

Ruprecht-Karls-Universität

**Detection and characterisation of open clusters
in the Milky Way with *Gaia***

Emily Lauren Hunt

Dissertation

submitted to the
Combined Faculty of Mathematics, Engineering and Natural Sciences
of Heidelberg University, Germany
for the degree of

Doctor of Natural Sciences

Put forward by

Emily Lauren Hunt
born in: Coventry, United Kingdom

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Detection and characterisation of open clusters in the Milky Way with *Gaia*

Referees: PD Dr. Sabine Reffert
Prof. Dr. Hans-Walter Rix

Emily Lauren Hunt

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Reviewers: PD Dr. Sabine Reffert and Prof. Dr. Hans-Walter Rix

Supervisor: PD Dr. Sabine Reffert

Ruprecht-Karls-Universität

Extrasolar Planet Research Group

Landessternwarte Königstuhl

Zentrum für Astronomie

Königstuhl 12

69117 Heidelberg

Abstract

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Abstract (different language)

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Acknowledgement

Even after eight years at university, it still feels *surprising* to see myself writing this PhD thesis and reaching this stage in my life. As a child, I looked up at the planets and the stars and I saw a universe of wonder. But as a teenager, I looked around me (here on the Earth) and I felt different, outcast, and fundamentally undeserving of the future I have managed to have. This thesis is for every LGBTQ+ child who grew up thinking the world is not for them.

I will forever be eternally indebted and grateful to the many, many people without whom I would never be here.

Dr. Michelle Cuthbert, your phenomenal commitment and passion for teaching had an impact on me that I will carry with me for the rest of my life. I still remember my first lesson of Year 12 physics, where you asked those of us intending to study physics at university to raise our hands. I think one or two hands were raised, of which I was not one. You proudly remarked that you would change our minds in just eight months. By the end of Year 13, a majority of our class went on to study physics, in no small part thanks to your teaching. This thesis would never have happened had I never been exposed to your infectious passionate physics teaching.

I next thank those I know from the University of Bath where I did my undergraduate degree. Dr. Vicky Scowcroft, the summer project I did with you and your

Contents

1	Introduction	1
1.1	From seven sisters	1
1.2	An observational history of open clusters	1
1.3	Open clusters in the <i>Gaia</i> era	1
1.4	The theoretical background of star clusters	1
1.5	Thesis structure	1
2	Comparison of clustering algorithms applied to <i>Gaia</i> DR2 data	3
2.1	System Section 1	3
2.2	System Section 2	5
2.3	System Section 3	6
2.4	Conclusion	8
3	A census of star clusters with <i>Gaia</i> EDR3	9
3.1	System Section 1	9
3.2	System Section 2	11
3.3	System Section 3	12
3.4	Conclusion	14
4	The dynamics of Milky Way star clusters	15
4.1	System Section 1	15
4.2	System Section 2	17
4.3	System Section 3	18
4.4	Conclusion	20
5	Conclusion	21
5.1	System Section 1	21
5.2	System Section 2	22
5.3	Future Work	24
A	Example Appendix	31
A.1	Appendix Section 1	31

A.2 Appendix Section 2	31
Declaration	35

Introduction

1

” *You can’t do better design with a computer, but
you can speed up your work enormously.*

— **Wim Crouwel**
(Graphic designer and typographer)

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1.1 From seven sisters

1.2 An observational history of open clusters

1.3 Open clusters in the *Gaia* era

1.4 The theoretical background of star clusters

1.5 Thesis structure

Chapter 1

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Comparison of clustering algorithms applied to *Gaia* DR2 data

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Fig. 2.1.: Figure example: (a) example part one, (c) example part two; (c) example part three

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The dynamics of Milky Way star clusters

” *Innovation distinguishes between a leader and a follower.*

— **Steve Jobs**
(CEO Apple Inc.)

And after the second paragraph follows the third paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

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4.1 System Section 1

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Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.



Fig. 4.1.: Figure example: (a) example part one, (c) example part two; (c) example part three

This is the second paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.

4.2 System Section 2

And after the second paragraph follows the third paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language.



Fig. 4.2.: Another Figure example: (a) example part one, (c) example part two; (c) example part three

After this fourth paragraph, we start a new paragraph sequence. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A

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4.3 System Section 3

This is the second paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of the original language. There is no need for special content, but the length of words should match the language. Hello, here is some text without a meaning. This text should show what a printed text will look like at this place. If you read this text, you will get no information. Really? Is there no information? Is there a difference between this text and some nonsense like “Huardest gefburn”? Kjift – not at all! A blind text like this gives you information about the selected font, how the letters are written and an impression of the look. This text should contain all letters of the alphabet and it should be written in of

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5.2 System Section 2

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5.3 Future Work

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List of Figures

2.1	Figure example: (a) example part one, (c) example part two; (c) example part three	4
2.2	Another Figure example: (a) example part one, (c) example part two; (c) example part three	5
3.1	Figure example: (a) example part one, (c) example part two; (c) example part three	10
3.2	Another Figure example: (a) example part one, (c) example part two; (c) example part three	11
4.1	Figure example: (a) example part one, (c) example part two; (c) example part three	16
4.2	Another Figure example: (a) example part one, (c) example part two; (c) example part three	17

List of Tables

A.1 This is a caption text. 31

A.2 This is a caption text. 32

List of Listings

Example Appendix



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Alpha	Beta	Gamma
0	1	2
3	4	5

Tab. A.1.: This is a caption text.

A.2 Appendix Section 2

And after the second paragraph follows the third paragraph. Hello, here is some text without a meaning. This text should show what a printed text will look like

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Colophon

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Declaration

You can put your declaration here, to declare that you have completed your work solely and only with the help of the references you mentioned.

Heidelberg, April 24th, 2023

Emily Lauren Hunt

