

CSST无缝光谱仿真及一维仿真光谱生成工具

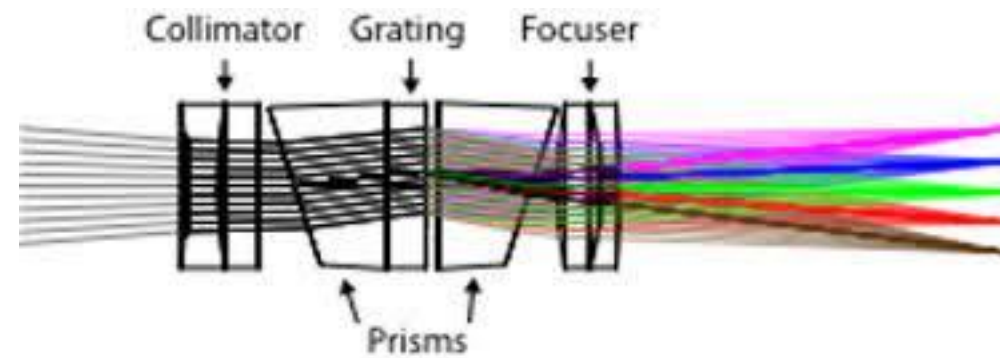
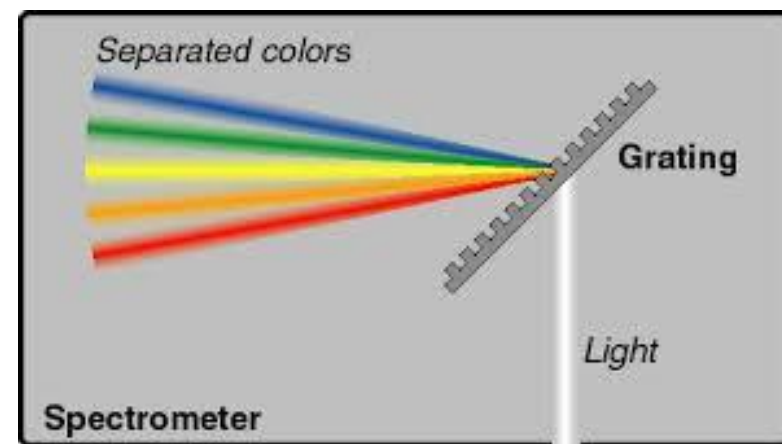
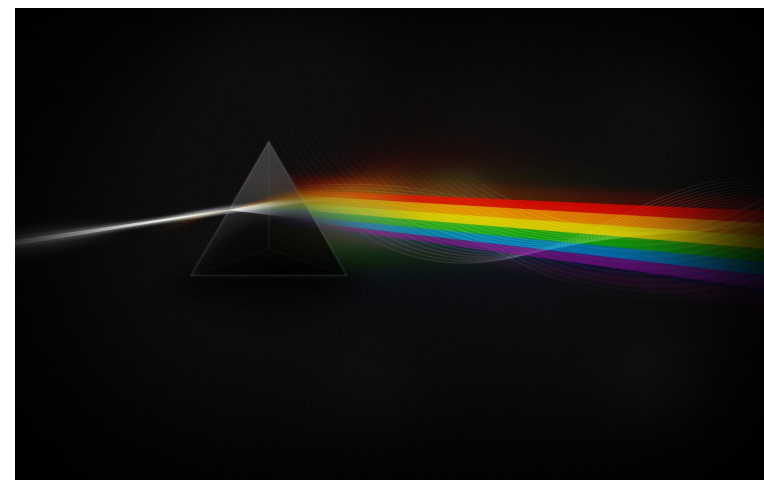
张鑫

国家天文台

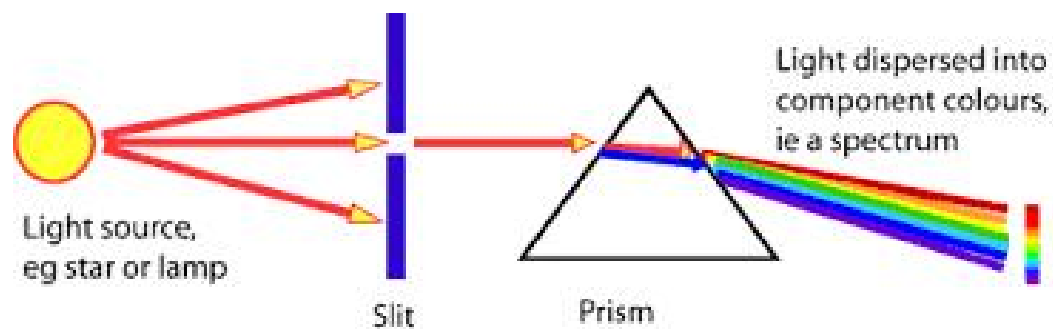
2023.4.21 桂林

- 光谱仪器介绍
- CSST无缝光谱介绍
- CSST无缝光谱仿真
- 一维仿真光谱生成工具

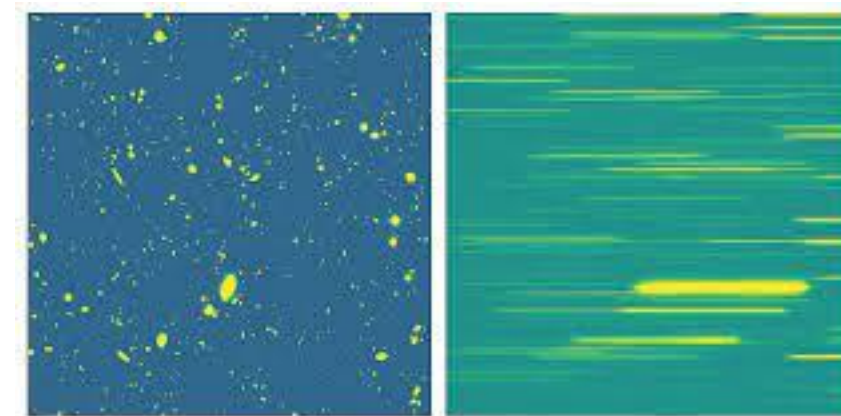
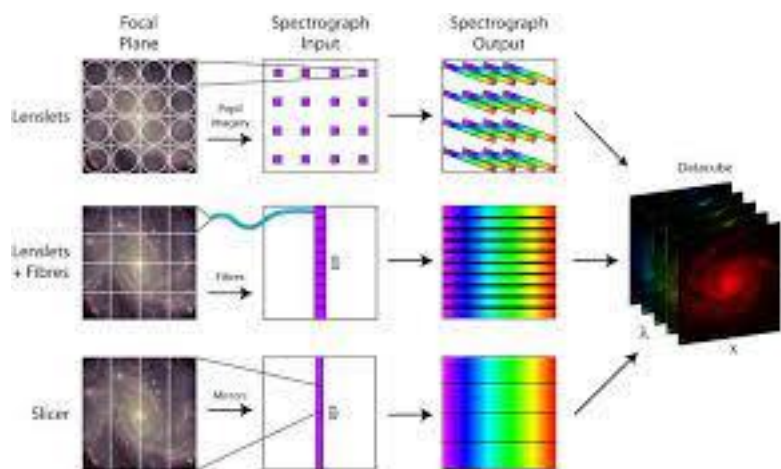
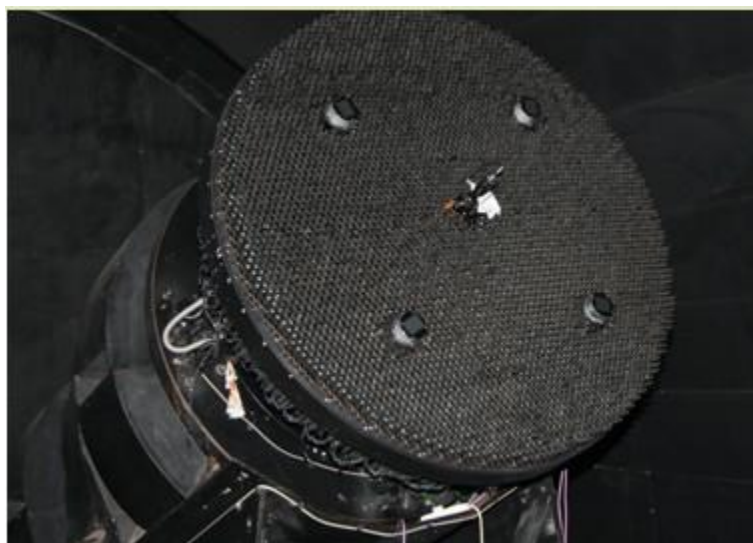
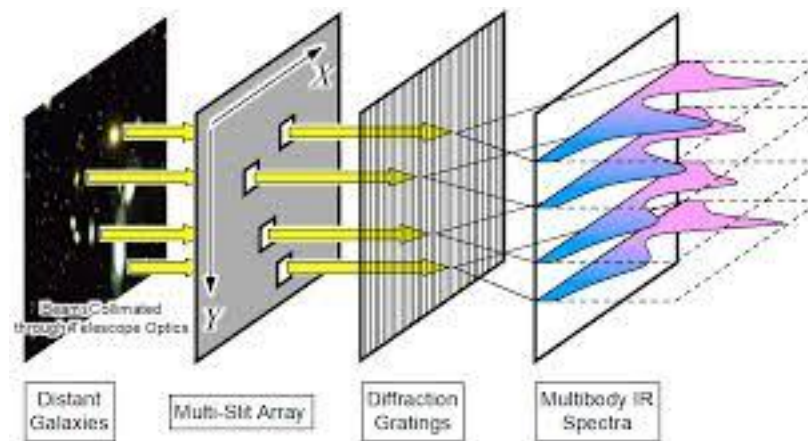
光谱仪器介绍



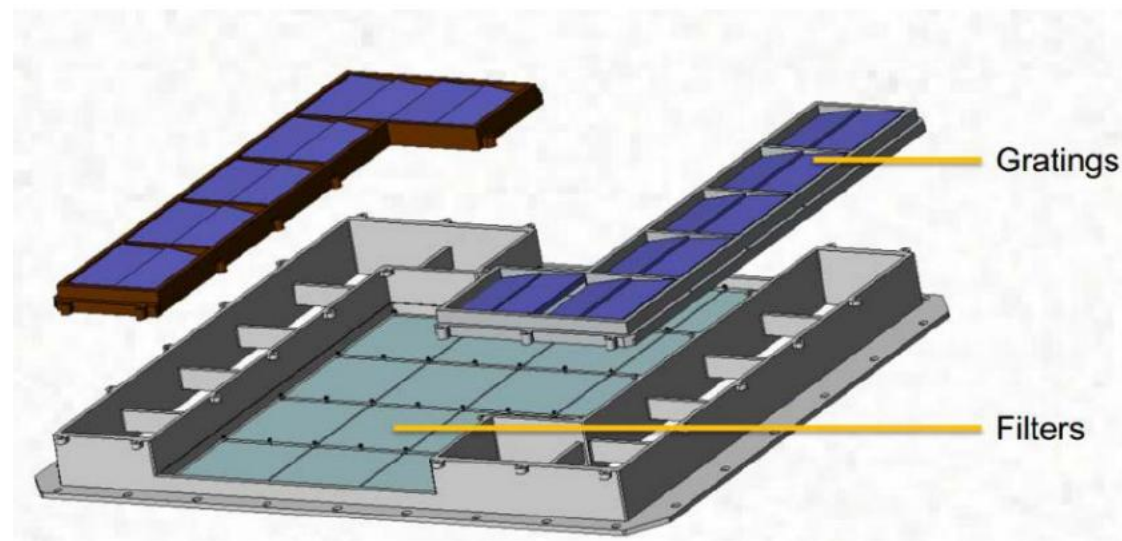
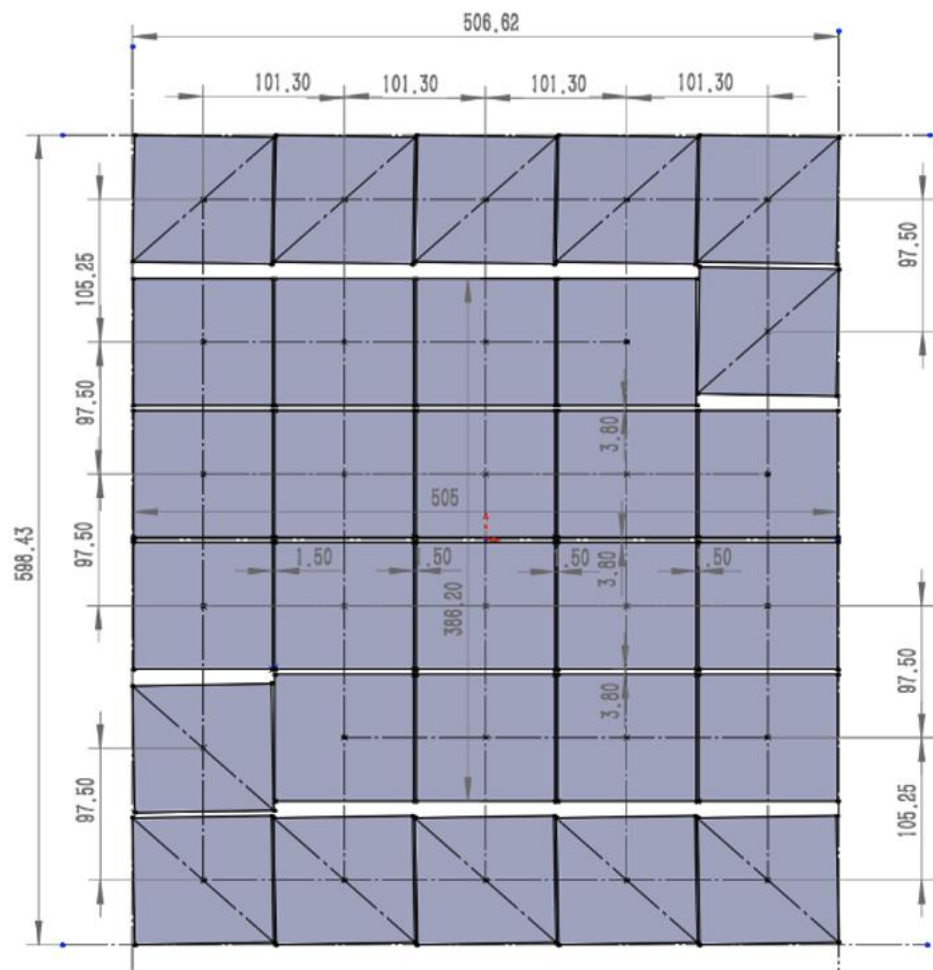
光谱仪器介绍



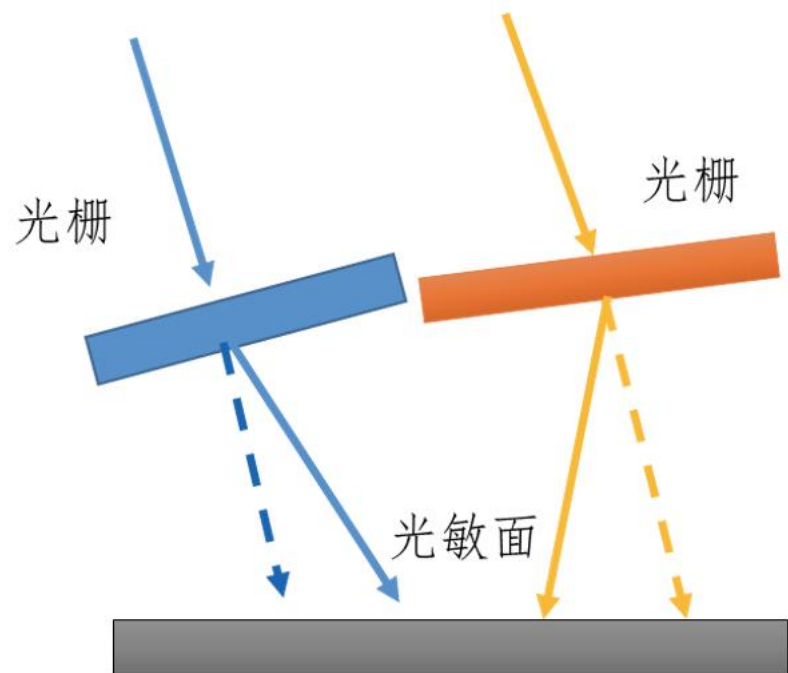
Dispersion of light through a prism



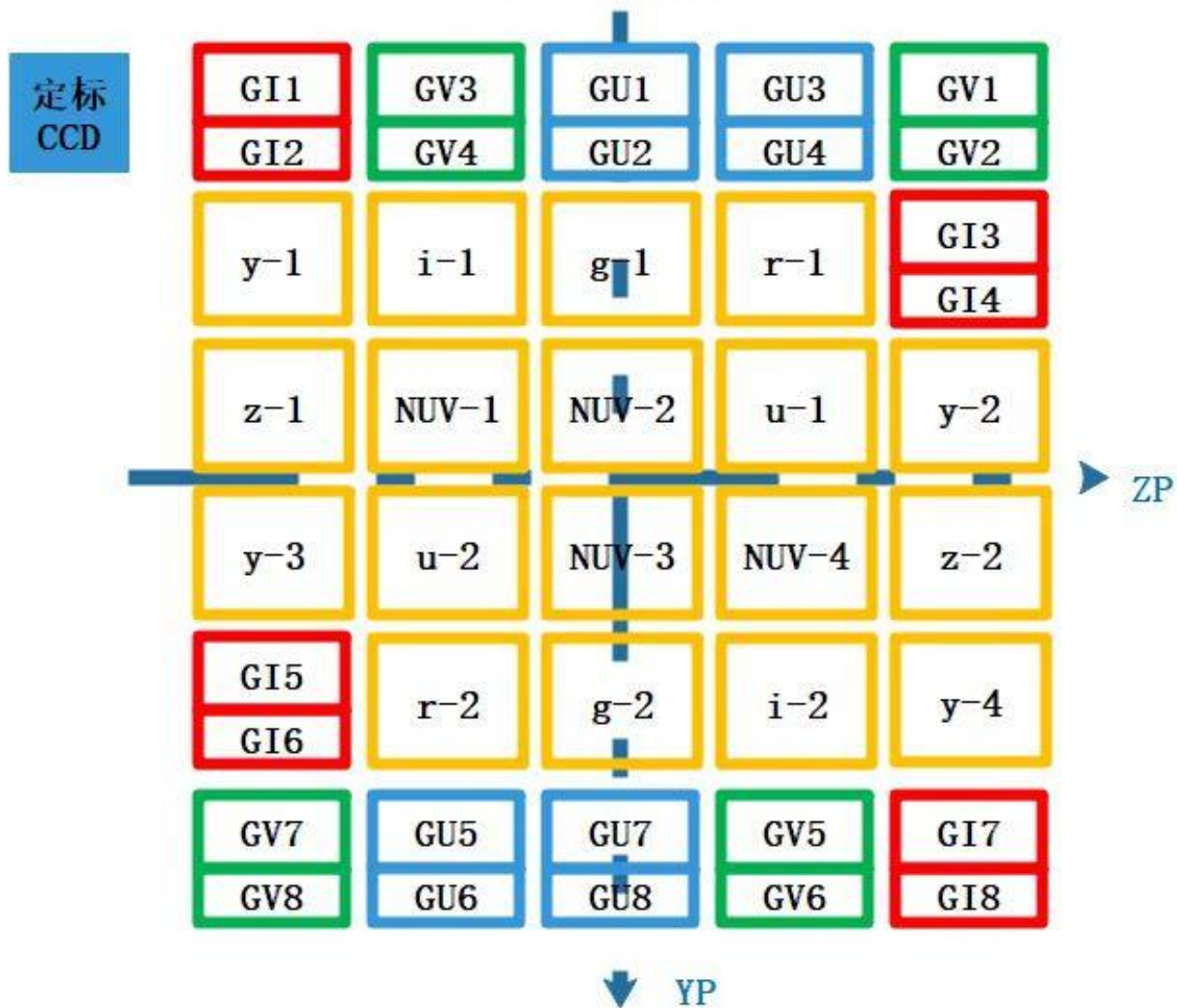
CSST无缝光谱介绍



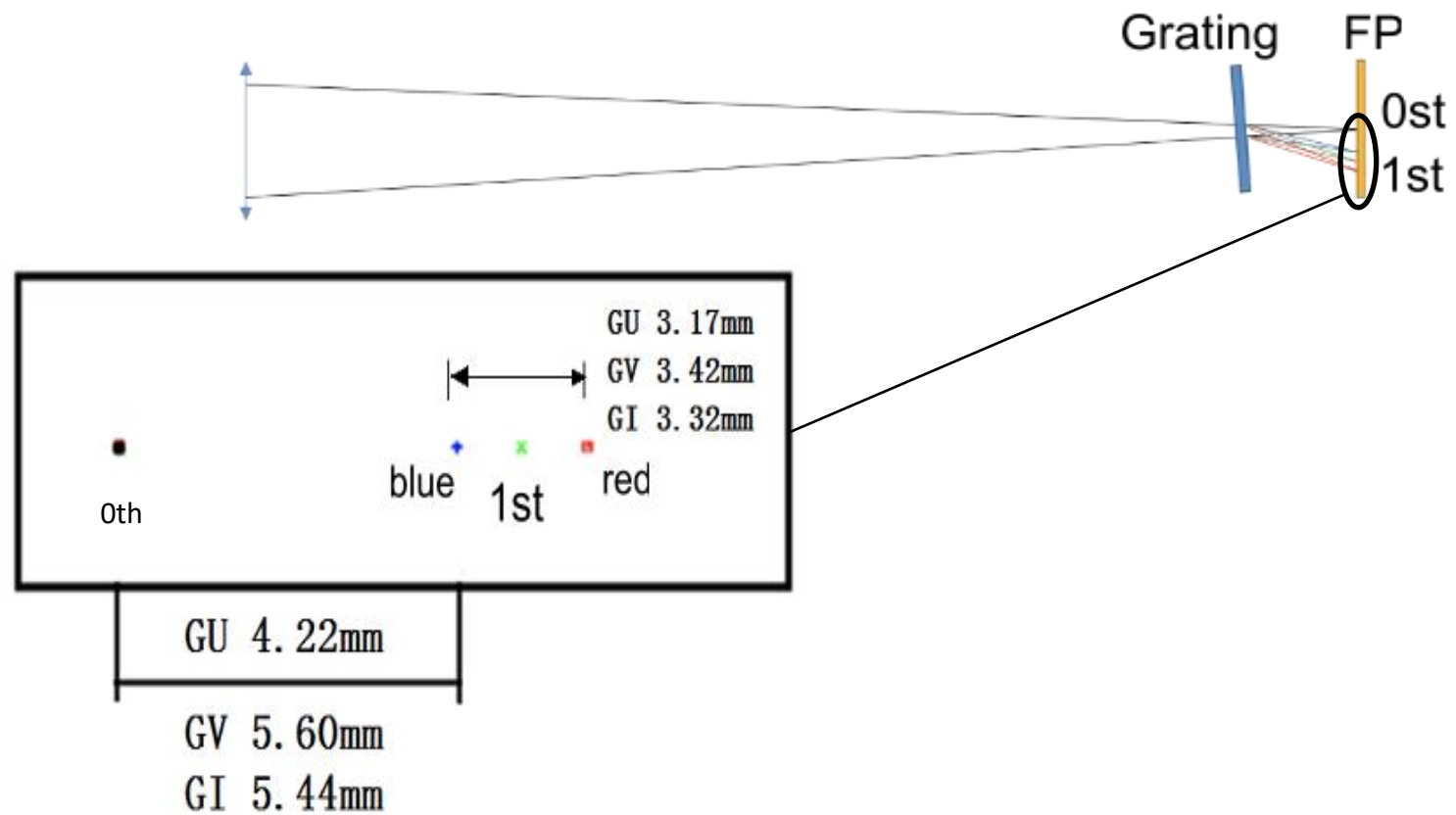
CSST无缝光谱介绍



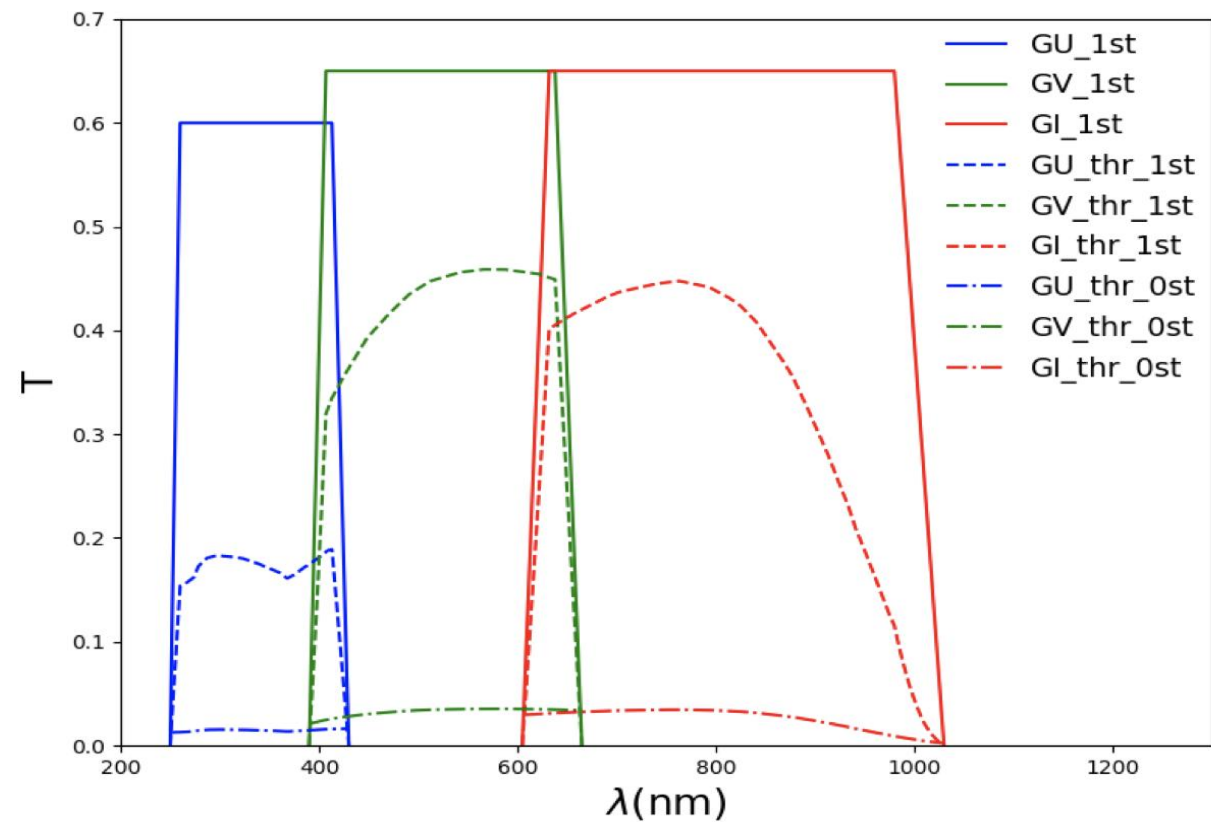
正样件焦面排布



CSST无缝光谱介绍



CSST无缝光谱介绍



	Exp.	GU(r es)	GV(r es)	GI(r es)	GU(t ot)	GV(t ot)	GI(t ot)
175 00 □°	4× 150s	20.5	21.0	21.0	23.1	23.4	23.5
400 □°	16× 250s	21.8	22.2	22.1	24.3	24.6	24.6

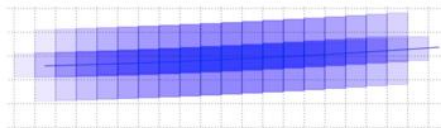
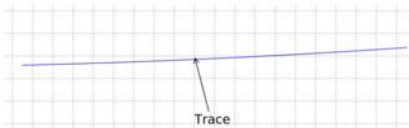
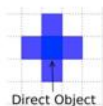
CSST无缝光谱仿真

intrinsic spectrum

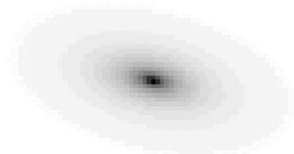
$$I(x, y) = \int f(x, y, \lambda) \mathcal{S}(\lambda) d\lambda$$

direct image

sensitivity curve



Direct image



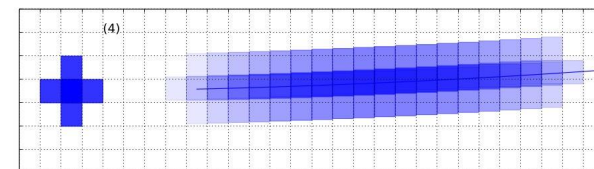
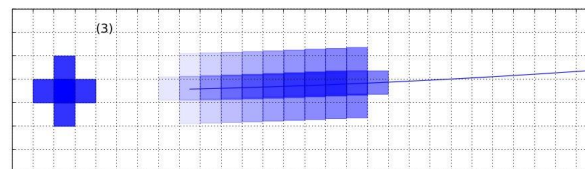
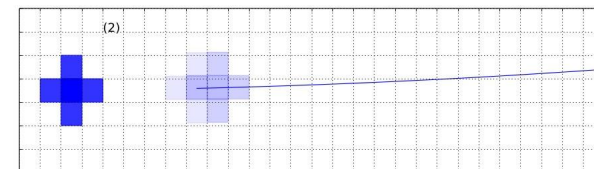
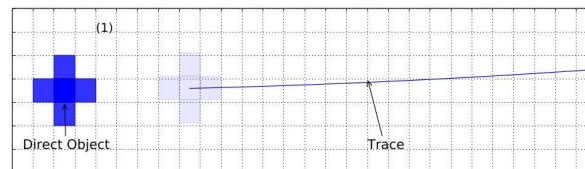
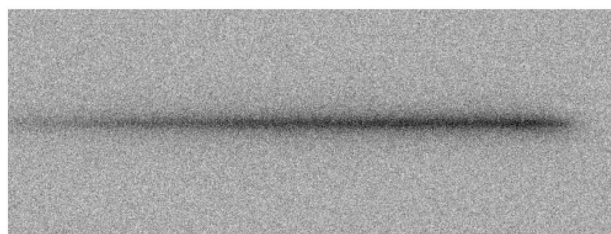
Discrete spectrum



Direct image  Discrete spectrum



Add PSF and noise



CSST无缝光谱仿真

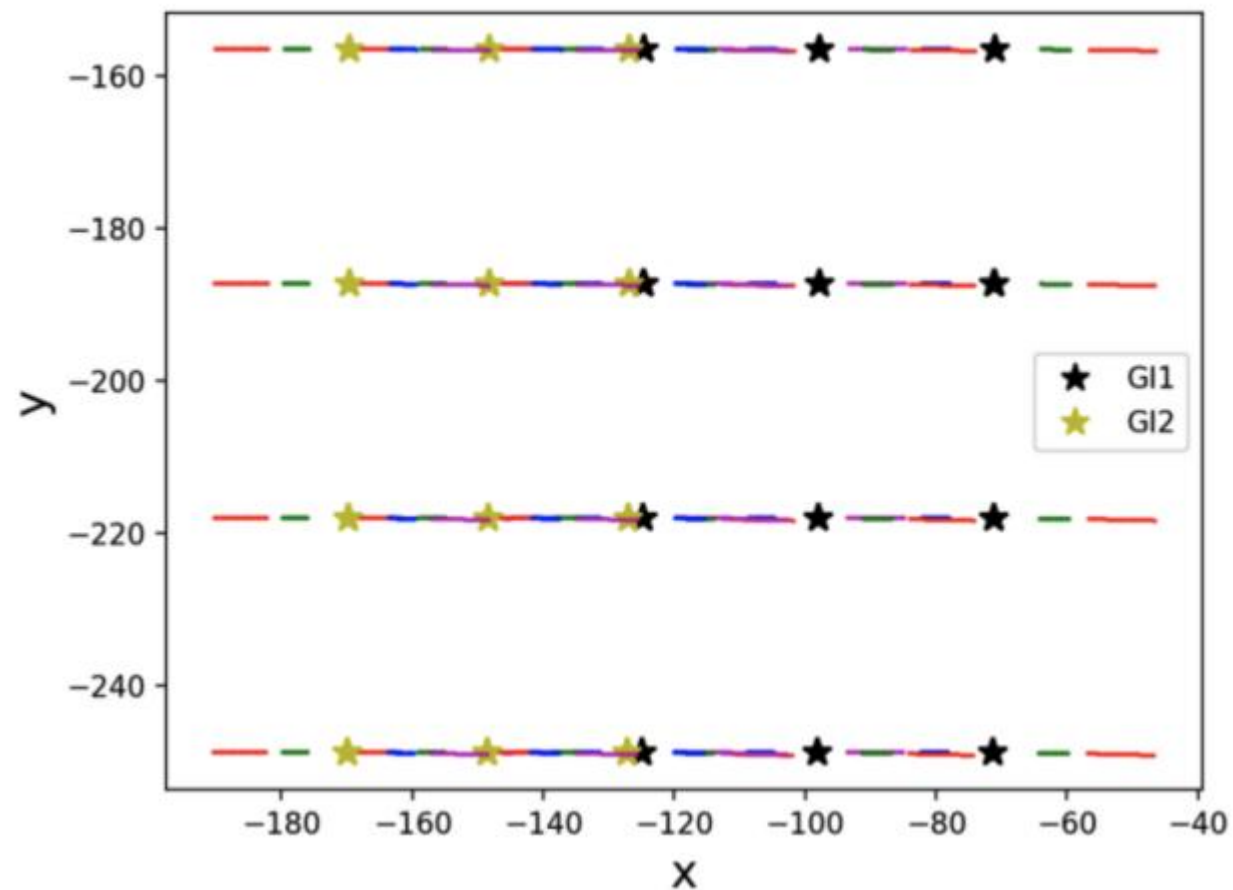
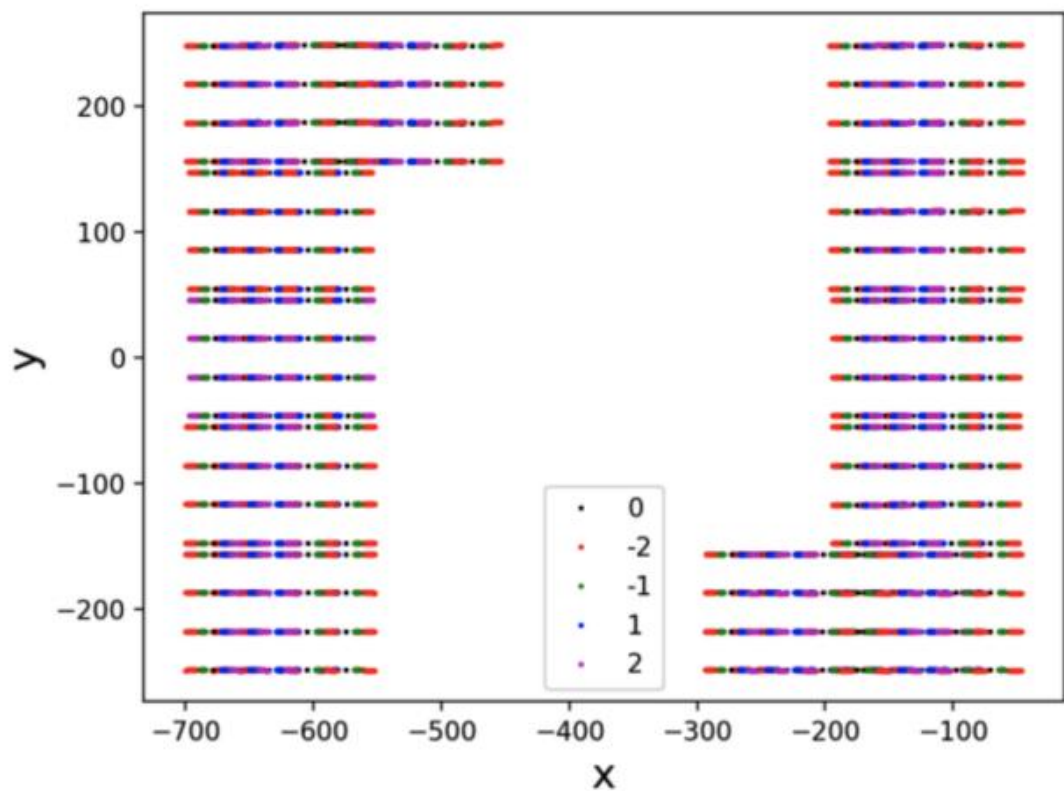
位置关系 $dy = a_0 + a_1 \cdot dx + a_2 \cdot dx^2 + \dots + a_n \cdot dx^n,$

$$a_n(i, j) = b_{n,0} + b_{n,1} \cdot i + b_{n,2} \cdot j + b_{n,3} \cdot i^2 + b_{n,4} \cdot i \cdot j + b_{n,5} \cdot j^2$$

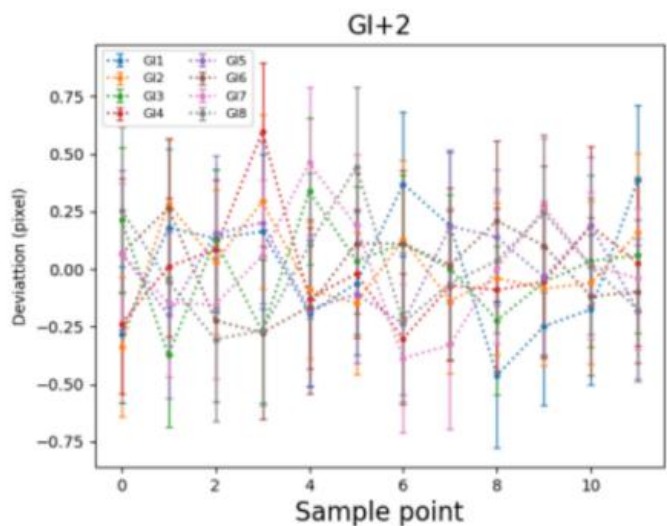
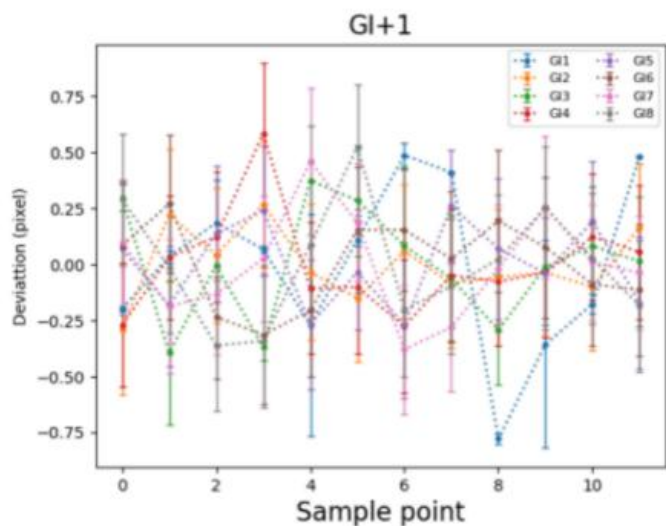
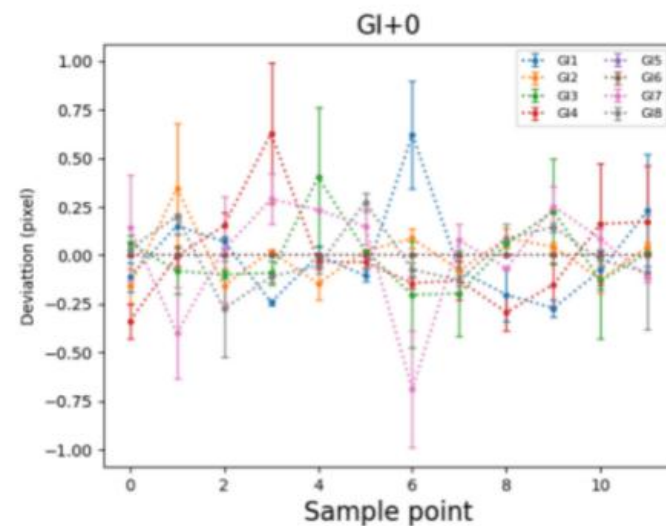
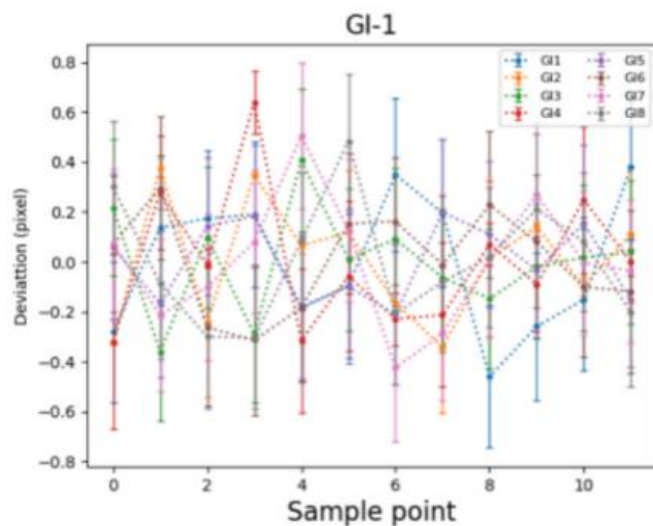
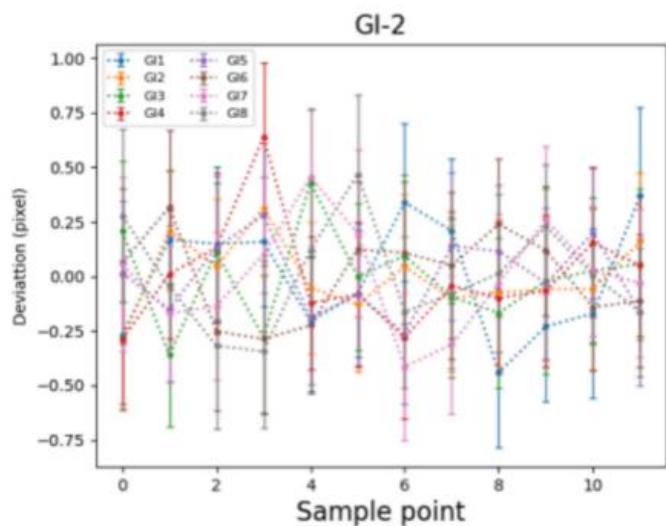
波长位置关系 $\lambda = \alpha_0 + \alpha_1 \cdot dp + \alpha_2 \cdot dp^2 + \dots + \alpha_n \cdot dp^n$

$$\alpha_n(i, j) = \beta_{n,0} + \beta_{n,1} \cdot i + \beta_{n,2} \cdot j + \beta_{n,3} \cdot i^2 + \beta_{n,4} \cdot i \cdot j + \beta_{n,5} \cdot j^2$$

CSST无缝光谱仿真



CSST无缝光谱仿真



```
INSTRUMETN CSSTSLS
GRATING GI
WAVELENGTH 6200 10000

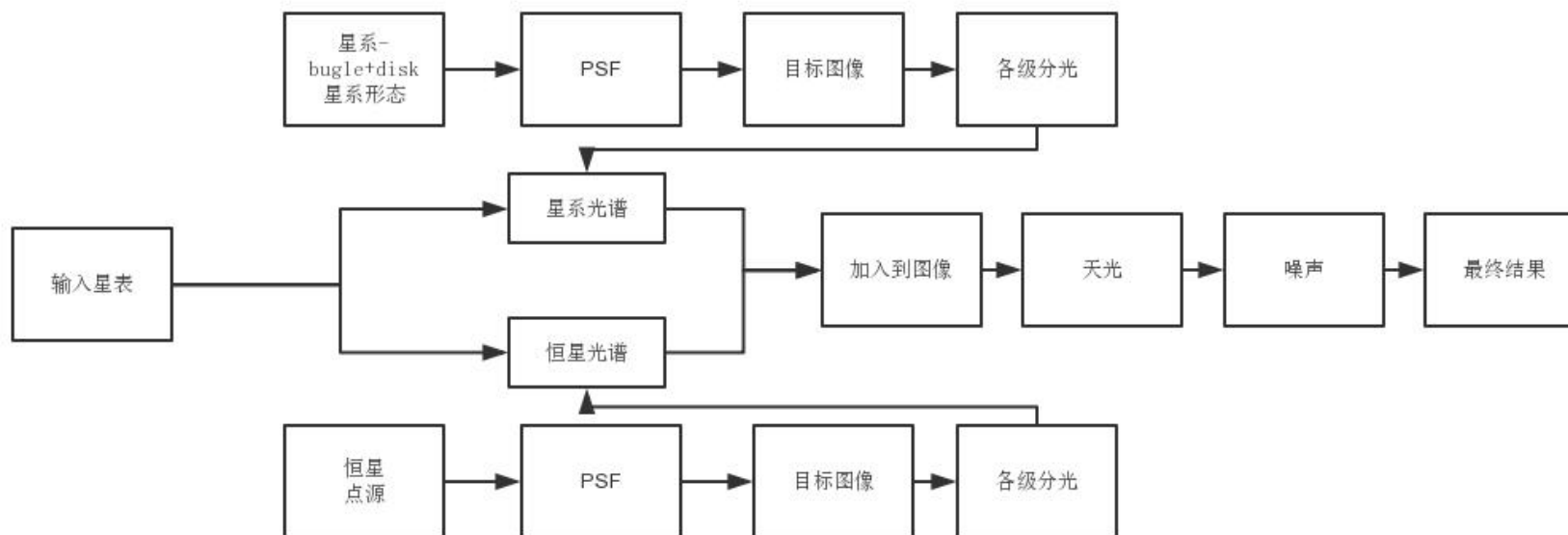
# 1 order (BEAM A) *****
BEAMA -1186 -528
MMAG_EXTRACT_A 30
MMAG_MARK_A 30
#
# Trace description
#
DYDX_ORDER_A 1
DYDX_A_0 0.14817231992808644 0.0005079228025548398 5.393015911919454e-05 -2.982451966637128e-08 -5.6367601736659e-09 1.5820426294476737e-09
DYDX_A_1 -0.0009276470296729458 3.1005740765743757e-07 -1.2237577325446853e-07 -2.0571882414473167e-11 1.8321776016715952e-11 -7.578903580318974e-12
#
# X and Y Offsets
#
XOFF_A 0.0
YOFF_A 0.0
#
# Dispersion solution
#
DISP_ORDER_A 1
DLDP_A_0 85.38358038937345 0.0032653138486398448 0.00031539654827738325 2.2556716283763742e-07 -5.583323908896222e-09 -3.9854304970418865e-08
DLDP_A_1 -8.619481286417143 -0.00010163441564111018 5.796132532958049e-07 -1.1409725324392857e-09 -1.2661986911495662e-10 5.161995577255066e-11
#
SENSITIVITY_A GI.Throughput.1st.fits
#
```

一级光谱

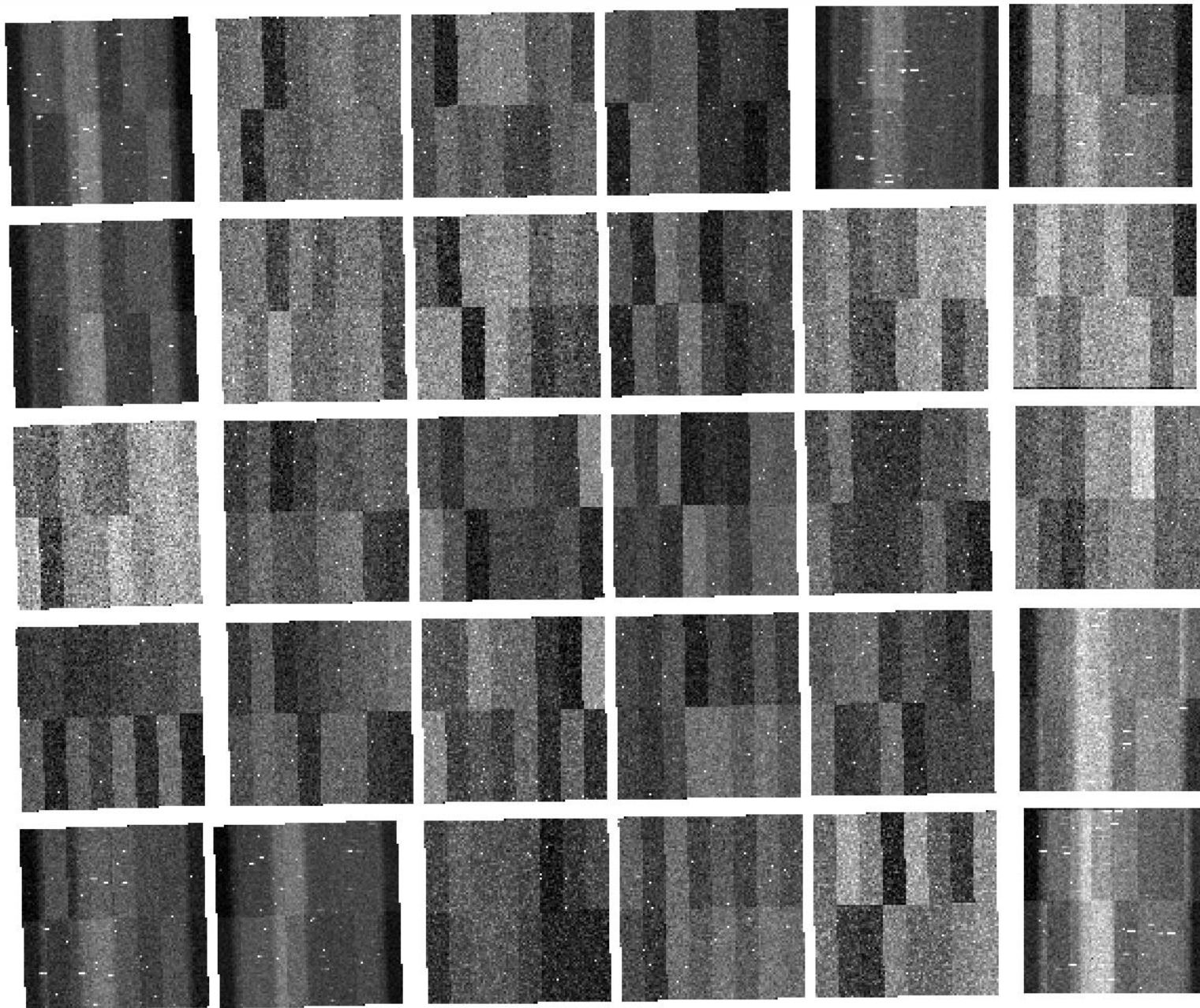
```
# 0 order (BEAM B) *****
BEAMB -85 116
MMAG_EXTRACT_B 30
MMAG_MARK_B 30
#
# Trace description
#
DYDX_ORDER_B 0
DYDX_B_0 -1.6980112570847214 0.000496763674347146 -3.984876156626912e-05 -3.30920819871009e-08 -3.2826138616433233e-09 4.068281942742765e-09
#
# X and Y Offsets
#
XOFF_B 0.0
YOFF_B 0.0
#
# Dispersion solution
#
DISP_ORDER_B 1
DLDP_B_0 -50799.93465739006 -1.0249446791288364e-06 1.4398214931432562e-07 6.515061995210521e-11 -8.555513184027325e-12 -2.263435794484282e-12
DLDP_B_1 3799.99600787394 -2.5740187050753252e-09 -7.967764019647142e-09 3.381327484806399e-13 1.1102413590842226e-13 8.056536395000781e-13
#
SENSITIVITY_B GI.Throughput.0st.fits
#
```

零级光谱

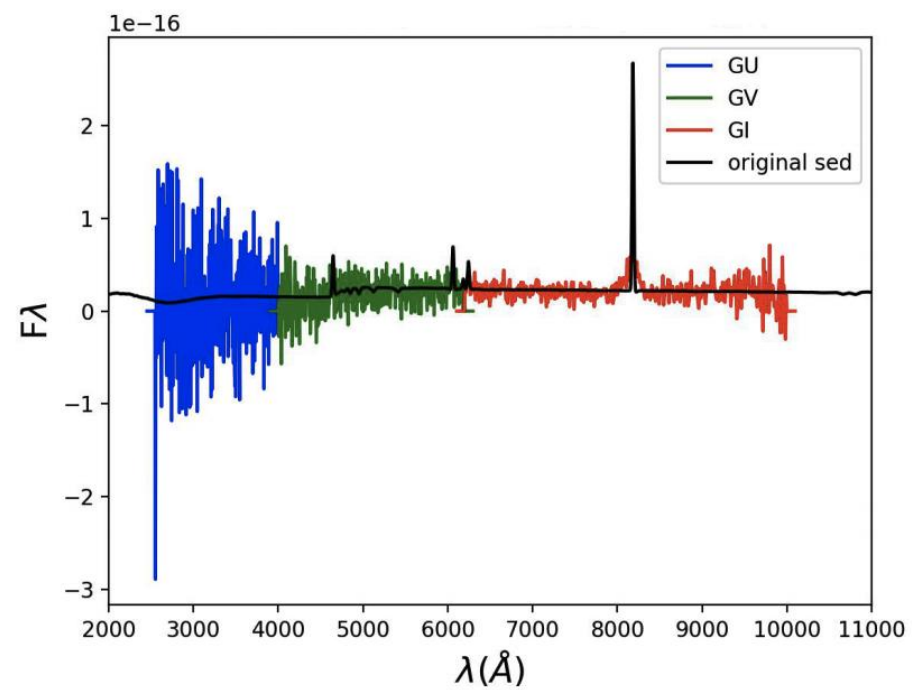
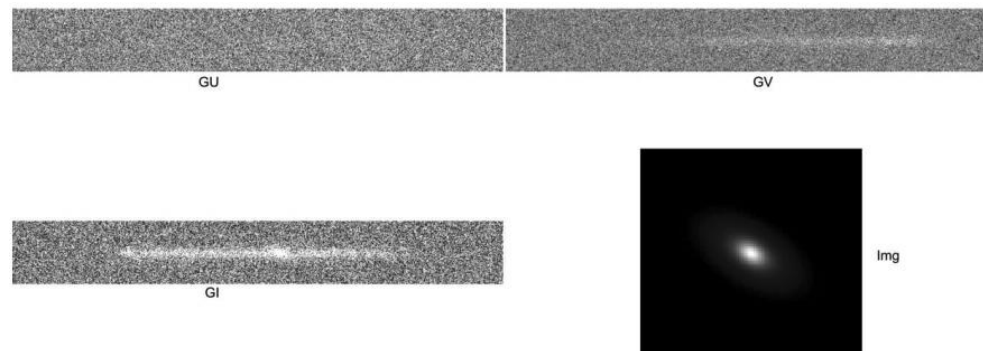
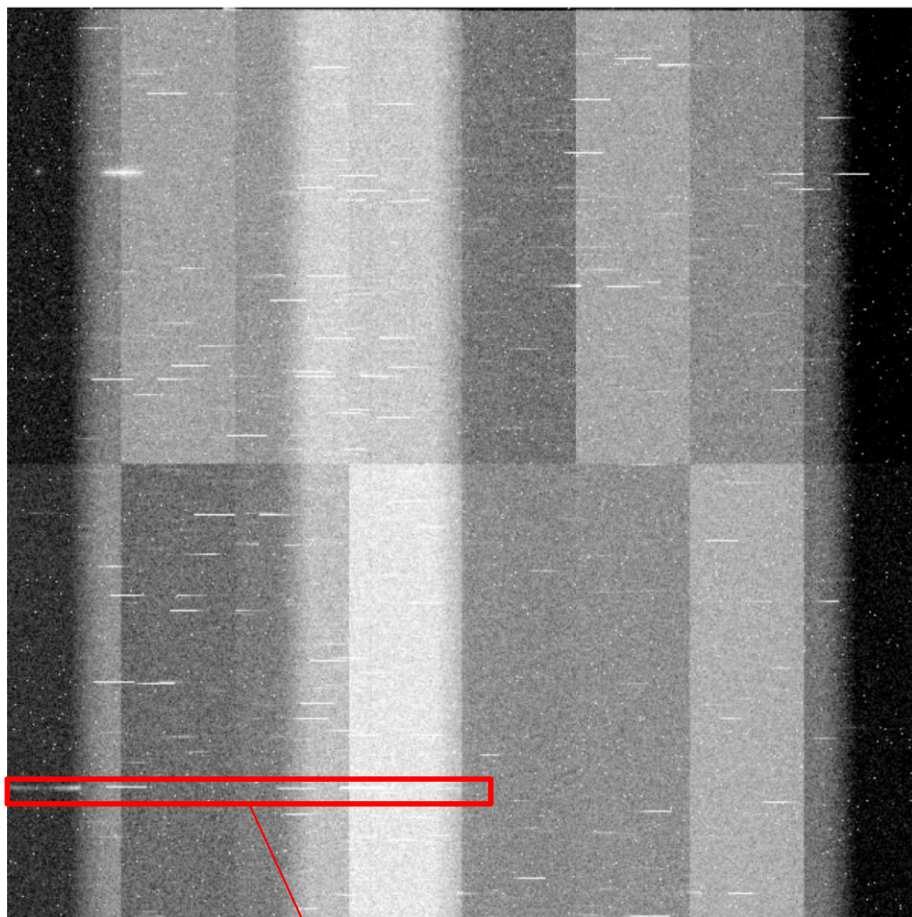
CSST无缝光谱仿真



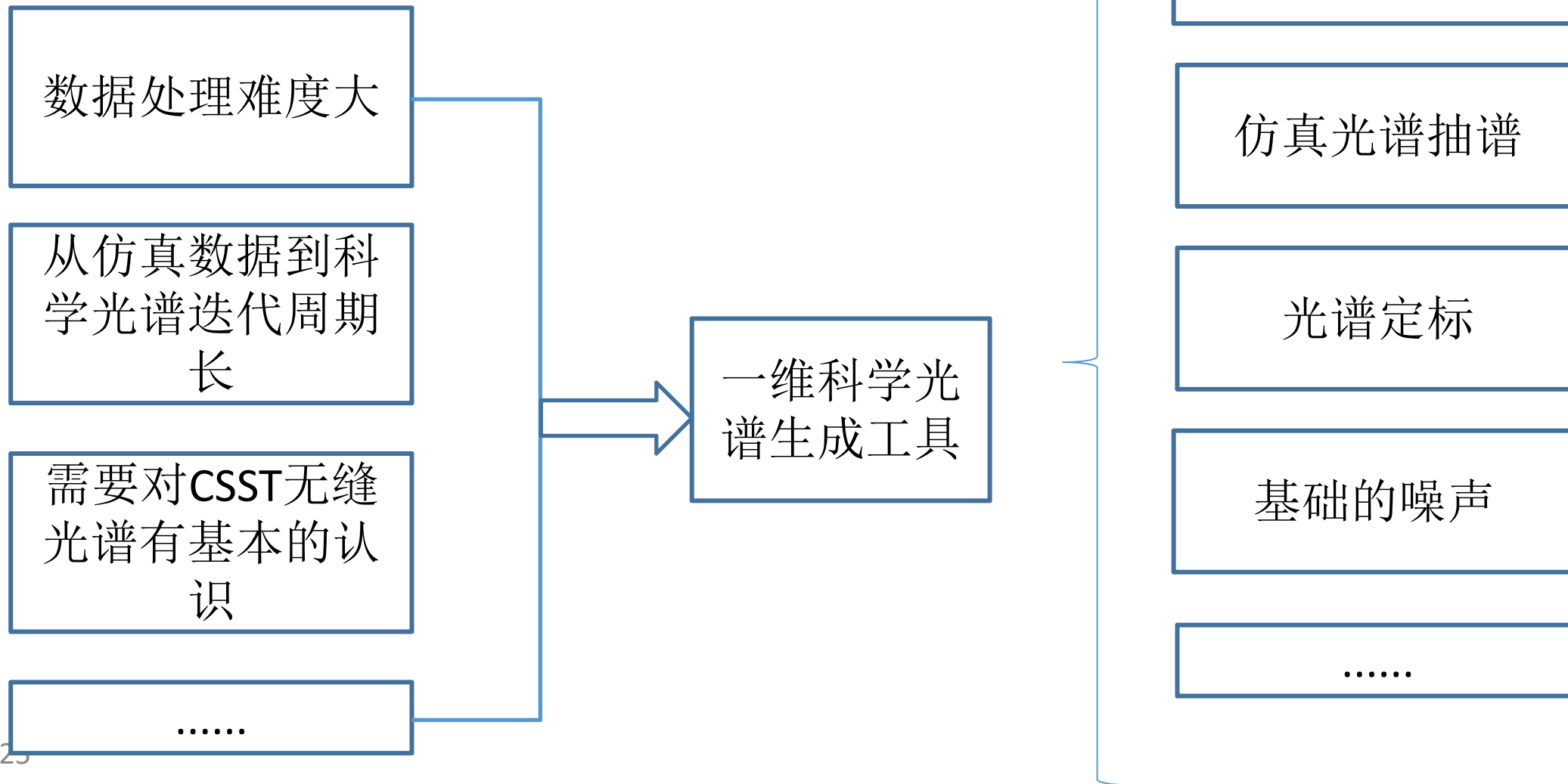
CSST



CSST无缝光谱仿真



CSST一维仿真光谱生成工具



CSST

图形界面版本

1-d spec generator

Input spec file

Grating

Beam Order

-----CCD Information-----

PSF(FWHM,")

Readout(e-/pixel)

Dark(e-/s/pixel)

Pixel size("/pixel)

-----Other Information-----

Sky background(e-/s/pixel)

Exposure Time(s/frame)

Frames

-----Source-----

Star
 Galaxy

Sersic n re(")

PA(deg) q

-----Output-----

output directory

-----Calculation Information-----

CSST

图形界面版本

Input spec file /Users/zhangxin/Work/SlitlessSim/sls_1d_sim/sls_1d_gitlab/sls_1d_spec/data/sed/sed_44575.tx

Grating

Beam Order

-----CCD Information-----

PSF(FWHM,")

Readout(e-/pixel)

Dark(e-/s/pixel)

Pixel size("/pixel)

-----Other Information-----

Sky background(e-/s/pixel)

Exposure Time(s/frame)

Frames

-----Source-----

Star

Galaxy

Sersic n re(")

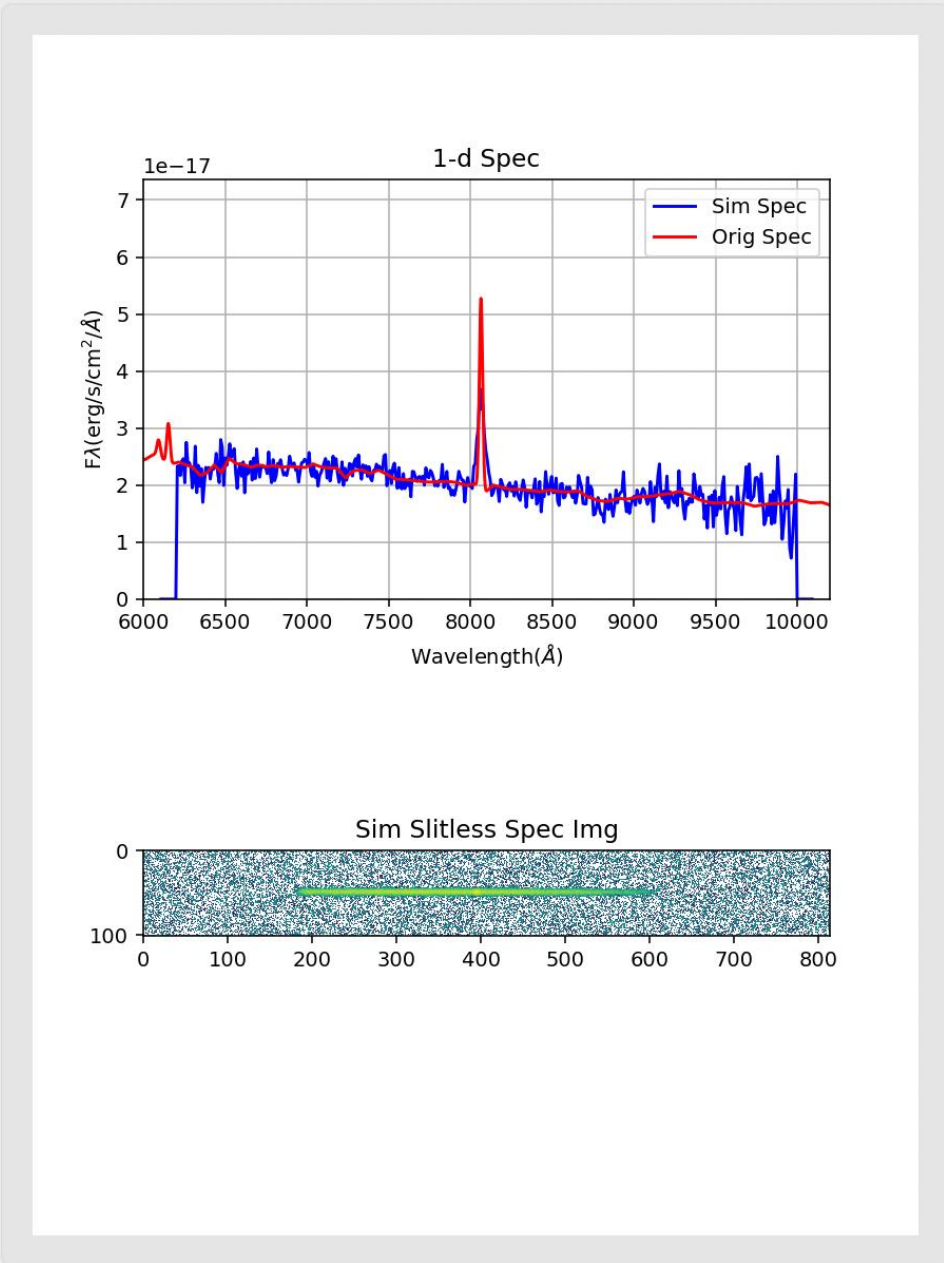
PA(deg) q

-----Output-----

output directory

-----Calculation Information-----

ue maximun: 751 e-, pixel value minimum: 342 e-



CSST一维仿真光谱生成工具

命令版本

```
dataDir = '../data/'
config = Config(dataDir = dataDir)
sedFn = dataDir + 'sed/sed_44575.txt'
psf = galsim.Gaussian(fwhm=0.39)
specG = SpecGenerator(sedFn = sedFn, grating = 'GI', beam = 'A', aper = 2.0, xcenter = 5000, ycenter = 5000, p_size = 0.074, psf = psf,
skybg = 0.3, dark = 0.02, readout = 5, t = 150, expNum = 1, config = config)
specTab, specImg, img, fluxRa=specG.generateSpec1dforStar()

fits.writeto("specImg.fits", specImg, overwrite=True)
fits.writeto("DImg.fits", img, overwrite=True)
specTab.write("specTab.fits", overwrite=True)
```

程序下载地址: https://csst-tb.bao.ac.cn/code/zhangxin/sls_1d_spec.git

谢谢