ExoplAn3T, the Novel Tool for Exosystems Studies. A. Zinzi[1,2], D. Turrini[3], E. Alei[4,5], F. Verrecchia[1,6], [1]ASI – Space Science Data Center, Via del Politecnico snc, 00133, Rome, Italy, angelo.zinzi@ssdc.asi.it, [2]Agenzia Spaziale Italiana, [3]INAF-IAPS, [4]ETH Zurich, Institute for Particle Physics and Astrophysics, [5]INAF-OAPD, [6]INAF-OAR

Introduction: ExoplAn3T (Exoplanet Analysis and 3D visualization Tool – https:/tools.ssdc.asi.it/exoplanet) is the SSDC scientific webtool designed to provide a unified and intuitive interface to access to multiple on-line exoplanet catalogues (i.e., NASA Exoplanetary Archive [1], The Extrasolar Planet Encyclopedia [2] and ExoMerCat [3]). ExoplAn3T interface is designed and optimized for the study of exoplanetary systems as global entities, while still allowing to extract information on individual planets.

When queried, ExoplAn3T applies a two-step procedure: the first one is the "planetary query", aimed at finding exoplanets having the characteristics required by the user; the second one is made up of a series of "system queries" (one query for every exosystem found in the first step) looking for all the planets belonging to each exosystem in which the exoplanets of the "planetary query" are found.

Furthermore, ExoplAn3T offers, the possibility of visualizing the systems in an interactive 3D mode, making it an ideal tool to visually compare different exosystems and explore architectural differences and similarities as those revealed by the Kepler and K2 datasets [4].

Tool capabilities: Up to now scientific users could generally search for planetary features in public tools using their individual interfaces. Because of their different design, extracting the same information from all databases could easily prove difficult and time consuming. Furthermore, with the exception of the recently updated NASA Exoplanet Archive, users were limited to retrieve as output a list of individual exoplanets sharing some characteristics.

ExoplAn3T offers instead the possibility to easily search for exosystems including similar planets: this capability could be valuable in studies pointing at finding a classification of exosystems [5, 6]. To further increase this capability we are currently working towards adding the computation of the NAMD (Normalized Angular Momentum Deficit) parameter described by [6], a unified measure of the global dynamical excitation of planetary systems only recently applied to exoplanetary studies.

ExoplAn3T produces different outputs (tabular results, 3D visualization, 2D plot). It is initialized by a web interface designed to allow for intuitively building complex queries in a transparent way and without any prior knowledge of the specific details and behavior of each queried database.

Example use case: Using the definition of "Conservative Habitable Zone" as found in [7], a query to the NASA Exoplanet Archive can be submitted imposing stellar effective temperature between 5500 and 6000 K, semi-major axis between 0.75 and 1.8 au and requiring a system with at least 3 planets, looking for systems with "habitable planets".

Two of the six systems thus found (HD-34445 and HD-10180) have 6 planets and, by visually comparing them by means of the default 3D view of ExoplAn3T (Fig. 1), these systems appear to be rather different, as the orbits of the outermost planet in the first one is almost a factor of two wider than that of the second one (6.36 and 3.38 au, respectively).

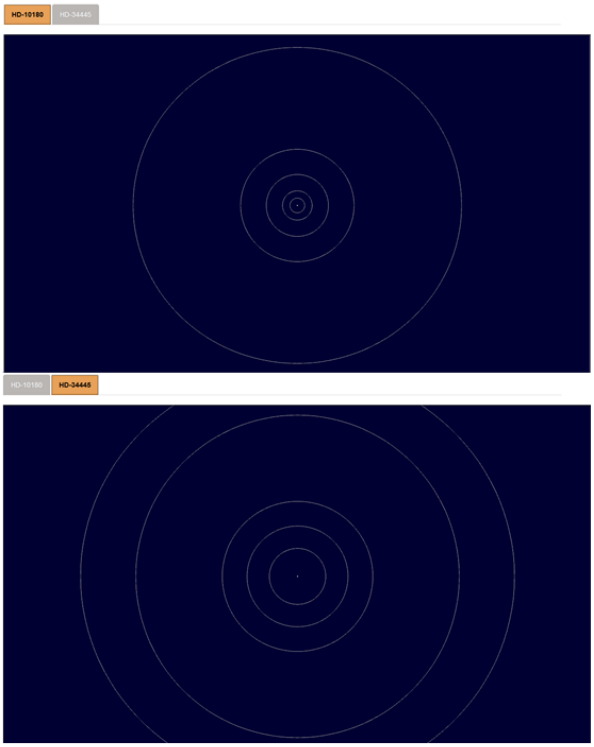

Figure 1: The two systems examined in the presented use case HD-10180, top, and HD-34445, bottom, as viewed by meas of ExoplAn3T.

However, the habitable planets of these systems are similarly located in their outer regions, and both systems host another inner planet just out of the habitable zone semi-axis range.

Conclusions and future works: ExoplAn3T is a tool designed to explore exosystem datasets, allowing researchers to shift their attention from the individual

exoplanets to the exosystems seen as global entities, and providing the possibility of querying using multiple archives.

In the future, the addition of the NAMD computation will further characterize the tool, making it more straightforward to take into account the orbital excitation and the probability of impacts, providing information on the history and evolution of the system both as stand-alone system and in comparison with other well-characterized systems as Trappist 1 and the Solar System [8].

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