HIRedux Pipeline

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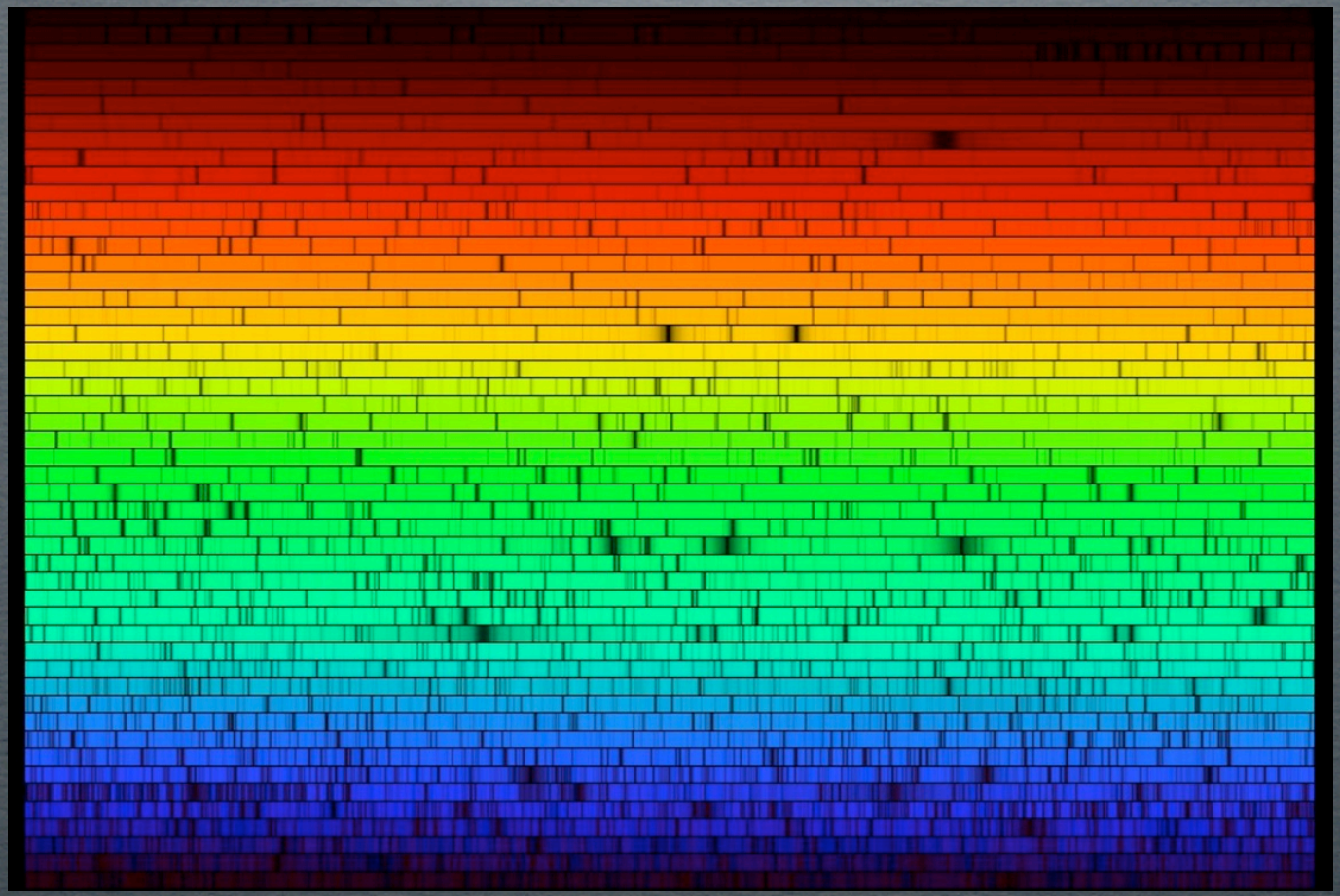


Overview

- IDL
- 'Fully' Automated
- Organize the observations
- Allow for multiple setups
  - Binning, decker, angles, etc.
- Flatten
  - Pixel-to-pixel variations are tricky
  - Trace order curvature
- Arcs
  - Automated, 2D solution
  - Improved sky subtraction (MAKEE)
- Object
  - Trace
  - Skysub
  - Extract

Code

- IDL
- Packages: SDSS
  - http://spectro.princeton.edu/idlspec2d_install.html
  - These include C code which must be compiled upon installation
- Packages: XIDL
  - http://www.ucolick.org/~xavier/IDL/
  - Includes ESI redux
  - CVS write access via Steve Allen
  - Also includes C code

Step I: Parse Headers

- hires_struct
- Define XDANGL, Binning, Gain, etc.

```
tmp = {hiresstrct, $
       frame: 0,   $          ; FRAME Number
       flg_anly: 0,$          ; Analysis flag 0=Don't Analyse, 2=bias sub, 4=scatt light
       chip: 0L, $            ; 1=blue; 2=green; 3=red
       exten: 0, $            ; Extension in original image
       obj_id: 0L, $          ; Obj ID
       Obj: ' ', $            ; Object Name
       type: ' ',   $         ; ObjTyp: OBJ,STD,DRK,ZRO,ARC,MSK,TWI,IFLT,TRC
       block: ' ', $          ; Blocking Filter
       decker: ' ', $         ; Decker
       cross: ' ', $          ; Cross-disperser (Blue/Red)
       XDANGL: 0.d, $         ; XDANGL
       ECHANGL: 0.d, $        ; ECHANGL
       setup: 0, $            ; Setup index
       exp: 0.d,   $          ; Exposure time
       colbin: 0L, $          ; Binning in column
       rowbin: 0L, $          ; Binning in row
       AM:   0.,   $          ; Airmass
       CCD: ' ',    $         ; CCD
       AMPMODE: ' ',    $     ; Mode of Readout: SINGLE:A, SINGLE:B, DUAL:A+B
       AMP: 0,    $           ; 1=A, 2=B
       TEL: ' ',    $         ; Telescope
       arc_xyoff: fltarr(2),$ ; Offsets for Arc IMG due to thermal expansion
       lamp: ' ', $           ; Lamp: none, ThAr1, ThAr2, quartz
       lampfil: ' ', $        ; Lamp: none, ThAr1, ThAr2, quartz
       gain: 0.,   $          ; Gain
       readno: 0., $          ; Read Noise
       date: 0.0d,  $         ; Date of Obs (MJD)
       RA: ' ',     $         ; RA
       DEC: ' ',    $         ; DEC
       Equinox: 0.,$          ; EQUINOX
       rootpth: ' ',$         ; Path of the Root
       img_root: ' ',$        ; Root name (usually in Raw directory)
       flg_ov:  0, $          ; OV FILE?  0=No, 1=Yes
       img_ov:  ' ', $        ; Name of OV file (with directory)
       flg_final: 0, $        ; Final File? 0=No
       img_final: ' ',$       ; Name of Final img
       ystrt: 0L, $           ; Column for initiating the trace
       arc_fil: ' ', $        ; Name of the Arc image file (fits)
       arc_img: ' ', $        ; Name of the Final Arc image file (fits)
       flat_fil: ' ', $       ; Name of the Flat image file (fits)
       obj_fil: ' ' $         ; Object structure
       }
```

StepII: Setups

- hires_setup
- Identify all unique setups
  - xdangl, echangl
  - Decker, Binning
  - Blocking filter
- Create ASCII summary files
- Launch hires_redux to view the setups

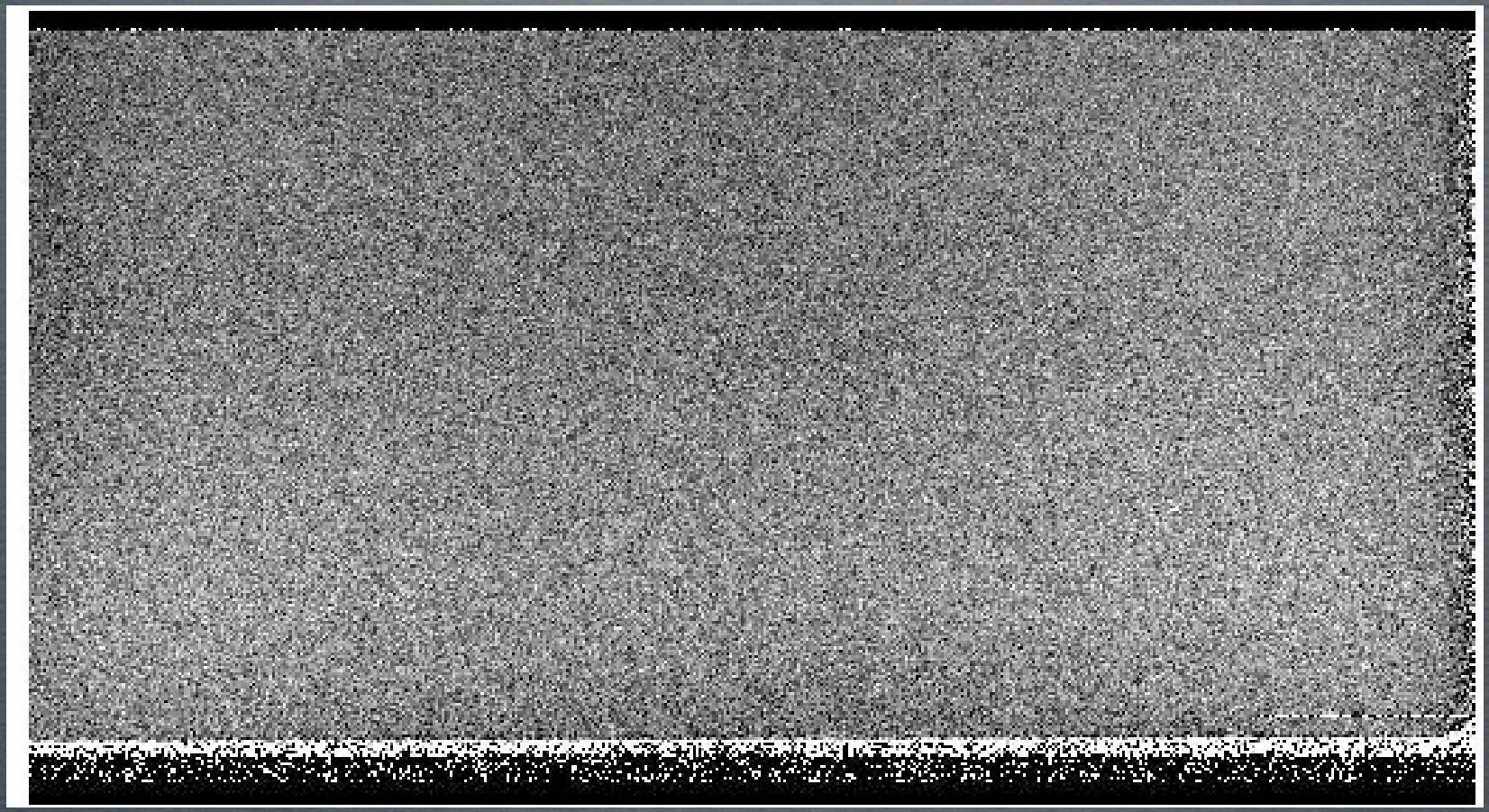
StepIII: Flats

- hires_allflat
- hires_findgain
  - Recommended
  - Estimate gain based on counting stats
- hires_mkflat
  - stacks the flats
  - Both *TFLT* (trace flats; traditional)
  - and *MFLT* (pixel-to-pixel)
- Pixel Flats
- hires_edgeflat
  - Trace order edges
  - PCA fit
  - Extrapolates well
  - QA

Pixel Flats

- For high SNR observations, flat fielding is a potentially major source of error
- 'Standard' flats are difficult
  - scattered light
  - small slit length
- Solution
  - Image X-disperser with cover closed
  - (Bob Kibrick)
  - One chip at a time
  - 1-2hrs per binning mode
  - Observatory function

Pixel Flat



Spectrum with the Cross-Disperser cover closed

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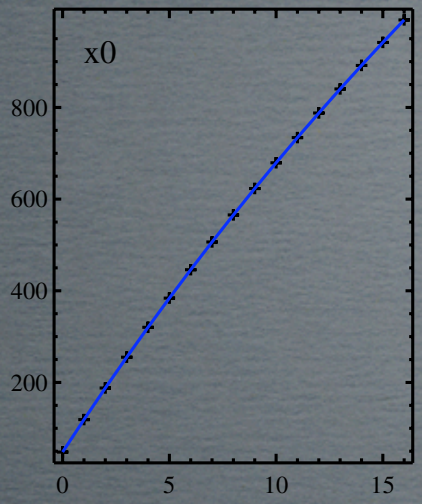
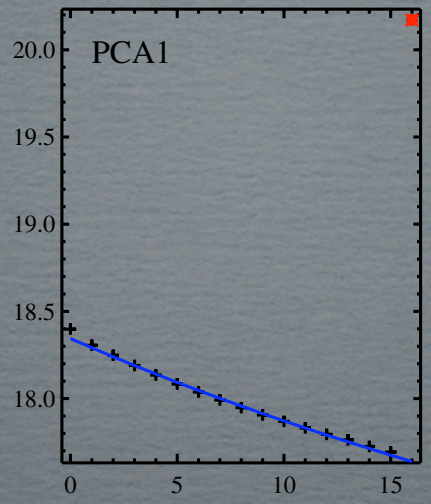
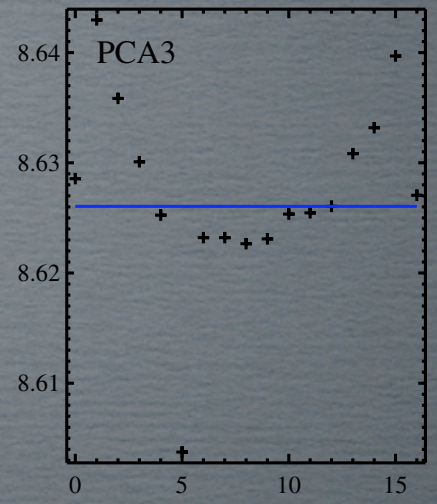
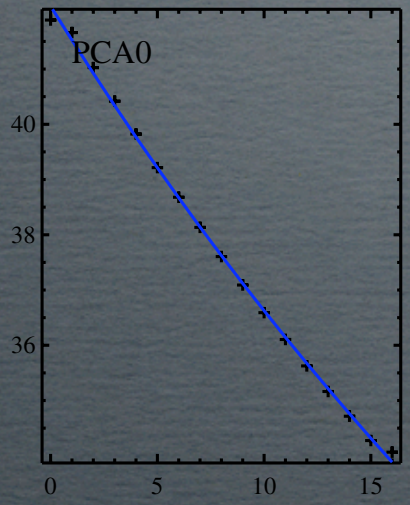
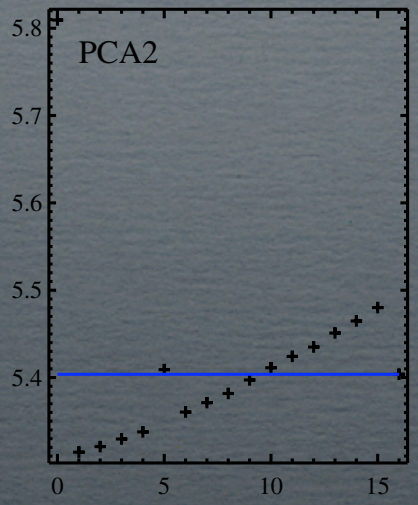
QA for Edgeflat

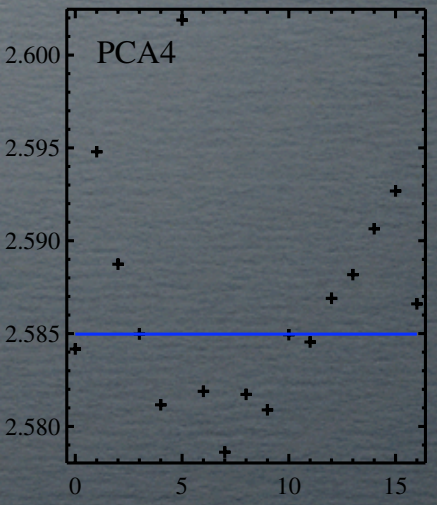




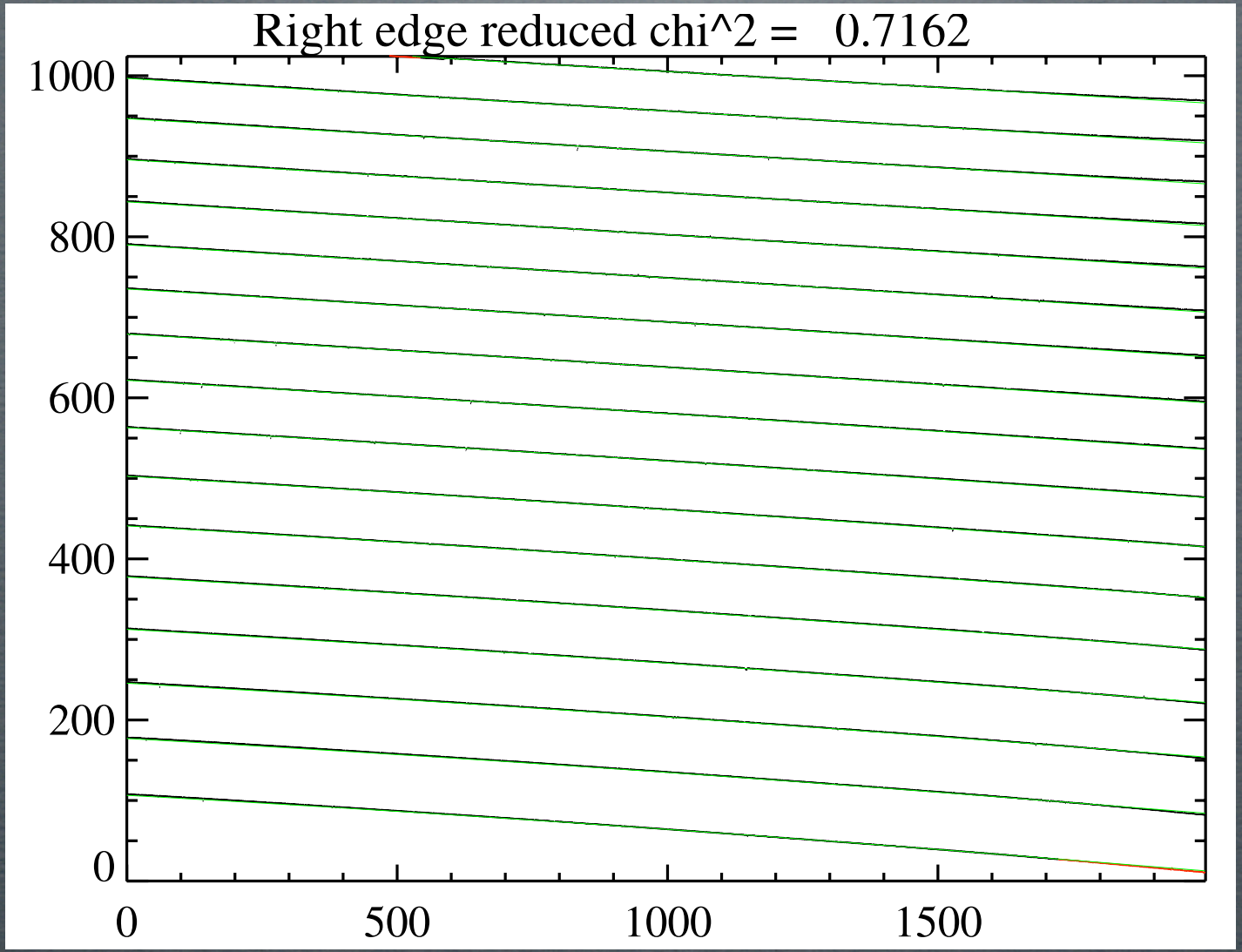








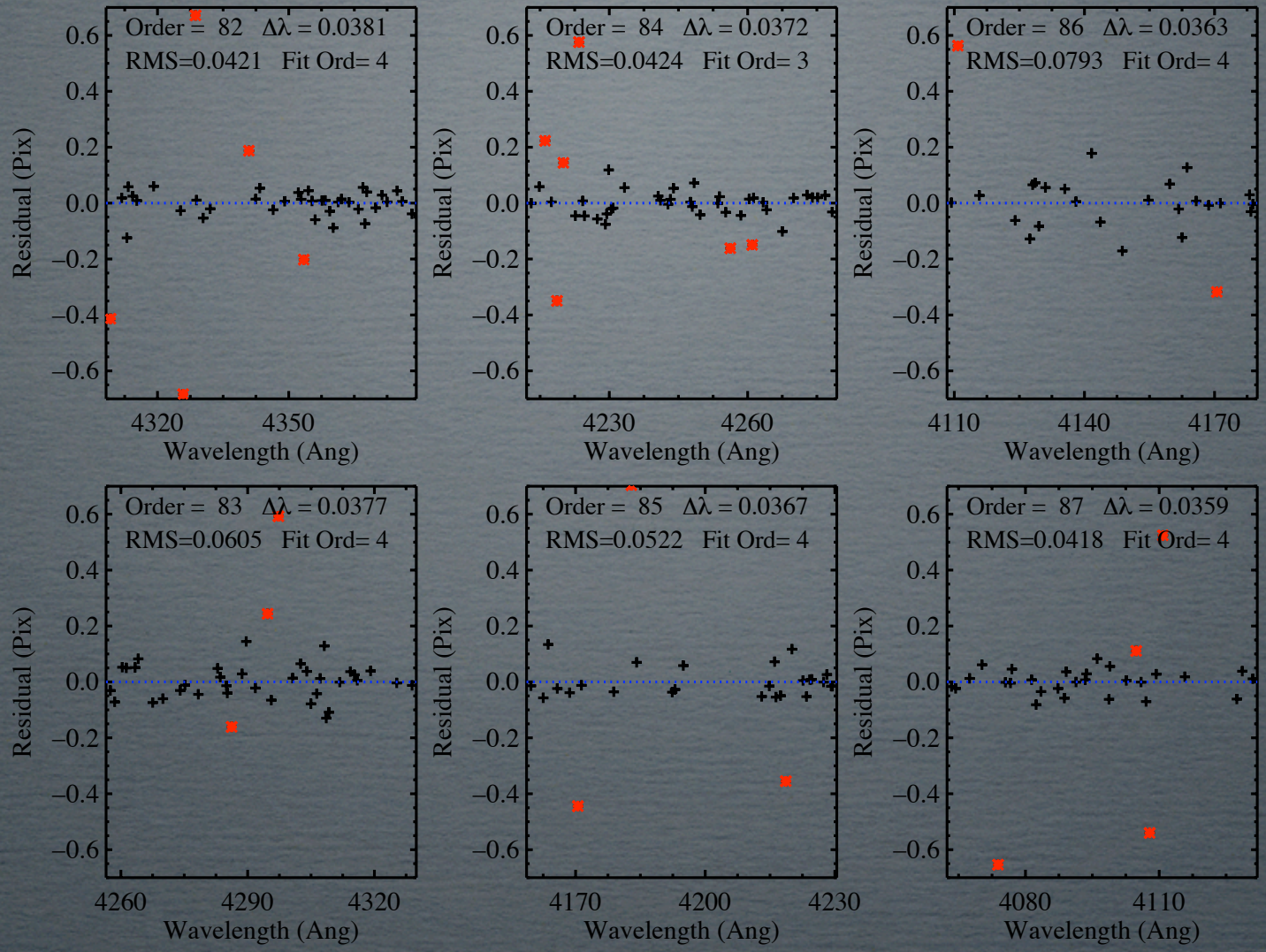
QA for Edgeflat



Step IV: Arcs

- hires_allarc
- hires_procarc: Bias, flatten
- hires_fitarc
  - find closest template match
  - Use same binning if possible
  - Database is building
  - HIRESr is not ready yet

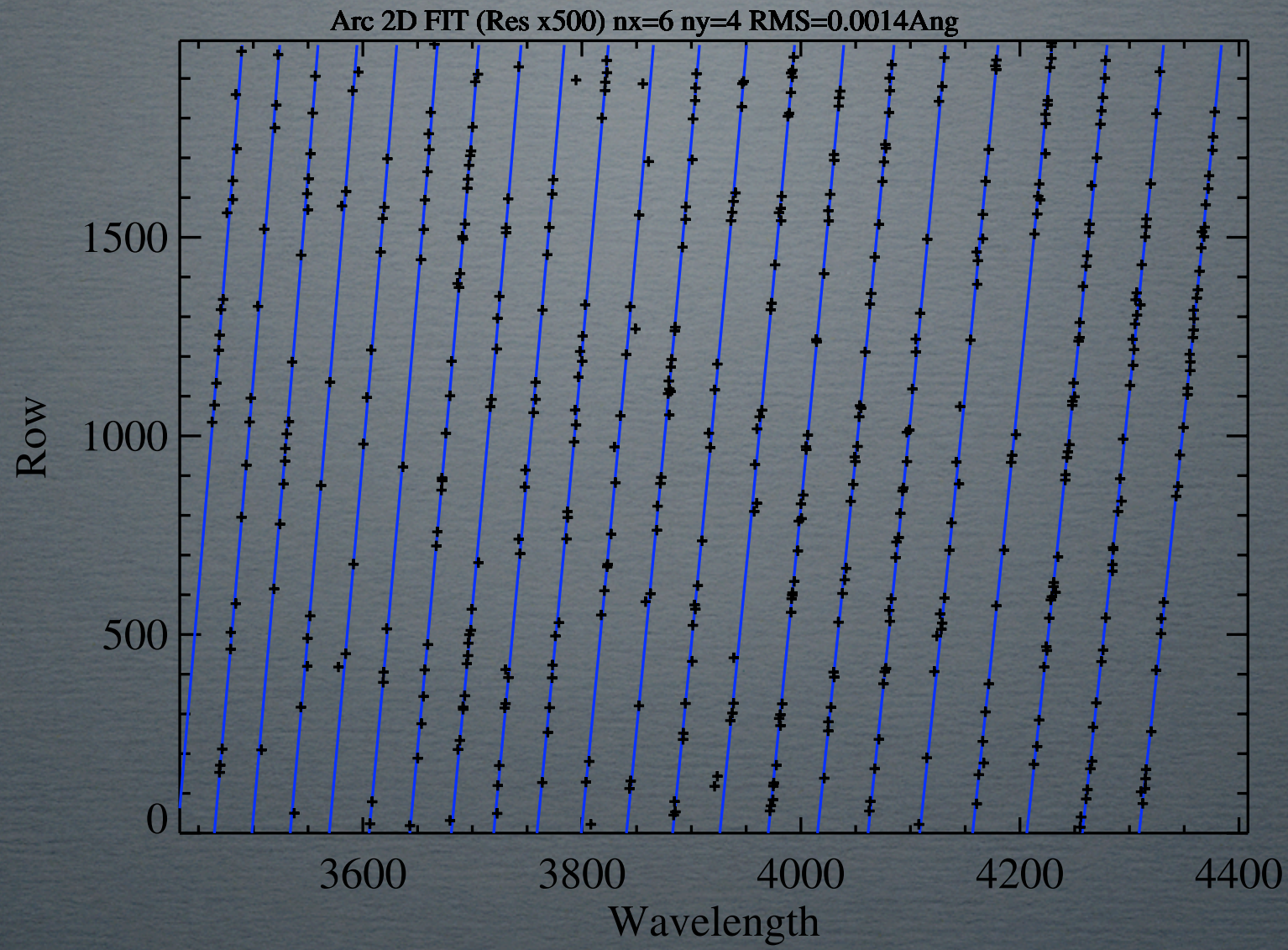
QA for FitArc



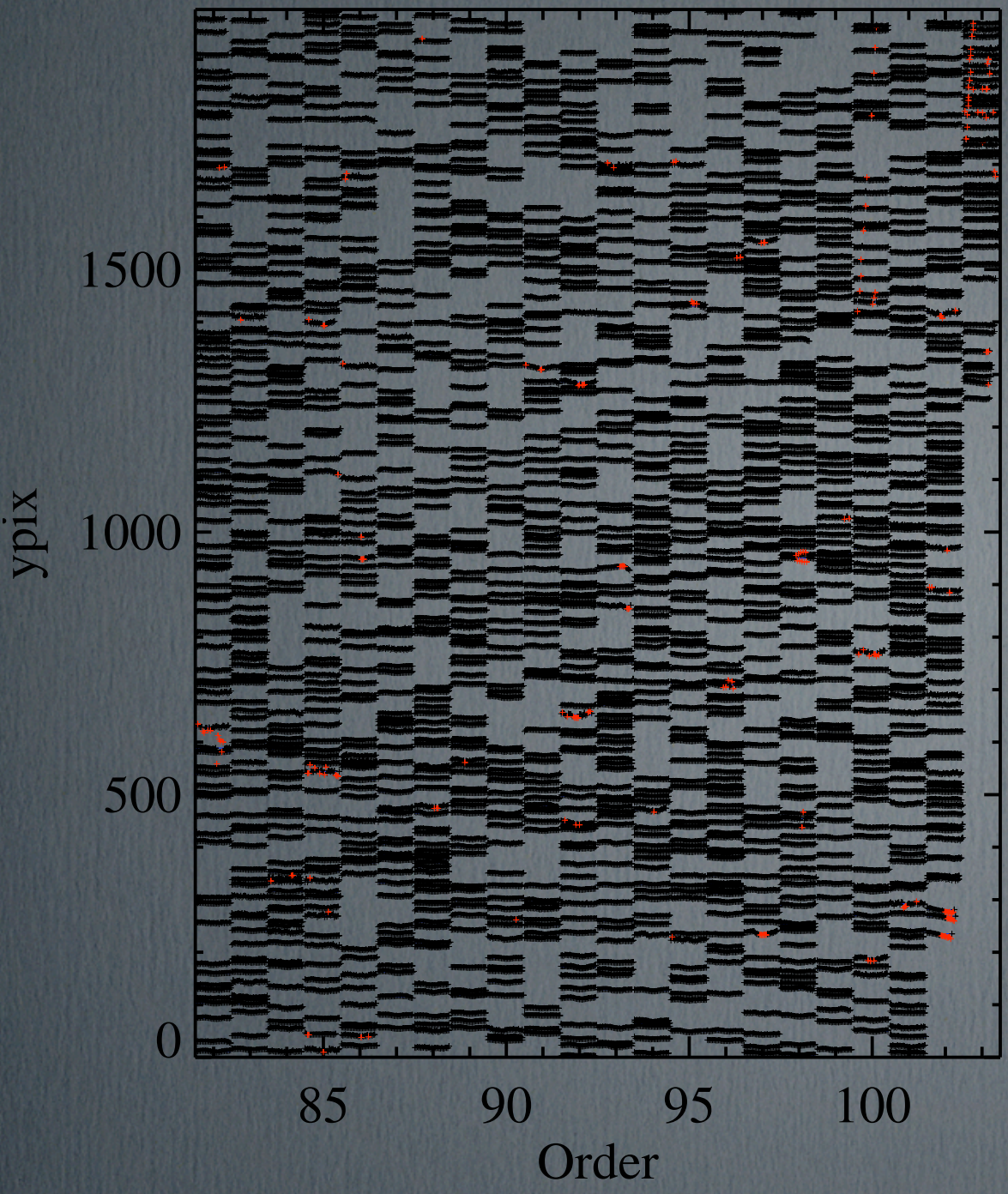
SetupIV: Arcs

- hires_2dfitarc
  - Prefrom 2D fit to wavelengths
  - Every pixel has a unique value
  - Ideal for sky subtraction
- hiers_trcarc
  - fit line to each arc line
  - Record the slopes
- hires_fittrcarc
  - Fit the slopes of the lines, order by order
- hires_aimg
  - Produce a 2D wavelength image

QA HIRES FIT2DARC

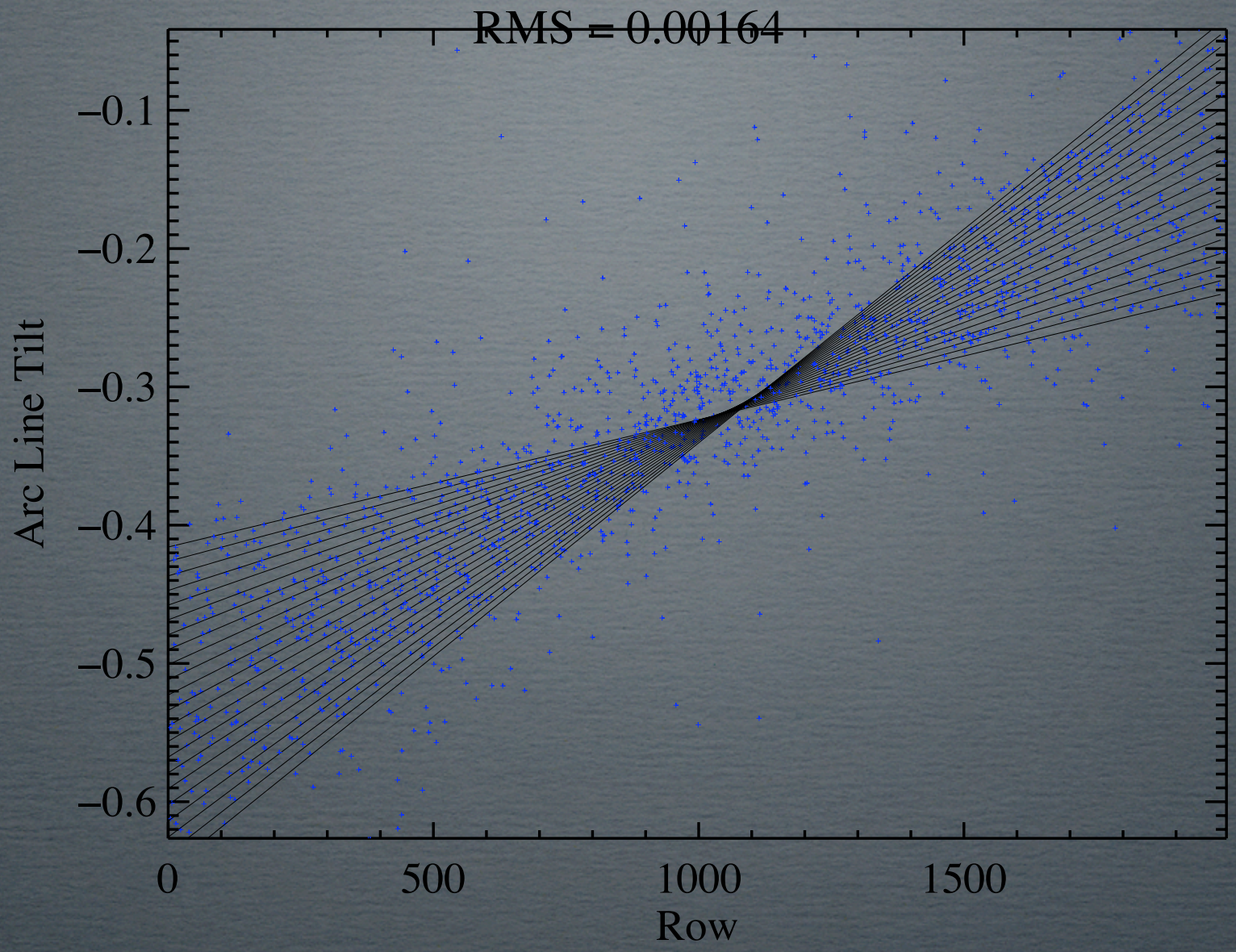


QA TracearcQA/Arcs04/qa_tracearc_B0107.ps (20x RES)

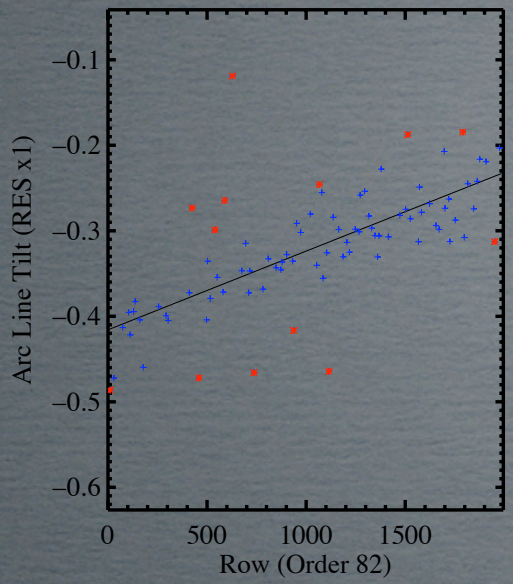


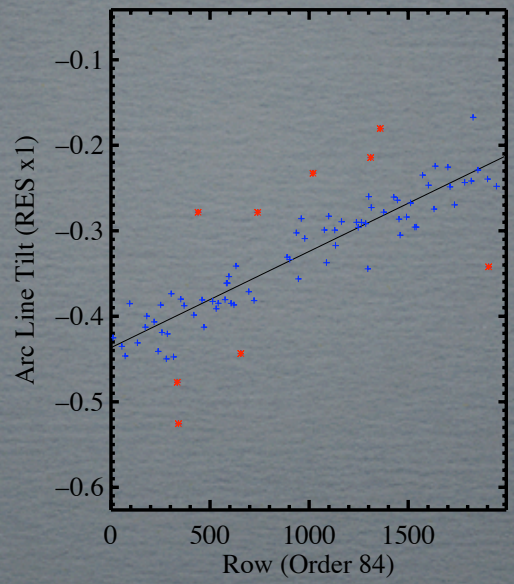
QA FOR HIRES TRCARC

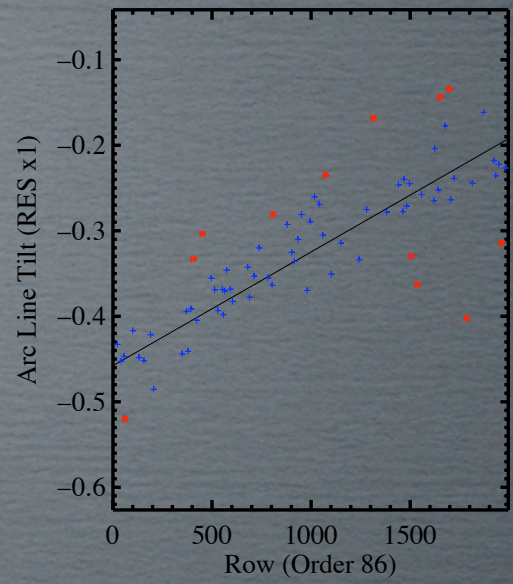
QA FOR HIRES_FITTRCARC

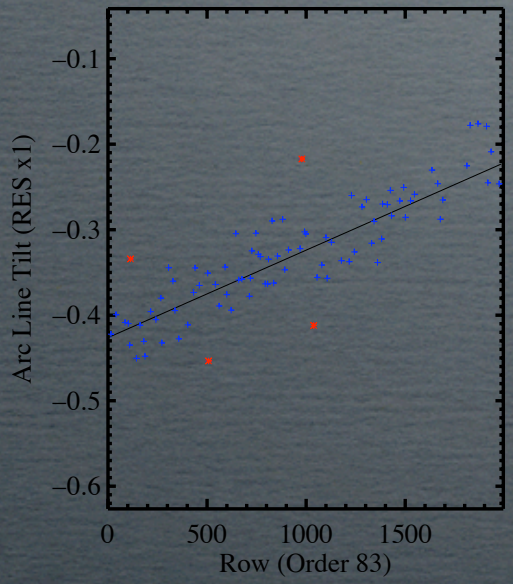


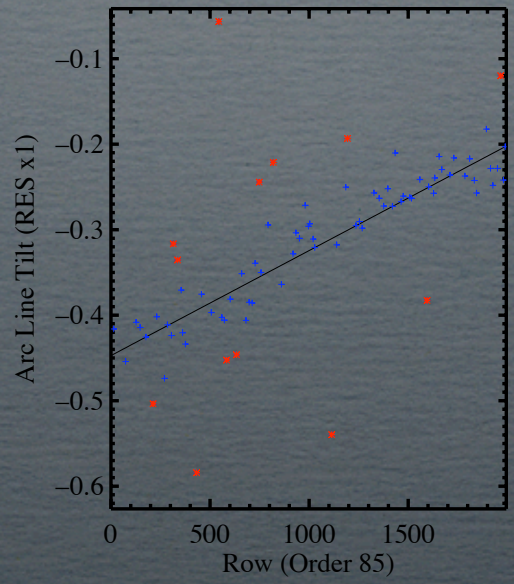
QA FOR HIRES FITTRCARC

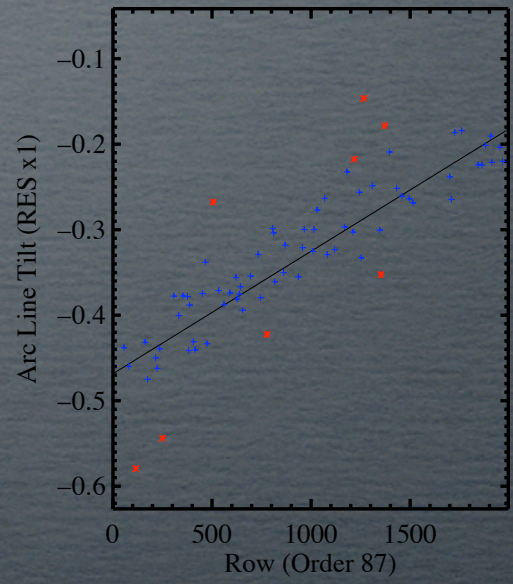








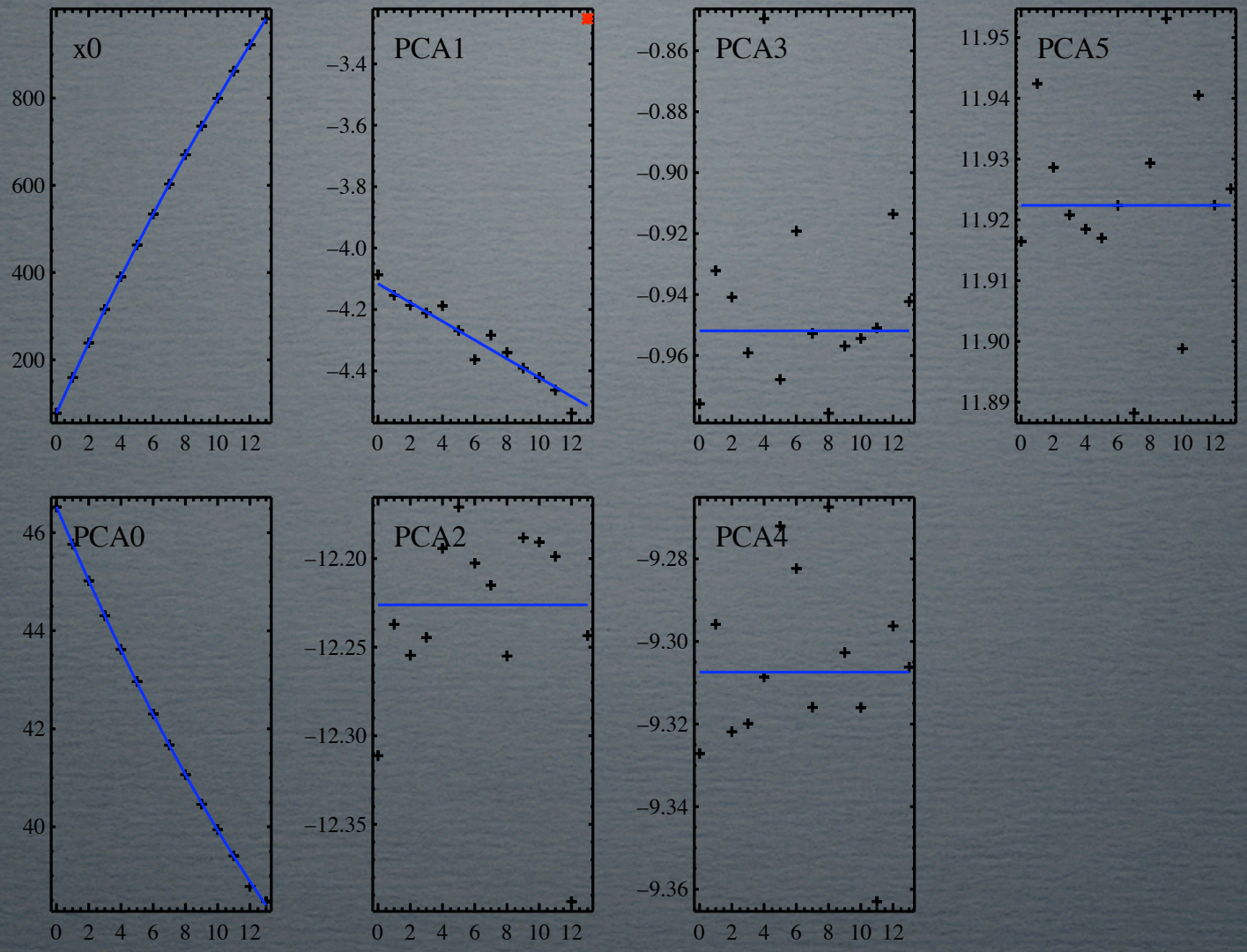




StepV: Object

- Process: hires_proc
  - Bias subtract
  - Flatten
  - Trim
- Trace: hires_fntobj
  - Legendre Poly to each order
  - PCA analysis of Legendre coefficients
  - Excellent for faint obj
- Skysub: hires_skysub
  - Subtract scattered light
  - Trouble with bright sky lines
- Extract: hires_extract
  - Boxcar
  - Optimal with Gaussian
  - Optimal with non-parametric (Developing)

QA FOR HIRES_FNTOBJ



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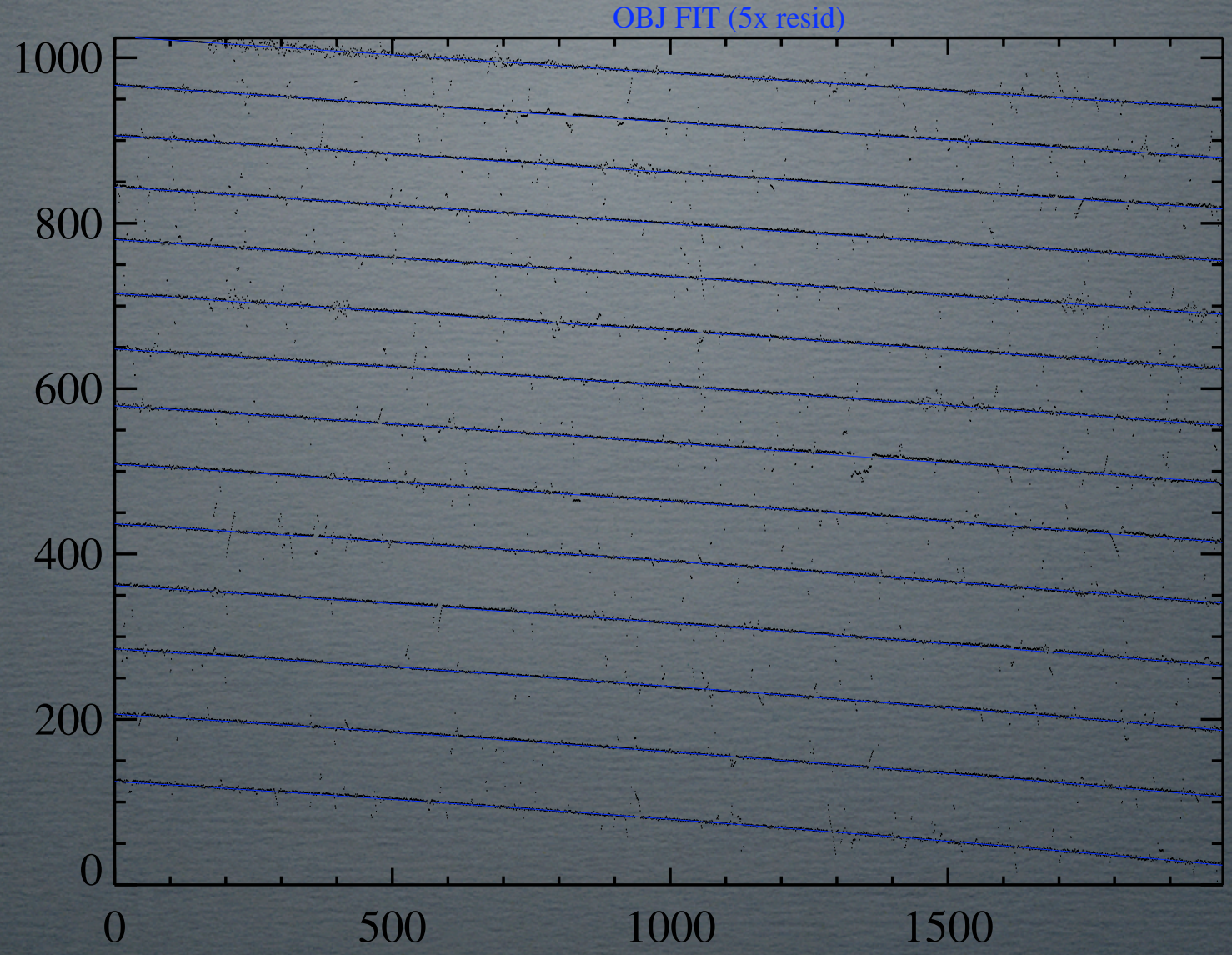

Other

- Fluxing -- in development
- Coadding -- in development
- GUI reducing: hires_redux
- Visualization: hires_specplot
- Quick redux: hires_qckrdx

Limitations v1.0

- Bright sky lines
- Order overlap at blue end
- Single object
- No HIRESr yet
- Optimal with non-parametric