THE UNIVERSITY of ADELAIDE

Astrophysics II: Group Research Project Report

Project Title

Albert Einstein Enrico Fermi Erwin Schrödinger
James Maxwell Richard Feynman

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Abstract

The abstract should contain approximately 300 words and could be structured as follows:
Motivation and aims. Motivation and aims. Motivation and aims. Motivation and aims. Motivation and aims. Motivation and aims. Motivation and aims. Motivation and aims. Motivation and aims.
Methods. Methods.
Results. Results.

Breakdown of Tasks

Albert
: Coordination of the project. Author of section 1, subsection 2.3 and subsection 2.5.

Enrico
: Calculation of the cross section of a fancy particle. Determination of Equation 2.5. Visualisation of the cross section with energy. Collection of experimental data to test theoretical predictions. Author of subsection 2.4.

Erwin
: Tasks.

James
: Tasks

Richard
: Tasks.

1 Introduction

This section should be 1-2 pages long.
The introduction should give a short overview of the research field of your project and also explain the motivation of your project.
Subsequent to this overview, it is recommended to end the introduction as follows:

This research project deals with ...

For these purposes, the report is structured as follows:

Section 2 gives an overview of ...

Section 3 explains ...

Section 4 describes ...

Section 5 presents ...

Section 6 illustrates ...

Section 7 concludes ...

2 Technical Tips

2.1 References

In a scientific text, you often need to reference sections, equations, tables or figures. Therefore, assign a *label* using the command `\label{SomeLabel}`. It is good practice to include the type of reference in the label, for example `sec:introduction` for a section, `eq:leastsquares` for an equation, `tab:data` for a table, `fig:velocity` for a figure.

To reference the created label, the command `\ref{SomeLabel}` is used, but it is strongly recommended to use `\autoref{SomeLabel}` from the `hyperref` package instead. It automatically writes the type, e. g. Figure, section, subsection, of your reference. Like this, not only the number of your reference, but also the type is used for the link. Furthermore, no line breaks between the type and the number will occur. To use it, just replace `\ref` by `\autoref`. Here is an example to show the differences between the commands: 2.1 vs. subsection 2.1.

For the appendix, the use of `\autoref` will create the following:
Appendix A for the section, and subsection A.1 for the subsection. For subsections, you might want to have it differently. Therefore, a specific command has been added in the preamble. Just use `\aref` instead of `\autoref`, and you will get the following:
Appendix A.1 for the subsection.

2.2 Citations

In a scientific text, you will also need to cite resources you used. In principle, there are two types of citations:
`\cite`: Fanaroff and Riley, 1974 suggests to use model XY.
`\citep`: The model describes the formation of stars (Fanaroff and Riley, 1974).
All your resources are listed in the file `bib/references.bib`. Have a look at the examples in the provided file. The word following the `@article{` is used as the label (e.g. `\cite {SomeLabel}`).

There are multiple different citation styles, for example a simple numbering (e.g. [1]) or a more informational style providing the author and the year (e.g. Einstein, 1905). The advantage of using the citation style *author year* (instead of numbers or abbreviations) is that a reader from your field will most probably know the corresponding publication and will not need to check the bibliography. Moreover, a name is easier to remember than just a number. Therefore, you will make it easier for the reader to read your report (and you want to make it as comfortable for your referee as possible).

2.3 Figures

Every figure should have a caption. The caption typically starts with some kind of "headline", followed by a more detailed description of the figure. Depending on the kind of figure and situation, you might want to describe the different things that are plotted or summarise the conclusion.
Figure captions should be positioned below the figure.

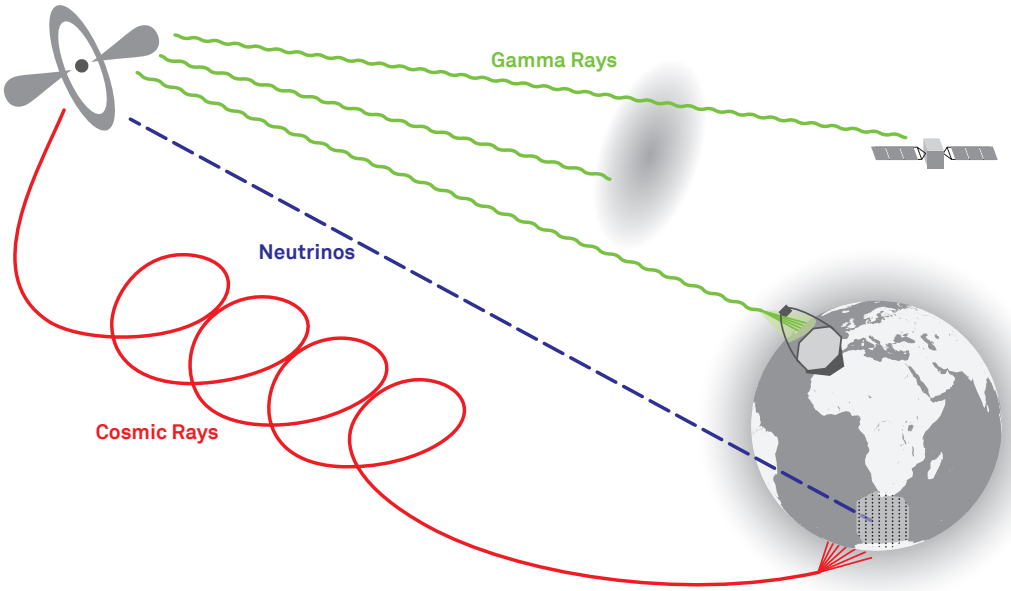

Figure 1: Astroparticle physics at a glance. Specific astronomical objects emit different messengers, such as neutrinos, cosmic and gamma rays, propagating through the universe. Depending on the type of messenger, they might interact with magnetic fields, interstellar clouds, the Earth's atmosphere or the Earth itself, and they can be detected with different instruments.

2.4 Tables

Every table should have a caption. The caption typically starts with some kind of "headline", followed by a more detailed description of the table and the columns.
Table captions should be positioned above the table.
Keep the table simple: Do not use many lines. Note the unit in the header. Use the same number of digits in a column.

Table 1: Description of physicists. The characteristics of famous physicists are specified by their age, height and weight. These data were obtained from `www.wikipedia.com`.

Name	Age / yr	Height / m	Weight / kg
Albert Einstein	55	1.56	88
Enrico Fermi	66	2.35	95
Erwin Schrödinger	111	1.43	75
James Maxwell	44	1.88	77
Richard Feynman	33	1.92	86

2.5 Equations

Equations can be used within a text. In physics, the mass-energy equivalence is stated by the equation $E = mc^2$, discovered in 1905 by Albert Einstein.
Equations can also be separated from the next and numbered.

$$f(x) = a \cdot x^2 + b \tag{1}$$

3 Further Tips

The structure of a scientific report is very important. It should be developed before you start writing, otherwise you will need to copy and paste paragraphs. This often leads to missing information or to sections that are not understandable. The following approach is recommended: Write dot points of the things and plots etc that should go in the report. Order them. Separate them in sections and subsections and find titles.

As mentioned before, the first section should be an introduction to the research topic to help the reader to place it into a broader subject area. It should also motivate the investigations you pursued.
The next section / sections should provide detailed information about your research topics that is needed to understand the used methods and the derived results and conclusions. The following section should explain the used methods, followed by a section presenting the results. These sections could also be combined.
The final section should provide a conclusion. Start with mentioning the aim of the investigation again. Then, summarise and discuss the results and based on that, explain your drawn conclusions.

Use the inbuilt spellchecker.
Proof read the sections of other group members and see if it is understandable.
Stick to British English.
Avoid I/we and use passive instead.
Use a scientific language.
Use ”do not” instead of ”don’t” etc.

A Data Sets

The following data has been used for this project.

A.1 Gamma-Ray Data Set

Table 2: Coordinates of associated 3FGL sources.

3FGL Name	Associated Name	RA	Dec
3FGL J0040.5-2339	PMN J0040-2340	10.10379	-23.66689
3FGL J0041.9+3639	RX J0042.0+3641	10.535	36.6875
3FGL J0042.0+2318	PKS 0039+230	10.51894	23.33363
3FGL J0043.5-0444	1RXS J004333.7-044257	10.89217	-4.71681
3FGL J0043.7-1117	1RXS J004349.3-111612	10.95288	-11.26867
3FGL J0043.8+3425	GB6 J0043+3426	10.95353	34.44059

B Some Additional Stuff

The following code was used for the task of plotting some data.

```
import numpy as np
import pandas as pd
import matplotlib.pyplot as plt

df = pd.read_csv('data.csv')

plt.plot(df.x, df.y)
plt.show()
```

References

Fanaroff, B. L. and J. M. Riley (1974). 'The Morphology of Extragalactic Radio Sources of High and Low Luminosity'. In: *Monthly Notices of the Royal Astronomical Society* 167.1, 31P–36P.