1. Introduction

Stellar Physics - Part 1: Stellar Properties

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Table of contents

Astronomy is a *observational* science. We cannot bring a star down to Earth to study it in the laboratory. Unlike other branches of Physics, we cannot experiment directly on stars and what happens in the universe is beyond our control, but we can use our knowledge of

Physics to make predictions and we can use observations to validate our theories. This can allow us to answer many questions about the stars. Some of these questions date back to the most ancient times, and through history have inspired philosophers and scientists to develop our understanding of the cosmos. This interplay between Astronomy and Physics is today called *Astrophysics*, which has grown to encompass phenomena from planets to galaxies to the evolution of the universe.

Astrophysics is very multidisciplinary

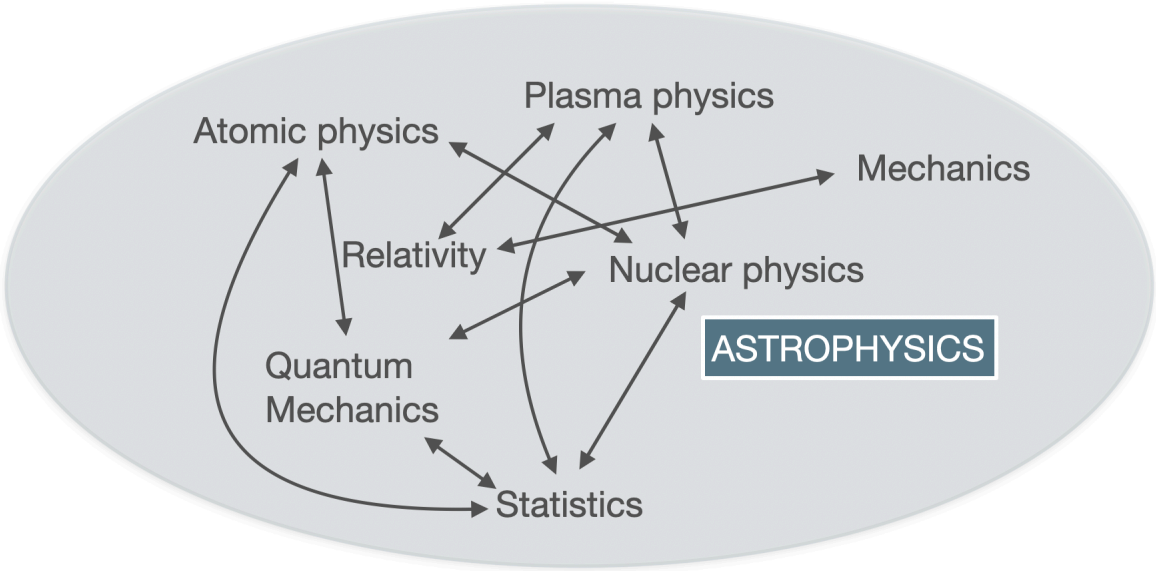

Figure 1: Multidisciplinarity in astrophysics

Astrophysics is very multidisciplinary because of 'several effects' that come into play in the physics of stars, galaxies, the universe… it is an 'arena' of different fields of physics (but also mathematics and chemistry), spanning across classical mechanics, relativity, nuclear and particle physics, statistics, atomic and molecular physics, plasma physics, quantum mechanics and more (the list above and in the picture is not exhaustive)! In this course you will see how some of these fields play a role in the physics of stars.

1.1. Look at the night sky, what do we see?

Let's start with some simple observations of the night sky… "Look at the night sky, what do we see?" Here in Scotland, the answer to this questions is likely 'clouds', but if you are curious to know what is beyond those clouds, you can check out Stellarium (you can download it or you can use the web version: https://stellarium-web.org/).

All that glitters is not (only) stars!

Figure 2: An example from Stellarium

Looking at the night sky we may be able to see planets, meteors, galaxies, satellites, comets, star clusters and many stars!

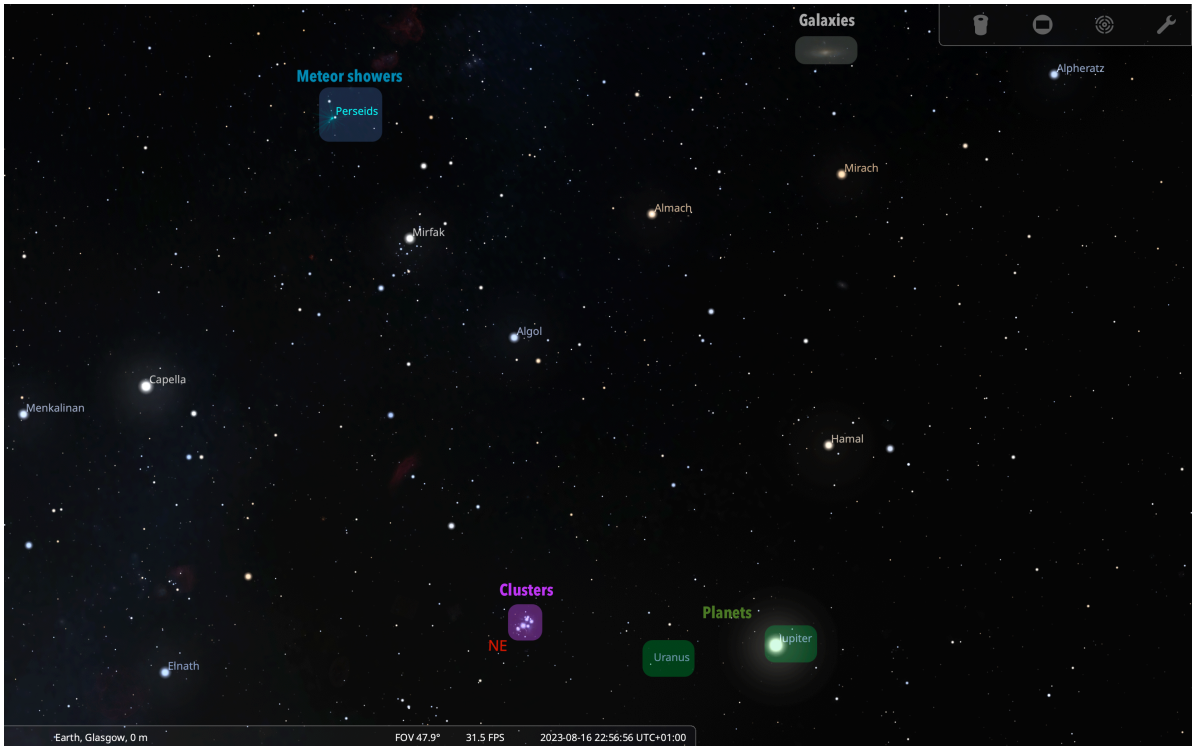

Figure 3: An example from Stellarium (with marked typical objects)

2. What is a star?

A star is an astronomical spheroid body: - held together by *self-gravity* - *radiating* energy from an internal source (tipycally from nuclear fusion reactions, and occasionally from the release of gravitational potential energy during contraction or collapse)

Having this definition you should be able to answer this question: "is the Death Star a (fictional) star"?

The answer is "no", because it does not radiate energy! The Death Star is actually a (fictional) space station orbiting the (fictional) planet moon of Endor. Enough with the fictional stuff now.

If you look at the sky you may see that planets and comets are also shining in the sky, so why can't they be considered stars, based on the definition given above? Do they radiate energy? Are they self-gravitating?