RevMexAA (Serie de Conferencias), **20**, 202–202 (2004)

SHORT-TERM RADIO–X-RAY CORRELATIONS OF CYGNUS X-1

T. Gleissner,[1] J. Wilms,[1,2] G. G. Pooley,[3] M. A. Nowak,[4] K. Pottschmidt,[5,6] S. Markoff,[4]
M. Klein-Wolt,[7] R. P. Fender,[7] and R. Staubert[1]

We analyze simultaneous radio–X-ray data of Cygnus X-1 from the Ryle telescope (RT) and *RXTE* over more than 4 a. We show that apparent correlations on short time scales in the lightcurves of Cyg X-1 are probably the coincidental outcome of white noise statistics.

As a measure of correlation between radio and X-ray emission, we calculate the maximum cross-correlation coefficient, ccf, of simultaneous radio and X-ray lightcurves, which are rebinned to a resolution of 32 s and smoothed. Every single X-ray lightcurve segment is cross-correlated with the corresponding radio lightcurve, up to a maximum shift $\Delta t = \pm 10$ h.

GRS 1915+105 does show radio–X-ray correlations (Mirabel et al. 1998; Klein-Wolt et al. 2002), qualifying it as a source to test the used ccf procedure. We use a set of 120 simultaneous radio–X-ray lightcurves, taken with the RT and *RXTE*.

In Fig. 1a the histogram of the maximum ccf for the observed data of GRS 1915+105 is drawn as solid line. The dotted line gives the histogram of ccf from random white noise (wn) lightcurves which are simulated with the same properties (μ, σ, sampling) and cross-correlated the same way as the observed lightcurves. For each observation we run the simulation 1000 times to achieve statistical significance.

Fig. 1a shows that the ccf distribution of the observed data of GRS 1915+105 is significantly different from the wn distribution. As expected, the existent radio–X-ray correlations in GRS 1915+105 are reflected by the fraction of ccf's with values close to ± 1. This means that the applied procedure is able to find radio–X-ray correlations in a data set.

Applying the procedure to Cyg X-1, we find that the ccf distribution of 301 observations is similar to the wn distribution (Fig. 1b). This suggests that similar patterns detected on short time scales in the X-ray and radio lightcurves of Cyg X-1 are random events which are a natural outcome in wn lightcurves. Taking into account existent loose correlations on a time scale of days (Pooley et al. 1999), this indicates a break-down of these correlations on shorter time scales. One explanation is a sufficiently wide distance between X-ray and radio emission regions so that small mass ejection variations at the base of the jet are levelled out in the jet stream before they reach the radio emission region. A detailed description will be given in Gleissner et al. (2004).

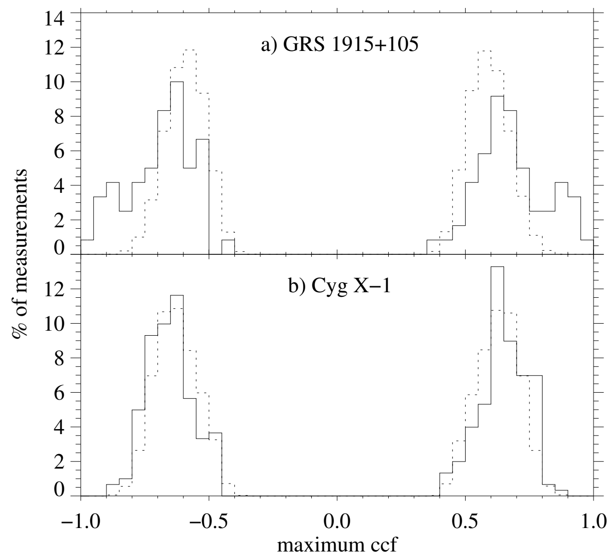

Fig. 1. Histograms of the distribution of maximum ccf for observed data (solid line) and simulated wn data (dotted line) for GRS 1915+105 (top) and Cyg X-1 (bottom).

REFERENCES

Gleissner, T., Wilms, J., Pooley, G. G., et al. 2004, A&A, to be submitted

Klein-Wolt, M., Fender, R. P., Pooley, G. G., et al. 2002, MNRAS, 331, 745

Mirabel, I. F., Dhawan, V., Chaty, S., et al. 1998, A&A, 330, L9

Pooley, G. G., Fender, R. P., & Brocksopp, C. 1999, MNRAS, 302, L1

[1]IAA Tübingen, Sand 1, 72076 Tübingen, Germany.
[2]present address: Univ. of Warwick, Coventry, UK.
[3]Astrophysics, Cavendish Laboratory, Cambridge, UK.
[4]MIT, Center for Space Research, Cambridge, USA.
[5]MPE, Garching, Germany.
[6]INTEGRAL Science Data Centre, Versoix, Switzerland.
[7]University of Amsterdam, Amsterdam, the Netherlands.