



Disentangling stellar activity and planetary signals

I. Boisse (1), F. Bouchy (1,2), G. Hébrard (1), X. Bonfils (3,4), N. Santos (5) and S. Vauclair (6)

(1) Institut d'Astrophysique de Paris, Université Pierre et Marie Curie, UMR7095 CNRS, 98bis bd. Arago, 75014 Paris, France

(2) Observatoire de Haute Provence, CNRS/OAMP, 04870 St Michel l'Observatoire, France

(3) Laboratoire d'Astrophysique de Grenoble, Observatoire de Grenoble, Université Joseph Fourier, CNRS, UMR 5571, 38041, Grenoble Cedex 09, France

(4) Observatoire de Genève, Université de Genève, 51 Ch. des Maillettes, 1290 Sauverny, Switzerland

(5) Centro de Astrofísica, Universidade do Porto, Rua das Estrelas, 4150-762 Porto, Portugal

(6) LATT-UMR 5572, CNRS & Université P. Sabatier, 14 Av. E. Belin, F-31400 Toulouse, France

Abstract

Photospheric stellar activity (i.e. dark spots or bright plages) might be an important source of noise and confusion in the radial-velocity (RV) measurements. Radial-velocimetry planet search surveys as well as follow-up of photometric transit surveys require a deeper understanding and characterization of the effects of stellar activities to disentangle it from planetary signals.

We simulate dark spots on a rotating stellar photosphere. The variations of the photometry, RV and spectral line shapes are characterized and analyzed according to the stellar inclination, the latitude and the number of spots.

The Lomb-Scargle periodograms of the RV variations induced by activity present power at the rotational period P_{rot} of the star and its two-first harmonics $P_{rot}/2$ and $P_{rot}/3$. Three adjusted sinusoids fixed at the fundamental period and its two-first harmonics allow to remove about 90% of the RV jitter amplitude. We apply and validate our approach on four known active planet-host stars: HD 189733, GJ 674, CoRoT-7 and ι Hor. We succeed in fitting simultaneously activity and planetary signals on GJ674 and CoRoT-7. We excluded short-period low-mass exoplanets around ι Hor. Our approach is efficient to disentangle reflex-motion due to a planetary companion and stellar-activity induced-RV variations provided that 1) the planetary orbital period is not close to that of the stellar rotation or one of its two first harmonics, 2) the rotational period of the star is accurately known, 3) the data cover more than one stellar rotational period. This method will then allow to discover more planetary systems around active stars.

1. Introduction

This is the introduction section of your paper. All section headings are in a large bold font. All sections and subsections are numbered, respectively. Please use the LaTeX command “\Section” for a numbered section, “\section*” (with an asterisk) for an unnumbered section and “\SubSection” for a sub-section. The sections and sub-sections are consecutively numbered.

1.1. Sub-Section

This is the example of a sub-section. As mentioned above, please use the command “\SubSection{Your sub-section title}” in order to include your sub-section title in the correct formatting. The sub-sections are also consecutively numbered.

2. An additional section

You will find an example of how to include your Reference list with the LaTeX bibliography environment at the end of this file. You may cite references with [1] or [2]. The reference list should be in an alphabetical order. All references are put in square brackets and the number in square brackets will appear in your paper if you use the “\cite{citation}” command. Please note that it is sometimes necessary to run LaTeX twice in order to have the citations be correctly included in the paper.

3. Figures

You may use any of the common file types, such as .jpg, .tiff, .pdf, etc. In order to include a figure, please use the LaTeX figure environment as shown in the template.

Figure 1: This is the example of an included figure.

4. Tables

You will find a sample of an included table below. Please use the LaTeX table environment in order to include a table.

Table 1: This is the example of an included table.

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

5. Equations

Below, you will find examples of two equations. You should use the LaTeX equation environment to include your equation. The equation number is automatically placed at the right side of the column. The equations are also consecutively numbered.

$$a^2 + b^2 = c^2 \quad (1)$$

$$E = m \cdot c^2 \quad (2)$$

6. Summary and Conclusions

After having finalized your paper in LaTeX, please create a respective pdf file out of the LaTeX document.

Acknowledgements

This is how to do an unnumbered section. In this example, the unnumbered section is the Acknowledgements section. Here, you may include all persons or institutions which you would like to thank. We recommend that the abstract is carefully compiled and thoroughly checked, in particular with regard to the list of authors, **before** submission.

References

- [1] Author, A., Author, B., and Author, C.: First example of a cited article title, First Example Journal, Vol. 1, pp. 1-100, 1999.
- [2] Author, D. and Author, E.: Second example of a cited book, Example Publishing House, 2000.
- [3] Author, F.: Third example of a cited conference paper, The Great Science Conference, 1–7 February 2001, Scinetown, Sciencecountry, 2001.