RevMexAA (Serie de Conferencias), **35**, 97–98 (2009)

SEARCH FOR NEW MICROQUASARS CANDIDATES THROUGH VLA/XMM-NEWTON OBSERVATIONS

J. A. Combi,[1] J. F. Albacete-Colombo,[2,3] and J. Martí[1]

RESUMEN

En este trabajo hemos desarrollado una estrategia de búsqueda para hallar nuevos candidatos a microcuasares, basada en la coincidencia posicional de fuentes de radio y rayos-X con criterios de seleción muy restrictivos. Para tal propósito, hemos usado propiedades de radio, infrarrojo y de rayos-X de las fuentes, obtenidas de diferentes catálogos disponibles en la literatura. Como resultado, encontramos 86 fuentes con coincidencia posicional a latitudes galácticas $|b| \leq 10°$. Para toda la muestra, cuando fue posible, hemos analizado diagramas color-color en el infrarrojo e índice de dureza en rayos-X y hemos encontrado 3 objetos con características de sistemas binarios de alta masa. Se presenta un estudio preliminar de uno de ellos.

ABSTRACT

In this work we have developed an improved search strategy based on positional cross-identification with very restrictive selection criteria to find new MQs candidate, using more sensitive modern X-ray data. For such purpose, we made combined use of the radio, infrared, and X-ray properties of the sources, using different available catalogs. As a result, we find 86 sources with positional coincidence in the NVSS/XMM catalogs at galactic latitudes $|b| \leq 10°$. For the fully coincident sources, whenever possible, we analyzed color-color and hardness ratio diagrams and found that at least 3 of them display high-mass X-ray binary characteristics. A preliminary study of one of them is presented.

Key Words: catalogs — infrared: stars — radio continuum: general — X-rays: binaries

1. GENERAL

Microquasars (MQs) are X-ray binaries (XRBs) containing compact objects like stellar black holes or neutron stars that accrete matter from a companion star. They copy the characteristics exhibited by distant quasars (Mirabel & Rodríguez 1999). They are known to emit from radio to X-ray energies (Mirabel & Rodríguez 1994) and possibly up to TeV gamma-ray energies, as in the case of Cygnus X-1 (Albert et al. 2007). These objects combine two important aspects of relativistic astrophysics: accreting black holes or neutron stars identified by the production of hard X-rays around accreting disks and relativistic radio jets detected by means of their synchrotron emission.

Finding new MQs candidates is not an easy task. Considerable effort in the past has been put in to increasing their number. The method of looking for such objects in the Galaxy usually includes a number of steps with very restrictive selection criteria for the sources being investigated. Mainly, a number of competing emission mechanisms and several physical parameters should be associated to the same source or system, and they basically include the properties of jet emission and XRB behavior.

Here, we have developed an improved search strategy that is also based on very restrictive, but improved, selection criteria aimed at finding new MQs in the Galaxy.

2. MAIN RESULTS

We performed a positional cross-identification of the NRAO VLA Sky Survey (NVSS) catalog with the Second XMM-*Newton* Serendipitous Source Calalog. The search strategy, sample definition and mail results can be found in Combi et al. (2008). After applying the criteria, we obtained a total of 86 sources with positional coincidence in the NVSS/XMM catalogs at galactic latitudes $|b| \leq 10°$. For the fully coincident sources, whenever possible, we analyzed color-color and hardness ratio diagrams and found that at least 3 of them display high-mass X-ray binary characteristics. A preliminary study of one of them (2XMM J165402.0-394630) is here developed.

[1]Departamento de Física (EPS), Universidad de Jaén, Campus Las Lagunillas s/n, Ed-A3, (23071) Jaén, Spain (jcombi@ujaen.es).

[2]Centro Universitario Regional Zona Atlántica (CURZA), Universidad Nacional del COMAHUE, Monseñor Esandi y Ayacucho (8500), Viedma (Rio Negro), Argentina.

[3]Osservatorio Astronomico di Palermo, Piazza del Parlamento 1, Palermo (90141), Italy.

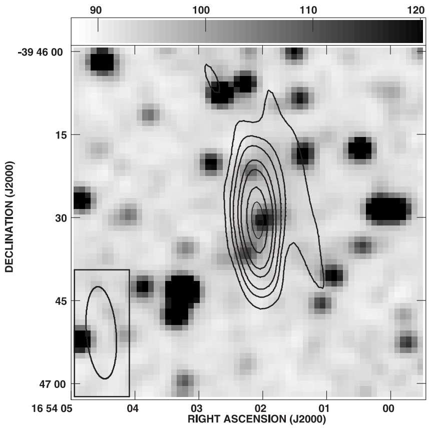

Fig. 1. Map of NVSS J165402−394630 obtained with the VLA in B configuration at 20 cm, superposed to the proposed 2MASS near infrared counterpart.

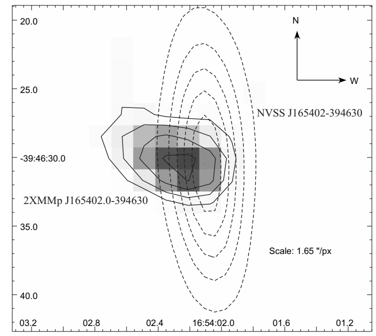

Fig. 2. The source 2XMM J165402.0-394630 in the 0.5–10 kev energies as it appears in the MOS1 camera. Radio contours (dashed lines) are overploted.

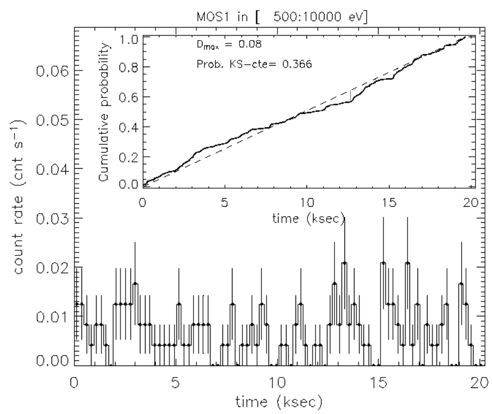

Fig. 3. X-ray light curve of 2XMM J165402.0-394630 in the 0.5–10 keV during the first 20 ksec of the observation.

2.1. *The case of 2XMM J165402.0-394630*

We present in Figure 1 the map of NVSS J165402−394630 at 20cm, superposed to the proposed 2MASS near infrared counterpart. It is remarkable as the radio peak is clearly coincident with the 2MASS source. For this source we have two independent radio detections, NVSS and VLA observations. In both radio data the sources display point-like morphologies, thus it is possible to compare if there exist hints of variability in the radio flux. In the case of the NVSS observations, the radio flux obtained is 5.8±0.6 mJy and in the VLA data of 0.57±0.04 mJy. Therefore, the source shows clear hints of variability in its radio emission of about one order of magnitud.

A spectral index was computed by using data at 6 and 20 cm. As a result, a negative spectral index value was found, indicating that the radio source is of non-thermal (i.e. synchrotron) origin. The radio spectrum is well fitted by a simple power law $S_\nu = (0.71 \pm 0.03 \text{ mJy}) \ (\nu/\text{GHz})^{-0.57\pm0.02}$.

Regarding to X-ray observations, we have also analyzed spatial, spectral and time properties of the source 2XMM J165402-394630. In Figure 2 we present an image of the source in the 0.5–10 kev energies, such as it appears in the MOS1 camera. Radio contours (dashed lines) are overploted showing that both emission are spatially well correlated (offset ∼1.5 arcsec), inside the error.

In Figure 3, we show the background corrected light-curve of 2XMM J165402-394630. We confirm that the source remains constant in time during the analysis of the 20 ksec. These last results show evidently that the source is in a quiescent X-ray state.

3. CONCLUSIONS

In this work we report a short description of the strategy used to found new MQs candidate and a multiwavelength study of the HMXB candidate 2XMMp J165402.0-394630. Re-analysing radio VLA, infrared, and XMM-*Newton* data, we found that the source have properties similar to some well-know MQs. Unfortunatelly, the existing radio and XMM data are not sufficient to allow us confirm the MQ nature of the object. Nevertheless, this study would be taken as a first step in the deep searching for new MQs candidates in the Galaxy. Further infrared spectroscopy as well as radio/X-ray simultaneous observations, allow confirm or reject the MQ nature of the source.

REFERENCES

Albert, J., et al. 2007, ApJ, 665, L51

Combi, J. A., Albacete Colombo, J. F., & Martí, J. 2008, A&A, 477, 125

Mirabel, I. F., & Rodríguez, L. F. 1994, Nature, 371, 46

_________. 1999, ARA&A, 37, 409