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Periodic Cataclysmic Variables in the Galactic Bulge: Application of the Gregory-Loredo Algorithm

Tong Bao,[1,2]★ Zhiyuan Li,[1,2]
[1]*School of Astronomy and Space Science, Nanjing University, Nanjing 210046, China*
[2]*Key Laboratory of Modern Astronomy and Astrophysics (Nanjing University), Ministry of Education, Nanjing 210046, China*

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ABSTRACT

We present the discovery of 22 X-ray periodic sources in the Limiting Window (LW), a low-extinction region in the Galactic bulge, locating 80' south of the Galactic center. Their luminosities range(10^{31} – 10^{33} erg s^{-1}) and period distribution(mostly between 1 to 3 hour), indicate they are cataclysmic variables (CVs). Most of them are polars with relatively harder spectrum, suggesting an unusual sub-class of mCVs. The brighter sources (6 out of 22 with L>10^{32} erg s^{-1}) in this sample are more likely IPs, with mean M_{WD} about 0.8 $M_{\odot}$. We also proved that the Gregory-Loredo (GL) method used in this work has better sensitivity and data usage compared to the Lomb-Scargle (LS) method. In combination with the simulation and the geometry of accretion in CVs, we constrain the proportion of polars to X-ray sources in LW about 14%, and the fraction of DNe is about 45%, though with more uncertainty. Still, this discovery confirms the sub-type of unusual mCVs and provides a practical way to study the population about X-ray sources based on periodic modulation.

Key words: Galaxy: bulge — X-rays: stars — X-rays: binaries

1 INTRODUCTION

This is a simple template for authors to write new MNRAS papers. See `mnras_sample.tex` for a more complex example, and `mnras_guide.tex` for a full user guide.

All papers should start with an Introduction section, which sets the work in context, cites relevant earlier studies in the field by Fournier (1901), and describes the problem the authors aim to solve (e.g. Van Dijk 1902). Multiple citations can be joined in a simple way like De Laguarde (1903); De la Guarde (1904).

2 METHODS, OBSERVATIONS, SIMULATIONS ETC.

Normally the next section describes the techniques the authors used. It is frequently split into subsections, such as Section 2.1 below.

2.1 Maths

Simple mathematics can be inserted into the flow of the text e.g. $2 \times 3 = 6$ or $v = 220\,\mathrm{km\,s^{-1}}$, but more complicated expressions should be entered as a numbered equation:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}. \quad (1)$$

Refer back to them as e.g. equation (1).

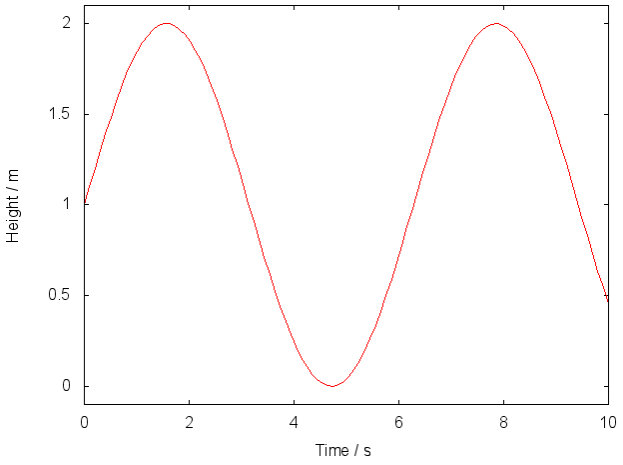

Figure 1. This is an example figure. Captions appear below each figure. Give enough detail for the reader to understand what they're looking at, but leave detailed discussion to the main body of the text.

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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.

★ E-mail: mn@ras.org.uk (KTS)

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.

REFERENCES

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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.

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