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PHYS6013 Midterm Report: A Machine Leanring Approach to Stellar Spin-Down

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ABSTRACT
Observations of young open clusters have shown a bimodal distribution in the rotation periods of cool stars. This bi-modality stems from stars having fast or slow rotation periods. The evolution of this trend through time suggests a fast transition from fast to slow rotating. Our current understanding of cool star spin down, through magnetic braking, accounts for the slow-rotators branch, while the fast rotators remain somewhat of a mystery.

Our goal is to build a predictive probabilistic spin-down model that links the period of a starat any given mass and age. We use machine learning to predict the age at which each star transitions from fast to slow-rotation. Using a graphical model we translate the distribution of initial periods into a rotation period probability distribution for a given mass and age.

Key words: keyword1 – keyword2 – keyword3

1 INTRODUCTION

Stars born spinning, Over time they spin down with a mechanism. First pointed out by skumanich and studied further for hopes of a gyrochronological model. Magnetic breaking modeled and used as a method of spin down by Garraffo et al. 2017. Linked to magnetic field complexity. Dipole causes large arms that make for an effecient spin down. Viewing open clusters one can see the fast, slow and transitional rotators. Some evolution between the two that is UNKNOWN(?).

2 METHODS, OBSERVATIONS, SIMULATIONS ETC.

Normally the next section describes the techniques the authors used. It is frequently split into subsections, such as Section **??** below.

2.1 Data Reduction

Collected from various papers stated in CITE BOOK, plus personal findings and unpublished data. Each cluster in different photometry and no one fits all conversion. Used MIST tracks to interpolate a mass from the given ages of the stars.

FIGURE OF ALL CLUSTERS REDUCED MERGE CLUSTERS?

2.1.1 M37 shift?

Perhaps due to metalicity

2.2 Unsupervised Clustering?

2.3 Polynomial Ridge Regression

slow rotators fit using a polynomial fit of order 4. Sigmoid function overlapped and optimised to change poly term on and off at switch point.

FIGURE OF CURRENT FIT

2.4 Initial Period and other parameters

Expand of the effect initial period and perhaps metalicity. Other parameters could allow for deeper understanding of the "overlap" sections of the open clusters

FIGURE OF HOW INTIAL PERIOD CAUSES MULTIPLE LINES TO OVERLAP AND MAKE THE TRANSITION "BLURRY"

2.5 Figures and tables

Figures and tables should be placed at logical positions in the text. Don't worry about the exact layout, which will be handled by the publishers.

Figures are referred to as e.g. Fig. 1, and tables as e.g. Table 1.

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Figure 1. This is an example figure. Captions appear below each figure. Give enough detail for the reader to understand what they're looking at, but leave detailed discussion to the main body of the text.

Table 1. This is an example table. Captions appear above each table. Remember to define the quantities, symbols and units used.

A	B	C	D
1	2	3	4
2	4	6	8
3	5	7	9

3 CONCLUSIONS

The last numbered section should briefly summarise what has been done, and describe the final conclusions which the authors draw from their work.

ACKNOWLEDGEMENTS

The Acknowledgements section is not numbered. Here you can thank helpful colleagues, acknowledge funding agencies, telescopes and facilities used etc. Try to keep it short.

APPENDIX A: SOME EXTRA MATERIAL

If you want to present additional material which would interrupt the flow of the main paper, it can be placed in an Appendix which appears after the list of references.

This paper has been typeset from a TEX/LATEX file prepared by the author.