# Taxonomy of extrasolar systems

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## Introduction

We present the guidelines for an extrasolar system taxonomy. When working with an extra-solar planet database, it is very useful to have a taxonomy scale (classification). The taxonomy has to be easily interpreted and present the most relevant information about extrasolar systems. We propose the extrasolar system taxonomy scale with five parameters.

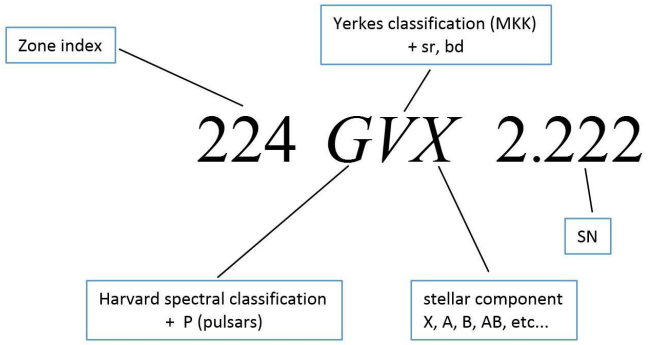



***Figure 1***. Schematic explanation – a definition of the taxanomy of extrasolar systems for the Solar system.

## Zone index ZI

We can divide the area around stars into three main parts - the hot zone, the habitable zone and the cold zone. This index describes the number of exoplanets in each zone. That's why we determine the weight $s_1$ = 100 for hot zone, $s_2$ = 10 for the conservative habitable zone and $s_3$ = 1 for the cold zone. We can calculate the Zone index ZI in the form

$$\mathrm{ZI} = \sum_{j=1}^{3} s_j k_j,$$

where $k_1$ is the number of exoplanets in hot zone, $k_2$ the number of exoplanets in conservative habitable zone, $k_3$ the number of exoplanets in cold zone. For example, the Solar System has the Zone index ZI = 224 and 55 Cancri system has Zone index ZI = 311.

## Spectral classes of extrasolar systems

The mother stars of extrasolar planets are spectral classes O, B, A, F, G, K, M and pulsars. The *second parameter* concerns Harvard spectral classification and shows e.g. the colour and temperature of the mother star. For example, for the Sun it is *G,* for 55 CnC it is *K* and for pulsar it is *P*.

## Dynamical classes of extrasolar systems

For the origin of a planetary system, the size of the mother star is very important. The *third parameter* is a value from Yerkers spectral classification (MKK system), which describes the size of the mother star (e.g. *III* are giants, *IV* are subgiants, *V* - main-sequence stars).

## Stellar components in extrasolar system

It is fundamentally important to establish if the mother star is a single star or if it is a member of a binary or multiple stellar system. This would greatly influence the origin of a given planetary system. *The fourth parameter* is the symbol of the stellar component (A,B,C …). For a single star we used *X* and for circumbinary systems we use its symbol (*AB*, *BC*, etc.).

## System number SN

We can classify exoplanets according to their mass and radius. Most of the mass boundaries were selected for physical reasons but they are not hard-limits and could be refined. A simpler solution is to apply a mass code that defines a physically motivated mass range. The one mass order could have physical sense for change the physical properties of planets and exoplanets.

***Table 1***. Description of the proposed classification of planets based on the mass.

| Class | Mass (Jupiter Units $M_J$) | Mass [kg] | $w_i$ |
|---|---|---|---|
| C | $\leq 0.00015$ | $\leq 3 \times 10^{23}$ | 0.00001 |
| M | $0.00015 - 0.0015$ | $3 \times 10^{23}$ - $3 \times 10^{24}$ | 0.0001 |
| E | $0.0015 - 0.015$ | $3 \times 10^{24}$ - $3 \times 10^{25}$ | 0.001 |
| N | $0.015 - 0.15$ | $3 \times 10^{25}$ - $3 \times 10^{26}$ | 0.01 |
| J | $0.15 - 1.5$ | $3 \times 10^{26}$ - $3 \times 10^{27}$ | 1 |
| S | $1.5 - 12$ | $3 \times 10^{27}$ - $2.3 \times 10^{28}$ | 10 |
| D | $\geq 12$ | $\geq 2.3 \times 10^{28}$ | – – |

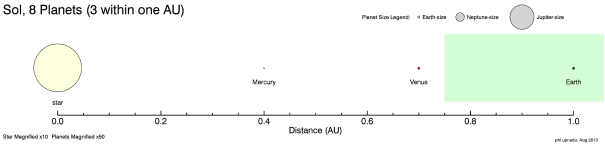
We can calculate the system number SN in the form

$$\mathrm{SN} = \sum_{i=1}^{6} w_i n_i$$

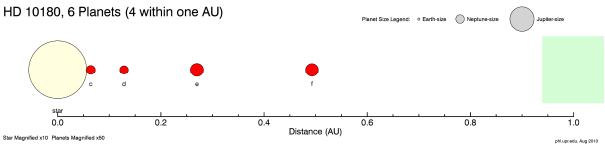
where $n_1$ is the number of exoplanets in S class, $n_2$ the number of exoplanets in J class, $n_3$ the number of exoplanets in N class, $n_4$ the number of exoplanets for E class, $n_5$ the number of exoplanets in M class and $n_6$ the number of exoplanets in C class and real weights $w_i$. For example, the Solar System has SN = 2.222 and 55 CnC has SN = 13.1.

## How it works?

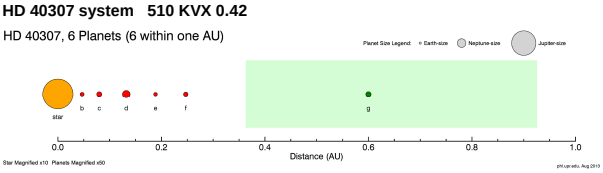
**Solar system 224 GVX 2.222**




**HD 10180 system 411 GVX 1.5**




**HD 40307 system 510 KVX 0.42**




## Conclusions

We have endeavored to build a taxonomy scale for extrasolar systems. This taxonomy could be used as a quick and easy mechanism to determine the main attributes for an extrasolar system and allows for a quick and clear comparison of large numbers of extrasolar systems.

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