Identification of ultracool dwarfs in J-PLUS DR2 using Virtual Observatory tools and machine learning techniques.

P. Mas-Buitrago[1,2], E. Solano[1,2], and A. González-Marcos[3]

[1] Centro de Astrobiología (CAB), CSIC-INTA, Camino Bajo del Castillo s/n, 28692, Villanueva de la Cañada, Madrid, Spain
[2] Spanish Virtual Observatory
[3] Departamento de Ingeniería Mecánica, Universidad de la Rioja, c/ San José de Calasanz 31, 26004 Logroño, La Rioja, Spain

Abstract

We present the search for ultracool dwarfs (UCDs, spectral types later than M7 V) performed across the entire Javalambre Photometric Local Universe Survey (J-PLUS) second data release ($2\,176\,\mathrm{deg}^2$) following a Virtual Observatory methodology. We also explored the ability to reproduce this search with a purely machine learning (ML)-based methodology that relies solely on J-PLUS photometry. We followed three different approaches based on parallaxes, proper motions, and colours, respectively, using the VOSA tool to estimate the effective temperatures. For the ML methodology, we built a two-step method based on principal component analysis and support vector machine algorithms. We identified a total of $7\,827$ new candidate UCDs, which represents an increase of about $135\,\%$ in the number of UCDs reported in the sky coverage of the J-PLUS second data release. With the ML approach, we obtained a recall score of $92\,\%$ and $91\,\%$ in the $20\times20\,\mathrm{deg}^2$ regions used for testing and blind testing, respectively. We consolidated the proposed search methodology for UCDs, which will be used in deeper and larger upcoming surveys such as J-PAS and Euclid. We concluded that the ML methodology is more efficient in the sense that it allows for a larger number of true negatives to be discarded prior to analysis with VOSA, although it is more photometrically restrictive.

My poster is available at https://zenodo.org/record/7018654#.Y4dCxdLMJFF