Universitatea din București
Facultatea de Fizică

Mircea DOLINEANU

TITLE

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Scientific Advisers
Conf. dr. Alexandru NICOLIN

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Contents

Chapter 1

Introduction

In this thesis . . .

Chapter 2

Electromagnetism and Laser Profiles

2.1 Classical Electrodynamics

The main principles and laws that govern the phenomena behind lasers, plasma and their interaction are those of classical electrodynamics. As such, like many others tackling this area of research, I find that adding an overview of electrodynamics is simply mandatory. My aim when it comes to differentiating this introductory review from the millions of others out there, if at all possible, is to offer through calculations on some aspects where I personally felt like I wanted to see things from a clearer perspective.

2.1.1 Maxwell's Equations

The Maxwell equations in the absence of magnetic and polarizable media are (**jacksonClassicalElectroc**

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\varepsilon_0} \tag{2.1a}$$

$$\nabla \cdot \mathbf{B} = 0 \tag{2.1b}$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \tag{2.1c}$$

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{j} + \frac{1}{c^2}\frac{\partial \mathbf{E}}{\partial t}\,, \tag{2.1d}$$

While most readers probably have already had at least a basic introduction to the phenomena from which these equations arise and are well acquainted to how to make use of these equations, I would direct those who haven't towards the book by **fleischStudentGuideMaxwell2008**

By extracting the current density from **??**, computing its divergence and then replacing the electric field term using **??** one obtains the continuity equation, which relates only the field sources to one another:

$$\nabla \cdot \mathbf{j}(\mathbf{r}, t) + \frac{\partial \rho(\mathbf{r}, t)}{\partial t} = 0\,. \tag{2.2}$$

These equations are also complemented by the Lorentz force, which describes how the fields act on the sources. The expression of the Lorentz force in the contiuous case is:

$$\mathbf{F} = \int \mathrm{d}\mathbf{r}' \left[\rho(\mathbf{r}', t)\mathbf{E}(\mathbf{r}', t) + \frac{1}{c}\mathbf{j}(\mathbf{r}', t) \times \mathbf{B}(\mathbf{r}', t)\right].$$

2.1.2 The Scalar and Vector Potentials

Since the electric ($\mathbf{E}$) and magnetic ($\mathbf{B}$) fields are vectors, they can be described together by a total of six quantities. The sources on the other hand can be described using only four quantities: the electric charge density ρ and the three components of the electric current density $\mathbf{j}$.

Chapter 3

Results

In this chapter we present the main results ...

Chapter 4

Conclusions

In conclusion . . .