# A Catalogue of Two-Dimensional Photometric Decompositions in the SDSS-DR7 Spectroscopic Main Galaxy Sample: Preferred Models and Systematics
## *The Electronic Tables*

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## Abstract

We present a description of the electronic tables for the catalogue of two-dimensional, PSF-corrected deVacouleur's, Sèrsic, deVacouleur's+Exponential, and Sèrsic+Exponential fits of $\sim 7 \times 10^5$ spectroscopically selected galaxies drawn from the SDSS DR7. Fits are performed for the SDSS $r$ band utilizing the fitting routine `Galfit` and analysis pipeline `PyMorph`. Tables are distributed in `FITS` format.

## 1 Introduction

This is the supplement to Meert, Vikram & Bernardi (2015) (hereafter M14) and describes the electronic data supplements of the M14 catalogue. The terms of use for this catalogue are 1) cite M14 in any work using this catalogue and 2) contact the authors via email and inform us of your use of the catalogue. The primary data is presented in Section 2, which describes the UPenn_PhotDec_nonParam_rband table and the UPenn_PhotDec_Models_rband table. We currently release the r-band fits to the `Dev`, `Ser`, `DevExp`, and `SerExp` models. An additional "best fit" catalogue containing a mixture of `Ser` (for pure bulges and disks) and `SerExp` (for all other galaxies) is included. The type of galaxy is determined by the `SerExp` flagging.

Section 3 describes ancillary data from SDSS and Galaxy Zoo. Ancillary data selected from several value-added SDSS catalogues and external data sources are available from the authors.

The published data includes these files:

1. "UPenn_PhotDec_nonParam_rband.fits" ($\sim$ 49MB) for non-parametric measurements
2. "UPenn_PhotDec_Models_rband.fits" ($\sim$ 474MB) for the `PyMorph` fits
3. "UPenn_PhotDec_CAST.fits" ($\sim$ 79MB) for redshift, spectroscopic information, and the minimum necessary identifiers needed for cross-matching to SDSS and other catalogues

The total download footprint is $\sim$ 600MB. For convenience, we package these tables, as well as the current document into the $\sim$ $360MB$ "Meert2014_v1.tgz" gzipped tarball. Additional catalogues can be individually downloaded.

## 2 Model Tables

The UPenn_PhotDec_nonParam_rband table contains the model-independent data from our `PyMorph` fits. The model-dependent fitting parameters are stored in the UPenn_PhotDec_Models_rband table which contains tables for each model ("best fit", `Dev`, `Ser`, `DevExp`, and `SerExp`, in that order) for our catalogue. The tables are available in `FITS` format. Any data that was not present is represented by value -999, with the exception of magnitudes, which are replaced by large positive values (999 or greater).

Table 1 provides the non-parametric measurements of galaxies in our catalogue. These data are available in the 'UPenn_PhotDec_nonParam_rband.fits' table and include the CASGM measurements (Conselice, 2003; Lotz, Primack & Madau, 2004). We also include `SExtractor` magnitude, halflight radius, and sky brightness estimates. The `num_targets` column indicates the number of sources found within $3''$ of the centre of the image. If this number is larger than 1, then the likelihood of contamination increases substantially. The `num_neighborfits` column indicates the number of neighbour sources fitted simultaneously to the target galaxy. The selection algorithm for simultaneous neighbour fitting is described in M14. Each neighbour is fit with a `Ser` profile, which increases the dimensionality of the fit by 7. If the number of neighbours is larger than 0, then the likelihood of contamination increases substantially.

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| Column Number | Column Name | Explanation | Data Type |
|---|---|---|---|
| 0 | SExMag | the `SExtractor` magnitude (mag) | float |
| 1 | SExMagErr | the `SExtractor` magnitude error (mag) | float |
| 2 | SExHrad | the `SExtractor` half-light radii (arcsec) | float |
| 3 | SExSky | the `SExtractor` sky brightness (mag/arcsec$^2$) | float |
| 4 | num_targets | the number of targets | int |
| 5 | num_neighborfit | the number neighbour sources fitted with `Ser` profiles | int |
| 6 | C | the Concentration | float |
| 7 | C_err | the Concentration error | float |
| 8 | A | the Asymmetry | float |
| 9 | A_err | the Asymmetry error | float |
| 10 | S | the Smoothness | float |
| 11 | S_err | the Smoothness error | float |
| 12 | G | the Gini coefficient | float |
| 13 | M20 | the $M_{20}$ value | float |
| 14 | extinction | The SDSS-provided galactic extinction (magnitude) | float |
| 15 | dismod | the calculated distance modulus | float |
| 16 | kpc_per_arcsec | the angular scale (kpc/arcsec) | float |
| 17 | Vmax | the Volume used for Vmax corrections (Mpc$^3$) | float |
| 18 | SN | the average S/N per pixel inside the half-light radius | float |
| 19 | kcorr | k-correction calculated using the SDSS model magnitudes | float |

Table 1: Description of columns in the electronic table UPenn_PhotDec_nonParam_rband. The data are model-independent measurements fitted by `PyMorph`. Problematic data or parameters are replaced with -999, with the exception of magnitudes, which are replaced by large positive values (999 or greater).

Fitting more than 1 neighbour simultaneously becomes very difficult at our resolution. As such, careful attention should be paid to galaxies with neighbour fits. The flags are designed to catch common problems caused by neighbour fits. The most common problem is contamination of the dimmer component of the two-component fits (either the `DevExp` or `SerExp` fits). While we show that a large number of these problem cases are captured in the catalogue, it is likely that a higher rate of contamination is found in these fits with neighbours.

Table 2 provides the parametric measurements of galaxies in out catalogue. These data are available in the 'UPenn_PhotDec_Models_rband.fits' table. The extensions 1, 2, 3, and 4 contain the `Dev`, `Ser`, `DevExp`, and `SerExp` fit parameters, respectively. When a fit failed, the values are replaced with -999. Likewise, for single component models, the disk parameters are set to -999. The exception to this is the magnitude, which is set to *positive* 999 to prevent any problems when adding magnitudes together. We provide the value and error terms for each model parameter. Most terms are self-explanatory. The x and y centres may not be very useful in their current form, and should probably be converted to rowc and colc terms.

The tables contain the $\chi^2_\nu$ for each fit as well as the flag assigned in M14 (the 'finalflag' column). We additionally include the intermediate automated flag (the 'autoflag' column) and the two flags output by `PyMorph` ('pyflag' and 'pyfitflag'). The user will likely not find these additional flags useful as most of the relevant information is contained in the 'finalflag' flag discussed in the main text. Nevertheless, we describe each flag in Section 2.1. We also summarize the recommendations for using the 'finalflag' to select samples in Section 2.2.

## 2.1 The Quality Flags

There are four quality flags supplied as part of the M14 catalogue. The most important of these is the "finalflag". The "finalflag" is used in the main paper and described in Table 3. Since we use this flag throughout the paper, we also provide a breakdown of the percentage of galaxies occupying each category in Table 4.

The "autoflag" contains flags that identify simple problems in the fitting, which we expect to be indicative of unphysical fits. We derive the "autoflag" flags from visual examination and training on a sample of manually classified galaxies. The "autoflags" are described in Table 5. We do not discuss these flags further, as they are incorporated into the "finalflags." However, they are available for use.

Finally, there are two `PyMorph` flags included. The "pyflag" is described in Table 6 and contains diagnostic information regarding the fitting process. The most relevant flag is bit 8 (the NEIGHBOR_FIT) in the "pyflag" which indicates that a neighbour is simultaneously fit and the resulting fit may be biased or unstable because of this neighbour. This flag is effectively available in the num_neighborfit value in the UPenn_PhotDec_nonParam_rband table along with the additional information of exactly how many neighbours are actually fit. The "pyfitflag" flags can be useful in finding suspect fits, but we do not discuss them here because our finalflag flags supersede these flags. However,

| Column Number | Column Name | Explanation | Data Type |
|---|---|---|---|
| 0 | m_tot | total fitted apparent magnitude | float |
| 1 | BT | the B/T (bulge-to-total light ratio) of the fit | float |
| 2 | r_tot | the half-light radius (arcsec) of the total fit | float |
| 3 | ba_tot | the axis ratio (semi-minor/semi-major of the total fit | float |
| 4 | xctr_bulge | the bulge x centre (pixels) | float |
| 5 | xctr_bulge_err | the bulge x centre error (pixels) | float |
| 6 | yctr_bulge | the bulge y centre (pixels) | float |
| 7 | yctr_bulge_err | the bulge y centre error (pixels) | float |
| 8 | m_bulge | the bulge magnitude | float |
| 9 | m_bulge_err | the bulge magnitude error | float |
| 10 | r_bulge | the bulge halflight radius (arcsec) | float |
| 11 | r_bulge_err | the bulge radius error (arcsec) | float |
| 12 | n_bulge | the bulge Sérsic index | float |
| 13 | n_bulge_err | the bulge Sérsic index error | float |
| 14 | ba_bulge | the bulge b/a | float |
| 15 | ba_bulge_err | the bulge b/a error | float |
| 16 | pa_bulge | the bulge position angle (degrees) | float |
| 17 | pa_bulge_err | the bulge position angle error (degrees) | float |
| 18 | xctr_disk | the disk x centre (pixels) | float |
| 19 | xctr_disk_err | the disk x centre error (pixels) | float |
| 20 | yctr_disk | the disk y centre (pixels) | float |
| 21 | yctr_disk_err | the disk y centre error (pixels) | float |
| 22 | m_disk | the disk magnitude | float |
| 23 | m_disk_err | the disk magnitude error | float |
| 24 | r_disk | the disk halflight radius (arcsec) | float |
| 25 | r_disk_err | the disk radius error (arcsec) | float |
| 26 | n_disk | the disk Sérsic index | float |
| 27 | n_disk_err | the disk Sérsic index error | float |
| 28 | ba_disk | the disk b/a | float |
| 29 | ba_disk_err | the disk b/a error | float |
| 30 | pa_disk | the disk position angle (degrees) | float |
| 31 | pa_disk_err | the disk position angle error (degrees) | float |
| 32 | GalSky | the `PyMorph` sky brightness (mag/arcsec$^2$) | float |
| 33 | GalSky_err | the `PyMorph` sky brightness (mag/arcsec$^2$) | float |
| 34 | chi2nu | the $\chi^2$/DOF | float |
| 35 | finalflag | the primary quality flag described in this work | float |
| 36 | autoflag | the intermediate, visually calibrated, automated flag described in this work | float |
| 37 | pyflag | the `PyMorph` run flag | float |
| 38 | pyfitflag | the `PyMorph` fit flag | float |

Table 2: Description of columns in the electronic table UPenn_PhotDec_Models_rband. The data are the "best model", `Dev`, `Ser`, `DevExp`, and `SerExp` model fit parameters fitted by `PyMorph`. Unfit parameters or missing data are replaced with values of -999, with the exception of magnitudes, which are replaced by large positive values (999 or greater).

| Flag Bit | Analysis Flag | Flag Criteria |
|---|---|---|
| – | **Good Total and Component Magnitudes and Sizes** | |
| 10 | **Two-Component Galaxies** | |
| 11 | No Flags | No Flags are present |
| 12 | Good `Ser`, Good `Exp` (Some Flags) | Some minor automated flags |
| 13 | Flip Components | `Exp` component fitting the inner and `Ser` component fitting the outer part of the profile |
| – | **Good Total Magnitudes and Sizes Only** | |
| 1 | **Bulge Galaxies** | |
| 2 | No `Exp` Component, $n_{Ser}$ >2 | 1000*(B/T-0.8)$^3$+($m_{disk}$-19)>0.5 AND $n_{Ser} \geq 2$ |
| 3 | `Ser` Dominates Always | B/T(r) $\geq$ 0.5 for all r AND $n_{Ser} \geq 2$ |
| 4 | **Disk Galaxies** | |
| 5 | No `Ser` Component | 1000*(0.2-B/T)$^3$+($m_{bulge}$-19)>0.5 |
| 6 | No `Exp`, $n_{Ser}$ <2, Flip Components | 1000*(B/T-0.8)$^3$+($m_{disk}$-19)>0.5 AND $n_{Ser}$ <2 |
| 7 | `Ser` Dominates Always, $n_{Ser}$ <2 | B/T(r) $\geq$ 0.5 for all r AND $n_{Ser}$ <2 |
| 8 | `Exp` Dominates Always | B/T(r) < 0.5 for all r |
| 9 | Parallel Components | $RMS\,[(B/T - \mu(B/T)) : 0 < r < r(0.9L_{tot}] <$ 0.1 AND $n_{bulge} < 2.0$ |
| 14 | **Problematic Two-Component Galaxies** | |
| 15 | `Ser` Outer Only | B/T< 0.7 AND B/T(r($0.9L_{tot}$)>0.5 AND $n_{bulge} \geq 2.0$ AND B/T(0)>0.5 |
| 16 | `Exp` Inner Only | B/T(0)<0.5 AND B/T(r: r< 2.7$r_{hl}$) > 0.5 AND $n_{bulge} \geq 2.0$ AND NOT Ser Outer Only |
| 17 | Good `Ser`, Bad `Exp`, B/T>=0.5 | B/T>0.75 AND $\Delta\phi > 45$ AND $b/a_{bulge} <$ 0.75 AND $b/a_{disk} < 0.4$ |
| 18 | Bad `Ser`, Good `Exp`, B/T<0.5 | B/T<0.25 AND $\Delta\phi > 45$ AND $b/a_{bulge} < 0.4$ AND $b/a_{disk} < 0.75$ |
| 19 | Bulge is point | Circularized bulge radius <0.188 arcsec |
| 20 | **Bad Total Magnitudes and Sizes** | |
| 21 | Centering Problems | (galaxy centroid-SDSS galaxy centroid)>0.7*$r_{sextractor}$ |
| 22 | `Ser` Component Contamination by Neighbours or Sky | $r_{bulge,cir}/r_{sextractor} > 4.0$ |
| 23 | `Exp` Component Contamination by Neighbours or Sky | $r_{bulge,cir}/r_{sextractor} > 4.0$ |
| 24 | Bad `Ser` and Bad `Exp` Components | Failure of measurements |
| 25 | `Galfit` Failure | `Galfit` fails to converge or other failure of the pipeline |
| 26 | Polluted or Fractured | CasJobs neighbours not properly masked/masked or target is separated into 2 or more objects |

Table 3: The description of our categories as described in the main text. The major flag bits used to select different catalogues are flag bits 10 (good two-component fits), 1 (good bulge galaxy), 4 (good disk galaxy), 14 (problematic two-component fit), and 20 (bad fit). We describe how to use these flags in the main text.

| Flag Bit | Descriptive Category | % Dev | % Ser | % DevExp | % SerExp | % Test |
|---|---|---|---|---|---|---|
| – | **Trust Total and Component Magnitudes and Sizes** | – | – | 42.223 | 39.055 | 38.333 |
| 10 | **Two-Component Galaxies** | – | – | 42.223 | 39.055 | 38.333 |
| 11 | No Flags | – | – | 30.152 | 18.095 | 18.125 |
| 12 | Good `Ser`, Good `Exp` (Some Flags) | – | – | 10.701 | 19.417 | 19.375 |
| 13 | Flip Components | – | – | 1.369 | 1.543 | 2.917 |
| – | **Trust Total Magnitudes and Sizes Only** | 97.653 | 97.380 | 52.444 | 54.945 | 54.375 |
| 1 | **Bulge Galaxies** | 97.653 | 58.378 | 14.636 | 18.964 | 18.958 |
| 2 | No `Exp` Component, $n_{Ser}$ >2 | 97.653 | 58.378 | 4.646 | 7.074 | 7.917 |
| 3 | `Ser` Dominates Always | – | – | 9.989 | 11.889 | 11.042 |
| 4 | **Disk Galaxies** | – | 39.001 | 28.462 | 25.146 | 23.958 |
| 5 | No `Ser` Component | – | – | 25.041 | 16.876 | 15.417 |
| 6 | No `Exp`, $n_{Ser}$ <2, Flip Components | – | 39.001 | – | 0.551 | 0.208 |
| 7 | `Ser` Dominates Always, $n_{Ser}$ <2 | – | – | – | 0.103 | 0.625 |
| 8 | `Exp` Dominates Always | – | – | 3.421 | 2.872 | 3.125 |
| 9 | Parallel Components | – | – | – | 4.745 | 4.583 |
| 14 | **Problematic Two-Component Galaxies** | – | – | 9.346 | 10.835 | 11.458 |
| 15 | `Ser` Outer Only | – | – | 5.289 | 7.504 | 8.125 |
| 16 | `Exp` Inner Only | – | – | 0.514 | 0.425 | 0.625 |
| 17 | Good `Ser`, Bad `Exp`, B/T>=0.5 | – | – | 0.011 | 0.017 | 0.000 |
| 18 | Bad `Ser`, Good `Exp`, B/T<0.5 | – | – | 0.884 | 0.652 | 0.625 |
| 19 | Bulge is point | – | – | 2.648 | 2.237 | 2.083 |
| 20 | **Bad Total Magnitudes and Sizes** | 2.347 | 2.620 | 5.334 | 6.000 | 7.292 |
| 21 | Centering Problems | 0.338 | 0.357 | 0.599 | 0.557 | 1.458 |
| 22 | `Ser` Component Contamination by Neighbours or Sky | 1.302 | 1.618 | 1.251 | 2.129 | 3.333 |
| 23 | `Exp` Component Contamination by Neighbours or Sky | – | – | 2.788 | 2.392 | 2.083 |
| 24 | Bad `Ser` and Bad `Exp` Components | – | – | 0.177 | 0.239 | 0.625 |
| 25 | `Galfit` Failure | 0.187 | 0.124 | 0.249 | 0.355 | 0.208 |
| 26 | Polluted or Fractured | 0.679 | 0.681 | 0.677 | 0.676 | 0.625 |

Table 4: A breakdown of the descriptive categories useful for analysis. We show percentages of the total catalogue for each of the fitted models and our visually classified test set. The one component models (`Ser` and `Dev`) can not be classified as two-component models, by definition. For the `Ser` and `Dev` models, many of the categories are empty. The major distinction for the one-component models is whether the fits have major problems (i. e., flag bit 20 is set).

when one of the "limit" flags is set in "pyfitflag" flags, it suggests that the convergence of `Galfit` to the best fit was prevented by the fitter encountering the edge of the parameter space. While such flags can indicate problems in the fitting, they can also be harmless (e. g. when the bulge radius goes to 0 and the B/T also approaches 0, the "RE_AT_LIMIT" flag will be set, but we do not expect this to be a bad fit as the fit is telling us that there is no bulge component. If there is no bulge, then we do not care that the bulge parameters are not properly determined.)

## 2.2 Recommended Flag Usage for Sample Selection

When using the catalogue, we recommend removing galaxies flagged as bad (flag 20) as these galaxies have catastrophically bad estimates of total magnitude and radius. Additional galaxies may be removed depending on how conservative the user seeks to be. The problematic two-component fits (flag 14) or the two-component fits with bulge Sérsic index n=8 may be used for total magnitude and radius measurements, but the sub-components are not reliable.

The user should also be aware that we have swapped the bulge and disk components of galaxies with bits 6, 7, or 13 set (which were flagged as inverted profiles in the `SerExp` fit). These galaxies have B/T inverted and the components reversed relative to the `SerExp` fit. Therefore, no additional alterations must be made to account for the inverted nature of the profile. However, using the "raw" fit produced prior to flagging requires swapping

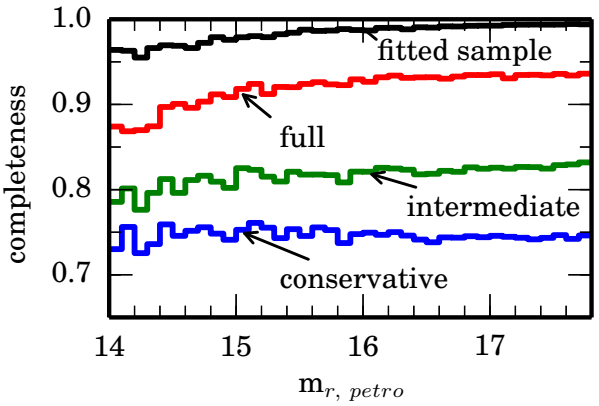


Figure 1: The completeness of the the samples described in Section 2.2. All completeness calculations are relative to the original magnitude-limited galaxy sample downloaded from SDSS DR7.

| Flag Bit | Flags | Flagging Criteria |
|---|---|---|
| 0 | **Centering** | (galaxy centroid-sdss galaxy centroid)>0.7*$r_{sex}$ |
| 1 | **Parallel Components** | $RMS(B/T - \mu(B/T)) : 0 < r < r(0.9L_{tot})$ & $n_{bulge} < 2.0$ |
| 2 | **No Ser Likely** | 1000*(0.2-B/T)$^3$+($m_{bulge}$-19)>0.5 |
| 3 | **No Exp Likely** | 1000*(B/T-0.8)$^3$+($m_{disk}$-19)>0.5 |
| – | **Ser Component Flags** | |
| 4 | *Ser Contaminated* | $r_{bulge,cir}/r_{sex} > 4.0$ AND $b/a_{bulge} <= 0.6$ |
| 5 | *Ser is Sky* | $r_{bulge,cir}/r_{sex} > 4.0$ AND $b/a_{bulge} > 0.6$ |
| 6 | *High e Ser* | $b/a_{bulge} < 0.4$ AND B/T<0.25 |
| 7 | *Ser PA Problem* | $\Delta\phi > 45$ AND B/T<0.5 AND $b/a_{bulge} < 0.75$ AND $b/a_{disk} < 0.75$ |
| 8 | *Ser Fitting Outer* | B/T< 0.7 AND B/T(r($0.9L_{tot}$)>0.5 |
| 9 | *Ser is Disk* | $r_b/r_d > 1.5$ AND $n_{bulge} < 2$ |
| 10 | *Ser Dominates Always* | B/T(r) >0.5 : $0 < r < r(0.95L_{tot})$ |
| 11 | *Low Sersic index Ser* | $r_b/r_d \leq 1.5$ AND $n_{bulge} < 2$ |
| – | **Exp Component Flags** | |
| 12 | *Exp Contaminated* | $r_{disk,cir}/r_{sex} > 3.0$ AND $b/a_{disk} <= 0.6$ |
| 13 | *Exp is Sky* | $r_{disk,cir}/r_{sex} > 3.0$ AND $b/a_{disk} > 0.6$ |
| 14 | *High e Exp* | $b/a_{disk} < 0.4$ AND B/T> 0.75 |
| 15 | *Exp PA Problem* | $\Delta\phi > 45$ AND B/T>0.5 AND $b/a_{bulge} < 0.75$ AND $b/a_{disk} < 0.75$ |
| 16 | *Exp Fitting Inner* | B/T(0)<0.5 AND B/T(r: r< $2.7r_{hl}$) > 0.5 |
| 17 | *Exp Dominates Always* | B/T(r)<0.5 : $0 < r < r(0.95L_{tot})$ |
| 18 | **Galfit Failure** | Galfit fails to converge and crashes |
| 19 | **Bad Total Fit** | Any of bits 0, 4, 5, 12, 13, 22, 24, or 25 set or at least 2 of bits 2, 3, 10, and 17 set |
| 20 | **Bad Disk** | Bits 12 or 13 set or bit 16 and any of bits 1, 8, 9, or 11 set or bit 14 and 15 set or bit 1 set |
| 21 | **Bad Bulge** | Bits 4 or 5 set or bit 8 and bits 9 or 16 set or bit 6 and 7 set or bit 1 set |
| 22 | **High $\chi^2$** | $\chi^2 > 20$ |
| 23 | **Flip Components** | At least 2 of bits 9, 8, or 16 set or bits 16 and 11 set or bit 9 set or bits 3 and 11 set |
| 24 | **Polluted** | Neighbour expected from SDSS not fitted or masked |
| 25 | **Fractured** | Neighbour fitted, but no neighbour exists in SDSS |
| 26 | **Tiny Bulge** | $r_{bulge,cir} < 0.188$ arcsec |

Table 5: The selection criteria used to define the automated flags. The first column gives the flag bit. The second column gives the flag name, the third column gives the cuts used on fitted parameters to set the flag.

| Flag Bit | Flag | Flag Criteria |
|---|---|---|
| 0 | REPEAT | This is a repeated fit |
| 1 | FIT_BULGE_CNTR | Bulge centre was a fitted parameter |
| 2 | FIT_DISK_CNTR | Disk centre was a fitted parameter |
| 3 | FIT_BULGE | Bulge component was fitted |
| 4 | FIT_DISK | Disk component was fitted |
| 5 | FIT_SKY | Sky component was fitted |
| 6 | FIT_POINT | Point component was fitted |
| 7 | FIT_BAR | Bar component was fitted |
| 8 | NEIGHBOR_FIT | Neighbour component was fitted |
| 9 | EXCEED_SIZE | CASgm module flag for galaxy that extends too far to be measured (i. e., the image is not big enough) |
| 10 | NO_TARGET | No target has a `SExtractor` centroid within 3″of the image centre |
| 11 | ASYM_NOT_CONV | CASgm module flag for galaxy asymmetry measurement that fails to converge |
| 12 | ASYM_OUT_FRAME | CASgm module flag for galaxy asymmetry that extends too far to be measured (i. e., the image is not big enough) |
| 13 | ELLIPSE_FAIL | CASgm module flag for failure to generate the mask used by the CASgm module |
| 14 | CASGM_FAIL | CASgm module crashes |
| 15 | GALFIT_FAIL | `Galfit` crashed |
| 16 | PLOT_FAIL | plotting module crashed |
| 17 | ERRORS_FAILED | uncertainty on fit parameters incorrectly calculated |
| 18 | AVGIE_FAILED | average surface brightness from `SExtractor` incorrectly calculated |
| 19 | BACK_FAILED | `PyMorph` fails to measure the background |
| 20 | DETAIL_FAILED | detailed fitting procedure failed |

Table 6: The selection criteria used to define the `PyMorph` flags. The first column gives the flag bit. The second column gives the flag name, the third column gives a description of the flag. More detailed descriptions can be found in Vikram et al. (2010).

| Flag Bit | Flag | Flag Criteria |
|---|---|---|
| 0 | LARGE_CHISQ | $\chi^2_\nu > 2.5$ |
| 1 | SMALL_GOODNESS | Goodness $< 0.60$ |
| 2 | FAKE_CNTR | bulge or disk component moves more than 3 pixels during fitting |
| 3 | IE_AT_LIMIT | bulge magnitude approaches $\pm 7$ mag from initial value set by `SExtractor` |
| 4 | ID_AT_LIMIT | disk magnitude approaches $\pm 7$ mag from initial value set by `SExtractor` |
| 5 | RERD_AT_LIMIT | Not currently used/ no constraint |
| 6 | BT_AT_LIMIT | Not currently used/ no constraint |
| 7 | N_AT_LIMIT | Sérsic index approaches 0.1 or 8.0 |
| 8 | RE_AT_LIMIT | bulge radius approaches 0 or 50 times the `SExtractor` halflight radius |
| 9 | RD_AT_LIMIT | disk radius approaches 0 or 50 times the `SExtractor` halflight radius |
| 10 | EB_AT_LIMIT | bulge b/a approaches 0 or 1.0 |
| 11 | ED_AT_LIMIT | disk b/a approaches 0 or 1.0 |

Table 7: The selection criteria used to define the `PyMorph` fit flags. The first column gives the flag bit. The second column gives the flag name, the third column gives a description of the flag. More detailed descriptions can be found in Vikram et al. (2010).

bulge and disk parameters and inverting the B/T. This alteration has been done in all catalogues.

We suggest one of these composite samples drawn from the preferred fit catalogue described in the previous paragraph:

**The conservative catalogue** Select all galaxies with final flag bits 11, 12, or 13 set and bulge Sérsic index <8. In addition, the user should select galaxies with `SerExp` final flag bits 1 or 4 set. These galaxies will have B/T of 1 (for bulges; final flag bit 1 set) or a B/T of 0 (for disks; final flag bit 4 set) and the relevant `Ser` parameters are reported in the catalogue.

**The intermediate catalogue** Use the catalogue above plus all galaxies with final flag bit 10 set and bulge Sérsic index =8.

**The full catalogue** Use the catalogue above plus all galaxies with final flag bit 14 set. This is the least restrictive version of the catalogue but may include galaxies with strange, difficult-to-interpret fit parameters.

Figure 1 shows the completeness of the three samples described above. The "fitted sample" represents our selection after the cuts made in the original text. All completeness calculations are relative to the original magnitude-limited galaxy sample downloaded from SDSS DR7. Not surprisingly, the completeness drops with more conservative catalogue choices. However, the completeness is largely flat across the magnitude range with a slight decrease of order 0.05 at magnitudes brighter than 14.5 extinction-corrected Petrosian r-band magnitude.

The data files for this catalogue are available online at `http://www.physics.upenn.edu/~ameert/SDSS_PhotDec/`. We also provide an interface for generating panels of postage stamp images of the 2D model and residual as well as the 1D profile. These panels can be generated for a user-uploaded list of galaxies on demand.

# 3 CAST (SDSS DR7 Spectroscopic Sample CasJobs Data) Table Description

The table "UPenn_PhotDec_CAST.fits" contains band-independent data used in fitting and analysis. Any data that was not present in the original table is represented by value -999. Table 8 describes the structure of the `FITS` file containing the CAST data. Most rows are self-explanatory. The $0^{\text{th}}$ row contains the `galnum` value, which is the unique identifier used throughout our work to identify galaxies in place of the much longer SDSS `objid`. The user is advised to refer to the `galnum` value when using galaxies in this catalogue. Any references made by the authors to specific galaxies is also done by `galnum`. The `badflag` value reports some of the most relevant flags used to select this sample from SDSS. There are many more flags that are produced by the SDSS photometric pipeline. Additional flags can be extracted from the SDSS data by the user.

We also provide both the raw (`spiral`, `elliptical`, and `uncertain`) as well as the debiased (`p_el_debiased` and `p_cs_debiased`) Galaxy Zoo parameters. These probabilities are selected from the Galaxy Zoo catalogue stored on the SDSS CasJobs server. The Galaxy Zoo project provides visual classifications for many of the galaxies in our catalogue. Classification was done by citizen-scientists and corrected for bias by the Galaxy Zoo science team. The project is described in Lintott et al. (2008) and the data release is described in Lintott et al. (2011).

Additionally, the Galaxy Zoo classification for each galaxy is collected for use in analysis. These probabilities are selected from the Galaxy Zoo catalogue stored on the SDSS CasJobs server. The Galaxy Zoo project provides visual classifications for many of the galaxies in our catalogue. Classification was done by citizen-scientists and corrected for bias by the Galaxy Zoo science team. The project is described in Lintott et al. (2008) and the data release is described in Lintott et al. (2011).

# References


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| Column Num | Column Name | Explanation | Data Type |
|---|---|---|---|
| 0 | galnum | the assigned unique galaxy id number | int |
| 1 | objid | the unique SDSS photometric object id | bigint |
| 2 | SDSSIAU | the SDSS IAU designation of the source | string |
| 3 | badflag | SDSS photometric pipeline flags SATURATED, BRIGHT, EDGE, NODEBLEND, CHILD, and DEBLENDED_AS_PSF | bigint |
| 4 | nchild | the number of child sources deblended by the SDSS | int |
| 5 | mode | 1: primary, 2: secondary, 3: family object, 4: outside chunk boundary | int |
| 6 | run | SDSS run number | int |
| 7 | rerun | SDSS rerun number | int |
| 8 | camCol | SDSS camCol number | int |
| 9 | field | SDSS field number | int |
| 10 | obj | SDSS object number | int |
| 11 | stripe | SDSS stripe number | int |
| 12 | startmu | SDSS starting mu for observation of the chunk | int |
| 13 | specobjid | the unique SDSS spectroscopic id number | bigint |
| 14 | plate | SDSS plate number | int |
| 15 | mjd | SDSS mjd of observation | int |
| 16 | fiberid | SDSS fiber ID | int |
| 17 | ra | right ascension (degrees) | float |
| 18 | dec | declination (degrees) | float |
| 19 | z | redshift of the galaxy | float |
| 20 | veldisp | SDSS measured velocity dispersion (km/s) | float |
| 21 | veldispErr | SDSS velocity dispersion error (km/s) | float |
| 22 | eclass | SDSS spectroscopic classification | float |
| 23 | p_el_debiased | Galaxy Zoo Debiased Probability of Elliptical Galaxy | float |
| 24 | p_cs_debiased | Galaxy Zoo Debiased Probability of Spiral Galaxy | float |
| 25 | spiral | The raw Galaxy Zoo votes for spiral type | float |
| 26 | elliptical | The raw Galaxy Zoo votes for elliptical type | float |
| 27 | uncertain | The raw Galaxy Zoo votes for uncertain type | float |

Table 8: The explanation of columns in the "UPenn_PhotDec_CAST.fits" table. These data are the band-independent collected from SDSS. The identifying information is also included to allow matching to external catalogues.