

Command

```
photometry_v8.py --fits SN2015bn_SDSS_r.fits --ra 11:33:41.55 --dec 00:43:33.50 --ref-file SDSS_r.cat
```

Step 1: Administration

Summary of your input

Command

```
photometry.py --ana-thresh 1 --ap-diam 1.0 2.0 3.0 4.0 --ap-diam-ul 2 --dec 00:43:33.50 --det-thresh 1 --fits SN2015bn_SDSS_r.fits --gain None --host-offset 5 --keeptemp False --loglevel INFO --mag-cut 12.0 --mag-stdbright 0 --mag-stdfaint 0 --maxstars 200 --outdir results/ --ra 11:33:41.55 --ref-file SDSS_r.cat --ref-radius 10 --sex-loglevel WARNING --tol 1
```

Is the object in the image footprint?

Yes.

Step 2: Flux calibration

A local catalogue is used.

Use catalog file: SDSS_r.cat

Building the local sequence

Selecting stars for local sequence

Path of the temporary files:

/var/folders/fk/8ny2rsqs0kgcgkhc1bqhbsrr0000gp/T/sewpy_workdir_9na13pxb

List contains more than 200 stars. Truncate the faint end.

Cross-match catalogues

Generate diagnostic plot to remove stars

Current magnitude cuts:

Lower: -5.43

Upper: -1.15

Choose a magnitude range where the line describes the observations, adequately.

Would you like to apply a magnitude cut? [y|[n]]

Final number of stars in the local sequence: 170

Step 3: Zeropoint calculation

Run sextractor

Path of the temporary files:

/var/folders/fk/8ny2rsqs0kgcgkhc1bqhbsrr0000gp/T/sewpy_workdir_zut08ukr

Compute zeropoint

Bootstrap ZP from 1000 resamplings

/Volumes/Home/steve/anaconda/envs/py36/lib/python3.6/site-packages/matplotlib/cbook/deprecation.py:150: DeprecationWarning: 'on', 'true', 'off', 'false' as a bool is deprecated. Use 'True', 'False' instead.

warnings.warn(message, mplDeprecation, 1)

ZP measurements for each star and each aperture

MAG_AUTO

```
['22.440' '22.441' '22.327' '22.633' '22.461' '22.453' '22.441' '22.453'
'22.444' '22.442' '22.440' '22.461' '22.438' '22.555' '22.448' '22.437'
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'22.389' '22.297' '22.461' '22.451' '22.732' '22.439' '22.208' '22.697']
```

'22.346'	'22.462'	'22.395'	'22.355'	'22.460'	'22.462'	'22.414'	'22.415'
'22.684'	'22.197'	'22.518'	'22.190'	'23.744'	'22.177'	'22.296'	'22.370'
'22.586'	'22.110'	'22.492'	'22.373'	'22.490'	'22.442'	'22.466'	'22.377'
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'0.012'	'0.013'	'0.013'	'0.014'	'0.013'	'0.015'	'0.016'	'0.016'
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'0.035'	'0.037'	'0.040'	'0.038'	'0.036'	'0.040'	'0.039'	'0.040'
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MAG_PETRO

['22.468'	'22.454'	'22.340'	'22.656'	'22.486'	'22.484'	'22.453'	'22.465'
'22.474'	'22.460'	'22.474'	'22.487'	'22.476'	'22.576'	'22.473'	'22.469'
'22.456'	'22.475'	'22.472'	'22.432'	'22.460'	'22.476'	'22.457'	'22.454'
'22.478'	'22.505'	'22.439'	'22.469'	'22.487'	'22.497'	'22.462'	'22.531'
'22.453'	'22.491'	'22.470'	'22.481'	'22.480'	'22.442'	'22.494'	'22.463'
'22.476'	'22.428'	'22.525'	'22.506'	'22.429'	'22.441'	'22.427'	'22.453'
'22.432'	'22.491'	'22.520'	'22.434'	'22.420'	'22.445'	'22.465'	'22.433'
'22.485'	'22.580'	'22.450'	'22.447'	'22.486'	'22.407'	'22.400'	'22.444'
'22.925'	'22.471'	'22.590'	'22.478'	'24.467'	'22.459'	'22.430'	'22.798'
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'22.339'	'22.836'	'22.495'	'22.456'	'22.473'	'22.473'	'22.450'	'22.375'
'22.531'	'22.530'	'22.967'	'22.559'	'22.610'	'22.315'	'22.431'	'22.422'
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'22.514'	'22.511'	'22.560'	'23.497'	'22.557'	'22.488'	'22.460'	'22.379'
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'22.405'	'22.232'	'22.351'	'22.548'	'22.758'	'22.442'	'22.280'	'22.554'
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'22.352'	'22.534']						
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MAG_APER

['22.346'	'22.336'	'22.251'	'22.476'	'22.305'	'22.280'	'22.339'	'22.362'
'22.125'	'22.353'	'22.352'	'22.249'	'22.143'	'22.443'	'22.262'	'22.347'
'22.351'	'22.352'	'22.285'	'22.298'	'22.356'	'21.841'	'22.348'	'21.985'
'22.303'	'22.125'	'21.984'	'22.346'	'22.359'	'22.139'	'22.351'	'22.266'
'22.345'	'22.256'	'22.338'	'22.274'	'22.283'	'22.242'	'22.169'	'22.281'
'22.152'	'22.236'	'22.344'	'22.266'	'22.157'	'22.311'	'22.255'	'22.140'
'22.341'	'22.312'	'21.858'	'22.292'	'21.999'	'22.253'	'21.904'	'22.151'

'22.358'	'22.391'	'22.365'	'22.343'	'21.980'	'22.136'	'22.132'	'22.340'
'22.631'	'22.355'	'22.334'	'22.279'	'24.259'	'21.832'	'21.984'	'22.274'
'22.099'	'22.325'	'21.973'	'22.190'	'22.221'	'22.178'	'22.401'	'22.360'
'22.067'	'21.822'	'22.356'	'22.340'	'22.333'	'22.358'	'22.122'	'22.324'
'22.349'	'22.283'	'22.260'	'22.345'	'22.275'	'22.156'	'22.153'	'21.988'
'22.365'	'22.333'	'22.294'	'22.123'	'22.301'	'22.327'	'22.269'	'21.848'
'22.335'	'22.239'	'22.364'	'22.426'	'22.340'	'22.318'	'22.305'	'22.197'
'22.322'	'21.803'	'22.281'	'22.221'	'22.375'	'22.348'	'21.803'	'22.136'
'22.129'	'22.093'	'22.432'	'22.354'	'22.336'	'22.280'	'22.329'	'21.789'
'21.900'	'22.279'	'22.192'	'22.245'	'22.352'	'22.277'	'22.136'	'22.341'
'22.305'	'22.265'	'22.389'	'22.239'	'22.237'	'22.414'	'22.139'	'22.346'
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'22.315'	'22.221'						

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'0.007'	'0.007'	'0.007'	'0.006'	'0.007'	'0.006'	'0.008'	'0.007'
'0.009'	'0.009'	'0.007'	'0.009'	'0.009'	'0.010'	'0.010'	'0.010'
'0.010'	'0.011'	'0.010'	'0.011'	'0.010'	'0.013'	'0.014'	'0.013'
'0.016'	'0.015'	'0.014'	'0.017'	'0.015'	'0.013'	'0.016'	'0.013'
'0.014'	'0.016'	'0.019'	'0.016'	'0.019'	'0.020'	'0.015'	'0.018'
'0.021'	'0.020'	'0.021'	'0.019'	'0.020'	'0.097'	'0.017'	'0.017'
'0.021'	'0.025'	'0.019'	'0.021'	'0.024'	'0.020'	'0.024'	'0.028'
'0.020'	'0.027'	'0.029'	'0.027'	'0.029'	'0.022'	'0.033'	'0.030'
'0.027'	'0.030'	'0.024'	'0.030'	'0.028'	'0.025'	'0.031'	'0.031'
'0.027'	'0.030'	'0.037'	'0.029'	'0.027'	'0.034'	'0.033'	'0.033'
'0.034'	'0.032'	'0.033'	'0.033'	'0.034'	'0.031'	'0.032'	'0.039'
'0.039'	'0.032'	'0.035'	'0.036'	'0.039'	'0.041'	'0.046'	'0.055'
'0.056'	'0.039'	'0.040'	'0.065'	'0.040'	'0.051'	'0.046'	'0.051'
'0.054'	'0.067'	'0.048'	'0.076'	'0.061'	'0.052'	'0.068'	'0.051'
'0.069'	'0.073'	'0.063'	'0.053'	'0.113'	'0.068'	'0.061'	'0.074'
'0.067'	'0.078'	'0.081'	'0.074'	'0.082'	'0.079'	'0.084'	'0.075'
'0.083'	'0.108'	'0.084'	'0.088'	'0.083'	'0.096'	'0.076'	'0.089']

MAG_APER_1

['22.462'	'22.461'	'22.356'	'22.636'	'22.473'	'22.464'	'22.464'	'22.478'
'22.424'	'22.472'	'22.470'	'22.464'	'22.429'	'22.572'	'22.455'	'22.468'
'22.466'	'22.474'	'22.457'	'22.439'	'22.460'	'22.335'	'22.470'	'22.366'
'22.470'	'22.422'	'22.356'	'22.471'	'22.495'	'22.437'	'22.488'	'22.500'
'22.453'	'22.464'	'22.473'	'22.467'	'22.466'	'22.434'	'22.442'	'22.450'
'22.428'	'22.413'	'22.514'	'22.491'	'22.405'	'22.442'	'22.413'	'22.428'
'22.431'	'22.489'	'22.339'	'22.430'	'22.350'	'22.435'	'22.358'	'22.408'
'22.485'	'22.608'	'22.449'	'22.458'	'22.359'	'22.402'	'22.396'	'22.461'
'22.885'	'22.490'	'22.543'	'22.471'	'24.455'	'22.323'	'22.336'	'22.610'
'22.343'	'22.421'	'22.350'	'22.474'	'22.385'	'22.461'	'22.811'	'22.521'
'22.321'	'22.380'	'22.510'	'22.460'	'22.478'	'22.481'	'22.354'	'22.371'
'22.515'	'22.515'	'22.677'	'22.493'	'22.479'	'22.394'	'22.477'	'22.353'
'22.538'	'22.523'	'22.494'	'22.395'	'22.510'	'22.399'	'22.474'	'22.425'
'22.544'	'22.472'	'22.556'	'22.914'	'22.536'	'22.481'	'22.478'	'22.469'
'22.493'	'22.376'	'22.661'	'22.439'	'22.461'	'22.516'	'22.307'	'22.372'
'22.370'	'22.271'	'22.745'	'22.551'	'22.369'	'22.506'	'22.543'	'22.281'
'22.334'	'22.214'	'22.510'	'22.451'	'22.722'	'22.424'	'22.304'	'22.754'
'22.371'	'22.532'	'22.166'	'22.332'	'22.454'	'22.606'	'22.457'	'22.562'
'22.769'	'22.066'	'22.614'	'22.229'	'23.666'	'22.140'	'22.358'	'22.494'
'22.640'	'22.276'	'22.505'	'22.468'	'22.509'	'22.687'	'22.460'	'22.445'
'22.680'	'22.373'	'22.816'	'23.291'	'22.619'	'22.398'	'22.423'	'22.367'
'22.382'	'22.626'						

['0.005'	'0.005'	'0.005'	'0.005'	'0.005'	'0.005'	'0.005'	'0.005'
'0.005'	'0.005'	'0.005'	'0.005'	'0.006'	'0.007'	'0.007'	'0.007'
'0.007'	'0.007'	'0.007'	'0.006'	'0.007'	'0.006'	'0.008'	'0.007'
'0.009'	'0.009'	'0.007'	'0.009'	'0.009'	'0.010'	'0.010'	'0.010'
'0.010'	'0.011'	'0.010'	'0.011'	'0.010'	'0.013'	'0.014'	'0.013'
'0.016'	'0.015'	'0.014'	'0.017'	'0.015'	'0.013'	'0.016'	'0.013'
'0.014'	'0.016'	'0.019'	'0.016'	'0.019'	'0.020'	'0.015'	'0.018'
'0.021'	'0.020'	'0.021'	'0.019'	'0.020'	'0.097'	'0.017'	'0.017'
'0.021'	'0.025'	'0.019'	'0.021'	'0.024'	'0.020'	'0.024'	'0.028'
'0.020'	'0.027'	'0.029'	'0.027'	'0.029'	'0.022'	'0.033'	'0.030'
'0.027'	'0.030'	'0.024'	'0.030'	'0.028'	'0.025'	'0.031'	'0.031'
'0.027'	'0.030'	'0.037'	'0.029'	'0.027'	'0.034'	'0.033'	'0.033'
'0.034'	'0.032'	'0.033'	'0.033'	'0.034'	'0.031'	'0.032'	'0.039'
'0.039'	'0.032'	'0.035'	'0.036'	'0.039'	'0.041'	'0.046'	'0.055'
'0.056'	'0.039'	'0.040'	'0.065'	'0.040'	'0.051'	'0.046'	'0.051'
'0.054'	'0.067'	'0.048'	'0.076'	'0.061'	'0.052'	'0.068'	'0.051'
'0.069'	'0.073'	'0.063'	'0.053'	'0.113'	'0.068'	'0.061'	'0.074'
'0.067'	'0.078'	'0.081'	'0.074'	'0.082'	'0.079'	'0.084'	'0.075'

'0.083' '0.108' '0.084' '0.088' '0.083' '0.096' '0.076' '0.089']

MAG_APER_2

['22.487' '22.479' '22.371' '22.719' '22.494' '22.504' '22.484' '22.509'
'22.477' '22.492' '22.498' '22.491' '22.487' '22.591' '22.490' '22.491'
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'22.503' '22.501' '22.429' '22.505' '22.558' '22.519' '22.531' '22.556'
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'22.484' '22.455' '22.503' '22.516' '22.434' '22.444' '22.419' '22.452'
'22.470' '22.509' '22.470' '22.465' '22.426' '22.471' '22.444' '22.446'
'22.540' '22.836' '22.470' '22.450' '22.475' '22.411' '22.407' '22.548'
'23.092' '22.582' '22.600' '22.538' '24.496' '22.424' '22.431' '22.782'
'22.337' '22.416' '22.425' '22.525' '22.448' '22.681' '23.165' '22.619'
'22.294' '22.545' '22.589' '22.556' '22.463' '22.647' '22.456' '22.359'
'22.546' '22.608' '23.071' '22.581' '22.668' '22.311' '22.401' '22.398'
'22.677' '22.539' '22.447' '22.456' '22.580' '22.293' '22.556' '22.577'
'22.580' '22.547' '22.653' '23.338' '22.577' '22.507' '22.601' '22.405'
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'22.399' '22.019' '22.430' '22.639' '22.696' '22.362' '22.523' '23.063'
'22.388' '22.241' '21.960' '22.357' '22.370' '22.881' '22.562' '22.403'
'22.890' '22.115' '22.749' '22.310' '24.089' '22.484' '22.320' '22.349'
'22.870' '22.146' '22.778' '22.751' '22.476' '22.915' '22.503' '22.640'
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'22.482' '22.591']

['0.005' '0.005' '0.005' '0.005' '0.005' '0.005' '0.005' '0.005' '0.005'
'0.005' '0.005' '0.005' '0.005' '0.006' '0.007' '0.007' '0.007' '0.007'
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'0.009' '0.009' '0.007' '0.009' '0.009' '0.010' '0.010' '0.010' '0.010'
'0.010' '0.011' '0.010' '0.011' '0.010' '0.013' '0.014' '0.013' '0.014'
'0.016' '0.015' '0.014' '0.017' '0.015' '0.013' '0.016' '0.013' '0.016'
'0.014' '0.016' '0.019' '0.016' '0.019' '0.020' '0.015' '0.018' '0.018'
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'0.020' '0.027' '0.029' '0.027' '0.029' '0.022' '0.033' '0.030' '0.026'
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'0.027' '0.030' '0.037' '0.029' '0.027' '0.034' '0.033' '0.033' '0.037'
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'0.039' '0.032' '0.035' '0.036' '0.039' '0.041' '0.046' '0.055' '0.037'
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'0.054' '0.067' '0.048' '0.076' '0.061' '0.052' '0.068' '0.051' '0.060'
'0.069' '0.073' '0.063' '0.053' '0.113' '0.068' '0.061' '0.074' '0.078'
'0.067' '0.074' '0.081' '0.074' '0.082' '0.079' '0.084' '0.075' '0.074'
'0.083' '0.108' '0.084' '0.088' '0.083' '0.096' '0.076' '0.089']

MAG_APER_3

['22.499' '22.492' '22.378' '22.782' '22.497' '22.532' '22.493' '22.528'
'22.492' '22.505' '22.509' '22.500' '22.512' '22.607' '22.491' '22.515'
'22.502' '22.534' '22.488' '22.498' '22.468' '22.474' '22.520' '22.468'
'22.526' '22.544' '22.449' '22.508' '22.632' '22.562' '22.573' '22.581'
'22.430' '22.451' '22.525' '22.566' '22.602' '22.435' '22.542' '22.544'
'22.504' '22.467' '22.493' '22.634' '22.426' '22.429' '22.331' '22.454'
'22.423' '22.530' '22.532' '22.477' '22.436' '22.487' '22.468' '22.406'
'22.556' '22.929' '22.502' '22.526' '22.529' '22.406' '22.400' '22.591'
'23.282' '22.612' '22.648' '22.625' '24.523' '22.464' '22.465' '22.921'
'22.253' '22.427' '22.455' '22.526' '22.867' '23.537' '22.689'
'22.251' '22.693' '22.680' '22.647' '22.498' '22.706' '22.451' '22.295'
'22.578' '22.743' '23.417' '22.607' '22.824' '22.346' '22.315' '22.377'
'22.767' '22.583' '22.562' '22.430' '22.787' '22.314' '22.596' '22.680'
'22.624' '22.733' '22.755' '23.702' '22.619' '22.313' '22.761' '22.149'
'22.527' '22.645' '22.931' '22.478' '22.645' '22.822' '22.608' '22.453'
'22.340' '21.849' '23.509' '23.035' '22.389' '22.771' '22.713' '22.393'
'22.357' '21.694' '22.582' '22.601' '23.019' '22.248' '22.722' '23.331'
'22.257' '22.247' '21.763' '22.475' '22.301' '23.253' '22.627' '22.308'
'23.107' '22.093' '22.941' '22.412' '24.557' '22.221' '22.394' '22.462'
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'23.131' '22.026' '23.249' '24.287' '22.561' '22.443' '22.728' '20.689'
'23.203' '22.582']

['0.005' '0.005' '0.005' '0.005' '0.005' '0.005' '0.005' '0.005' '0.005'
'0.005' '0.005' '0.005' '0.005' '0.006' '0.007' '0.007' '0.007' '0.007'
'0.007' '0.007' '0.007' '0.006' '0.007' '0.006' '0.008' '0.007' '0.007'
'0.009' '0.009' '0.007' '0.009' '0.009' '0.010' '0.010' '0.010' '0.010'
'0.010' '0.011' '0.010' '0.011' '0.010' '0.013' '0.014' '0.013' '0.014'
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'0.014' '0.016' '0.019' '0.016' '0.019' '0.020' '0.015' '0.018' '0.018'
'0.021' '0.020' '0.021' '0.019' '0.020' '0.097' '0.017' '0.017' '0.018']

```
'0.021' '0.025' '0.019' '0.021' '0.024' '0.020' '0.024' '0.028' '0.024'
'0.020' '0.027' '0.029' '0.027' '0.029' '0.022' '0.033' '0.030' '0.026'
'0.027' '0.030' '0.024' '0.030' '0.028' '0.025' '0.031' '0.031' '0.031'
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'0.034' '0.032' '0.033' '0.033' '0.034' '0.031' '0.032' '0.039' '0.045'
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'0.054' '0.067' '0.048' '0.076' '0.061' '0.052' '0.068' '0.051' '0.060'
'0.069' '0.073' '0.063' '0.053' '0.113' '0.068' '0.061' '0.074' '0.078'
'0.067' '0.078' '0.081' '0.074' '0.082' '0.079' '0.084' '0.075' '0.074'
'0.083' '0.108' '0.084' '0.088' '0.083' '0.096' '0.076' '0.089']
```

Step 4: Aperture photometry

Run sextractor

Path of the temporary files:
/var/folders/fk/8ny2rsqs0kgcgkhc1bqhbsrr0000gp/T/sewpy_workdir_qs4us5j6

Path of the temporary files:
/var/folders/fk/8ny2rsqs0kgcgkhc1bqhbsrr0000gp/T/sewpy_workdir_rajt_dvv

Post-process SExtractor output

```
Recalculate magnitude errors [ mag_err_+/- = -2.5 log (F +/- dF)/F ]
Runtime warning is expected if F < 0. Objects with negative flux values
are converted to 3 sigma limits [ mag = -2.5 log (3 dF); mag_err = -99 ]
```

```
/Volumes/Home/steve/anaconda/envs/py36/lib/python3.6/site-
packages/astropy/table/column.py:965: RuntimeWarning: invalid value encountered in less_equal
    return getattr(self.data, op)(other)
/Volumes/Work/Dropbox (Weizmann
Institute)/python_programs/Photometry/Photometry/phot_routines_v2.py:1284: RuntimeWarning:
invalid value encountered in log10
    errp = -2.5 * np.log10(DATA[key.replace('FLUXERR_', 'FLUX_')] - DATA[key]) + 2.5
* np.log10(DATA[key.replace('FLUXERR_', 'FLUX_')])
```

Convert instrumental to calibrated magnitudes

Step 5: Summaries

```
/Volumes/Home/steve/anaconda/envs/py36/lib/python3.6/site-
packages/astropy/table/column.py:965: RuntimeWarning:
greater_equal
    return getattr(self.data, op)(other)
```

Zeropoint

METHOD	ZP	ZP_ERRP	ZP_ERRM	NUMBER	r(FWHM)	diam(px)	MAG_3UL_GLOB	AP_cor
MAG_AUTO	22.435	0.004	0.005	147	nan	nan	21.486	0.082
MAG_PETRO	22.469	0.005	0.006	143	nan	nan	21.553	0.048
MAG_APER	22.289	0.012	0.011	158	1.0	7.140	22.777	0.228
MAG_APER_1	22.458	0.006	0.008	151	2.0	14.280	21.444	0.059
MAG_APER_2	22.489	0.006	0.007	146	3.0	21.420	21.444	0.059
MAG_APER_3	22.517	0.012	0.011	146	4.0	28.560	21.444	0.059

Science

One or more object found within 5.0 arcsec from the

PROPERTY	VALUE	ERROR+	ERROR-	COMMENT
FILENAME	nan	nan	nan	SN2015bn_SDSS_r.fits
DATE-OBS	nan	nan	nan	...
MJD	nan	nan	nan	...
EXPTIME	nan	nan	nan	...
NCOMBINE	nan	nan	nan	1
PHOTCAL	nan	nan	nan	SDSS_r.cat
RA	173.42313	nan	nan	degree
DEC	0.725972	nan	nan	degree

Summary of the ZP
measurement for each aperture

Summary of the photometry of
your science object

X_IMAGE_EXP	1212.0	nan	nan	px
Y_IMAGE_EXP	1212.0	nan	nan	px
XWIN_IMAGE_OBS	1211.9	nan	nan	px
YWIN_IMAGE_OBS	1210.9	nan	nan	px
DISTANCE (px)	1.14	nan	nan	px
DISTANCE (arcsec)	0.45	nan	nan	arcsec
MAG_APER_PHOTUTILS	nan	nan	nan	mag
MAG_APER_PHOTUTILS_3SIGMA	nan	nan	nan	mag
FNU_APER_PHOTUTILS	nan	nan	nan	mag
MAG_APER_1_PHOTUTILS	nan	nan	nan	mag
MAG_APER_1_PHOTUTILS_3SIGMA	nan	nan	nan	mag
FNU_APER_1_PHOTUTILS	nan	nan	nan	mag
MAG_APER_2_PHOTUTILS	nan	nan	nan	mag
MAG_APER_2_PHOTUTILS_3SIGMA	nan	nan	nan	mag
FNU_APER_2_PHOTUTILS	nan	nan	nan	mag
MAG_APER_3_PHOTUTILS	nan	nan	nan	mag
MAG_APER_3_PHOTUTILS_3SIGMA	nan	nan	nan	mag
FNU_APER_3_PHOTUTILS	nan	nan	nan	mag
MAG_AUTO	22.852	0.375	0.278	mag
MAG_PETRO	22.985	0.718	0.428	mag
MAG_APER	22.835	0.363	0.271	mag
MAG_APER_1	23.243	1.33	0.58	mag
MAG_APER_2	25.869	nan	2.748	mag
MAG_APER_3	121.517	nan	nan	mag

Step 6: Make poststamp

Step 7: Save to file

Step 8: Remove all temps