MaNGA data structure

居梦婷

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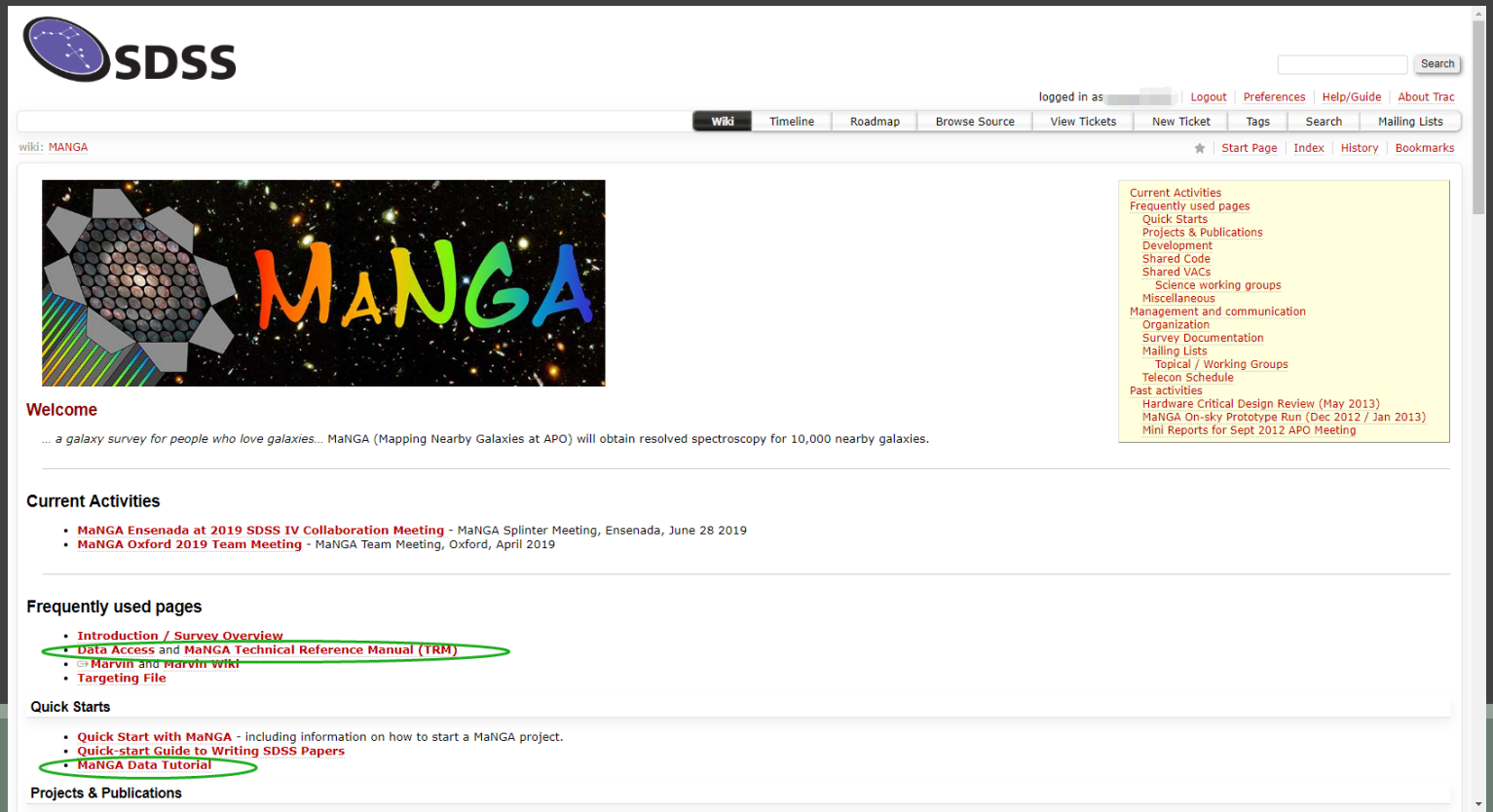
简介 https://trac.sdss.org/wiki/MANGA

Manga(Mapping Nearby Galaxies at APO)所有的文件说明，全在manga wiki上。我讲的内容基本上都是Wiki上可以查到的。(all contents can see in webside)



简介

Frequently used pages

- Introduction / Survey Overview
- Data Access and MaNGA Technical Reference Manual (TRM)
- Marvin and Marvin Wiki
- Targeting File

Quick Starts

- Quick Start with MaNGA - including information on how to start a MaNGA project.
- Quick-start Guide to Writing SDSS Papers
- MaNGA Data Tutorial

Projects & Publications

- MaNGA Project listings: Informal wiki pages for individual MaNGA science projects development.
- Project Archive: Official SDSS-IV site.
- Publication Archive: Official SDSS-IV site
- MaNGA post-stamps: Monthly plots to debate on scientific results.
- MaNGA Style Guide: Style and usage guidance for talks and papers.

Development

Data and Software	Projects	Sample Design	Operations	Hardware	EPO

- Data products policy and the Data Products Committee (DPC)

简介

数据获取：组里的服务器/wiki

Data Access

MPL-8 6507 represent galaxies

To be announced in November 2018, MPL-8 contains the output of version-2_5_3 of the Data Reduction Pipeline. The products are based on galaxy and stellar library observations from March 2014 - July 2018. In this version, all minibundle observations from dark and bright-time plates now contribute to the MaStar 1d stellar spectra instead of producing data cubes. This release also fixes an issue with the fiber bundle metrology scaling that will affect reconstructed images and flux calibration at a low level for almost all MaNGA data.

Product	Version	Tag Date	Status	What's New?	Known Issues	SAS Location	Contact	Description	Documentation
DRP	v2_5_3	Oct 23, 2018	**Science**	See: What's New	See: Known Issues	redux/MPL-8	David Law	950 plates - 6779 data cubes, 20649 stellar library stars. Fully reduced intermediate products, fiber row-stacked spectra (RSS), and datacubes. 13 TB.	MPL-8 Technical Reference Manual
DAP	2.3.0	31 Jan 2019	**Science**	See: What's New	See: Known Issues	analysis/MPL-8	Kyle Westfall	`MAPS` and new model `LOGCUBE` files for 3 analysis approaches (SPX, VOR10, HYB10) of (6520, 6515, 6500) observations.	MPL-8 Technical Reference Manual
Pipe3D	v2.5.3	Dec, 2018	**Contributed Product**	See: What's New	See: Known Issues	/pipe3d/v2_5_3/2.5.3/	Sebastian Sanchez	6457 galaxies.	Pipe3D mainpage

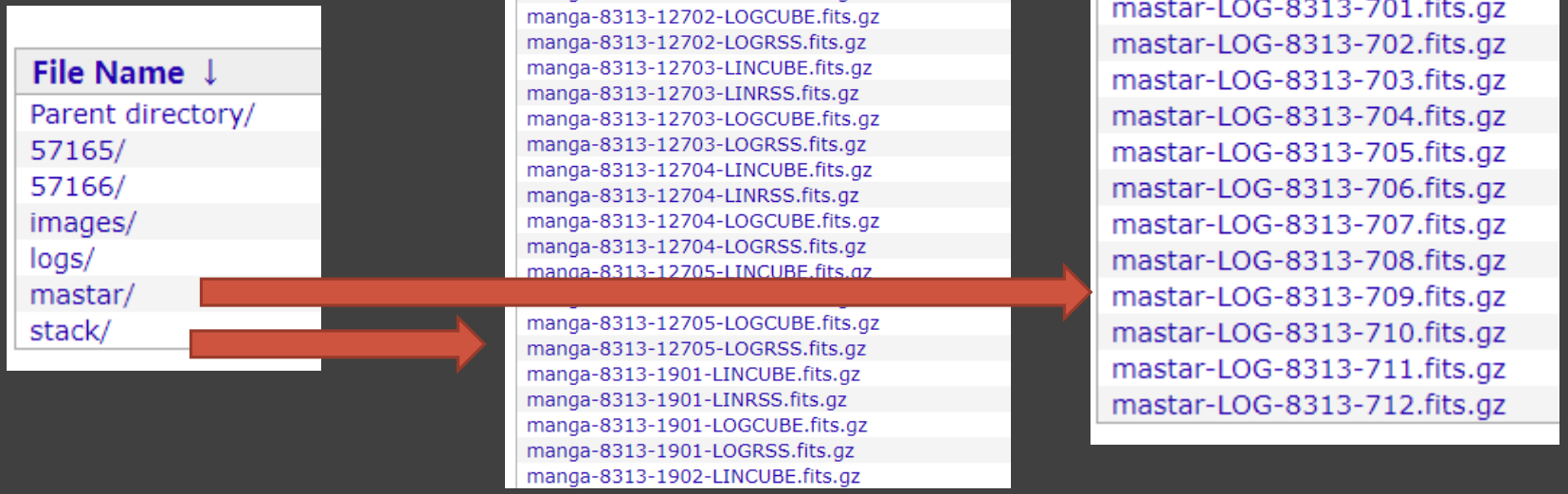
MPL-7 4706 represent galaxies

Announced in April 2018, MPL-7 contains the output of version-2_4_3 of the Data Reduction Pipeline. The products are based on galaxy and stellar library observations from March 2014 - July 2017. The objects in MPL-7 are exactly the same as MPL-6 but include an overhaul of the MaStar spectra and some minor bugfixes to the MaNGA data. MPL-7 is identical to DR15 to be released in December 2018 (symlinks to the same files).

Product	Version	Tag Date	Status	What's New?	Known Issues	SAS Location	Contact	Description	Documentation
DRP	v2_4_3	Mar 16, 2018	**Science**	See: What's New	See: Known Issues	redux/MPL-7	David Law	675 plates - 4706 galaxies, 6608 stellar library stars. Fully reduced intermediate products, fiber row-stacked spectra (RSS), and datacubes. 8.7 TB.	MPL-7 Technical Reference Manual
DAP	2.2.1	Mar 28, 2018	**Science**	See: What's New	See: Known Issues	analysis/MPL-7	Kyle Westfall	`MAPS` and new model `LOGCUBE` files for 2 analysis approaches (VOR10, HYB10) of (4722, 4718) observations, or (4652, 4648) unique galaxies.	MPL-7 Technical Reference Manual
Pipe3D	v2.4.3	May, 2018	**Contributed Product**	See: What's New	See: Known Issues	/pipe3d/v2_4_3/2.4.3/	Sebastian Sanchez	4676 observations.	Pipe3D mainpage

DRP
(Data Reduction Pipeline)

DRP



文件名	Spaxel个数 （每个格子长度约0.5”）
19	34*34（32*32）
37	44*44
61	54*54
91	64*64
127	74*74

DRP(wiki 数据介绍）

Frequently used pages

- Introduction / Survey Overview
- Data Access and MaNGA Technical Reference Manual (TRM)
- ⇨Marvin and Marvin Wiki
- Targeting File

Available editions of the TRM:

- Active Development
- MPL-8 (Fall 2018)
- MPL-7 (Spring 2018; identical to DR15)
- MPL-6 (Fall 2017)
- MPL-5 (Summer 2016)
- MPL-4 (Fall 2015; nearly identical to DR13)
- MPL-3 (Spring 2015)
- MPL-2 (Fall 2014)
- MPL-1 (Spring 2014)

Public Installation Guide- DR13

This link is temporarily included during a transition and should not be used:

- Version 1.0 (Spring 2014) [deprecated]

所有版本的数据介绍，都在这个网页中。

这次用的数据，主要是 MPL-8

(MaNGA Product Launches)

DRP(wiki 数据介绍）

1. Introduction
2. What's New in MPL-8
3. Known Issues in MPL-8

Operations, Observing, and Target Selection

Owned by Renbin and Jose?

4. Planning and Operations (OUTDATED)
5. Target Selection Data Model (OUTDATED)

Data Reduction Pipeline

Owned by David and Brian

6. DRP Metadata Model
7. DRP Data Model
8. Data Reduction Pipeline Overview (DRP and DOS) (OUTDATED)
9. Guide to installing and running the DRP

Data Analysis Pipeline (DAP)

Owned by Kyle and Brett

1. Introduction
2. What's New in MPL-8
3. Known Issues in MPL-8
Operations, Observing, and Target Selection
4. Planning and Operations (OUTDATED)
5. Target Selection Data Model (OUTDATED)
Data Reduction Pipeline
6. DRP Metadata Model
7. DRP Data Model
8. Data Reduction Pipeline Overview (DRP and DOS) (OUTDATED)
9. Guide to installing and running the DRP
Data Analysis Pipeline (DAP)
10. Getting started with DAP output data
11. DAP Metadata Model
12. DAP Data Model
13. Data Analysis Pipeline Overview (DAP)
14. DAP installation, execution, and development guidelines
Databases and data delivery
15. Databases (OUTDATED)
16. Data Delivery (OUTDATED)

DRP数据结构

RSS和cube的区别在于一个是原始观测数据，一个是处理后的数据

6.5.2、3 和6.5.4、5 主要的区别在于波长的不同，前两个是 log10 的对数波长，后两个线性波长。

*我们**常用**的数据主要就是官方已经处理好的直接用的**logcube的数据**。*

manga-[PLATE]-[IFUDESING]-LOGCUBE.fits.gz

6. MaNGA TRM: Data Model
  - 6.1. Raw Data
    - 6.1.1. sdR-[CAMERA]-[EXPNUM].fit.gz
  - 6.2. Preimaging data
  - 6.3. DOS output
    - 6.3.1. mgtset-[MJD]-[PLATE]-[EXPNUM]-[CAMERA].fits
    - 6.3.2. mgwset-[MJD]-[PLATE]-[EXPNUM]-[CAMERA].fits
    - 6.3.3. mgfflat-[MJD]-[PLATE]-[EXPNUM]-[CAMERA].fits
    - 6.3.4. mgsci-[PLATE]-[CAMERA]-[EXPNUM].fits
    - 6.3.5. mgscisky-[PLATE]-[CAMERA]-[EXPNUM].fits
  - 6.4. DRP 2d output
    - 6.4.1. mgArc-[CAMERA]-[EXPNUM].fits.gz
    - 6.4.2. mgFlat-[CAMERA]-[EXPNUM].fits.gz
    - 6.4.3. mgFrame-[CAMERA]-[EXPNUM].fits.gz
    - 6.4.4. mgSFrame-[CAMERA]-[EXPNUM].fits.gz
    - 6.4.5. fluxcal-[SPEC]-[EXPNUM].fits.gz
    - 6.4.6. mgFFrame-[CAMERA]-[EXPNUM].fits.gz
    - 6.4.7. mgCFrame-[EXPNUM]-LOG.fits.gz
    - 6.4.8. mgCFrame-[EXPNUM]-LIN.fits.gz
  - 6.5. DRP 3d output: Dark time data
    - 6.5.1. HDUCLASS
    - 6.5.2. manga-[PLATE]-[IFUDESIGN]-LOGRSS.fits.gz
    - 6.5.3. manga-[PLATE]-[IFUDESIGN]-LOGCUBE.fits.gz
    - 6.5.4. manga-[PLATE]-[IFUDESIGN]-LINRSS.fits.gz
    - 6.5.5. manga-[PLATE]-[IFUDESIGN]-LINCUBE.fits.gz
  - 6.6. DRP 3d output: Bright time data
    - 6.6.1. mastar-LOG-[PLATE]-[IFUDESIGN]-[MJD].fits.gz

HDU #0 = Empty except for global header
HDU #1 [FLUX] = 3d rectified cube in units of $10^{(-17)}$ erg/s/cm^2/Angstrom/spaxel [NX x NY x NWAVE]
HDU #2 [IVAR] = Inverse variance (1/sigma^2) for the above [NX x NY x NWAVE]
HDU #3 [MASK] = Pixel mask [NX x NY x NWAVE] (defined values are set in https://trac.sdss.org/browser/repo/sdss/idlutils/trunk/data/sdss/sdssMaskbits.par)
HDU #4 [DISP] = Broadened dispersion solution (1sigma LSF in units of Angstroms) [NX x NY x NWAVE]
HDU #5 [PREDISP] = Broadened pre-pixel dispersion solution (1sigma LSF in Angstroms) [NX x NY x NWAVE]
HDU #6 [WAVE] = Wavelength vector [NWAVE]
HDU #7 [SPECRES] = Median spectral resolution as a function of wavelength for the fibers in this IFU [NWAVE]
HDU #8 [SPECRESD] = Standard deviation of spectral resolution as a function of wavelength for the fibers in this IFU [NWAVE]
HDU #9 [PRESPECRES] = Median pre-pixel spectral resolution as a function of wavelength for the fibers in this IFU [NWAVE]
HDU #10 [PRESPECRESD] = Standard deviation of pre-pixel spectral resolution as a function of wavelength for the fibers in this IFU [NWAVE]
HDU #11 [OBSINFO] = Yanny-format structure detailing exposures that went into this file. [BINARY FITS TABLE]
HDU #12 [GIMG] = Broadband 'g' image created from the data cube
HDU #13 [RIMG] = Broadband 'r' image created from the data cube
HDU #14 [IIMG] = Broadband 'i' image created from the data cube
HDU #15 [ZIMG] = Broadband 'z' image created from the data cube
HDU #16 [GPSF] = Reconstructed 'g'-band point source profile
HDU #17 [RPSF] = Reconstructed 'r'-band point source profile
HDU #18 [IPSF] = Reconstructed 'i'-band point source profile
HDU #19 [ZPSF] = Reconstructed 'z'-band point source profile
HDU #20 [GCORREL] = Binary table containing 'g' band sparse correlation matrix; see description here
HDU #21 [RCORREL] = Binary table containing 'r' band sparse correlation matrix; see description here
HDU #22 [ICORREL] = Binary table containing 'i' band sparse correlation matrix; see description here
HDU #23 [ZCORREL] = Binary table containing 'z' band sparse correlation matrix; see description here

DRP数据结构

HDU #0 = 空
HDU #1 [FLUX] = 流量（eg 34*34*4563)
HDU #2 [IVAR] = 误差(1/sigma^2) （eg. 34*34*4563)
HDU #3 [MASK] = MASK （eg. 34*34*4563)
HDU #6 [WAVE] = 波长（真空） （eg. 34*34*4563)
HDU #12~15 [G~ZIMG] = ‘g‘, ’r’ , ‘i’ , ‘z’ 波段数据（全谱）
HDU #16 ~19[G~ZPSF] = ‘g‘, ’r’ , ‘i’ , ‘z’ 波段PSF
HDU #20~23 [G~ZCORREL] = ‘g‘, ’r’ , ‘i’ , ‘z’ sparse correlation matrix（与logcube数据内插有关）

```
Filename: /share/data/sdss/manga/DRP/MPL-8/8313/stack/manga-8313-1901-LOGCUBE.fits.gz
No.    Name         Ver    Type      Cards   Dimensions   Format
  0  PRIMARY       1 PrimaryHDU       75   ()
  1  FLUX          1 ImageHDU        100   (34, 34, 4563)   float32
  2  IVAR          1 ImageHDU         17   (34, 34, 4563)   float32
  3  MASK          1 ImageHDU         17   (34, 34, 4563)   int32
  4  DISP          1 ImageHDU         11   (34, 34, 4563)   float32
  5  PREDISP       1 ImageHDU         11   (34, 34, 4563)   float32
  6  WAVE          1 ImageHDU          9   (4563,)   float64
  7  SPECRES       1 ImageHDU          9   (4563,)   float64
  8  SPECRESD      1 ImageHDU          9   (4563,)   float64
  9  PRESPECRES    1 ImageHDU          9   (4563,)   float64
 10  PRESPECRESD     1 ImageHDU          9   (4563,)   float64
 11  OBSINFO       1 BinTableHDU     148   9R x 65C   [25A, 17A, 5A, J, I, 8A, E, E, E, E, E, E, J, J
A, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, E, 13A, E, E, E, E, D, D, D, D, E, E, J, J
, J, J, E, E, E, E]
 12  GIMG          1 ImageHDU         28   (34, 34)   float32
 13  RIMG          1 ImageHDU         28   (34, 34)   float32
 14  IIMG          1 ImageHDU         28   (34, 34)   float32
 15  ZIMG          1 ImageHDU         28   (34, 34)   float32
 16  GPSF          1 ImageHDU         28   (34, 34)   float32
 17  RPSF          1 ImageHDU         28   (34, 34)   float32
 18  IPSF          1 ImageHDU         28   (34, 34)   float32
 19  ZPSF          1 ImageHDU         28   (34, 34)   float32
 20  GCORREL       1 BinTableHDU      32   20189R x 5C   [J, J, J, J, D]
 21  RCORREL       1 BinTableHDU      32   20030R x 5C   [J, J, J, J, D]
 22  ICORREL       1 BinTableHDU      32   20698R x 5C   [J, J, J, J, D]
 23  ZCORREL       1 BinTableHDU      32   21110R x 5C   [J, J, J, J, D]
```

DRP（头文件）

基础信息（mangaid，坐标之类的在第0/1层）

```
drp[1].header
```

```
XTENSION= 'IMAGE   '           / IMAGE extension
BITPIX  =                  -32 / Number of bits per data pixel
NAXIS   =                    3 / Number of data axes
NAXIS1  =                   34 /
NAXIS2  =                   34 /
NAXIS3  =                 4563 /
PCOUNT  =                    0 / No Group Parameters
GCOUNT  =                    1 / One Data Group
AUTHOR  = 'Brian Cherinka & David Law <bcherin1@jhu.edu, dlaw@stsci.edu>' /
VERSDRP2= 'v2_3_1  '           / MaNGA DRP version (2d processing)
VERSDRP3= 'v2_3_1  '           / MaNGA DRP Version (3d processing)
VERSPLDS= 'v2_52   '           / Platedesign Version
VERSFLAT= 'v1_26   '           / Specflat Version
VERSCORE= 'v1_6_0  '           / MaNGAcore Version
VERSPRIM= 'v2_5    '           / MaNGA Preimaging Version
VERSUTIL= 'v5_5_30 '           / Version of idlutils
VERSIDL = 'x86_64 linux unix linux 7.1.1 Aug 21 2009 64 64 ' / Version of IDL
BSCALE  =              1.00000 / Intensity unit scaling
BZERO   =              0.00000 / Intensity zeropoint
BUNIT   = '1E-17 erg/s/cm^2/Ang/spaxel' / Specific intensity (per spaxel)
MASKNAME= 'MANGA_DRP3PIXMASK' / Bits in sdssMaskbits.par used by mask extension
TELESCOP= 'SDSS 2.5-M'         / Sloan Digital Sky Survey
INSTRUME= 'MaNGA   '           / SDSS-IV MaNGA IFU
SRVYMODE= 'MaNGA dither'       / Survey leading this observation and its mode
PLATETYP= 'APOGEE-2&MaNGA'     / Type of plate (e.g. MaNGA, APOGEE-2&MANGA)
OBJSYS  = 'ICRS    '           / The TCC objSys
```

Mask类型

```
TPLDATA = 'BOSZ_3000-11000A.fits' /
NEXP    =                    9 / Total number of exposures
EXPTIME =               8100.69 / Total exposure time (seconds)
BLUESN2 =               28.4318 / Total SN2 in blue channel
REDSN2  =               47.4029 / Total SN2 in red channel
AIRMSMIN=               1.01287 / Minimum airmass
AIRMSMED=               1.03529 / Median airmass
AIRMSMAX=               1.11705 / Maximum airmass
SEEMIN  =               1.30285 / Best guider seeing
SEEMED  =               1.56713 / Median guider seeing
SEEMAX  =               1.74604 / Worst guider seeing
TRANSMIN=              0.812497 / Worst guider transparency
TRANSMED=              0.850412 / Median guider transparency
TRANSMAX=              0.859391 / Best guider transparency
MJDMIN  =                 57165 / MJD of first exposure
MJDMED  =                 57165 / MJD of median exposure
MJDMAX  =                 57166 / MJD of last exposure
DATE-OBS= '2015-05-23'         / Date of median exposure
MJDRED  =                 58043 / MJD of the reduction
DATERED = '2017-10-17'         / Date of the reduction
MNGTARG1=                  1168 / manga_target1 maskbit
MNGTARG2=                     0 / manga_target2 maskbit
MNGTARG3=                     0 / manga_target3 maskbit
IFURA   =       240.287130000 / IFU R.A. (J2000 deg.)
IFUDEC  =       41.8807490000 / IFU Dec. (J2000 deg.)
OBJRA   =       240.287125377 / Object R.A. (J2000 deg.)
OBJDEC  =       41.8807489359 / Object Dec. (J2000 deg.)
CENRA   =       241.038070000 / Plate center R.A. (J2000 deg.)
CENDEC  =       41.2252620000 / Plate center Dec. (J2000 deg.)
```

重点：头文件没有红移

```
PLATEID =                 8313 / Current plate
DESIGNID=                 8826 / Current design
IFUDSGN =                 1901 / ifuDesign
FRLPLUG =                   29 / Plugged ferrule
PLATEIFU= '8313-1901'          / PLATEID-ifuDesign
CARTID  = '1       '           / Cart(s) used
HARNAME = 'ma032   '           / Harness name(s)
METFILE = 'ma032-56834-1.par'  / IFU metrology file(s)
MANGAID = '1-248352'           / MaNGA ID number
CATIDNUM= '1       '           / Primary target input catalog
PLTTARG = 'plateTargets-1.par' / plateTarget reference file
DRP3QUAL=                    0 / DRP-3d quality bitmask
IFUGLON =       66.5447651125 / IFU Galactic longitude (deg)
IFUGLAT =       48.8239292790 / IFU Galactic latitude (deg)
EBVGAL  =           0.0138495 / Galactic reddening E(B-V)
GFWHM   =             2.59661 / Reconstructed FWHM in g-band (arcsec)
RFWHM   =             2.58166 / Reconstructed FWHM in r-band (arcsec)
IFWHM   =             2.55897 / Reconstructed FWHM in i-band (arcsec)
ZFWHM   =             2.52468 / Reconstructed FWHM in z-band (arcsec)
CTYPE3  = 'WAVE-LOG'           /
CRPIX3  =                    1 / Starting pixel (1-indexed)
CRVAL3  =       3621.59598486 / Central wavelength of first pixel
CD3_3   =      0.833903304339 / Initial dispersion per pixel
CUNIT3  = 'Angstrom'           /
CRPIX1  =             18.0000 /Reference pixel (1-indexed)
CRPIX2  =             18.0000 /Reference pixel (1-indexed)
CRVAL1  =       240.287130000 /
CRVAL2  =       41.8807490000 /
CD1_1   =        -0.000138889 /
CD2_2   =         0.000138889 /
```

数据的健康状况

pixelscale in x, in degree

（网站上写错了）

DRP（头文件）

Mask文件阅读

HDU #2 [IVAR] = Inverse variance (1/sigma^2) for the above [NX x NY x NWAVE]
HDU #3 [MASK] = Pixel mask [NX x NY x NWAVE] (defined values are set in https://trac.sdss.org/browser/repo/sdss/idlutils/trunk/data/sdss/sdssMaskbits.par)

有链接，根据头文件里提供的mask类型选择（理论上mask=0的数据才是有用的）

eg.

```
1062 # The following mask bits are for a cube spaxel, set in MDRP_DRP3PIXMASK_BITS()
1063 masktype MANGA_DRP3PIXMASK 32 "Mask bits per spaxel for a MaNGA data cube."
1064 maskbits MANGA_DRP3PIXMASK  0  NOCOV       "No coverage in cube"
1065 maskbits MANGA_DRP3PIXMASK  1  LOWCOV      "Low coverage depth in cube"
1066 maskbits MANGA_DRP3PIXMASK  2  DEADFIBER   "Major contributing fiber is dead"
1067 maskbits MANGA_DRP3PIXMASK  3  FORESTAR    "Foreground star"
1068 maskbits MANGA_DRP3PIXMASK 10  DONOTUSE    "Do not use this spaxel for science"
1069
```

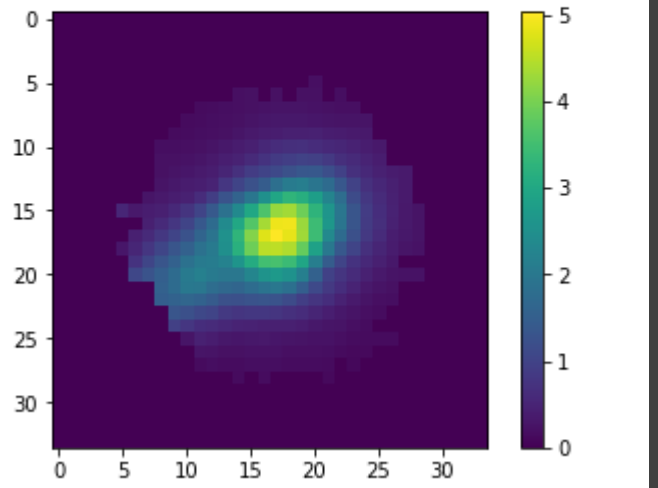
DRP

Broadband 'g' image created from the data cube *#HDU12*

Reconstructed 'r'-band point source profile *#HDU17*

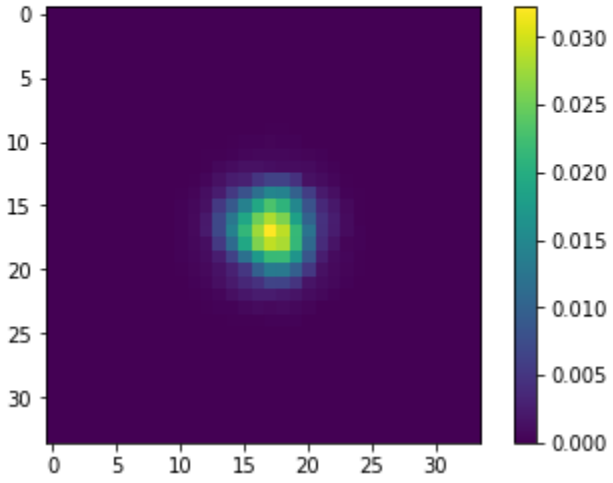
```
imshow(drp[12].data)        #  HDU#12
colorbar()
```

```
<matplotlib.colorbar.Colorbar at 0x26ec1bbcef0>
```




```
imshow(drp[17].data)        #  HDU#17
colorbar()
```

```
<matplotlib.colorbar.Colorbar at 0x26ec1c5fda0>
```



m = [22.5 mag] – 2.5 $\log_{10} f$.

DRP（补充）

https://trac.sdss.org/wiki/MANGA/TRM/TRM_MPL-8/metadata

Mandatory columns (for all typeid) are:
1) designid: Design ID of the plate
2) plateid: Plate ID (0 if unknown)
3) manga_tileid: the MaNGA-specific tile (field) identifier
4) ifudesign: The IFU (e.g., 12701) meant to be used
5) mangaid: The XX-XXXX format mangaid
6) neverobserve: if set to 1, this target won't be observed and will be ignored by the reduction pipeline.
7) ifu_ra: RA of the IFU center in decimal degrees
8) ifu_dec: DEC of the IFU center in decimal degrees
9) object_ra: RA of the target center (usually same as ifu_ra, unless offset)
10) object_dec: DEC of the target center (usually same as ifu_dec, unless offset)
11) catalog_ra: RA of the target in its parent catalogue (usually same as ifu_ra and object_ra, unless offset).
12) catalog_ra: DEC of the target in its parent catalogue (usually same as ifu_ra and object_dec, unless offset).
13) racen: RA of the plate center
14) deccen: DEC of the plate center
15) xfocal: xfocal location of the IFU hole in the plate
16) yfocal: yfocal location of the IFU hole in the plate
17) epoch: Epoch of the coordinates
18) manga_target1: Primary target bitmask. To be used for galaxies.
19) manga_target2: Secondary target bitmask. To be used for stars, standards and sky positions.
20) manga_target3: Tertiary target bitmask. To be used for ancillary programs.
21) ifudesignsize: The size of the IFU assigned to the target.
22) ifutargetsize: The size of the IFU that was meant to be assigned. Same as ifudesignsize unless changed during the plate design process.
23) ifudesignwrongsize: 1 if the IFU assigned is of the wrong size (for instance, if it does not cover 1.5Reff).

The following columns are included in `plateTargets-1.par` and `plateTargets-12.par`. Other plateTargets may include different columns:
24) zmin: The minimum redshift at which the galaxy could still have been included in the Primary sample.
25) zmax: The maximum redshift at which the galaxy could still have been included in the Primary sample.
26) szmin: The minimum redshift at which the galaxy could still have been included in the Secondary sample.
27) szmin: The maximum redshift at which the galaxy could still have been included in the Secondary sample.
28) ezmin: The minimum redshift at which the galaxy could still have been included in the Color-Enhanced sample.

drpall 的说明

MANGA_DRP3QUAL bits:

BIT	VALUE	LABEL	DESCRIPTION
0	1	RETIRED	Bit is retired from use
1	2	BADDEPTH	IFU does not reach target depth
2	4	SKYSUBBAD	Bad sky subtraction in one or more frames
3	8	HIGHSCAT	High scattered light in one or more frames
4	16	BADASTROM	Bad astrometry in one or more frames
5	32	VARIABLELSF	LSF varies signif. between component spectra
6	64	BADOMEGA	Omega greater than threshhold in one or more sets
7	128	BADSET	One or more sets are bad
8	256	BADFLUX	Bad flux calibration
9	512	BADPSF	PSF estimate may be bad
10	1024	MANYDEAD	Many dead fibers
11	2048	RETIRED2	Bit retired, moved into MASTAR_QUAL instead
30	1073741824	CRITICAL	Critical failure in one or more frames

数据健康状况（头文件里可以查）

DAP
(Data Analysis Pipeline)

DAP数据类型

Available editions of the TRM:

- Active Development
- MPL-8 (Fall 2018)
- MPL-7 (Spring 2018; identical to DR15)
- MPL-6 (Fall 2017)
- MPL-5 (Summer 2016)
- MPL-4 (Fall 2015; nearly identical to DR13)
- MPL-3 (Spring 2015)
- MPL-2 (Fall 2014)
- MPL-1 (Spring 2014)

Public Installation Guide- DR13

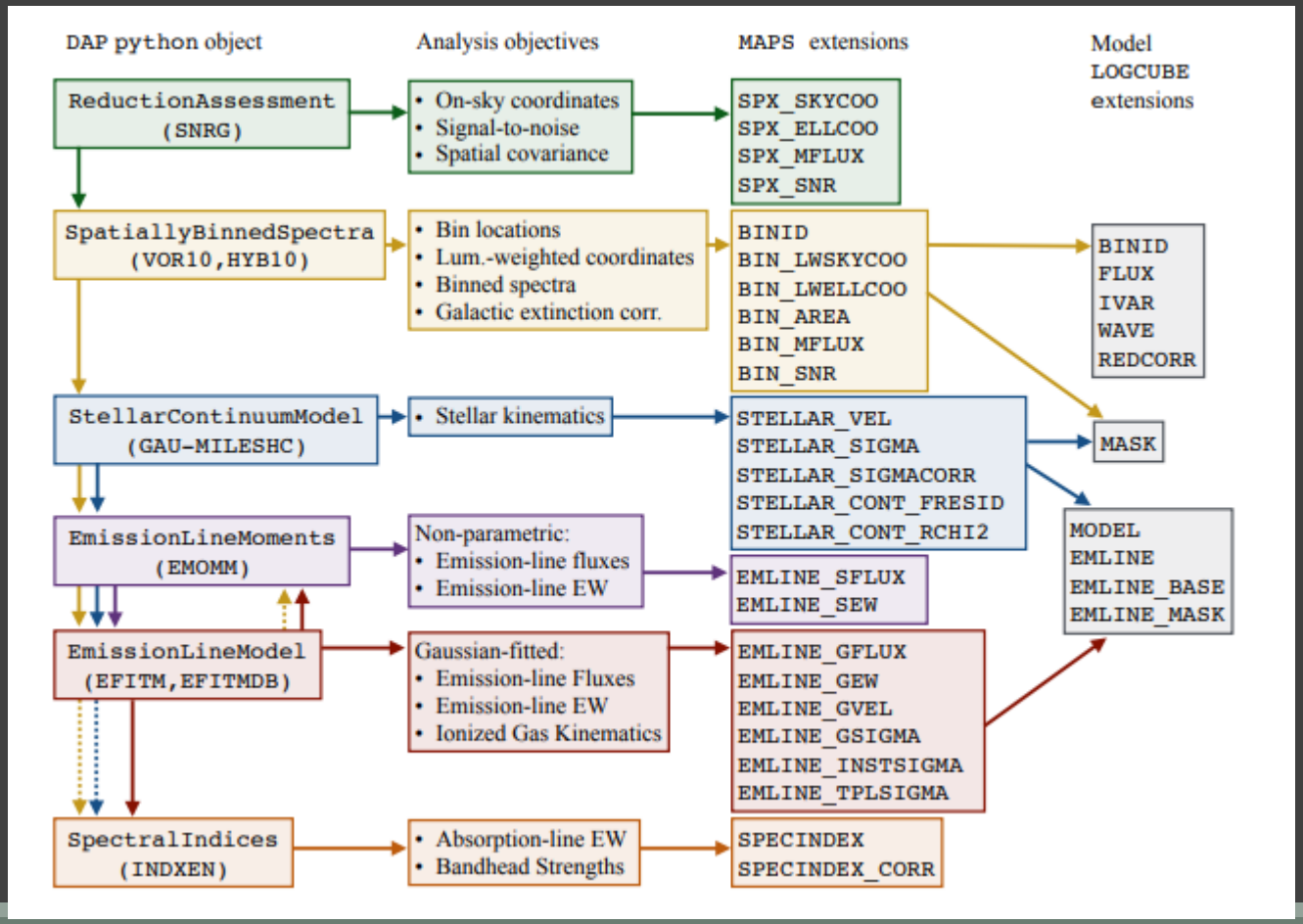
Data Analysis Pipeline (DAP)

Owned by Kyle and Brett

10. Getting started with DAP output data
11. DAP Metadata Model
12. DAP Data Model
13. Data Analysis Pipeline Overview (DAP)
14. DAP installation, execution, and development guidelines

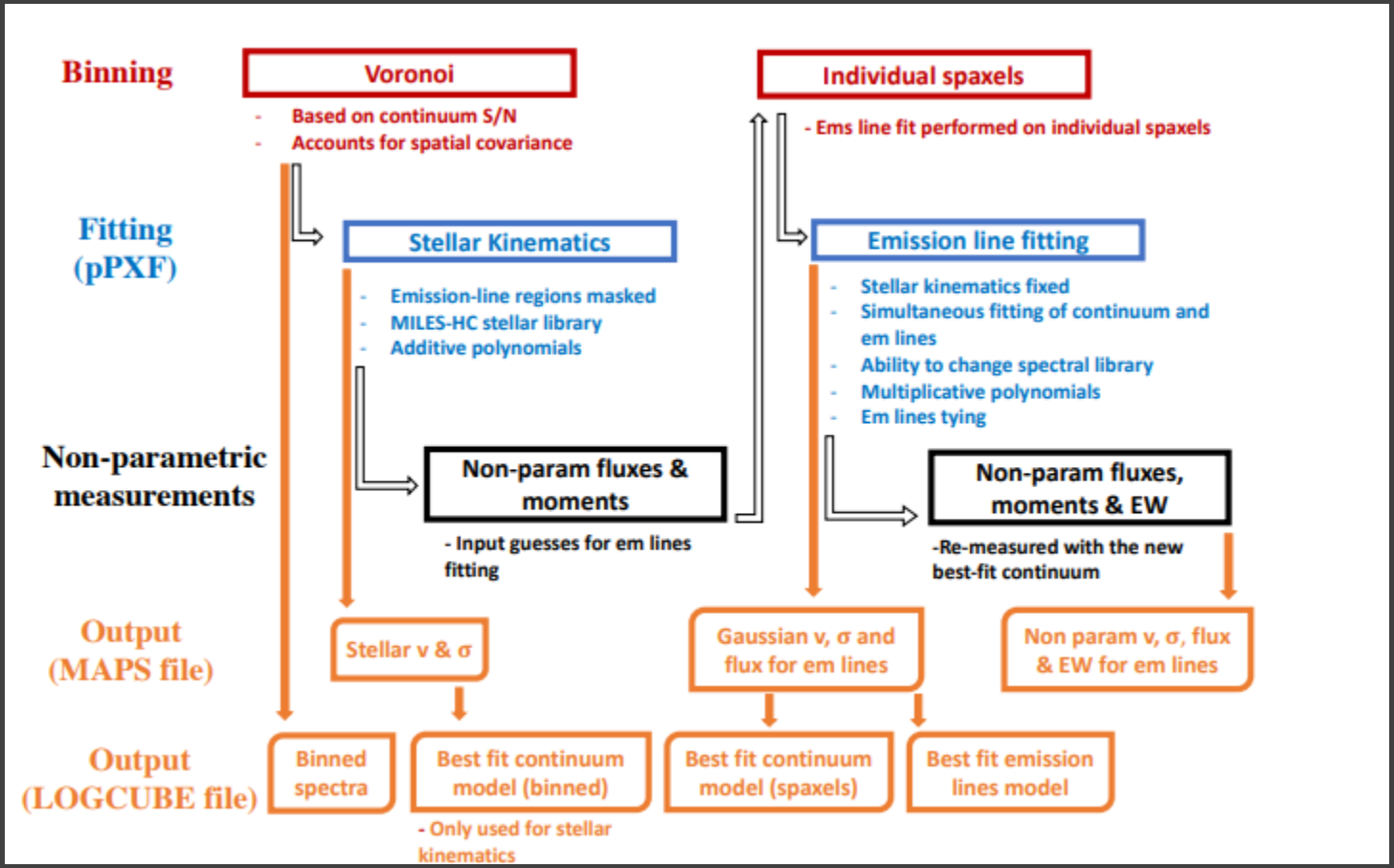
DAP数据类型

arXiv:1901.00856v1



DAP数据类型

arXiv:1901.00866v2



DAP数据类型

一共有三种DAP数据类型

- SPX-MILESHC-MILESHC/ - Analysis of each individual spaxel; spaxels must have a valid continuum fit for an emission-line model to be fit
- VOR10-MILESHC-MILESHC/ - Analysis of spectra binned to S/N~10 using the Voronoi binning algorithm (Cappellari & Copin 2003)
- HYB10-MILESHC-MILESHC/ - Stellar-continuum analysis of spectra binned to S/N~10 for the stellar kinematics (same as VOR10 approach); however, the emission-line measurements are performed on the individual spaxels. See a description of the hybrid binning scheme here and here.

ALL——全加起来

NRE——bin了0-1，1-2有效半径数据

在MPL-8之前的数据类型

SPX——没bin，每个spaxel独立

VOR10——bin S/N~10的spaxel

HYB10——（从MPL-6开始才有的）和VOR一样的bin，发射线数据是每个spaxel的数据

DAP数据类型

除了常用的这三种，官方还提供了他们在拟合时会用的东西或者是部分产物（我的理解），在ref文件中。

https://trac.sdss.org/wiki/MANGA/TRM/TRM_MPL-8/DAPDataModel#ReferenceFilesOUTOFDATE

- `snrtype` : Currently just `SNRG`
- `bintype` : Can be `SPX`, `VOR10`, `HYB10`, `NRE`, or `ALL`
- `sctype` : Currently just `GAU-MILESHC`
- `elmtype` : Currently just `EMOMM`
- `elftype` : Can be `EFITM` or `EFITMDB`
- `sitype` : Can be `INDXEN` or `INDXEND`

对于想要重新run dap数据的人也许有帮助。

DAP数据结构

所有的数据都有LOGCUB和MAP的数据

```
qa/
ref/
manga-8084-6101-LOGCUBE-SPX-MILESHC-MILESHC.fits.gz
manga-8084-6101-MAPS-SPX-MILESHC-MILESHC.fits.gz
```

```
qa/
ref/
manga-8079-6101-LOGCUBE-VOR10-MILESHC-MILESHC.fits.gz
manga-8079-6101-MAPS-VOR10-MILESHC-MILESHC.fits.gz
```

```
qa/
ref/
manga-8081-6103-LOGCUBE-HYB10-MILESHC-MILESHC.fits.gz
manga-8081-6103-MAPS-HYB10-MILESHC-MILESHC.fits.gz
```

- **qa/:** Contains (limited) PNG plots for quick QA of the output.
- **ref/:** A reference directory with intermediate files written during processing.

LOGCUB是光谱数据，MAP是二维map数据（即已经通过光谱拟合分析好的数据，如流量，速度等）

stellar (MILES-HC) and SSP (M11-MILES, MIUSCAT, BC03) templates.

DAPTYPE is now `binning-stellar templates-emission-line templates`.

DAP数据结构

LOGCUBE

Data Analysis Pipeline (DAP)

Owned by Kyle and Brett

10. Getting started with DAP output data

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The `LOGCUBE` files contain the following extensions:

HDU No.	Name	Units	Description
0	PRIMARY		Empty extension with primary header information.
1	FLUX	10^{-17} erg/s/cm^2/angstrom/spaxel	Flux of the *binned* spectra
2	IVAR		Inverse variance in the binned spectra
3	MASK		Bitmask for the binned spectra. **New to MPL-8**, note that this mask only applies to the binned spectra.
4	WAVE	angstrom	Vacuum-wavelength vector
5	REDCORR		Reddening correction applied during the fitting procedures; `dereddened_flux = FLUX * REDCORR`
6	MODEL	10^{-17} erg/s/cm^2/angstrom/spaxel	The best-fitting model spectra (sum of the fitted continuum and emission-line models)
7	MODEL_MASK		**New to MPL-8**: The mask from the combined continuum+emission-line model fit
8	EMLINE	10^{-17} erg/s/cm^2/angstrom/spaxel	The model spectrum with *only* the emission lines
9	STELLAR	10^{-17} erg/s/cm^2/angstrom/spaxel	**New to MPL-8**: The best-fitting model spectra fit from the stellar-continuum-only fit (used to model the stellar kinematics)
10	STELLAR_MASK		**New to MPL-8**: The mask for the best-fitting model spectra fit from the stellar-continuum-only fit (used to model the stellar kinematics)
11	BINID		Numerical ID for spatial bins in 5 channels: (1) binned spectra, (2) stellar-continuum results, (3) empty, (4) emission-line model results, and (5) empty; i.e., channels 1, 2, and 4 are the same as the BINID extension in the `MAPS` files and channels 3 and 5 are empty (see known issues)

所有的DAP数据结构都是一样的

DAP数据结构

No.	Name	Ver	Type	Cards	Dimensions	Format
0	PRIMARY	1	PrimaryHDU	127	()	
1	FLUX	1	ImageHDU	44	(34, 34, 4563)	float32
2	IVAR	1	ImageHDU	45	(34, 34, 4563)	float32
3	MASK	1	ImageHDU	44	(34, 34, 4563)	int16
4	WAVE	1	ImageHDU	9	(4563,)	float32
5	REDCORR	1	ImageHDU	9	(4563,)	float32
6	MODEL	1	ImageHDU	43	(34, 34, 4563)	float32
7	MODEL_MASK	1	ImageHDU	43	(34, 34, 4563)	int16
8	EMLINE	1	ImageHDU	42	(34, 34, 4563)	float32
9	STELLAR	1	ImageHDU	43	(34, 34, 4563)	float32
10	STELLAR_MASK	1	ImageHDU	43	(34, 34, 4563)	int16
11	BINID	1	ImageHDU	45	(34, 34, 5)	int32

1：原始数据流量（就是drp的flux数据）bin/没bin

2：误差---1层数据的误差

3：mask 原始数据

4：真空波长

5：在拟合过程中用的红化改正

6：model

7：模型的mask

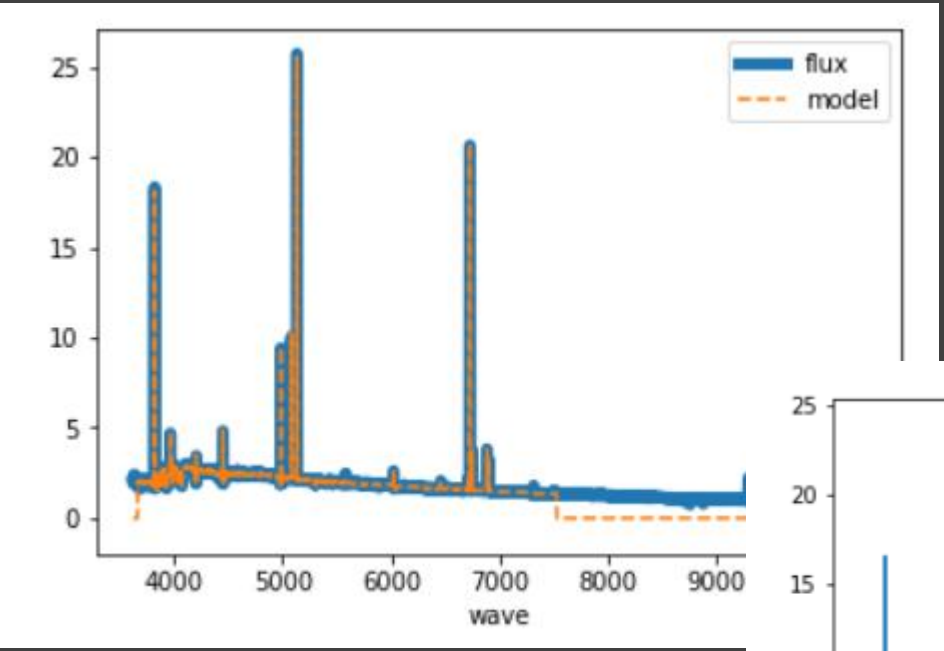
8：发射线

9：恒星谱

10：恒星谱的mask

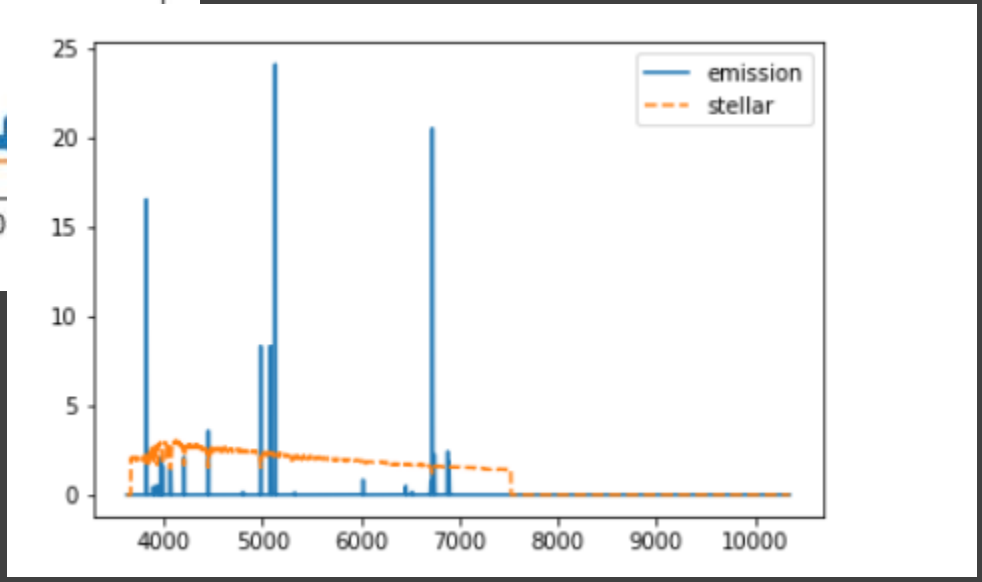
11：Numerical ID for spatial bins in 5 channels

DAP数据结构



蓝色为被拟合线，虚线为model。

DAP 就把原始光谱拆分为发射线和连续谱



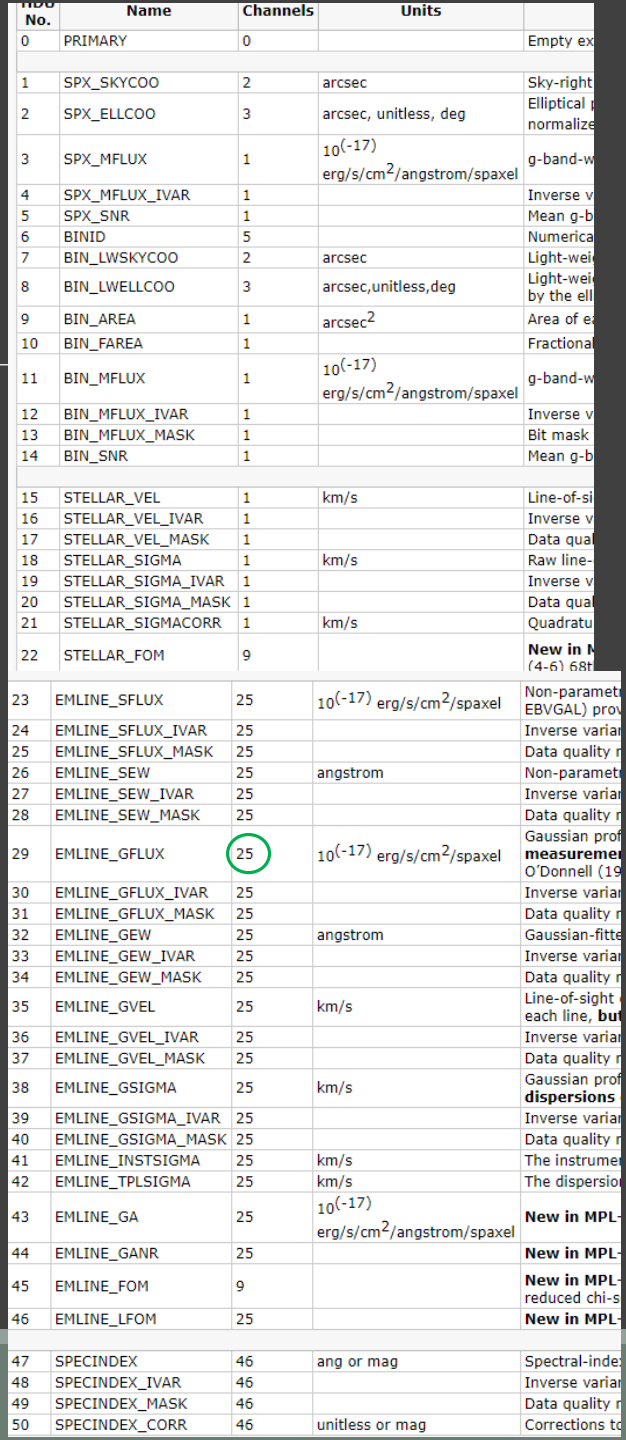
DAP数据结构

MAP

层数较多（51层）

https://trac.sdss.org/wiki/MANGA/TRM/TRM_MPL-8/DAPDataModel#DAPLOGCUBEfile

全是已经计算好的map信息，在网站上有所有详细的数据信息。



HDU No.	Name	Channels	Units	
0	PRIMARY	0		Empty ex
1	SPX_SKYCOO	2	arcsec	Sky-right
2	SPX_ELLCOO	3	arcsec, unitless, deg	Elliptical normalize
3	SPX_MFLUX	1	$10^{(-17)}$ erg/s/cm^2/angstrom/spaxel	g-band-w
4	SPX_MFLUX_IVAR	1		Inverse v
5	SPX_SNR	1		Mean g-b
6	BINID	5		Numerica
7	BIN_LWSKYCOO	2	arcsec	Light-wei
8	BIN_LWELLCOO	3	arcsec,unitless,deg	Light-wei by the ell
9	BIN_AREA	1	arcsec^2	Area of e
10	BIN_FAREA	1		Fractiona
11	BIN_MFLUX	1	$10^{(-17)}$ erg/s/cm^2/angstrom/spaxel	g-band-w
12	BIN_MFLUX_IVAR	1		Inverse v
13	BIN_MFLUX_MASK	1		Bit mask
14	BIN_SNR	1		Mean g-b
15	STELLAR_VEL	1	km/s	Line-of-si
16	STELLAR_VEL_IVAR	1		Inverse v
17	STELLAR_VEL_MASK	1		Data qua
18	STELLAR_SIGMA	1	km/s	Raw line-
19	STELLAR_SIGMA_IVAR	1		Inverse v
20	STELLAR_SIGMA_MASK	1		Data qua
21	STELLAR_SIGMACORR	1	km/s	Quadratu
22	STELLAR_FOM	9		**New in N** (4-6) 68t
23	EMLINE_SFLUX	25	$10^{(-17)}$ erg/s/cm^2/spaxel	Non-parametr EBVGAL) prov
24	EMLINE_SFLUX_IVAR	25		Inverse varia
25	EMLINE_SFLUX_MASK	25		Data quality r
26	EMLINE_SEW	25	angstrom	Non-parametr
27	EMLINE_SEW_IVAR	25		Inverse varia
28	EMLINE_SEW_MASK	25		Data quality r
29	EMLINE_GFLUX	25	$10^{(-17)}$ erg/s/cm^2/spaxel	Gaussian prof **measureme** O'Donnell (19
30	EMLINE_GFLUX_IVAR	25		Inverse varia
31	EMLINE_GFLUX_MASK	25		Data quality r
32	EMLINE_GEW	25	angstrom	Gaussian-fitte
33	EMLINE_GEW_IVAR	25		Inverse varia
34	EMLINE_GEW_MASK	25		Data quality r
35	EMLINE_GVEL	25	km/s	Line-of-sight each line, **but**
36	EMLINE_GVEL_IVAR	25		Inverse varia
37	EMLINE_GVEL_MASK	25		Data quality r
38	EMLINE_GSIGMA	25	km/s	Gaussian prof **dispersions**
39	EMLINE_GSIGMA_IVAR	25		Inverse varia
40	EMLINE_GSIGMA_MASK	25		Data quality r
41	EMLINE_INSTSIGMA	25	km/s	The instrume
42	EMLINE_TPLSIGMA	25	km/s	The dispersio
43	EMLINE_GA	25	$10^{(-17)}$ erg/s/cm^2/angstrom/spaxel	**New in MPL-**
44	EMLINE_GANR	25		**New in MPL-**
45	EMLINE_FOM	9		**New in MPL-** reduced chi-s
46	EMLINE_LFOM	25		**New in MPL-**
47	SPECINDEX	46	ang or mag	Spectral-inde
48	SPECINDEX_IVAR	46		Inverse varia
49	SPECINDEX_MASK	46		Data quality r
50	SPECINDEX_CORR	46	unitless or mag	Corrections to

DAP--SPX

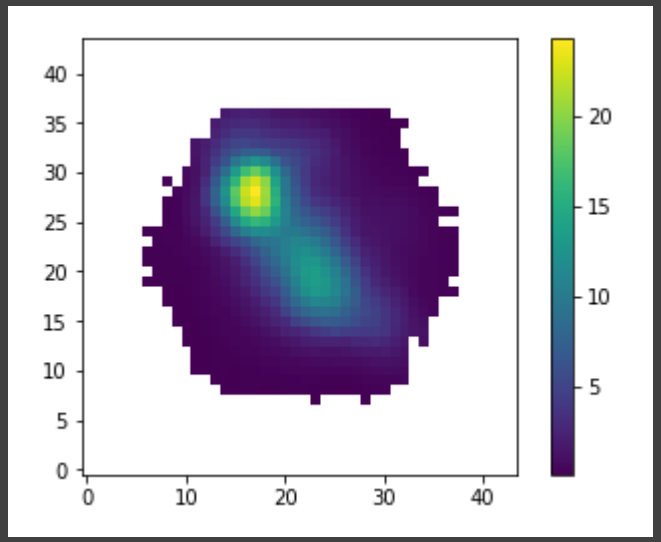
每个spaxel独立拟合，得到独立的数据

These are useful for most science applications that can push to very low S/N. They're also useful for characterizing the performance of the measurements toward the low S/N limit of the data.

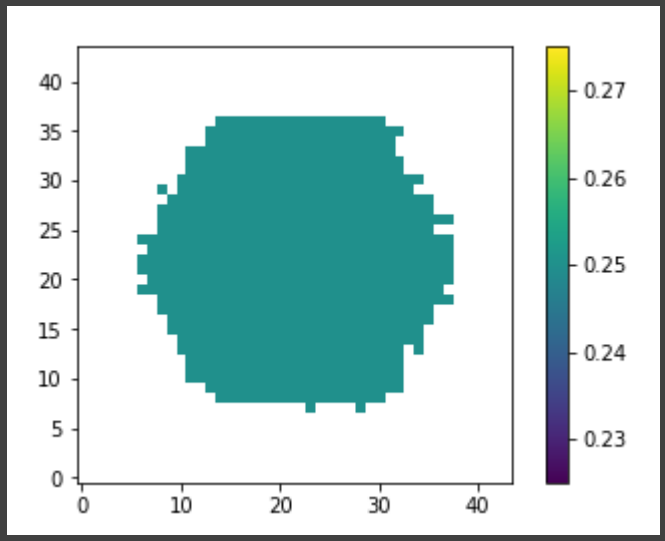
WARNING

- Spectra with g-band S/N < 1 will not have a stellar-continuum model or Gaussian emission-line model.
- **Please consult the DAP** Overview **and** Emission-line Modeling **papers** for usage guidelines and limitations of the data.

FHa

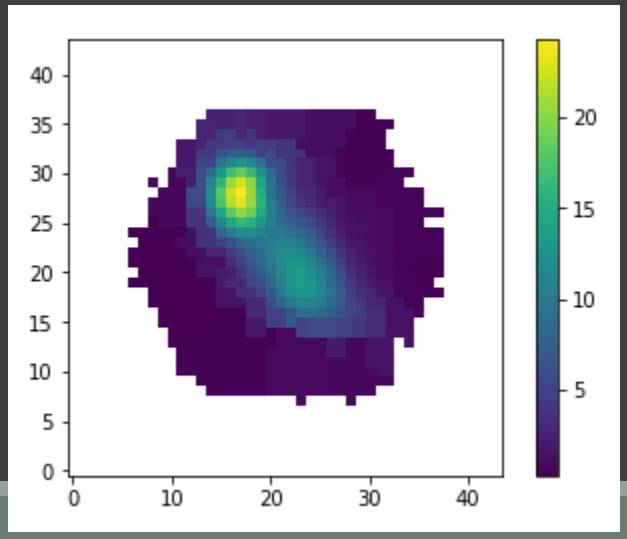


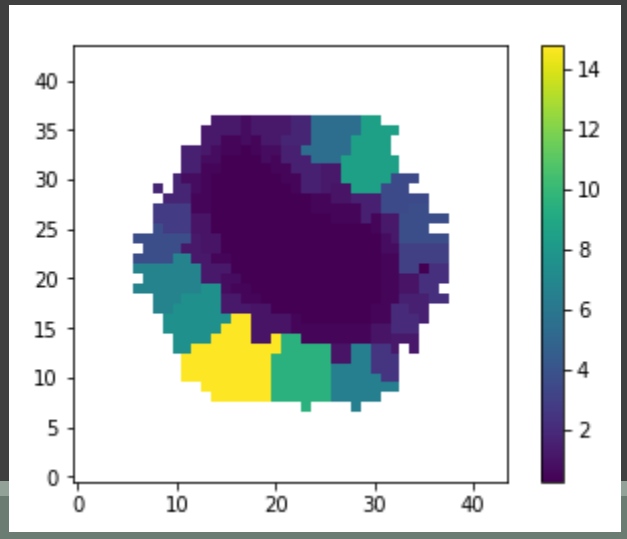
Area of each bin



DAP—VOR10

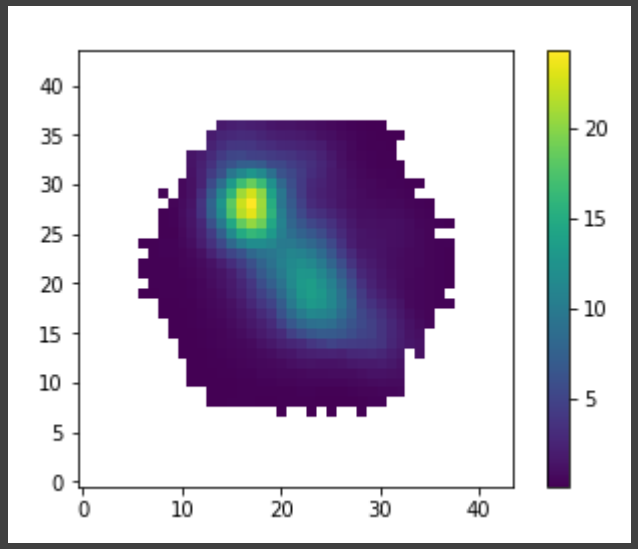
WARNING	• No spectrum with a g-band S/N < 1 is included in any bin. • Voronoi binned spectra are just simple means of all the spectra in the bin. • The covariance in the datacube is propagated to the variance in the stacked spectra. • The spectral resolution in each binned spectra is propagated from the PREDISP cube provided by the DRP, similar to the formalism explained ⇨ here. • (Binned) Spectra with g-band S/N < 1 will not have a stellar-continuum model or Gaussian emission-line model. • **Please consult the DAP ⇨ Overview and ⇨ Emission-line Modeling papers** for usage guidelines and limitations of the data. • Because the binning is done based on the *continuum* S/N, this limits the emission-line science that can be done at low continuum S/N.

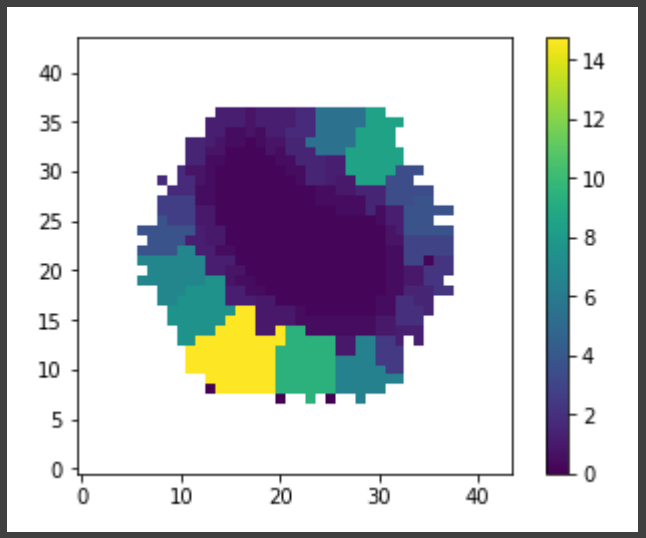




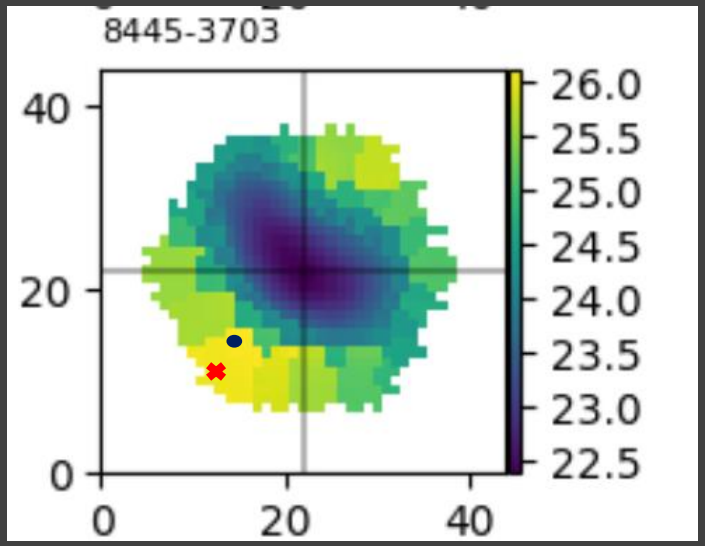
DAP– HYB10

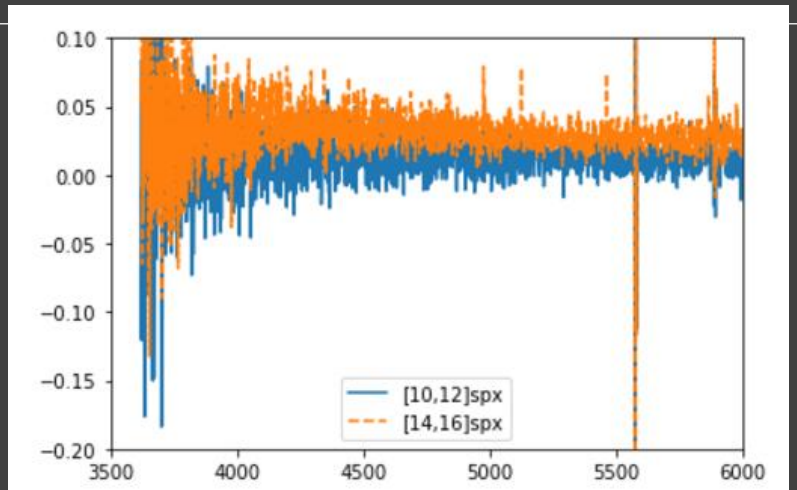
WARNING	• No spectrum with a g-band S/N < 1 is included in any bin. • Voronoi binned spectra are just simple means of all the spectra in the bin. • The covariance in the datacube is propagated to the variance in the stacked spectra. • The spectral resolution in each binned spectra is propagated from the PREDISP cube provided by the DRP, similar to the formalism explained ⇨ here. • (Binned) Spectra with g-band S/N < 1 will not have a stellar-continuum model. • **Please consult the DAP ⇨ Overview and ⇨ Emission-line Modeling papers** for usage guidelines and limitations of the data. • All spectra with 80% valid pixels will have a combined emission-line+stellar-continuum model, where the stellar kinematics have been fixed by the fits to the binned spectra. • This is the only file where the BINIDs are different for the emission-line properties.

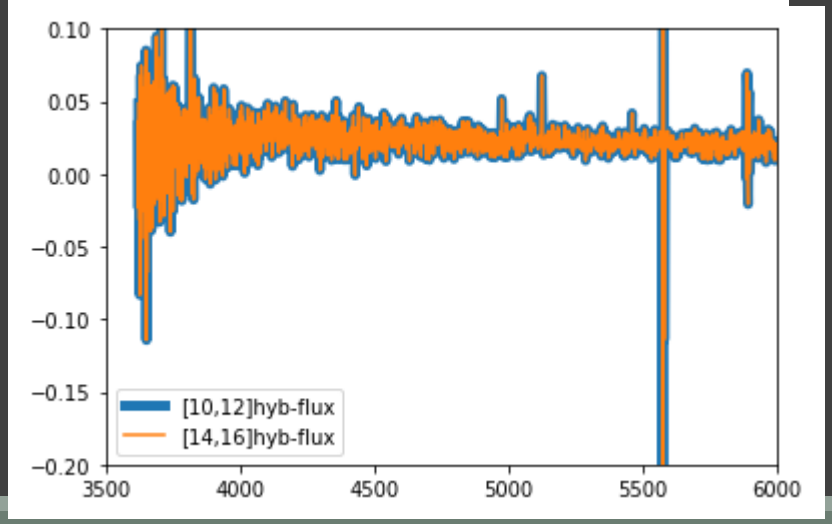




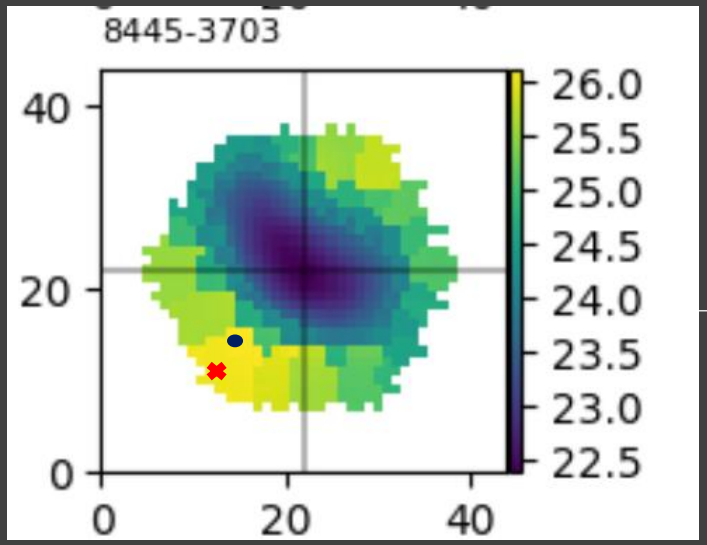
DAP– HYB and VOR







[10,12]是红×，[14,16]是黑点


8445-3703
40
20
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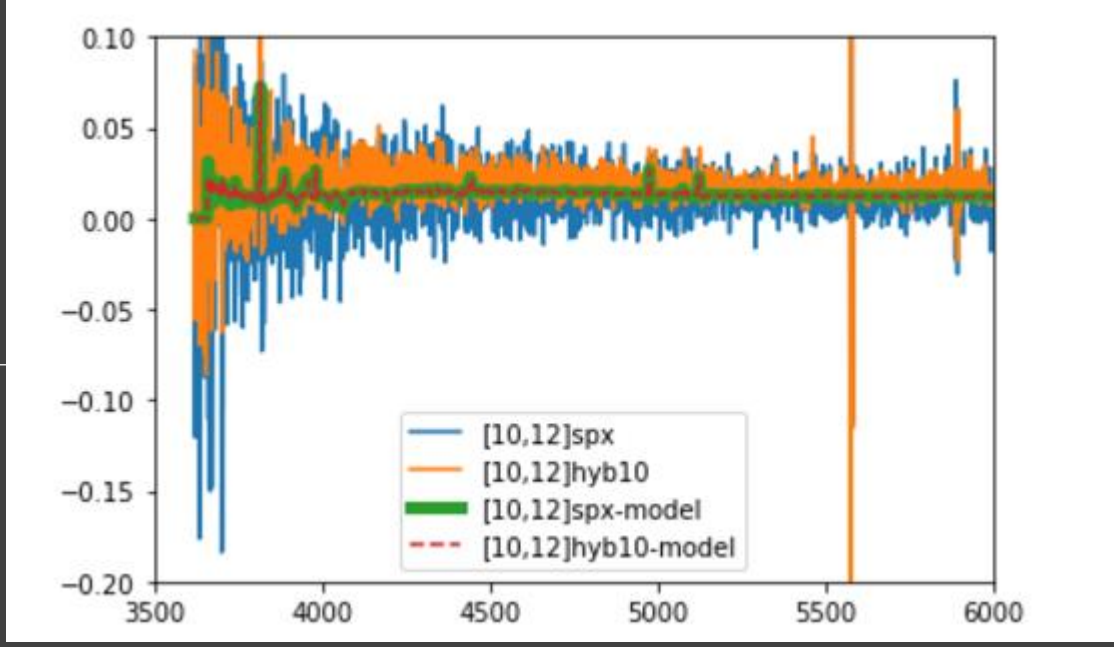
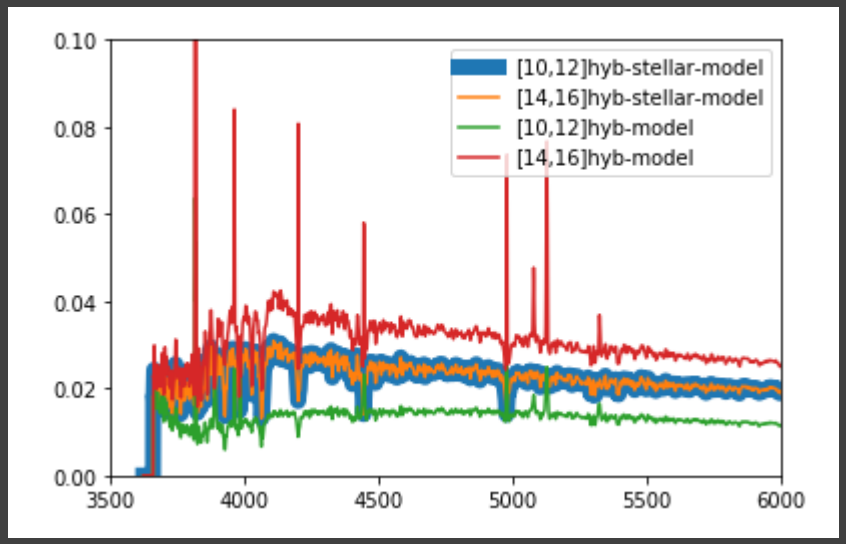
20
40
26.0
25.5
25.0
24.5
24.0
23.5
23.0
22.5


0.10
0.05
0.00
−0.05
−0.10
−0.15
−0.20
3500
4000
4500
5000
5500
6000
[10,12]spx
[10,12]hyb10
[10,12]spx-model
[10,12]hyb10-model


0.10
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3500
4000
4500
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5500
6000
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[14,16]hyb-stellar-model
[10,12]hyb-model
[14,16]hyb-model