JWST ETC Source Spectral Energy Distributions

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The JWST Exposure Time Calculator (ETC) offers a series of spectral energy distributions (SEDs) that may be used when building a source. Templates include many flavors of stellar and extragalactic spectra and analytic spectral distributions. A user-supplied spectrum may also be uploaded to the ETC for use in calculations.

Introduction

When creating a new source in the Exposure Time Calculator (ETC), the user may choose to apply a template spectrum for the source's continuum. Many of the commonly used stellar and extragalactic templates have been provided which cover a wide range of observed spectral energy distributions, along with several analytic functions. The available choices for source spectral energy distributions are described below. They are accessed from the "Continuum" tab of the Source Editor pane on the Scenes and Sources page in the ETC. The "Continuum" tab is also where the redshift and extinction parameters may be entered.

Analytic Spectra

Analytic spectral energy distributions include a Flat continuum, Black Body continuum, or Power Law continuum.

Flat

This is a special case of the power law spectrum, where n=0. This distribution is so named because the spectrum has constant (flat line) energy per either wavelength (flam) or frequency (fnu) units.

> ⚠ Please note that countrate calculations use photons per wavelength unit.

Blackbody

The blackbody spectrum is computed at the temperature of the blackbody specified by the user.

Power-law

The flux distribution is given by

$$F(\lambda) = \lambda^n$$

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where *n* is specified by the user. In addition to the form *flam* (wavelength units), or *fnu* (frequency units), the user must choose an integer exponent for the power law.

Stellar Spectra

Stellar template spectral energy distributions include a library of Phoenix stellar models and spectra of HST standard stars.

Phoenix stellar models

The pull-down menu of Phoenix stellar models contains synthetic spectra obtained using the Star, Brown Dwarf, and Planet Simulator. They use static, spherically symmetric, 1D simulations to completely describe the atmospheric emission spectrum. The models account for the formation of molecular bands, such as those of water vapor, methane, or titanium dioxide, solving for the transfer equation over more than 20,000 wavelength points on average, producing synthetic spectra with 2 Angstroms resolution. The line selection is repeated at each iteration of the model until it has converged and the thermal structure obtained. The models here are calculated with a cloud model, valid across the entire parameter range. Each model's name contains a concatenation of the spectral type, effective temperature, and gravity (log g value).

HST stellar spectra

Several HST calibration standard spectra are available. Those provided here are the recommended spectra for the calibrator. These spectra are stored in the Calibration Database System (CDBS) and were originally chosen from the paper *Spectrophotometric Standards from the Far-UV to the Near-IR on the White Dwarf Flux Scale* by Bohlin (1996) and later updated as new data became available. See also *Comparison of White Dwarf Models with ACS Spectrophotometry* by Bohlin et al. (2001). The selection also includes a spectrum of the Sun.

More information, along with a list of the complete set of files, including older versions, can be found in the CALSPEC Calibration Database**.** This page provides a table with the all the available Flux Standards and their CDBS name. In this table the order of preference for the choice of a standard flux distribution is from left to right in the Table, i.e. from the best in column 6 to the last choice with the lowest quality in column 9. In this case, models have higher fidelity and extend to longer wavelength ranges while the more outdated are those derived applying corrections to the original IUE and optical fluxes. Note that for the cases when the CALSPEC data is updated after the ETC software is released, the ETC will not be able to access the most recent files, but only those that were available at the time of the build. If the ETC produces an error when trying to access an HST Standard Star spectrum, review the update history at the bottom of the CALSPEC page

to determine when the spectrum was updated. If it was updated after the current ETC version, you may want to use the previous version of the model, or download the most recent spectrum, and apply it as a user-supplied spectrum.

Each stellar model's spectral type and related identifying information is shown in the pull-down menu listing the star by name. The related information includes the spectral type and V magnitude in parentheses, and wavelength range in Angstroms in brackets.

⚠ The use of spectra that do not fully overlap the wavelength range of the JWST instrument configuration used in a calculation will cause warnings or errors in the calculation. Typically, HST calibration spectra will be useful only for near-IR calculations.

Extragalactic Spectra

Extragalactic template spectral energy distributions include models from Brown et al. (2014). Wavelength coverage for these models spans UV to mid-infrared wavelengths. The atlas includes a broad range of galaxy types, including ellipticals, spirals, merging galaxies, blue compact dwarfs and luminous infrared galaxies.

Related links

JWST Exposure Time Calculator (ETC)

JWST ETC Scenes and Sources Page Overview

JWST ETC Defining a New Source

JWST ETC Defining a New Scene

JWST ETC User Supplied Spectra

Star, Brown Dwarf, and Planet Simulator

Phoenix models README file

http://perso.ens-lyon.fr/france.allard/

CALSPEC Calibration Database

References

go to the on-line JWST Exposure Time Calculator Tool

Brown et al. 2014, ApJS, 212,18
An Atlas of Galaxy Spectral Energy Distributions from the Ultraviolet to the Mid-infrared

Bohlin et al. 1996, AJ, 111, 1743
Spectrophotometric Standards From the Far-UV to the Near-IR on the White Dwarf Flux Scale

Bohlin et al. 2001, AJ, 122, 2118
Spectrophotometric Standards from the Far-Ultraviolet to the Near-Infrared: STIS and NICMOS Fluxes

Pontoppidan, K. M., Pickering, T. E., Laidler, V. G. et al., 2016, *Proc. SPIE* 9910, Observatory Operations:

Strategies, Processes, and Systems VI, 991016 ,
Pandeia: a multi-mission exposure time calculator for
JWST and WFIRST