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VOSA: A VO Spectral Energy Distribution Analyzer

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Abstract. The advent of new and more sensitive surveys providing photometry at many wavelength ranges and covering large sky areas (GALEX, SDSS, 2MASS, UKIDSS, AKARI, WISE, VISTA...) is pushing astronomy towards a change of paradigm where small groups, and not only large consortia, need to analyze large multi-wavelength data sets as part of their everyday work. In this context, the Virtual Observatory (VO), as a common frame to exchange not only observational data but also theoretical models, plays a very important role.
VOSA (VO Sed Analyzer) is a public web-tool developed by the Spanish Virtual Observatory (`http://svo.cab.inta-csic.es`) and designed to help users to (1) build objects SEDs combining user data with photometry from VO services, (2) analyze them comparing observed photometry with synthetic photometry from theoretical models or observational templates, using different techniques (chi-square fit, Bayesian analysis) and thus (3) estimate physical parameters for the observed objects. VOSA is in operation since 2008 (Bayo et al. 2008).

1. Introduction

VOSA (VO Sed Analyzer) is a public web-tool developed by the Spanish Virtual Observatory, [1] and designed to help astronomers to build and analyze Spectral Energy Distributions (SEDs) for many objects at the same time (tested for ~2000 objects), combining user inputs with Virtual Observatory data.

VOSA offers different workflows for stars (and brown dwarfs) and galaxies given that the physics involved is different in many aspects and, thus, the relevant VO catalogues, theoretical models, etc are also different.

VOSA is in operation since 2008 (Bayo et al. 2008) although several important improvements have been done since then and will be done in the future (mostly taking into account user requests). It has proved to be a useful tool with more than 200 users

[1]`http://svo.cab.inta-csic.es`

analyzing more than 165.000 objects (only last year) and around 33 published papers making use of VOSA.

2. Build objects SEDs

The first step in the workflow is uploading a user file with a list of objects to be studied. This can be done in a special VOSA format or uploading and transforming an ascii or VOtable file. This file can contain different levels of information, from just object names to, optionally, photometry tables provided by the user and can include extinction and distance information together with specific options that will affect some VOSA operations.

All this information can be completed searching in VO services able to provide name resolution, distance information and extinction properties.

VOSA also allows to search in (right now) more than 20 VO photometry catalogues so that any obained information is added to user inputs to build the SED.

Once the SED is built VOSA makes a preliminary estimation of the presence of infrared excess so that points with infrared excess are not used when the SED is analyzed using stellar models.

Then the user has the posibility of visualizing the final SED and adjusting each SED manually: changing excess, excluding SED points due to blue/UV excess, deleting points, marking points to be upper limits and no real photometry points, etc. Some of these options can be applied together to all the objects in the file if desired.

3. Analyze objects SEDs

VOSA offers several options to analyze the objects SEDs.

First, observed photometry is compared to synthetic photometry for different collections of theoretical models in two different ways: chi-square fit and bayesian analysis. Chi-square fit provide the best fit model and thus an estimation of the stellar parameters (temperature, gravity, metallicity or other parameters offered by the particular model). The bayesian analysis provides, not only the best fit value for each parameter but an estimation of the probabibility for each possible value. VOSA offers now 25 different collections of models considering different physics.

Simmilar analysis can be done using collections of observational templates and thus getting an estimation of the spectral type of each object.

Once the best fit values for temperature and luminosity have been obtained, it is possible to build an HR diagram using isochrones and evolutionary tracks from VO services and making interpolations to estimate values of the age and mass for each object.

References

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