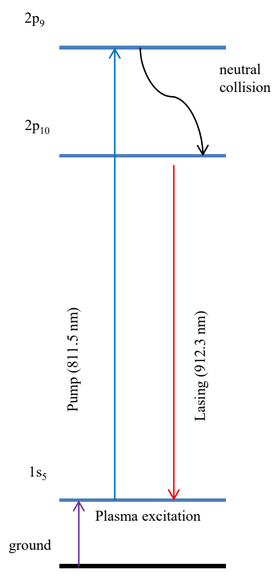

Figure 2 – Basic 3-Stage lasing diagram

Key Findings/Results

- Stark broadening found that the electron temperature was around 1.8 eV and the density was around 1.02*10^20 m^-3.

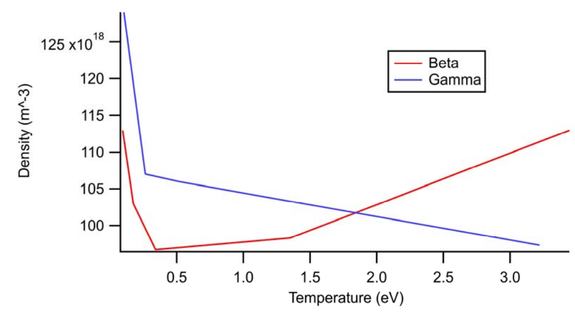

Figure 4 – Gigosis plot of calculated temperature and density based on H beta and gamma lines

- Boltzmann-Saha method requires an assumed electron parameter. In this case, the density is assumed to be 10^20 m^-3. The resulting temperature calculated is around 1.21-1.41 ev.

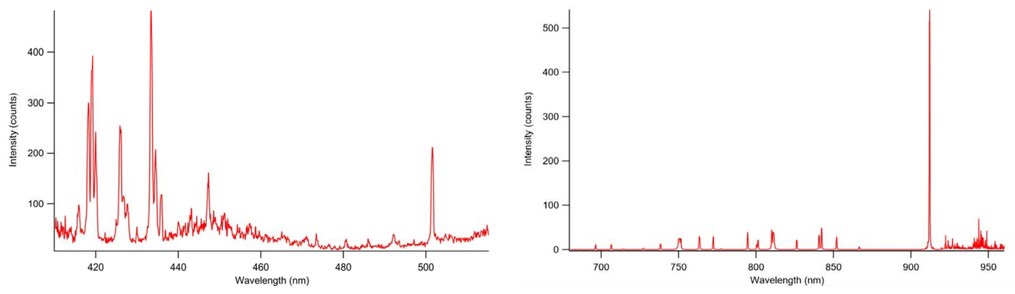

Figure 5 – Wavelength intensities of Ar ion and neutral lines looking at a microplasma glow

Explanation

- Diagnostic techniques for microplasmas are explored to determine metastable population, as well as electron temperature and density.
- Wavelength emissions from Argon neutrals and ions can be examined using Optical Emissions Spectroscopy (OES) to determine these characteristics.
- Using hydrogen as a tracer species, Stark broadening can also be used.

Impact/Conclusions

- Future research on maximizing metastable population can now be conducted.
- Boltzmann-Saha relation confirmed as a diagnostic technique. Work will be continued to improve the accuracy.
- Preliminary work with hydrogen balmer lines indicates that Stark broadening can be used for determining properties.

Acknowledgements

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