A Study of Properties of Open Star Clusters

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Abstract

Gaia is an astrometry mission by the ESA, which has helped in cataloguing numerous objects in our galaxy in unprecedented detail. The cluster membership information based on Gaia DR2 data of open clusters will be used to understand the effect of dynamical evolution on the observed properties of star clusters. In particular, star clusters with a clear binary track are examined to study the radial distributions of these binary stars with respect to the radial distribution of single stars. Alongside, the morphology of star clusters is examined to look for the presence of any tidal tails in the star clusters.

Contents

Introduction

1.1 Gaia Mission

We have come a long way in observing the skies, from the naked eye to the mural instrument, from telescopes to space missions. The Gaia mission [1] [2] is one such astrometry mission launched in 2013. The spacecraft aims to measure the positions, distances and motions of celestial objects. The mission aims to be the most precise 3D catalogue of the sky, mapping every object it can while also measuring their motions which can give clues about the origin and evolution of our galaxy, the Milky Way.

The mission aims to determine the position and parallax of around a billion stars to an accuracy of around 20 μas. The catalogue is set to be released in stages. The first data release took place in 2016 [3], based on 14 months of observation. It inlcuded the positions and magnitudes for over a billion stars using only Gaia data. The second data release took place in 2018 [4], after 22 months of observations, and improved on the precision of the previous release, as well as adding parallaxes and proper motions.

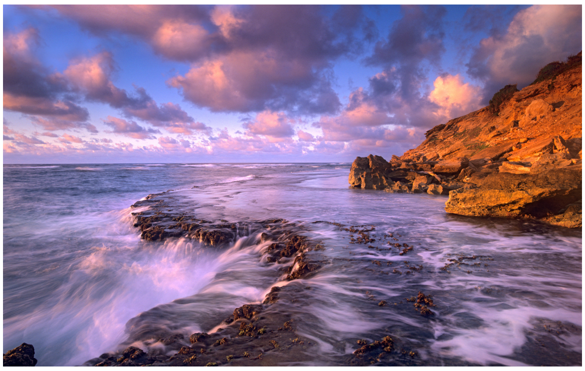
1.2 Star Clusters

In order to create a document in LaTeX, you first write a file, say document.tex, using your preferred text editor. Then you give your document.tex file as input to the TeX program (with the LaTeX macros loaded), and TeX writes out a file suitable for viewing onscreen or printing. This write-format-preview cycle is one of the chief ways in which working with LaTeX differs from what-you-see-is-what-you-get word-processing. It is similar to the code-compile-execute cycle familiar to computer programmers. Today, many LaTeX-aware editing programs make this cycle a simple matter of pressing a single key, while showing the output preview on the screen beside the input window. Some online LaTeX editors automatically refresh the preview. Other online tools provide incremental editing in-place, mixed in with the preview in a streamlined single window.

1.3 Subfigure

A useful extension is the subcaption package, which uses subfloats within a single float. The subfig package (subfigure package is deprecated) is a useful alternative when used in-conjunction with LaTeX templates (i.e. templates for journals from Springer and IOP, IEEETran and ACM SIG) that are not compatible with subcaption. These packages give the author the ability to have subfigures within figures, or subtables within table floats. Subfloats have their own caption, and an optional global caption.

Figure 1.1: Caption of fig. 1.



(a)

(b)

Figure 1.2: Two figure side by side

Table 1.1: Random table

1	2	3	4	2	3	4
5	6	7	8	2	3	4
9	10	11	12	2	3	4
13	14	15	16	2	3	4

1.4 Table

Tables are a common feature in academic writing, often used to summarize research results. Mastering the art of table construction in LaTeX is therefore necessary to produce quality papers and with sufficient practice one can print beautiful tables of any kind.

Keeping in mind that LaTeX is not a spreadsheet, it makes sense to use a dedicated tool to build tables and then to export these tables into the document. Basic tables are not too taxing, but anything more advanced can take a fair bit of construction; in these cases, more advanced packages can be very useful. However, first it is important to know the basics. Once you are comfortable with basic LaTeX tables, you might have a look at more advanced packages or the export options of your favorite spreadsheet. Thanks to the modular nature of LaTeX, the whole process can be automated in a fairly comfortable way. Table 1.1.

Literature

Literature, most generically, is any body of written works. More restrictively, literature refers to writing considered to be an art form or any single writing deemed to have artistic or intellectual value, often due to deploying language in ways that differ from ordinary usage.

2.1 Equation

One of the greatest motivating forces for Donald Knuth when he began developing the original TeX system was to create something that allowed simple construction of mathematical formulae, while looking professional when printed. The fact that he succeeded was most probably why TeX (and later on, LaTeX) became so popular within the scientific community. Typesetting mathematics is one of LaTeX's greatest strengths. It is also a large topic due to the existence of so much mathematical notation.

The velocity, v ($v = d/t$) is ....

$$v = \frac{\mu}{\rho} \tag{2.1}$$

Table 2.1: Random table-2

a	b	c	d	b	c	d	b	c	d
5	6	7	8	b	c	d	b	c	d
9	10	11	12	b	c	d	b	c	d
a	b	c	d	b	c	d	b	c	d
5	6	7	8	b	c	d	b	c	d
9	10	11	12	b	c	d	b	c	d
a	b	c	d	b	c	d	b	c	d

Experiments

3.1 First section of this chapter

An experiment is a procedure carried out to support, refute, or validate a hypothesis. Experiments provide insight into cause-and-effect by demonstrating what outcome occurs when a particular factor is manipulated. Experiments vary greatly in goal and scale, but always rely on repeatable procedure and logical analysis of the results. There also exists natural experimental studies.

3.1.1 First subsection of this chapter

A child may carry out basic experiments to understand gravity, while teams of scientists may take years of systematic investigation to advance their understanding of a phenomenon. Experiments and other types of hands-on activities are very important to student learning in the science classroom. Experiments can raise test scores and help a student become more engaged and interested in the material they are learning, especially when used over time. Experiments can vary from personal and informal natural comparisons (e.g. tasting a range of chocolates to find a favorite), to highly controlled (e.g. tests requiring complex apparatus overseen by many scientists that hope to discover information about subatomic particles). Uses of experiments vary considerably between the natural and human sciences.

An experiment usually tests a hypothesis, which is an expectation about how a particular process or phenomenon works. However, an experiment may also aim to answer a “what-if” question, without a specific expectation about what the experiment reveals, or to confirm prior results. If an experiment is carefully conducted, the results usually either support or disprove the hypothesis. According to some philosophies of science, an experiment can never "prove" a hypothesis, it can only add support. On the other hand, an experiment that provides a counterexample can disprove a theory or hypothesis, but a theory can always be salvaged by appropriate ad hoc modifications at the expense of simplicity. An experiment must also control the possible confounding factors—any factors that would mar the accuracy or repeatability of the experiment or the ability to interpret the results. Confounding is commonly eliminated through scientific controls and/or, in randomized experiments, through random assignment.

3.1.1.1 First subsubsection of this chapter

In engineering and the physical sciences, experiments are a primary component of the scientific method. They are used to test theories and hypotheses about how physical processes work under particular conditions (e.g., whether a particular engineering process can produce a desired chemical compound). Typically, experiments in these fields focus on replication of identical procedures in hopes of producing identical results in each replication. Random assignment is uncommon.

First paragraph of this chapter. According to his explanation, a strictly controlled test execution with a sensibility for the subjectivity and susceptibility of outcomes due to the nature of man is necessary.

Supporting Information

Figure A.1: Caption of image 2.

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