Pažangi karštųjų nykštukių klasifikacija naudojant Gaia DR3 ir dirbtinį intelektą

Advanced Classification of Hot Subdwarfs: a Gaia DR3 and AI Approach

Carlos Viscasillas Vázquez[1], Enrique Solano[2], Ana Ulla Miguel[3], Marco Antonio Álvarez González[4], Raúl Santoveña Gómez[4], Minia Manteiga Outeiro[4], José Carlos Dafonte Vázquez[4], Esther Pérez Fernández[3], Carlos Rodrigo[2], Alba Aller[2], Raquel Oreiro[3].

[1]Institute of Theoretical Physics and Astronomy, Vilnius University, Sauletekio av. 3, 10257 Vilnius, Lithuania
[2]Centro de Astrobiología (CSIC-INTA), Camino Bajo del Castillo s/n, E-28692 Villanueva de la Cañada, Madrid, Spain
[3]IFCAE -- Universidade de Vigo (UVIGO), Campus Lagoas-Marcosende, s/n, 36310 Vigo, Spain
[4] CIGUS CITIC - University of A Coruña, Campus Elviña s/n, A Coruña, 15071, Spain
[5]CIGUS CITIC - University of A Coruña, Paseo de Ronda 51, A Coruña, 15011, Spain

carlos.viscasillas@ff.vu.lt

Hot subdwarf stars (hot sds) are compact blue evolved objects, burning He in their cores surrounded by a thiny H envelope. In the H-R Diagram they are located by the blue end of the Horizontal Branch, near the so-called Extended Horizontal Branch. Besides, most models agree on a quite probable common envelope binary evolution scenario in the Red Giant (RG) phase, because it is virtually impossible for a single RG to lose so much of its total mass by its own. However, the actual current binarity rate for this class of objects is a yet unsolved, but key question in this field. We conduct an in-depth analysis of hot sds classification utilizing the dataset provided by [1] and with a dual purpose: to further our comprehension of the evolutionary processes underlying hot subdwarf stars and to augment our insights into binary systems belonging to this stellar category. Our analysis incorporates the use of the recently released Gaia DR3 data, with a particular focus on the processing of BP/RP spectra through state-of-the-art artificial intelligence (AI) techniques. These techniques include Self-Organizing Maps (SOMs) and specialized software tools, to build up on previous hot sds uncovering via Virtual Observatory techniques ([2], [3]).

We have now worked with hot sd catalogues by [4] (with about 6,000 confirmed objetcs) and [5] (about 39,000 candidates). We selected training samples from [1] and [6] and then applied to a larger catalog of over 39,000 blue candidates from [5]. Techniques such as supervised ML and probabilistic color-magnitude approaches were utilized to classify binary systems (Figure 1). At this point, we compute a single-binary frontier and probability of belonging to each class using Support Vector Machines (SVMs) [7]. For a SOM classification, we worked with GDR3 BP/RP spectra of 2815 objects out of the [4] catalogue. The result is plotted in Figure 2, with the aid of the Gaia Utility for the Analysis of self-organizing maps (GUASOM) [8]. For comparison, we also used a 'cosine similarity' measure to check the spectra of a well-defined subsample of 35 binaries from [1] and 53 single stars from [6]. Preliminary results from the application of this methods show promising outcomes.

Key words: binary hot subdwarfs, virtual observatory, artificial intelligence.

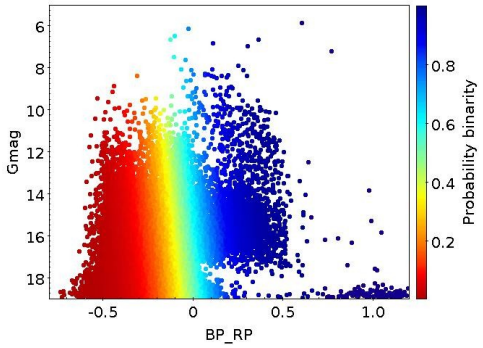

Figure 1. Colour-magnitude diagram color coded by probability of being binary.

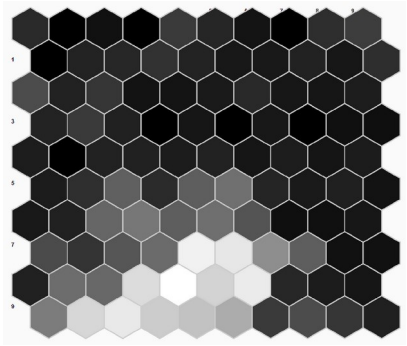

Figure 2. SOM classification of 2815 objets from GDR3.

Acknowledgments
This abstract is framed within a MW-Gaia Cost Short-Term Scientific Mission (STSM), as a collaborative effort between members from the Galician Group for the Gaia Satellite (GGG), in conjunction with partners from the Gaia DPAC consortium, the Spanish Virtual Observatory (SVO), and the Vilnius University (presenter author).

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