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INFRARED COMPOSITION OF THE LARGE MAGELLANIC CLOUD

M. SIUDEK[1], A. POLLO[1,2,3], T. T. TAKEUCHI[4], Y. ITA[5], D. KATO[6], AND T. ONAKA[7]
[1]Centre for Theoretical Physics of the Polish Academy of Sciences, Al. Lotnikow 32/46, 02-668 Warsaw, Poland
[2]Astronomical Observatory of the Jagiellonian University, Orla 171, 30-001 Cracow, Poland
[3]National Centre for Nuclear Research, Hoza 69, 00-681 Warsaw, Poland
[4]Division of Particle and Astrophysical Science, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8602, Japan
[5]Astronomical Institute, Tohoku University, 6-3 Aramaki Aoba, Aoba-ku, Sendai, Miyagi 980-8578, Japan
[6]Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency, 3-1-1 Yoshino-dai, Chuo-ku, Sagamihara, Kanagawa 252-5210, Japan
[7]Department of Astronomy, The University of Tokyo, Bunkyo-ku, Tokyo 113-0033, Japan
E-mail: malgorzata.siudek@poczta.fuw.edu.pl
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ABSTRACT

Understanding the birth and evolution of galaxies, and the history of star formation in them, is one of the most important problems in astronomy. Using the data from the AKARI IRC survey of the Large Magellanic Cloud at 3.2, 7, 11, 15, and 24 μm, we have constructed a multi-wavelength catalog containing data from the cross-correlation with a number of other databases at different wavelengths. We present the first approach with a Support Vector Machine (SVM)-based method to separate different classes of stars in LMC in the color-color and color-magnitude diagrams.

Key words: Large Magellanic Cloud; sky surveys; infrared; AKARI

1. INTRODUCTION

AKARI observed an area of 10 deg^2 of the Large Magellanic Cloud (LMC) using the Infrared Camera (IRC) at wavelengths of 3.2 μm (*N3*), 7.0 μm (*S7*), 11.0 μm (*S11*), 15.0 μm (*L15*), 24.0 μm (*L24*). For our first analysis, from the Release Candidate version 1 of the AKARI LMC Large Area Survey point source catalog (Ita et al., 2008) we selected sources (3,852) detected at all NIR and MIR wavelengths of: 3.2, 7.0, 11.0, 15.0, and 24.0 μm, i. e. with complete five-band color information.

In order to identify and classify these sources, we searched for their counterparts in public databases at different wavelengths: 2MASS, NED, SIMBAD, AKARI FIS All-Sky Survey, and OGLE. We cross-correlated our sources with these catalogs using a positional tolerance of 3.0 arcsec, extended to 20 arcsec for the cross-correlation only for the AKARI-FIS data. Counterparts were found for $\simeq$ 75% of the sample. The majority ($\sim$ 70%) of identified sources are AGB stars and similar evolved giants.

2. COLOR-MAGNITUDE DIAGRAMS

In all color-magnitude diagrams, different types of sources are well separated, especially, there is a prominent separation between (1) a group consisting of multiple stellar systems, Asymptotic Giant Branch (AGB) stars, other late-type pulsating giants, foreground objects and (2) a group including Young Stellar Objects (YSOs), post-AGB stars and background objects (Fig. 1).

We made an atttempt to classify non-identified sources using Support Vector Machine (SVM) (Chang & Lin, 2011). For our data, a binary classification was performed using non-linear Support Vector Classification (SVC) with a radial basis function (RBF) kernel. SVM was trained on identified sources. We used three well separated groups: (1) multiple stellar objects, (2)

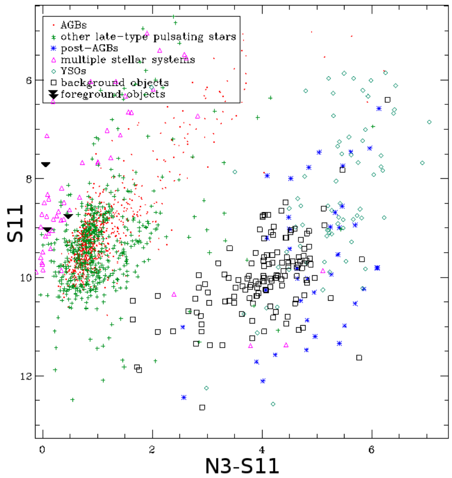

Fig. 1. Positions of different types of objects in the color-magnitude diagram *N3 – S11* vs. *S11*.

AGB stars, and (3) YSOs and post-AGBs (Table 1). The obtained separation conditions of different groups of objects were then used to classify unknown sources using a diagram *N3 – S11* vs. *S11* (Fig. 2).

Sources without a counterpart can be stars invisible due to a large amount of surrounding dust. Such sources should be further investigated. Here we present the first attempt to determine their type. From our first SVM-based analysis, a majority of these sources might be post-AGBs and YSOs. We show that the SVM-based method, applied to color-magnitude diagrams, is useful to classify IR sources and search for new candidates for post-AGBs and YSOs.

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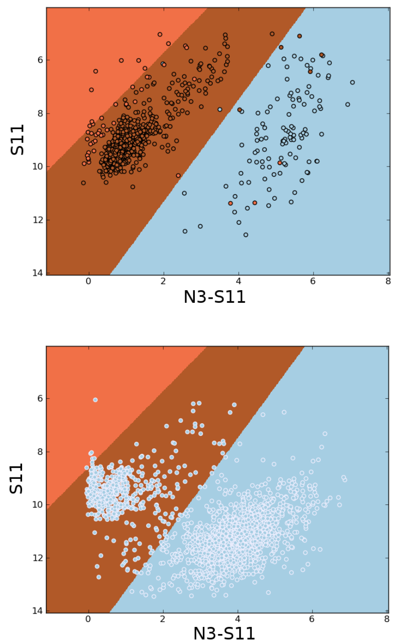

Fig. 2. Color-magnitude diagram N3 – *S11* vs. *S11*. Upper panel: sources identified as multiple stellar objects (red), AGBs (brown), post-AGBs and YSOs (blue). Lower panel: unidentified sources and their SVM-based classification. Most of not identified sources are probably post-AGBs and YSOs.

TABLE 1.

I. Sample Used to Train SVM

Group of objects	No of sources	%
(1) Multiple stellar systems	49	5
(2) AGB stars	828	84
(3) Post-AGBs and YSOs	110	11

II. Classification of Unidentified Sources

Group of objects	No of sources	%
(1) Multiple stellar systems	7	0.4
(2) AGB stars	546	29
(3) Post-AGBs and YSOs	1335	71

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