



INSTITUTE FOR RESEARCH IN  
**ELECTRONICS**  
& **APPLIED PHYSICS**

**TREND**  

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# **Analysis of Microwave Propagation In Plasma**

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# Plasma Overview

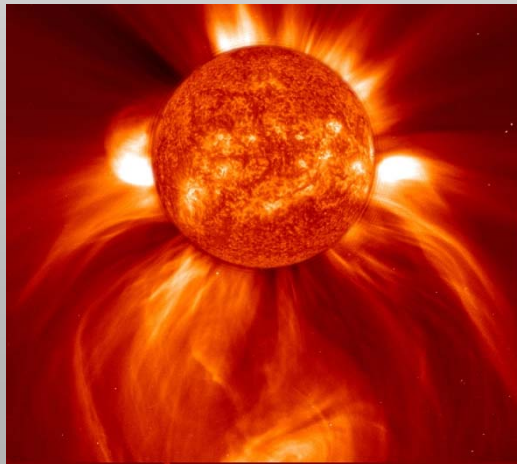
- Plasma – ionized gas



<http://www.noaa.gov>



<http://www.photoeverywhere.co.uk>



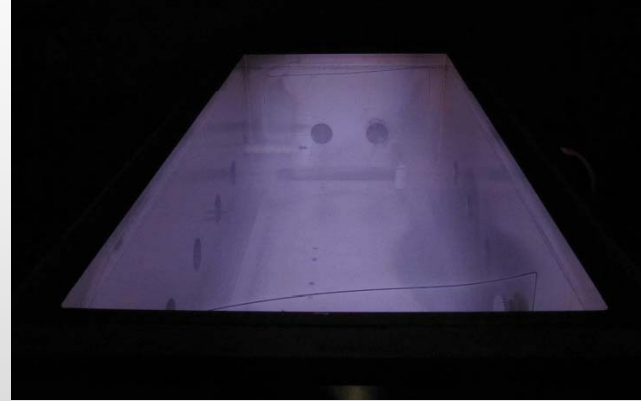
<http://sohowww.nascom.nasa.gov/>

# Experimental Plasma

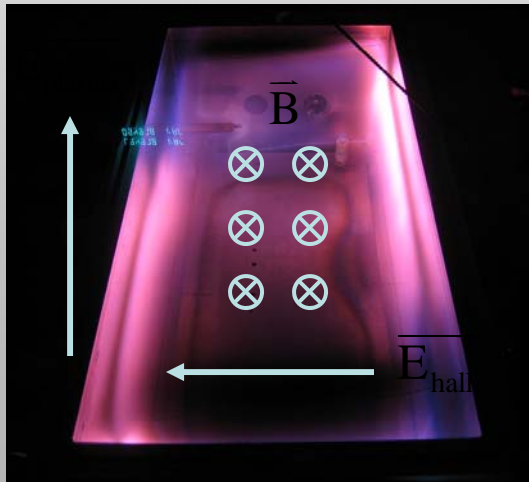
- Formed by collisional excitation of gas in an electric field



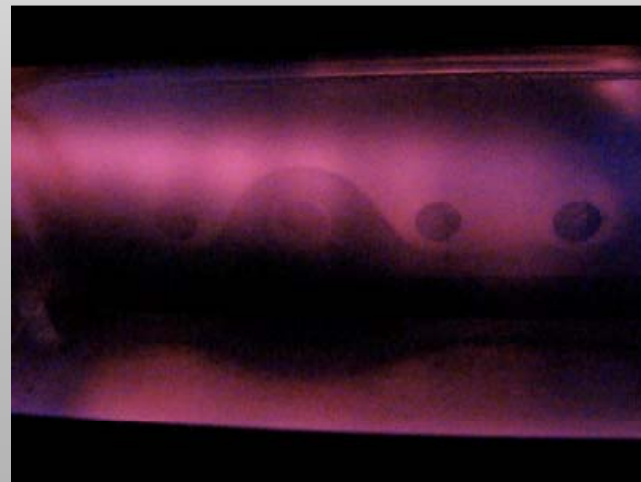
Electrode



Non-magnetized plasma



Magnetized plasma



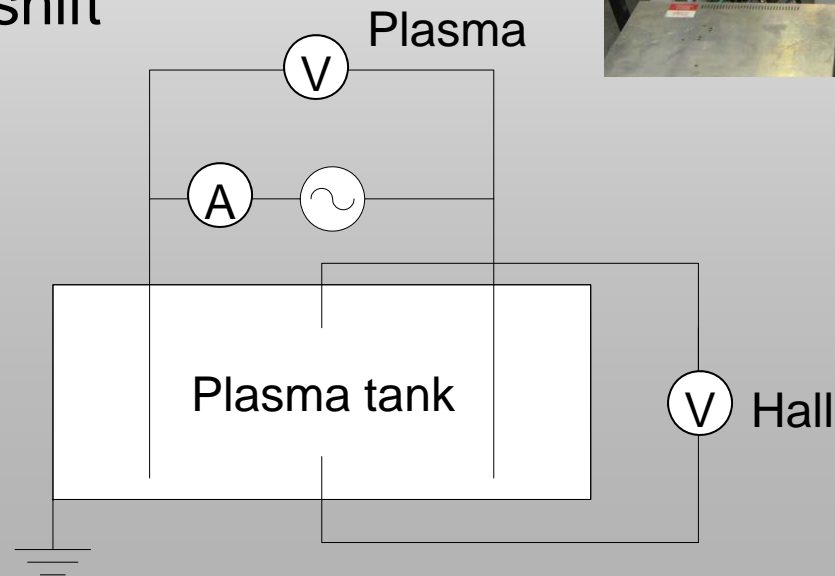
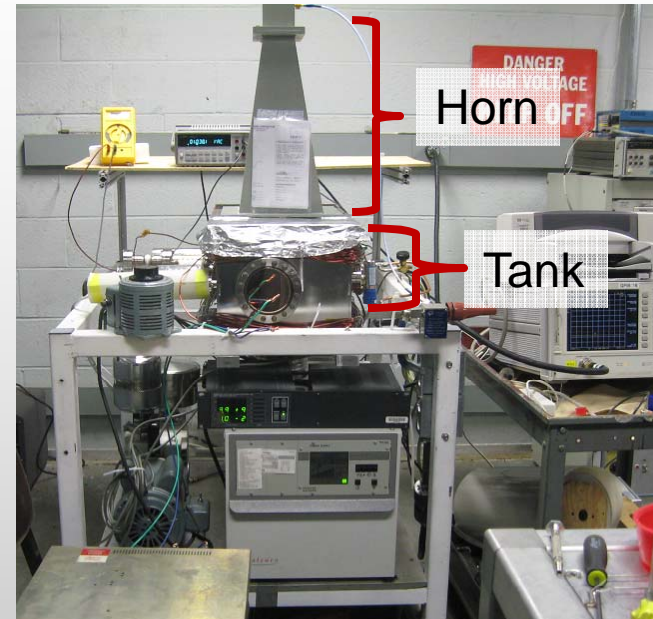
Striations

# Introduction

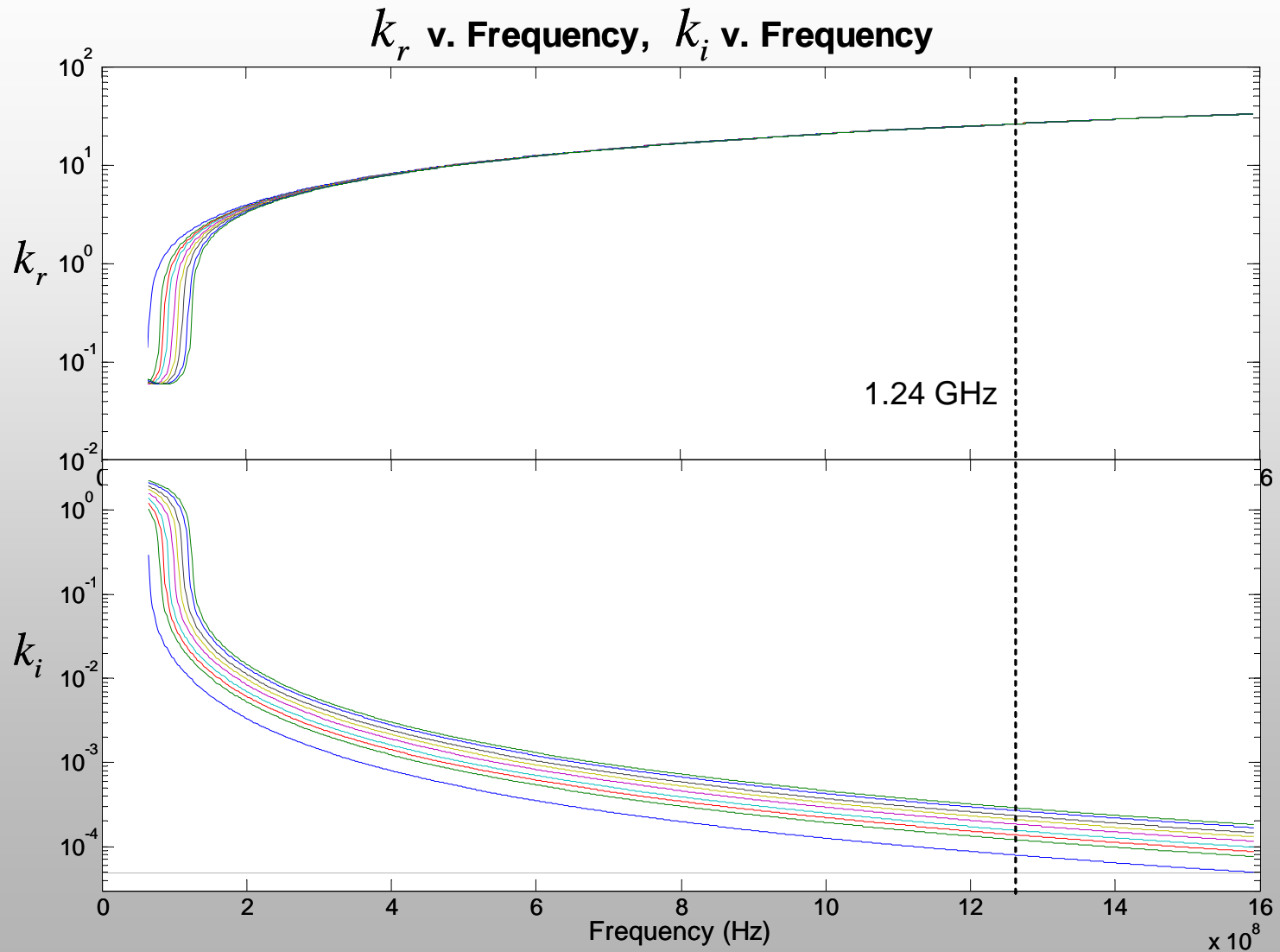
- Plasma
  - Can be controlled electronically
  - Supports the propagation of high-powered electromagnetic waves
  - Has a refractive index
- Applications:
  - Feedback mechanism in a backwards wave oscillator (BWO)
  - Beam steering using plasma
  - Focusing high-powered microwaves at a distance
  - 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



# 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

