
fsps-age Documentation

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This project uses FSPS, and python-FSPS to estimate the age of a stellar populations from a photometric SED. The code is available on [github](#).

1.1 Science goal

We check local environment effects on SNIa by looking for correlations between Hubble Residual and the mass weighted average age of the local environment calculated from SDSS Scene Modeling Photometry. We also look at correlations between other variables including SALT2 stretch and color, and host galaxy stellar mass.

1.1.1 Data File Documentation

General Comments

These are the assumptions of the data file formats:

- tab separated values
- **NOT** dust corrected
- **Contains these column names**
 - SNID, u, g, r, i, z, err_u, err_g, err_r, err_i, err_z, redshift, ra, dec
 - ra and dec are assumed to be floats in degrees
 - order is not important

Detailed Data Set Comments

Detailed comments and documentation on each data set file in the `data/` folder.

RA & Dec are in degrees. PetroRad_r is in arcsec. Photometry is in magnitudes.

Main Data

- **`campbell_local.tsv`**
 - An original data set that combines information from `SDSS_Photometric_SNe_Ia.fits` (Campbell) and `SMP-photometry\` (Holtzman). * Hubble residuals ('hr') use the Malmquist bias corrected distances. * It was created via `Collecting Local SN Data.ipynb` with the data cuts in the paper: $z < 0.5$, $\text{sigma_mag} < 1.5 \text{ mag}$, $\text{HR} < 0.7 \text{ mag}$. * $N = 104$
- **`campbell_global.tsv`**
 - The global photometry of the same hosts as `campbell_local.tsv`
 - Retrieval SEDs in the same way as `gupta_global.tsv`.
 - $N = 104$
- **`campbell_formass.csv`**
 - TODO
 - a csv version of `campbell_global.tsv`
 - with `PetroRad_r` column removed

Calibration Data

- **`ellipt_burst_global.tsv`**
 - TODO
 - note really SNID's but rather galaxy number. More details are in the `notes` header
- **`ellipt_burst_local.tsv`**
 - Not needed therefore not there.
- **`gupta_global.tsv`**
 - The objects analyzed in Gupta 2011 but with the same quality cuts I performed on the Campbell/Holtzmann data set.
 - This is the global photometry for the host galaxies of many SDSS-II SN. From DR12 via astroquery 0.3.4, by hand on SkyServer DR13, and Gupta 2011 redshift if none was found before
 - $N = 77$
- **`Gupta11_table2.???`**
 - TODO

`self_consistancy.tsv`

- no need for RA and Dec in this file. Code skips dust correction for this data set.

H₀ analysis

`riess_local.tsv` `riess_global.tsv` `riess_formass.csv`

Others

- Table 7
- Table 8
- Table 9

Folders

- **calibration_sample_lc/**
 - Raw light curves
 - & light curves in the form needed by `sncosmo` and will be analysed by `get_salt_values.py`
- **olddrums/**
 - original version of data folder. Used for much of the development. Was removed on 2018-07-27 for this current system.
- **SDSS - coadded, SDSS - spectra**
 - Not used and are self evident
- **SMP-photometry**
 - “raw” data for from Holtzman scene modeling.

-
- **CampbellHoltzman_formass.csv**
 - This file was used as part of the inputs to `kcorrect`.
 - is a subset of `CampbellHoltzman_global.tsv`
 - It was created via an older copy of `Collecting Local SN Data.ipynb`.
 - **CampbellHoltzman_global.tsv**
 - The global photometry of the same hosts as `CampbellHoltzman.tsv`
 - Retrieval method is the same as `GobalPhotometry-Gupta.tsv`.
 - **circlePhotometry.tsv**
 -
 - **final_mags.txt**
 - Output from Peter’s magnitude calculations.
 - **galaxyPhotometry.tsv**
 - Am I even using this?
 - **GlobalPhotometry-Gupta.tsv**
 - This is the global photometry for the host galaxies of many SDSS-II SN

From DR12 via `astroquery` 0.3.4, by hand on SkyServer DR13, and Gupta 2011 redshift if none was found before *
`Gupta11_table2.txt`

- The ascii version of table 2 from Gupta 2011. Paper has complete citation.
- tsv file is the same, I mean to only use the txt file but I appear to be using the tsv once in this whole setup.

- **Riess2016_calibrators.tsv**

- These are the galaxies used to calibrate the SN M_0 value.
- They are first reported in Table 1 and used for the middle frame in figure 10.
- 101 is M101, 9391 is UGC 9391, and all the rest are NGC objects.
- The redshifts are from Simbad
- The photometry was done by Peter emailed to me on 2018-06-27 with the subject “final mags for cepheid hosts”
- “The uncertainties should be dominated by systematics and not statistical noise given the brightness of these objects. I would say that the relative uncertainty from band to band is 0.03 mag. The over-all uncertainty is larger as a slightly bigger aperture might include more light. But use 0.03 mag and we can inflate the errors on the mass.” – Peter
- Some objects are outside of SDSS footprint, but sadly PanSTARS did not observe in the u band:

```
“” 1365 0.005476 0.00001 1448 0.003895 2442 0.004846 4038 0.005593 5917 0.006472 “” *
Riess2016_calibrators_local.tsv
```

- Same as `Riess2016_calibrators.tsv` but for 1.5kpc radii apertures around the location of their SN.

- **Riess2016_formass.csv**

- same as `Riess2016_calibrators.tsv` but saved as a csv rather than tsv.
- except that these “redshifts” are derived from the median NED cepheid distance and assuming a $H_0 = 73.8$ km/s/Mpc as fit by Campbell 2013 and used throughout this paper.

- **SDSS_Photometric_SNe_Ia.fits**

- This is the data released in Campbell 2013. It is the cosmological data

for the spectroscopic and photometrically classified SN Ia from SDSS. * It is originally available at http://www.icg.port.ac.uk/stable/campbellh/SDSS_Photometric_SNe_Ia.fits

- **lc/**

- Raw light curves
- & light curves in the form needed by `sncosmo` and will be analysed by `get_salt_values.py`

- **ellipt_burst_global.tsv**

- IC 219 host of SN 2005dm (elliptical)
- NGC 524 host of SN 2000cx (elliptical)
- Arp 299 (starburst) host of many CC SN (local is 2010P)
- M82 (NGC 3034) (starburst) host of SN 2014J

1.1.2 Consistency Tests

Circle Test

The first test is to make sure the MCMC can get out the same result that `FSPS` was given. Seeing the flow of the values

Input 1 (to FSPS)	Output 1 (from FSPS)	Input 2 (to spae)	Output 2 (from spae)
SFH parameters, redshift	SED	SED, redshift	SFH parameters

So the output of `spea` should be the same as the input to `FSPS`.

Setting and generating the values in `data/circlePhotometry.tsv`

Lets generate the needed stellar population. This should be the same as the default in `calcualeAge.py`^{L427}.

```
import fsps
sp = fsps.StellarPopulation(zcontinuous=2, cloudy_dust=True,
                           add_neb_emission = True, sfh=5)
sdss_bands = ['sdss_u', 'sdss_g', 'sdss_r', 'sdss_i', 'sdss_z']
```

Here are the different input 1, star formation histories in a table

name	logzsol	dust2	tau	tStart	sfTrans	sfSlope	description
c1	-0.5	0.1	0.5	1.5	9.0	-1.0	old
c2	-0.5	0.1	0.5	1.5	9.0	15.0	sharp burst & young
c3	-0.5	0.1	7.0	3.0	10.0	15.0	flat burst & young
c4	-0.5	0.1	7.0	3.0	13.0	0.0	flat burst
c5	-1.5	0.1	0.5	1.5	9.0	-1.0	metal poor, like c1
c6	-0.5	0.8	7.0	3.0	10.0	15.0	dusty, like c2
c7	-0.5	0.1	0.5	1.5	6.0	15.0	mostly late linear, like c2
c8	-0.5	0.1	0.1	8.0	12.0	20.0	very young

and as copyable code

```
logzsol, dust2, tau, tStart, sfTrans, sfSlope = -0.5, 0.1, 0.5, 1.5, 9.0, -1.0
logzsol, dust2, tau, tStart, sfTrans, sfSlope = -0.5, 0.1, 0.5, 1.5, 9.0, 15.0
logzsol, dust2, tau, tStart, sfTrans, sfSlope = -0.5, 0.1, 7.0, 3.0, 10.0, 15.0
logzsol, dust2, tau, tStart, sfTrans, sfSlope = -0.5, 0.1, 7.0, 3.0, 13.0, 0.0
logzsol, dust2, tau, tStart, sfTrans, sfSlope = -1.5, 0.1, 0.5, 1.5, 9.0, -1.0
logzsol, dust2, tau, tStart, sfTrans, sfSlope = -0.5, 0.8, 7.0, 3.0, 10.0, 15.0
logzsol, dust2, tau, tStart, sfTrans, sfSlope = -0.5, 0.1, 0.5, 1.5, 6.0, 15.0
logzsol, dust2, tau, tStart, sfTrans, sfSlope = -0.5, 0.1, 0.1, 8.0, 12.0, 20.0
```

```
sp.params['logzsol'] = logzsol
dust1 = 2.0*dust2
sp.params['dust1'] = dust1
sp.params['dust2'] = dust2
sp.params['tau'] = tau
sp.params['sf_start'] = tStart
sp.params['sf_trunc'] = sfTrans
sp.params['sf_slope'] = sfSlope
sp.get_mags(tage=13.185, redshift=0.05, bands=sdss_bands)
```

And the results can be found in `data/circlePhotometry.tsv` available on [GitHub](#) with a boost of `c = 25` comment on photometric uncertainties.

SED Check

Messier Objects

The paper covers this well.

Gupta Objects

The paper covers this well.

1.1.3 Script Documentation

These are the documentation for the helper scripts. These scripts are used for pre- and post-processing of data.

Combine Ages

1.1.4 API Documentation

Main usage

Usage and Options are available, correctly formatted, via `fspsage.py -h` once installed.

`fsps-age.py` – Estimates the age of a Photometric SED using FSPS.

Science goal: Check local environment effects on SNIa by looking for correlations between HR and the age of the local environment calculated from SDSS Scene Modeling Photometry

Usage: `fspsage.py burnin OBJID fspsage.py run DATASET JOBID JOBLENGTH [-d | -debug] fspsage.py (-h | -help) fspsage.py -version`

Option: `burnin` run a shorter run on specific objects only OBJID the SN (or Messier) ID of the object to observe run estimate age for a given data set DATASET analyses circle, messier, gupta, campbell, campbellG, and riess data sets JOBID the ID for the piece of the data set to be analyzed JOBLENGTH the total number of objects looked at -d -debug run shorter and with more logs -h -help show this screen -version show version

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`fspsage.burnin (cli)`

Runs a smaller *emcee.sampler* to see how the sampling is progressing. Hopefully these values will not effect how it samples, but it will likely effect how well it sampled.

`fspsage.calculateAge (SNID)`

Get MCMC running and be able to calculate an age with uncertainties.

`fspsage.formatLogging ()`

Setting up the logger parts that are the same for all commands

`fspsage.redoGupta (cli)`

Test on global SED's

We want to redo what Gupta did to make sure we can actually do something before we analyze on new data.

Parameters `cli` – The dictionary of the CLI constructed by :docop:.

`fspsage.testFspParameters ()`

CalculateAge

Utilities

1.2 Indices and tables

- `genindex`
- `modindex`

1.3 Assumptions

- This code assumes you are using SDSS *ugriz* SED's. There are several lines of code that would need to be updated if this assumption is changed. Hopefully they are marked with comments.

B

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