Analysis of Microwave Propagation In Plasma

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Plasma Overview

- Plasma – ionized gas

http://www.noaa.gov
http://www.photoeverywhere.co.uk
http://sohows.nascom.nasa.gov/
Experimental Plasma

- Formed by collisional excitation of gas in an electric field
Introduction

• Plasma
  – Can be controlled electronically
  – Supports the propagation of high-powered electromagnetic waves
  – Has a refractive index

• Applications:
  – Feedback mechanism in a backwards wave oscillator (BWO)
  – Beam steering using plasma
  – Focusing high-powered microwaves at a distance
  – Propagating microwaves in space
Experiment

- Generate plasma (gas pressure: 10 mTorr)
- Take measurements (freq: 1.24 GHz)
  - Plasma potential
  - Hall potential
  - Plasma current
  - RF phase shift
Dependence of Wavenumber $k$ on Frequency

$k_r$ v. Frequency, $k_i$ v. Frequency

$1.24 \text{ GHz}$
Conclusion and Discussion

• Above 400 MHz, $k_r \gg k_i$ was demonstrated, therefore electromagnetic wave propagation is low loss.

• Can use a simple electronic means to adjust $k_r$.

• Results are useful for applications where the dispersion of microwaves in plasma is needed
  – Ex: selecting a region of operation in the BWO