STELES – SOAR Telescope Echelle Spectrograph

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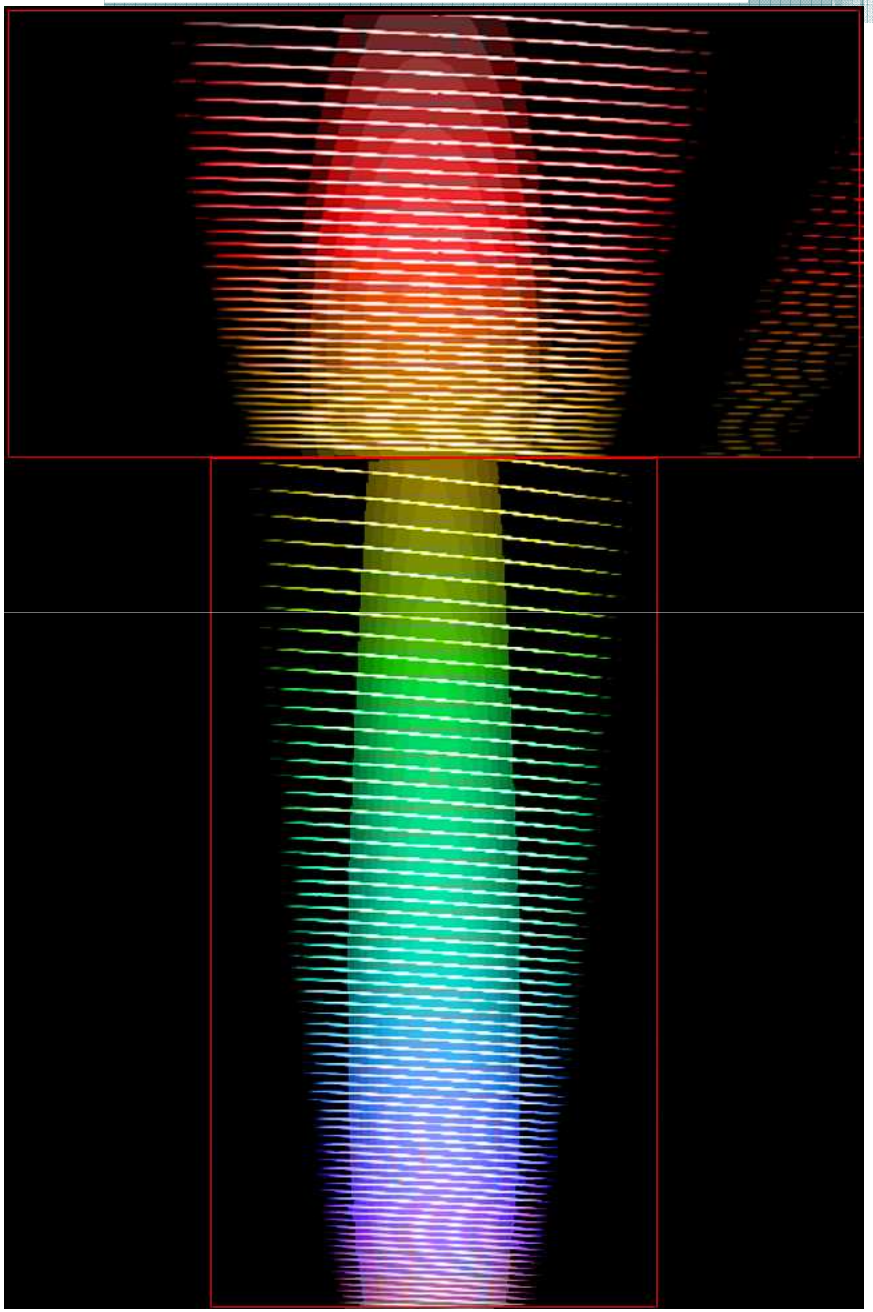
STELES Characteristics

- λλ - 300-890nm (in one shot)
- R4 echelle gratings
  50k (75K narrow slits)
- 2 independent slits
  0.8” (0.5-5”)
  8.0” (0.5-20”)
- CCD - 2 x 4096x2048
  - graded coating
- Reduction pipeline



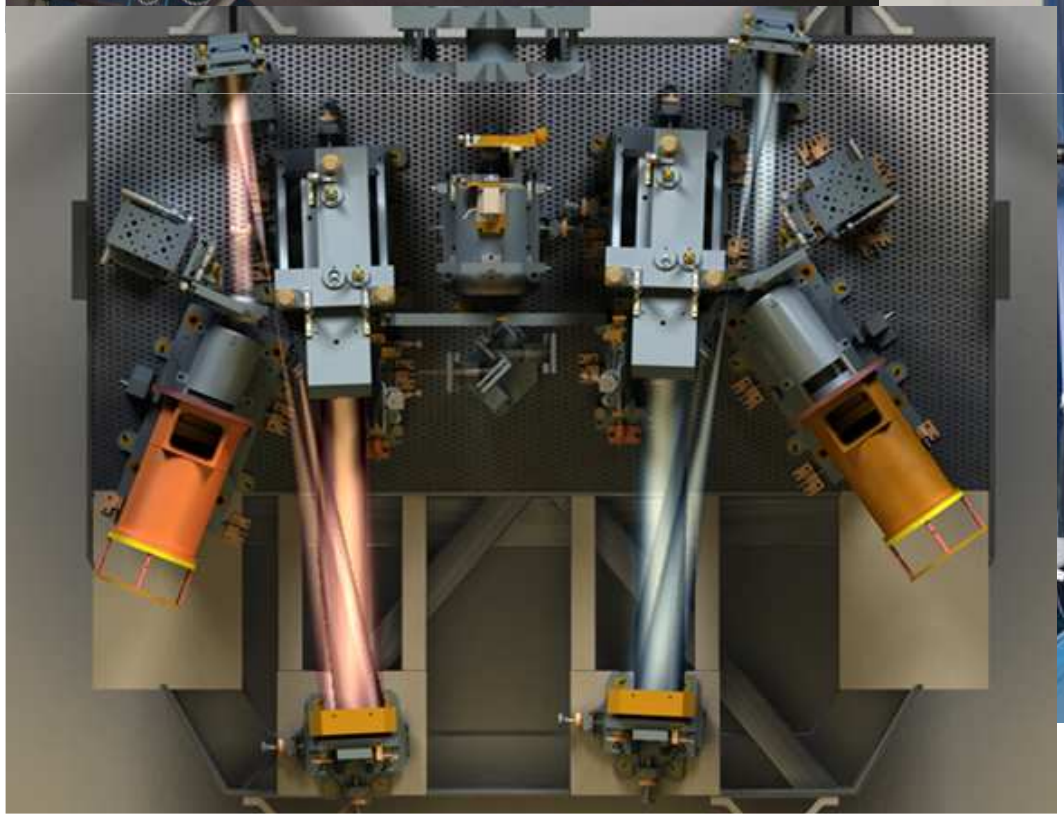
Science Cases

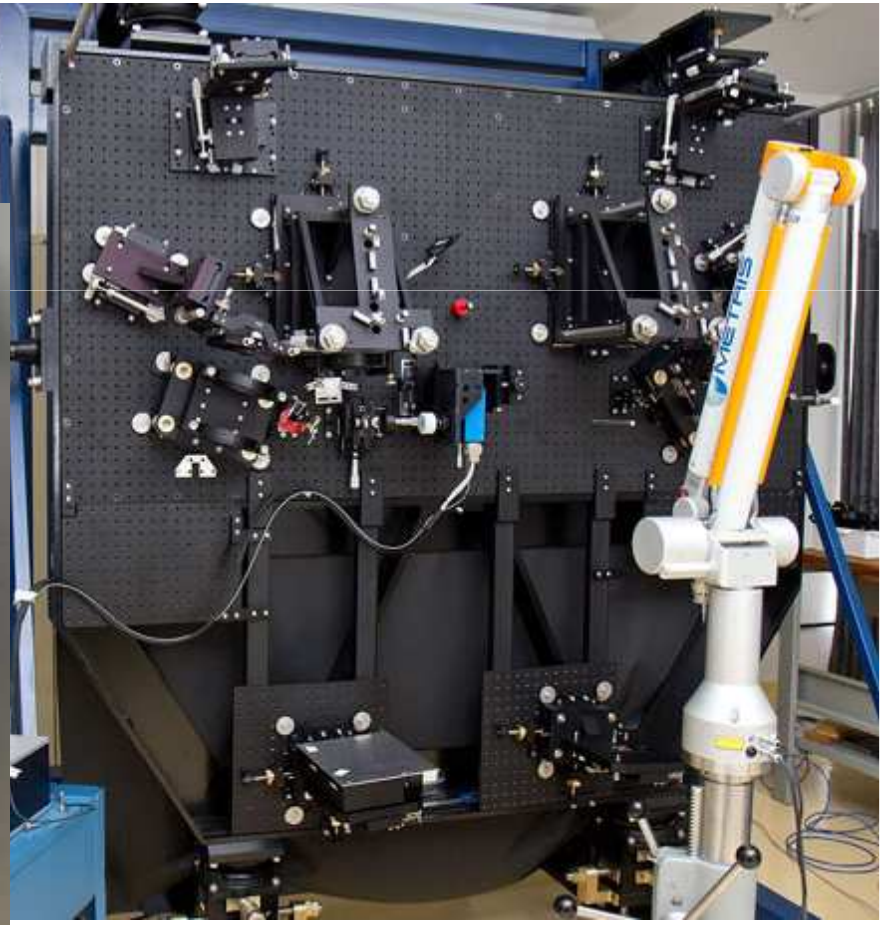
- *Some of the leading science cases for STELES:*
  - Heavy Elements abundances
  - Asterosismology
  - Isotopic abundances
  - Planetary nebulae abundances
  - Stellar rotation
  - Line variations in young stars
  - Emission lines in SN
  - HII regions
  - Kinematics in AGN and clusters

Status

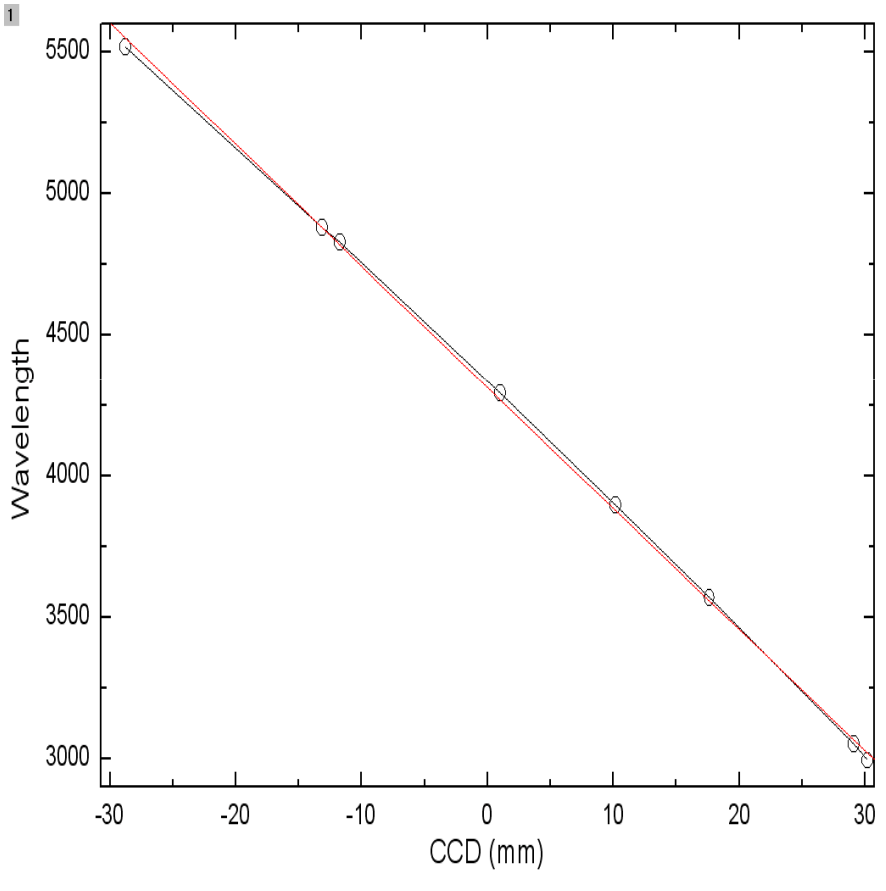
- Optics 100% - arrived, to be tested
- CCDs 100% - at CTIO, in characterization
- Dewars fabrication finished – being assembled at CTIO
- Mechanics fabrication 85%
  - imported parts arrived
  - in fabrication at LNA and contractors
- Electronics 85% arrived
- Data reduction - tests performed in March2013

STELES computer models and actual instrument on assembly room

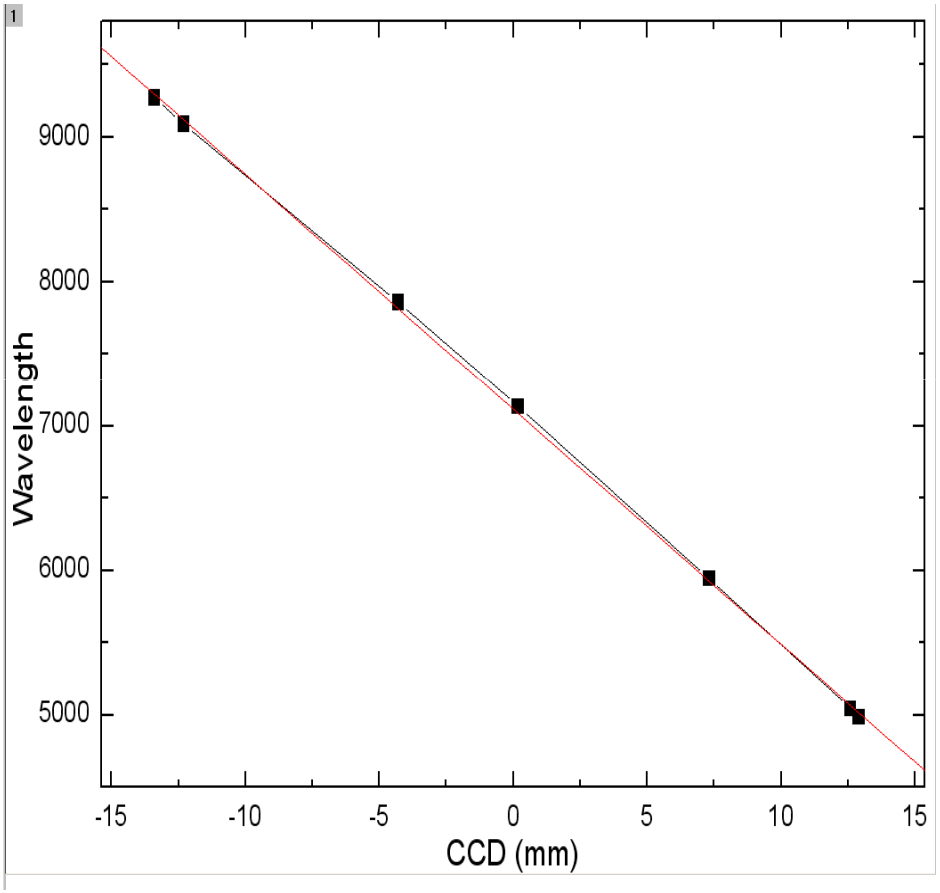




Spectral format / Detectors
Gradient Coating Format



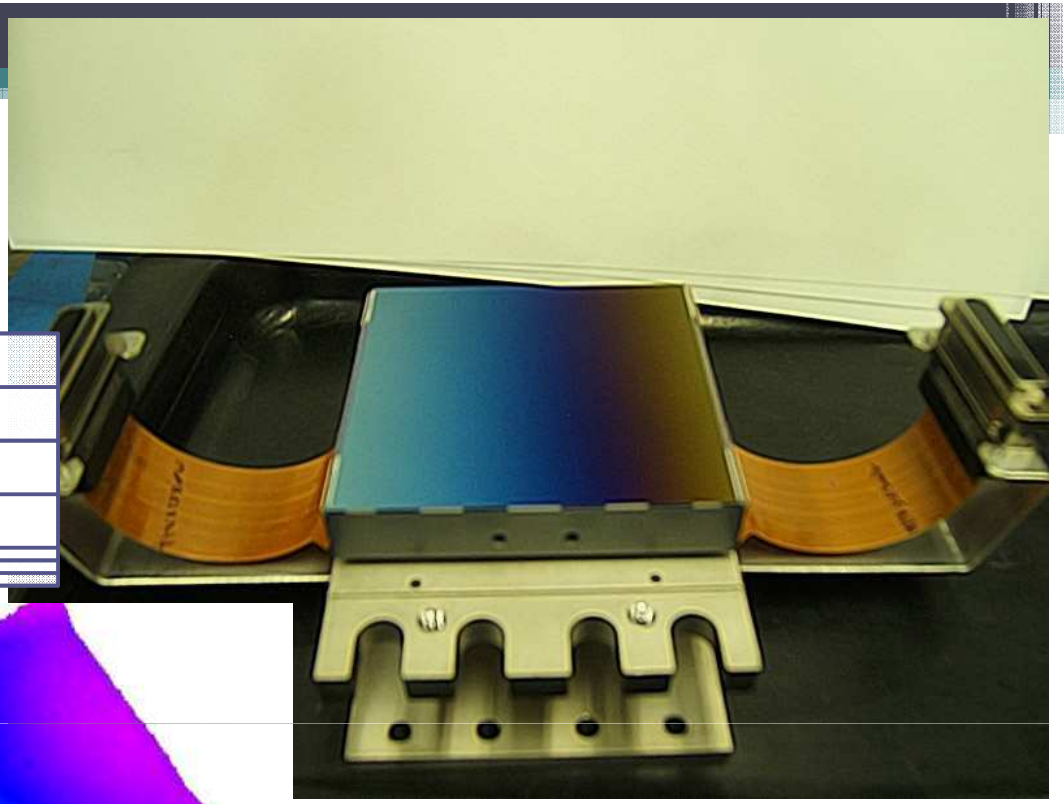
Blue chip

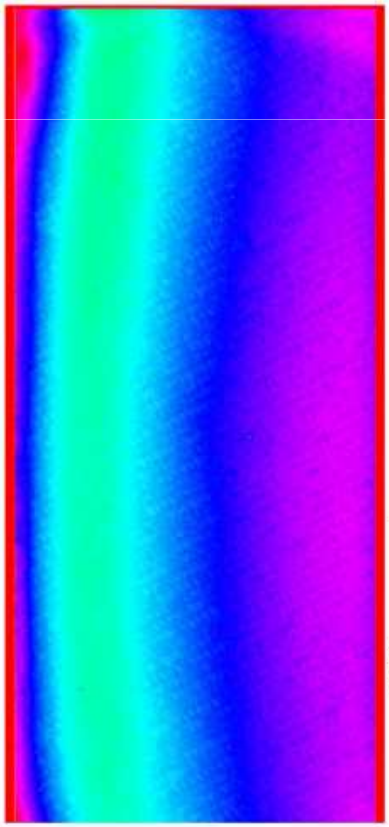


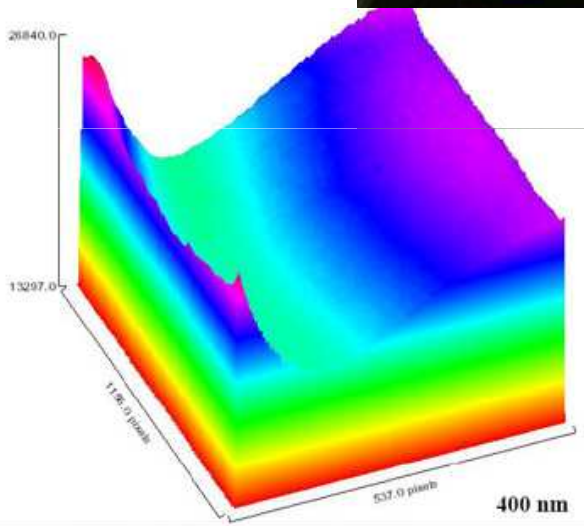
Red chip

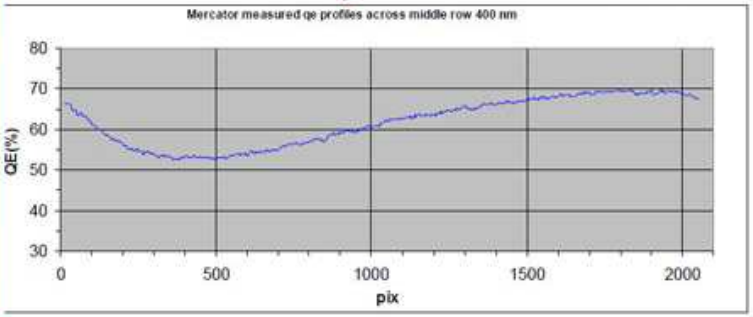
Spectral format / Detectors
Results for coating

Other consumers:
CCD42-90 2kX4k5 pixels to Mercator telescope
CCD231-84 4k4k pixels to SAO (Harvard)
CCD231-84 set of 25 devices for ESO MUSE project



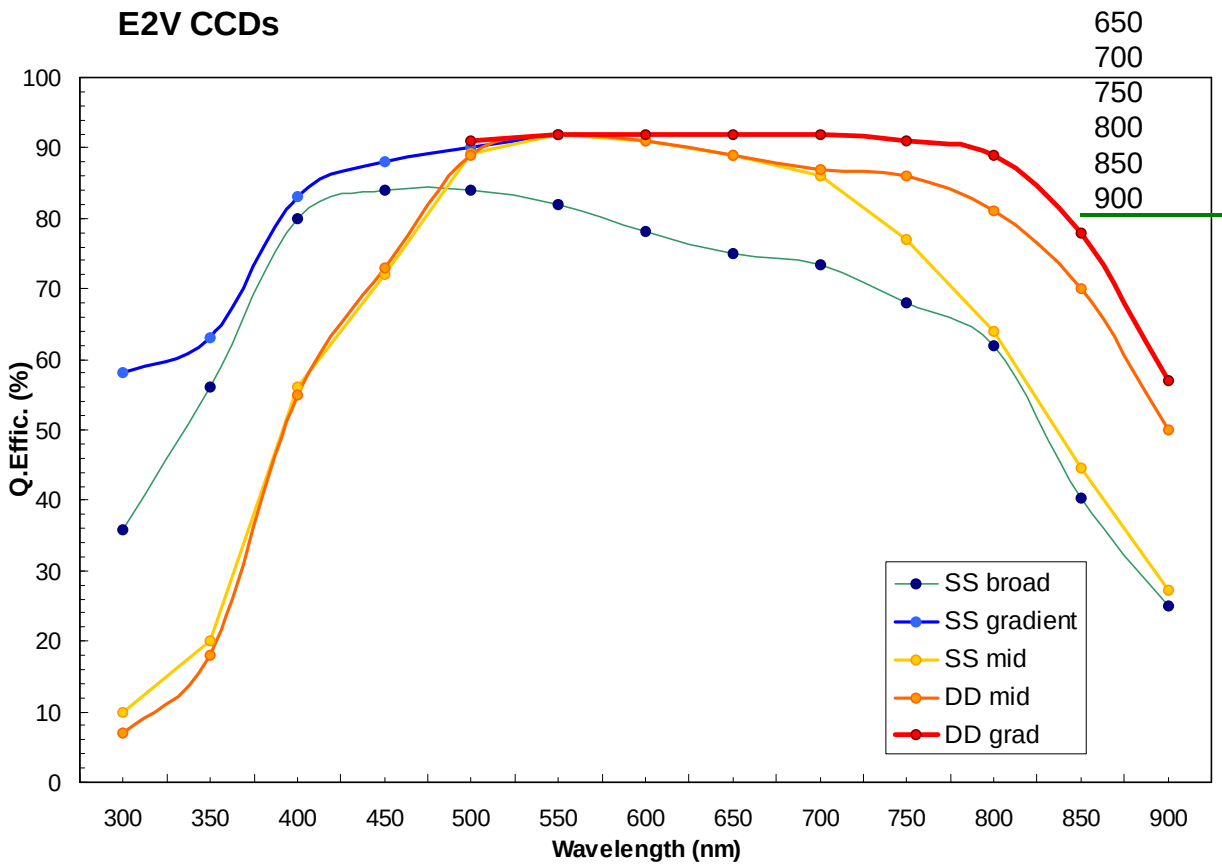






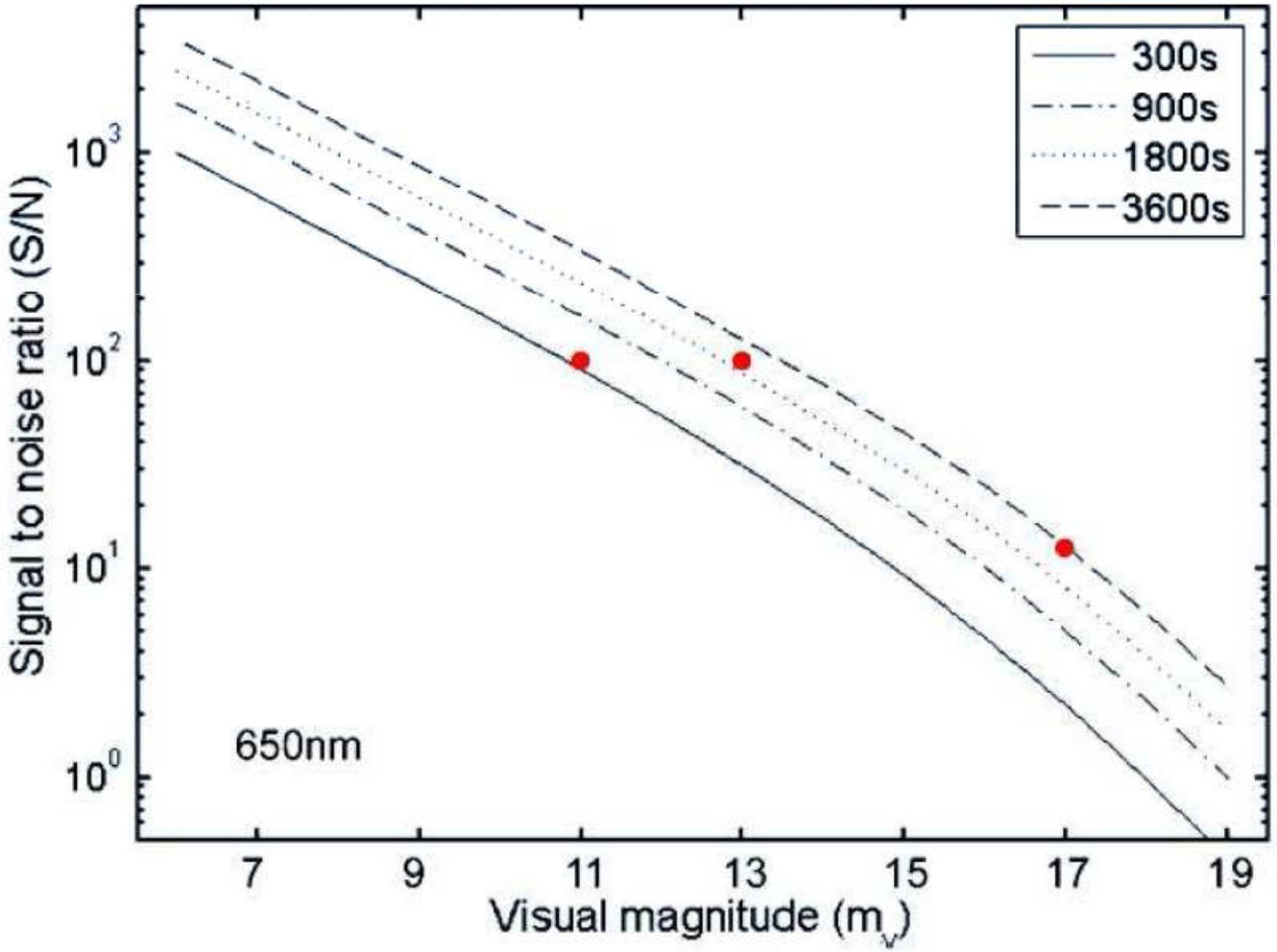
Spectral format / Detectors
Expected QEf

E2V 44-82 -100deg					
	SS broad	SS grad	SS mid	DD mid	DD grad
300	36	**58**	10	7	
350	56	**63**	20	18	
400	80	**83**	56	55	
450	84	**88**	72	73	
500	84	**90**	89	89	91
550	82	**92**	92	**92**	92
600	78		91	**91**	92
650	75		89	**89**	92
700	73		86	**87**	92
750	68		77	**86**	91
800	62		64	**81**	89
850	40		45	**70**	78
900	25		27	**50**	57



Based on E2V test sheets and previsions

Efficiency



M v	S/N	T(min)
11	100	5
13	100	30
17	12	60

650nm
0.8”
dark time

STELES exposure time calculator

STELES

Exposure Time Calculator
SOAR Telescope Echelle Spectrograph

Online help for SPECTIME

Signal-to-noise ratio: 100 Integration time in seconds: 720
Maximum time per single exposure (seconds): 1200
Central wavelength: 4500 From 3000 to 5399 [A] data is computed for Channel A
From 5400 to 9000 [A] data is computed for Channel B

Slit width in arcsecs (+) or pixels (-): 0.8 Dichroic: Da
Filter: None
Detector binning (dispersion): 1
Seeing (arcsecs): 0.8 Airmass: 1.0

Lunar Phase (0-14 days from new moon, 0 = new, 14 = full): 0=new

Describe the source with the following parameters. The power law index is only used if the source spectrum is set to Fλ_power or Fν_power. Setting the power law index to 0 is equivalent to a flat spectrum for that particular power law function. If the value of the wavelength of the source flux is set to INDEF then the central wavelength value above is used. The wavelength of the source flux is ignored for source units = U, B, V, R, I.

Source spectrum: Blackbody Temperature (K) for blackbody source: 6000 Power law index: 0
Wavelength (λ) of source flux or magnitude: INDEF Source flux or magnitude: 12 Units of source flux or magnitude: B
E(B-V) (reddening of source in magnitudes): 0

Detector: MIT/LL Help for Detector Type

Execute Reset

sediyama@efei.br

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sptime

Object spectrum: Blackbody spectrum of temperature 6000. K
Reference wavelength: 5500. Angstroms
Reference flux: V = 12. (6.03E-14 ergs/s/cm^2/A)
Sky spectrum: Cerro Pachon
      Moon phase: 0
Extinction:
      Airmass: 1.
Seeing: 0.8" (FWHM)

Telescope: Slit
      Area: 13.2 m^2, Scale: 3.144 arcsec/mm
Spectrograph: STELES
Collimator:
      Focal length = 0.85 m
Apertures: Slit with Gaussian profile
      Size: 0.80" x 21.63", 0.254 x 6.88 mm, 4.2 x 100.0 pixels
Filter: Dichroic A
Disperser: Echelle
      Central order = 104
      Central wavelength = 4500. Angstroms
      Central dispersion = 2.66 Angstroms/mm, 0.0399 Angstroms/pixel
      Ruling = 41 lines/mm
      Blaze = 76.0 deg
      Grating tilt = 76.1 degrees
      Grating magnification = 0.96
      Using predicted efficiencies
Crossdisperser: VPH
      Central order = 1
      Central wavelength = 4500. Angstroms
      Central dispersion = 2.66 Angstroms/mm
      Ruling = 1200 lines/mm
      Blaze = 14 deg
      Grating tilt = 16.2 degrees
      Grating magnification = 0.86
      Using tabulated efficiencies
^
Camera:
      Focal length = 0.215 m, Resolution = 3. pixels
Detector: MIT/LL
      Pixel size: 15 microns, 0.19"
      Number of pixels = 2048
      Read noise = 0.0 e-, Gain = 1.0 e-/DN, Dark = 0. e-/s

Source pixels: 14 pixels (3xFWHM seeing disk)
Background pixels:  89 pixels

WARNING: Orders overlap

---- Results for 919.61s exposure at 4500. Angstroms ----

Source flux: 0.0141 photons/s/cm^2/A (AB=12.4)
Background flux: 2.71E-6 photons/s/cm^2/A (over source pixels)

Transmision/Efficiencies:          indivdual cumulative
   Telescope                        75.8%     75.8%
   Aperture (seeing=0.8")           62.4%     47.3%
   Filter                           97.6%     46.2%
   Spectrograph                     44.3%     20.5%
   Disperser                        84.2%     17.2%
   Detector DQE                     87.0%     15.0%

Statistics per exposure per pixel:          e-      sigma
   Source                          10001     100.0
   Background                          1       1.0
   Dark                                0       0.0
   Readout                                     0.0
   Net                             10002     100.0

Signal-to-Noise Statistics:
  100 per exposure per pixel
  223 per exposure per 0.208 Angstroms (5 pixel) resolution element

Exposure time: 919.61s (0:15:19.6)
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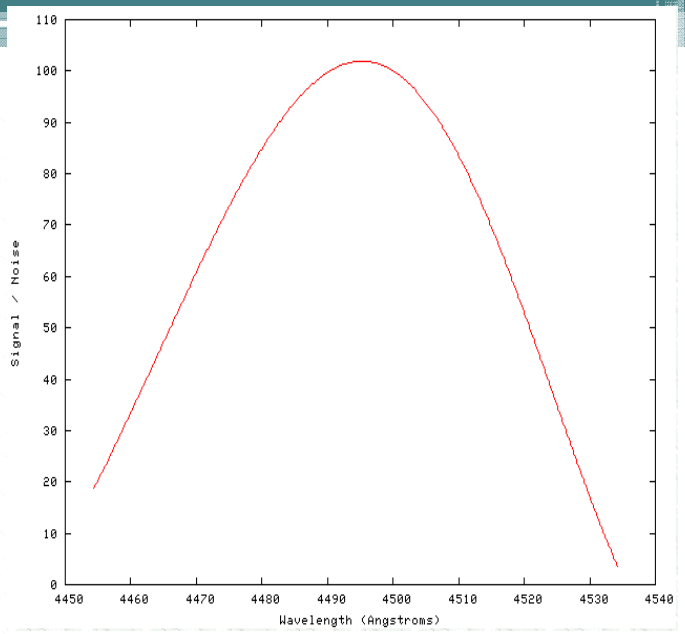
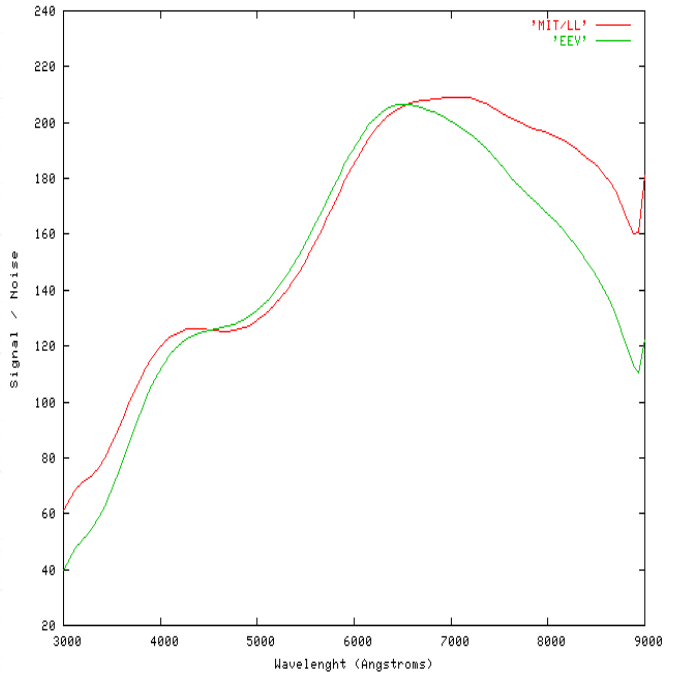
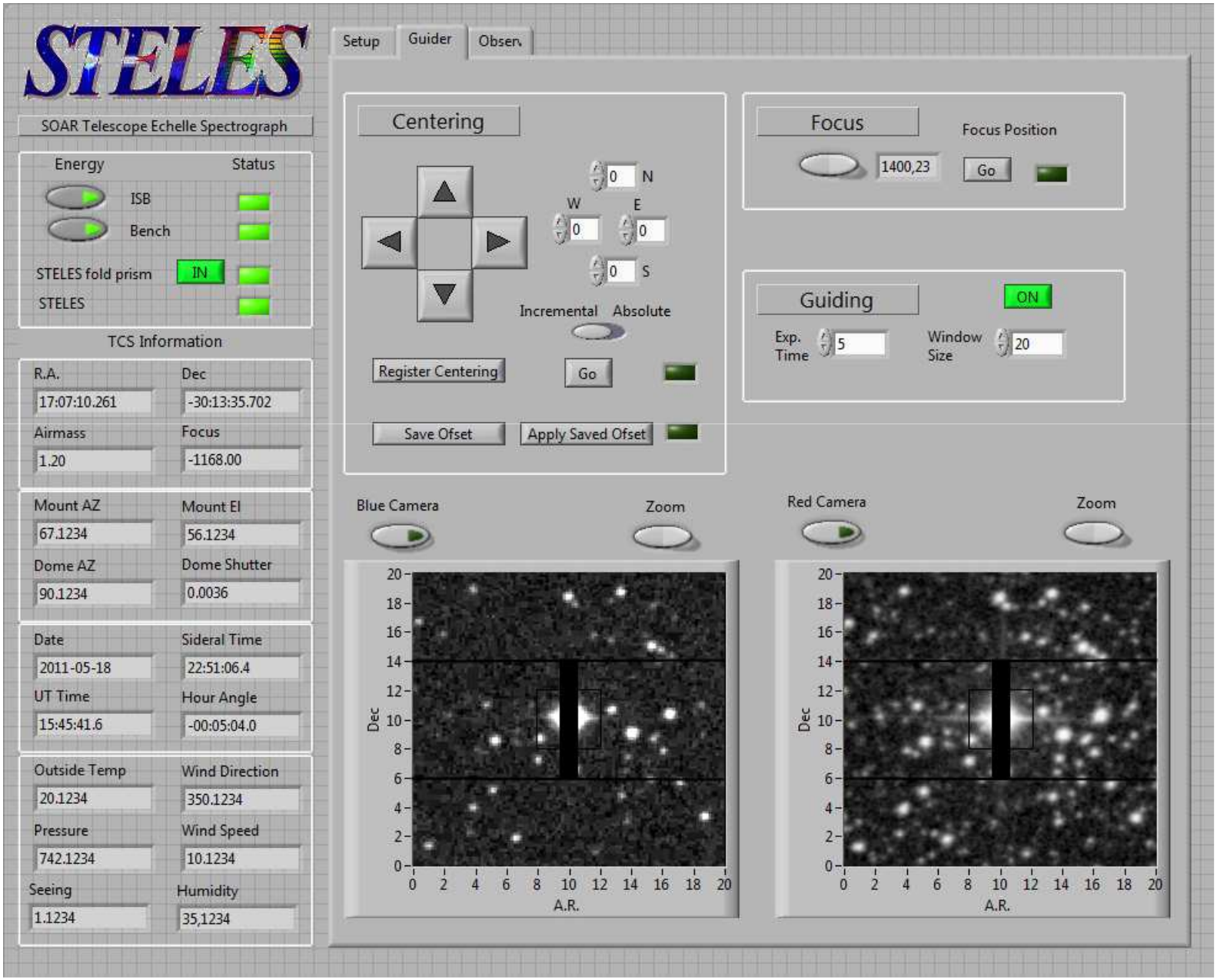


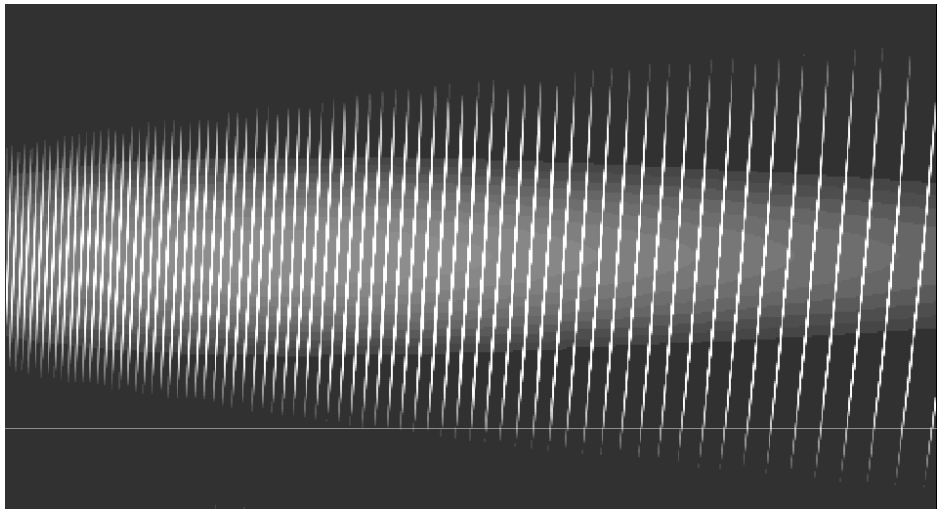


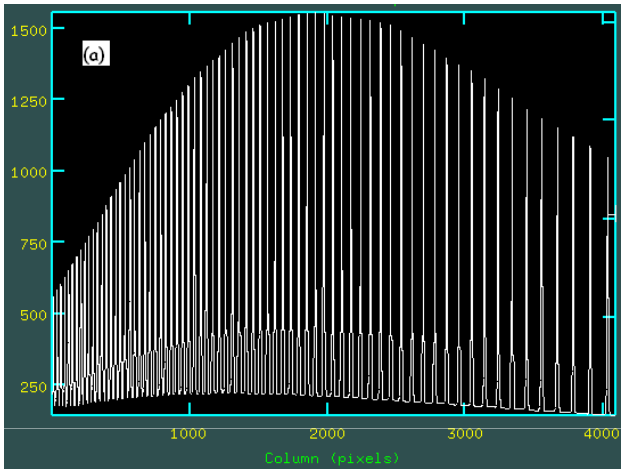
STELES Control system Visual Interface



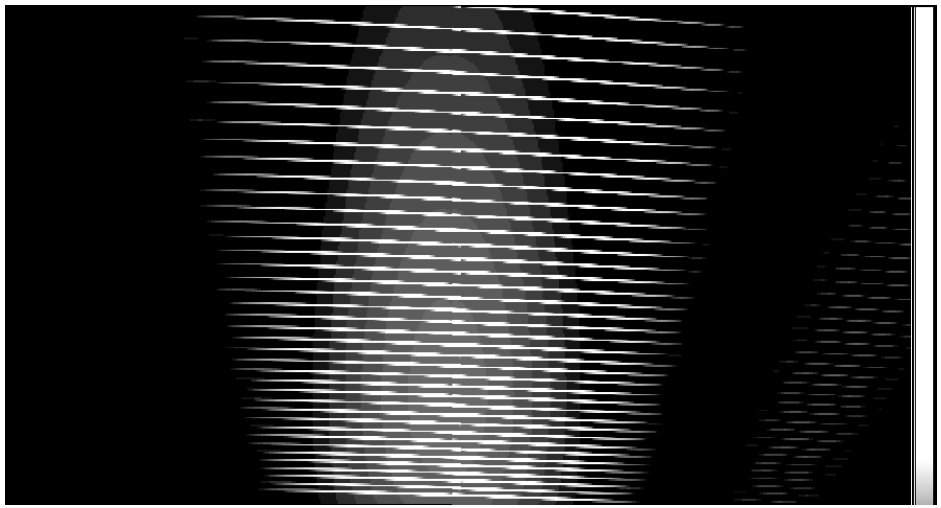
STELES spectral format

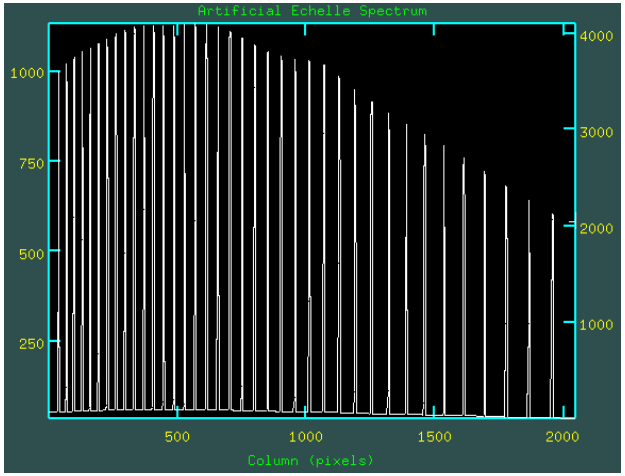
Blue





Red

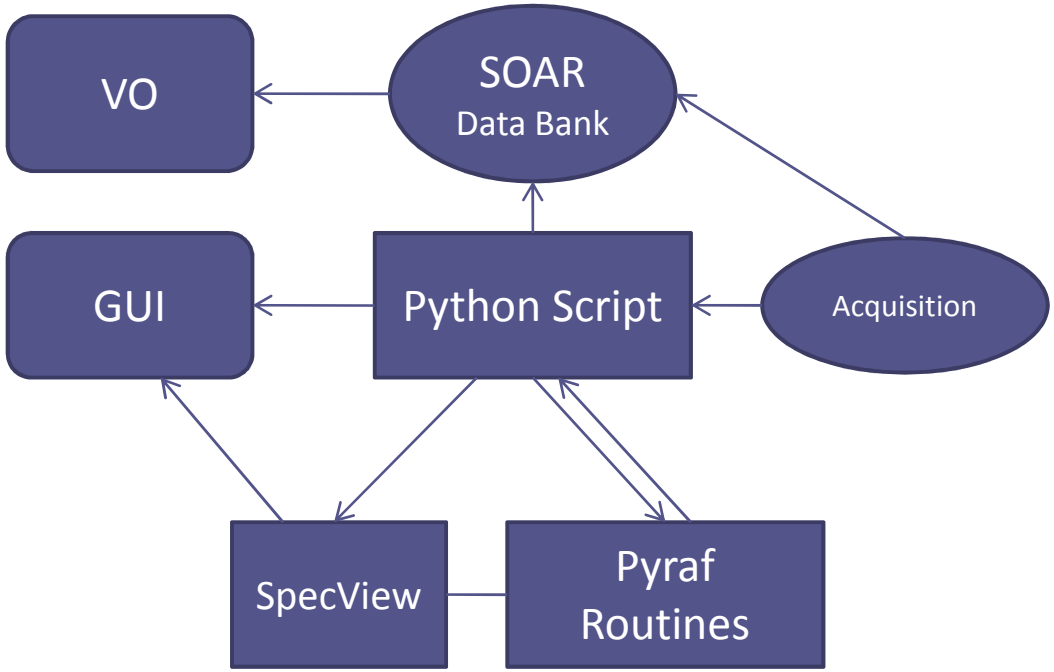




Data Reduction - Structure

First light – IRAF script, tests and early science

Pineline – optimized based on the first data



STELES Solar spectrum Halfa – obtained at lab.