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Citizen Science and the Virtual Observatory with college students: Characterization of exoplanets

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Abstract. The Citizen Science Astronomy (CSA) as a collaboration of scientists, software developers and educators, is an excellent project to motivate college students to pursuing a scientific career. As an introduction to the citizen science project, we teach in our astronomy classes simple ways to study and analyze astronomical objects. We are trying to combine the CSA with the Virtual observatory. Many students are not pursuing STEM degrees, so we hope to approach, have access to interact and talk with scientist, it can motivate them to give more financial support to science projects in later in their future careers. Here we present the results of an exercise done for college students using the CSA and the Virtual Observatory towards the characterization of exoplanets.

Keywords. methods: data analysis, catalogs, Facilities: Kepler Mission

1. Introduction

The Citizen Science Astronomy (CSA) is an excellent project to motivate college students to become a scientist in their lifetimes. We combine the CSA with the tools of the Virtual observatory with College student from STEM as well with students who are not pursuing STEM degrees to analyze the information from the catalog published in 2014 about the exoplanets observed during the Kepler mission. The Kepler spacecraft mission launched in March 2009 according to the Kepler science web page. The objectives for our students are learn how to find scientific information, analyze the information with tables and graphics representations, then compare the exoplanets with planets in our star system. They will also compare the stars associated to the exoplanets they are studying with the star we orbit around of on Earth. The students lastly generated a report type of paper om their analysis.We motivate the students with this activity and they feel like young but real astronomers during 2 days in lab class.

2. Methods

In order to get familiar with the tools from the virtual observatory, the students watched a video on youtube (Virtual Observatory Tools for Astronomers) that I showed them. The first thing that they learned was how to search for the information of the objects in SIMBAD and catalogs with VizieR. The students use a catalog published by Rowe (2014), and as tool for graphics we use Excel because our institution does not accept the installation of Topcat. The students used as example the paper of Villicaña-Pedraza (2017) for their report.

3. Results, Discussion and Conclusions

The students created tables in Excel with information of the Temperature (T_{eff}) and the Radius of the stars from the catalog. Also they did a second table with information of the exoplanets associated to that stars including the period and the radius of the planets. Using the table of exoplanets they did a plot of Period versus radius (Fig. 1). Then the students compared the information of the stars that were analyzed with the star that we orbit, as well as the information of the exoplanets in the plot compared with the planets of our Solar System. Finally, they discuss the differences among these astronomical objects and the classification of that exoplanets compared with the planets in our System using the NASA, JPL, and the exoplanetary Ipac Caltech web pages. Some of the results from the students are presented here. It is important to study and learn the characterization of the Exoplanets so we can compare them to Earth or any other planet in our solar system, study them can help us to survive in the future. Kepler 65 is a star slightly more massive than the sun and has at least three planets named c, b and d. It is 1.4 solar radius large with temperature of 6169 K. Kepler 65-c is 2.57 earth radius large and it can be classified as Neptune size. Kepler 65-b has a earth radius of 1.53 and it can be classified as Super-Earth size which is similar to Kepler 65-d. The star Kepler-101 has a mass of 1.12(M_{Sun}) and a radius of 1.66 (R_{Sun}), so it is like our sun, just a bit bigger. Kepler-101b is a Jovian planet classified as a sub Jupiter class and it is best described as a super hot Neptune. It has an incredibly short orbit of 3.49 days around its parent star. Its a bit bigger than Neptune, but unlike any planets in our system, it is a Jovian planet very close to its parent star. Kepler-101c is a super earth class planet lies in an orbit that takes it 6.03 days to make a full trip around, so it lies further outside than than Kepler-101b, but is still very close to its star. This system only has those two known planets, compared to our solar system, in contrast Jovian planets lie in the outer solar system with terrestrial planets in the inner solar system, their orbits would both lie inside Mercurys orbit, which is about 18 times longer than orbit of Kepler-101-c.

References

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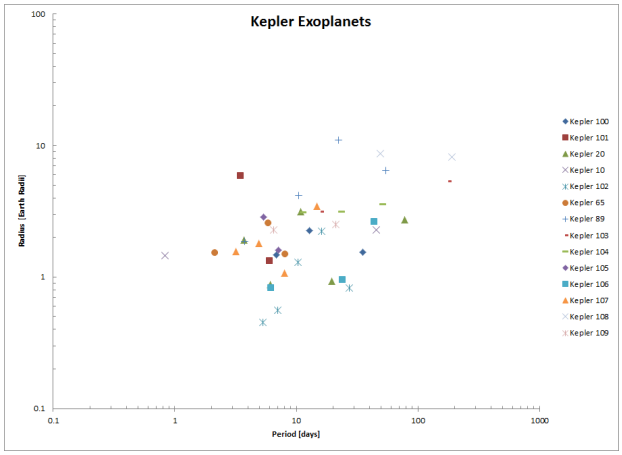

Figure 1. Plot sample of results from students about exoplanets studied in this work.