OGLE BLAZARS BEHIND MAGELLANIC CLOUDS

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ABSTRACT

Blazars are extragalactic objects which emit the electromagnetic spectrum in a wide range: from radio to TeV-gamma rays. Blazars have a non-thermal continuum in the entire range of the electromagnetic radiation and observed maximum of emission is located in the range between GeV and TeV. Hence one can conclude that blazars are the most energetic emitters in the observed Universe. The identification of our blazar candidates was based on the *Quasars behind the Magellanic Clouds* catalogue produced by the OGLE experiment. The list contains 758 quasars. Our procedure of candidate selection was divided into three parts based on object type and availability of the multiwavelength data from the OGLE experiment and other astronomical databases. Selection of the sample was performed using a radio and optical positions and a cross-matching procedure. The positions of the blazar candidates in the LMC/SMC region were, in a further step, cross-matched using the CRATES and the FERMI catalogues. Most of our candidates are newly detected blazars.

INTRODUCTION

Blazars are a subclass of Active Galactic Nuclei (AGNs), which are emitting in the entire range of the electromagnetic spectrum. The characteristic features of these objects are as follows: high and variable degree of polarization, flat radio spectrum, steep spectrum in the infrared domain, and weak spectral emission lines or their total absence (Massaro et al. 2011). In general, blazars are divided into two groups: BL Lacertae (BL Lac) objects and Flat Spectrum Radio Quasars (FSRQ).

METHODS

The blazar candidates were selected from the catalogue of quasars (Kozłowski et al. 2013) and the list of "featureless objects" using the radio and optical positioning (a), the cross-matching procedure (b), and the parameters examination of identified objects (c). The *Quasars behind the Magellanic Clouds* catalogue was produced by the OGLE team and it contains 758 confirmed quasars. The list of "featureless objects" consists of rejected sources and it is a result of a process of catalogue creation.

(a) In the first step, the positions of selected quasars from the OGLE catalogue and objects from the "featureless spectra" list were checked with positions from two radio catalogues: SUMSS at 0.84 GHz and ATCA at 4.8 and 8.6 GHz.

(b) The cross-matching procedure was based on archival data from four sky surveys: SUMSS (Murphy et al. 2007) at 0.84 GHz, AT20G (Murphy et al. 2010) at 5, 8, and 20 GHz, ATPMN (McConnell et al. 2012) at 4.8 and 8.6 GHz and PMN (Condon et al. 1993) at 4.85 GHz.

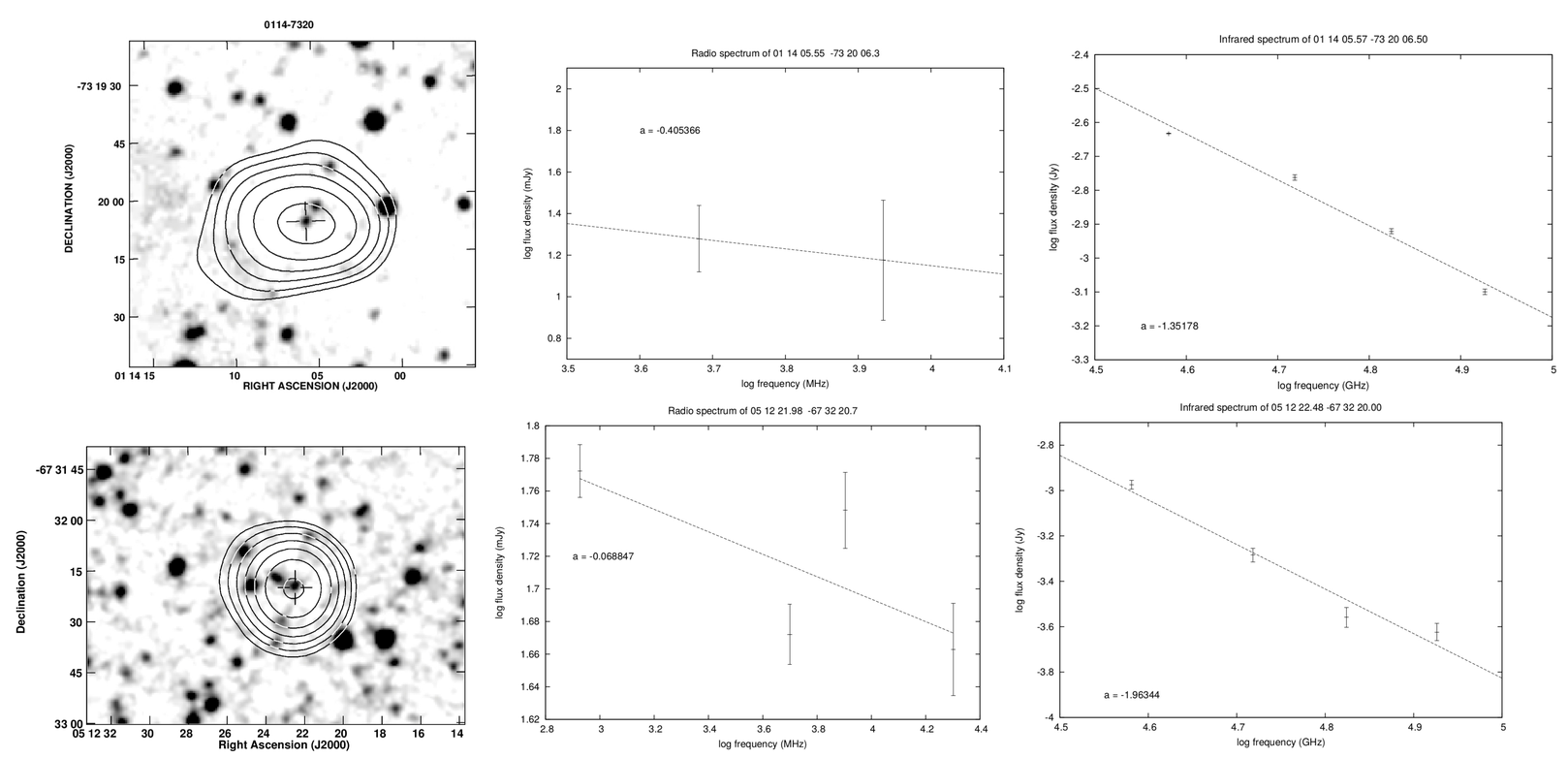
(c) The examination of selected objects was based on calculation of three parameters: radio loudness (R), radio spectral indexes (a_r), and mid-infrared spectral indexes (a_{IR}). Radio and optical data for calculating two first parameters were taken from earlier mentioned catalogues. Mid-infrared data was produced by IRAC and MIPS instruments onboard the Spitzer Space Telescope. The sources were observed at 3.6, 4.5, 5.8, and 8.0 microns.

RESULTS

As a result of the positioning and cross-matching procedures two lists of blazar candidates were produced. The first list of the FSRQ type blazars is based on the quasar catalogue and consists of 27 objects. The second list of BL Lac type blazar was obtained from the list of "featureless objects" and consists of 20 Bl Lac type blazar candidates.

The radio spectra and indices were prepared for the selected objects, which have been found in more than one radio catalogue or for which at least two data points in different frequencies were known in the available astronomical databases.

The mid-infrared spectra and the indexes were calculated for all objects from both lists of blazars candidates.



Radio and optical maps (left panel), radio spectra (middle panel), and mid-infrared spectra (right panel) of two blazar candidates: 0114-7320 (top panel) and 0512-6732 (bottom panel). The maps were created from DSS-R band optical images (greys) and 8.6 GHz ATPMN radio data (contours). A black cross marks the OGLE position of the blazar candidate.

Moreover, the positions of known blazars in the LMC/SMC region were cross-matched using the CRATES (Healey et al. 2007) and the FERMI (Nolan et al. 2012) catalogues. Only two sources from our list of the FSRQ type blazar candidates and another two from the list of the BL Lac type blazar candidates were found in CRATES catalogue. The remaining 25 FSRQ type and 18 BL Lac type sources are newly detected blazar candidates. Any of our blazar candidates were found in the FERMI catalogue.

CONCLUSIONS AND FURTHER WORK

The sample of objects consists of 43 newly detected blazar candidates. Some of them possess sets of archival data from radio to X-rays. We are going to use this data to calculate and model the spectral energy distribution (SED) of each individual object in the sample.

We are planning to apply for polarimetric observations of identified objects to confirm their nature.

We are also going to examine more archival radio data at different frequencies to obtain thick radio spectra of the objects.

The last goal is to study light curves of all selected blazar candidates at optical wavelength.

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