Preliminary Proposal for Research

Project: Helicons for Gas-Discharge Lighting
For: Senior Design 2016-2017
Proposer: Mattison Siri (sirims01@students.ipfw.edu)
Date: 15 July 2016

Overview:
In this project, a small team of 2-3 members (electrical and computer engineering and/or physics students) will investigate the use of helicon discharges in lighting applications. The team should compare the luminous efficacy of to-be-chosen lamps when operated using helicon, inductively-coupled plasma, and point-to-point discharge techniques. The team will design and construct an evaluation system to produce these discharges (including radio frequency sources, matching networks, antennas, etc.) and to quantify the luminous efficacy of chosen lamps when operated in the described manners.

The project outcomes will be:
- Systems and methods to produce and confirm the existence of helicons in various gas discharge lamps
- A system and method of quantifying the luminous efficacy of a lamp
- An assessment of the commercial feasibility of helicon lamps

Background:
Helicon discharges are helical electron waves which propagate through a plasma along a magnetic field. It has been shown by F. Chen and many others that helicon discharges ionize a gas more efficiently than do other discharges (inductively-coupled)[1]. Typically, the higher the ion density in a plasma, the more light it emits. Therefore, using a helicon discharge for lighting may result in a higher luminous efficacy than more conventional methods.

Research Questions:
- Can helicon discharges improve the luminous efficacy of gas discharge lamps?
- Is a lighting system utilizing helicon discharges viable?

Possible Directions:
The team may decide to take the research in many possible directions, including:
- Retrofitting existing fluorescent or germicidal tubes with equipment to produce helicons
- Building custom discharge tubes and exploring gas combinations (O₂, CO₂, Ar, Hg vapor, etc.)
- Try utilizing different helicon modes (i.e. m = 0, ±1, ±2, …)
- Designing novel antennas for helicon excitation
Works Cited: