# CHAPTER 1

# Introduction

## 1.1 The Sun

Its significance, structure, and magnetic phenomena.

## 1.2 Magnetohydrodynamics

To build up a mathematical description of the Sun's plasma dynamics, let's motivate some assumptions.

The Sun's plasma, just like all matter in the Universe, is made up of particles[1], but the phenomena such as MHD waves that we are concerned with in this Thesis operate on a *macroscopic* level. By this we mean on length-scales much larger than the *mean free path*[2]. This means that the *Knudsen number*, the dimensionless parameter defined by the ratio of the mean free path to a characteristic length scale, in the Sun is much less than unity. This motivates the **continuum assumption**, where the fluid is considered to "fill up" the space in which is is contained, so that small-scale inhomogeneities caused by particle dynamics are negligible. This gives us a coherent notion of fluid density, $\rho$ and pressure, $p$.

We are gratefully gifted fundamental laws that are universally obeyed by classical mechanics systems upon which we can build our framework. These are the **conservation of mass**, *conservation of momentum*, and *conservation of energy*. The conservation of mass tells us that the change in density in a fixed infinitesimal volume is due only to mass entering or leaving the volume. Mathematically, we can equate the rate of change of density, $\partial\rho/\partial t$ to the incoming density flux $-\nabla(\rho\mathbf{v})$, *i.e.*

$$\frac{\partial\rho}{\partial t} + \nabla(\rho\mathbf{v}) = 0, \tag{1.1}$$

[1] atoms or subatomic particles, depending on the temperature of its location in the Sun

[2] Approximately 1 cm - 1 km in the Sun. REFERENCE

where $\mathbf{v} = (v_1, v_2, v_3)$ is the velocity of the fluid.

## 1.3 Waves in the solar atmosphere

### 1.3.1 Magnetohydrodynamic waves in homogeneous plasma

### 1.3.2 Magnetohydrodynamic waves in homogeneous plasma

#### 1.3.2.1 Interface

#### 1.3.2.2 Symmetric slab

#### 1.3.2.3 Cylinder

## 1.4 Thesis outline

# Bibliography