IGRINS – QLP (Quick Look Package)

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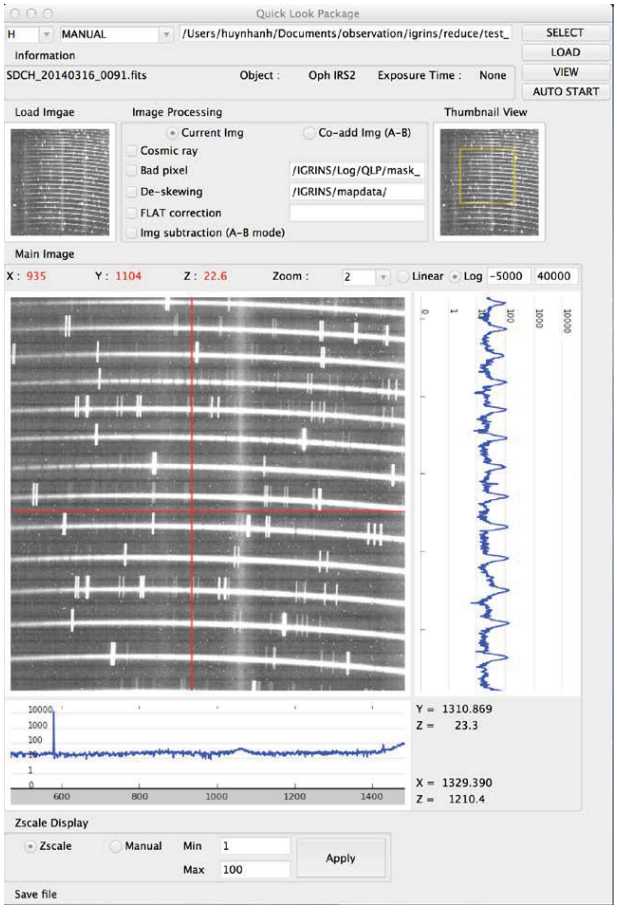
OPERATION SCENARIOS

QUICK LOOK PACKAGE OPERATIONS

Quick Look Overview

- **Purpose :**
  - During observation, to check the spectra with wavelength
- **Required :**
  - Current observation log file and FITS files
  - FLAT image for (optional) flat-fielding
  - Predefined function or fine-tuning result
- **Features :**
  - Read the current observation log, provide to view the raw image
  - Provide de-skewed spectrum image using predefined function
  - (Optional) Bad pixel correction and cosmic-ray correction
    - These processes may take long time, relative to others
  - Sky subtraction image (A-B mode)

Quick Look GUI



Quick Look Operations (1)

- **Load image**
  - `Load()`: click the “LOAD” button
    - Read the data from the FITS file
    - Load the image to “Load image” frame and FITS information in “Information”
- **Check options**
  - Check the display image options
    - Current image: Display the current image from the log file observation.
    - Co-add image: Display the co-add image from the log file observation.
  - Check the image processing options
    - Bad-pixel/cosmic-ray correction (optional), flat-fielding, subtracting (A-B), de-skewing
  - Input the image processing parameters
    - Bad-pixel mask, flat image file, subtracting image (A-B) file, de-skewing function path
- Mode observations
  - Manual mode: load log file observation and display image.
  - Auto Real time: load log file observation and display image with refresh real time.
  - FITS mode: load FITS image and display.

Quick Look Operations (1)

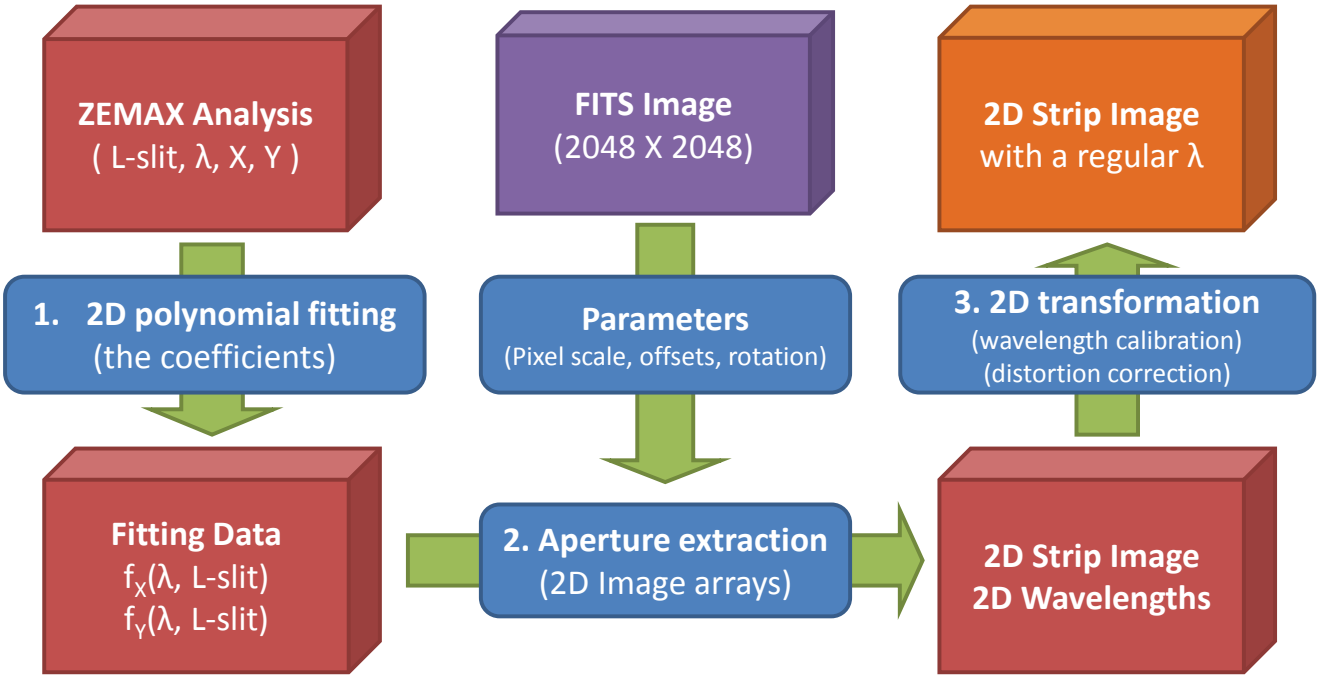
- **View image**
  - `View()`: click the “VIEW” button
    - Perform the image processes, that are checked by user
    - `ThumbDraw()`: Load the result image to “Thumbnail view”
- **Load the main image**
  - Check the zoom option (1x, 2x, 5x, …)
  - `ThumbClick()`: click the area, where user want to examine in more detail
  - `MainDraw()`: load the cropped image to the “Main image”

Quick Look Operations (2)

- View the profiles
  - `MainClick()` : click the position to draw the vertical/horizontal profiles
    - `VProfDraw()`: draw the vertical (column) profile of image
    - `HProfDraw()`: draw the horizontal (line) profile of image
    - If de-skew option is checked, the x-axis of the horizontal profile view is in wavelength scale by μm
  - View the position of mouse-pointer
    - `VProfHover(), VProfHover()`:
    - Show the values of (x, y) at the mouse-pointe
  - Scaling bar to change the scale display of images

Function Processes in QL-Pkg

Process Flow
(Based on ZEMAX Analysis)



Process Overview
(Based on ZEMAX Analysis)

1. **Extract the FITTING DATA from ZEMAX Analysis Data**
   - `fitting.fit_ech_xy()`
   - Perform polynomial fitting of ZEMAX data
   - Find the coefficients of polynomial functions
     - (x, y) position on the focal plane from (wavelength, field position)
2. **Find MAPPING DATA**
   - `mapping.mapping_ap()`
   - Mapping parameters
     - Convert the coordinate on the focal plane into pixel positions
   - Rotation position angle, offsets, pixel scale (convert mm unit into pixel)
3. **Aperture Extraction**
   - `extract.extract_ap()`
   - Apply FITTING/MAPPING DATA to the raw image
   - Fit the aperture (X, Y) pixel positions with polynomial function
   - Fit the wavelength of each pixel with polynomial function
   - Extract the strip image from the raw image

1. Extract the FITTING DATA from ZEMAX Analysis Data

- **Inputs**
  - fp (field position along the slit)
  - λ (wavelength)
  - [5,3] = polynomial orders for wavelength and field position
- **Outputs**
  - fitting functions : $f_{X,ORDER}$ / $f_{Y,ORDER}$
  - x-positions on (λ, fp) domain ; mx = $\mathbf{f_{X,ORDER}}$ (λ, fp)
  - y-positions on (λ, fp) domain ; my = $\mathbf{f_{Y,ORDER}}$ (λ, fp)

Coefficient output in fitting folder, filename (eg, mx_H099_05_03.dat …)
mx, my are coefficient fitting from Zemax data for each order. This output file will be used in mapping function.

2. Find MAPPING DATA (Extract strip image)

- **Inputs**
  - mx, my coefficient from Zemax fitting
  - λ (wavelength), field position
- **Function**

  [5,3] = polynomial orders for wavelength and field position
  - ax = (λ, field, mx)
  - ay = (λ, field, my)

  Convert [mm] to pixel units (ax, ay) → (px, py)

- **Outputs**

  Coefficient = 1D polynomial fitting of (px, py, ap-degree)
  - Coefficient output file is in mapdata folder, filename (eg, apmap_H_07.000.dat …)

  The output coefficient is used for extracting strip image from the raw image.

Find MAPPING DATA
(Interpolate of wavelength)

- **Inputs**
  - mx, my coefficient from Zemax fitting
  - iλ (wavelength), i-field position (2D-strip)
- **Function**

  [5,3] = polynomial orders for wavelength and field position
  - oxx = (iλ, i-field, mx)
  - oyy = (iλ, i-field, my)

  Convert [mm] to pixel units (oxx, oyy) → (pxx, pyy)
  - Grid data for interpolate, xx, yy = (ap_width, ap_length)

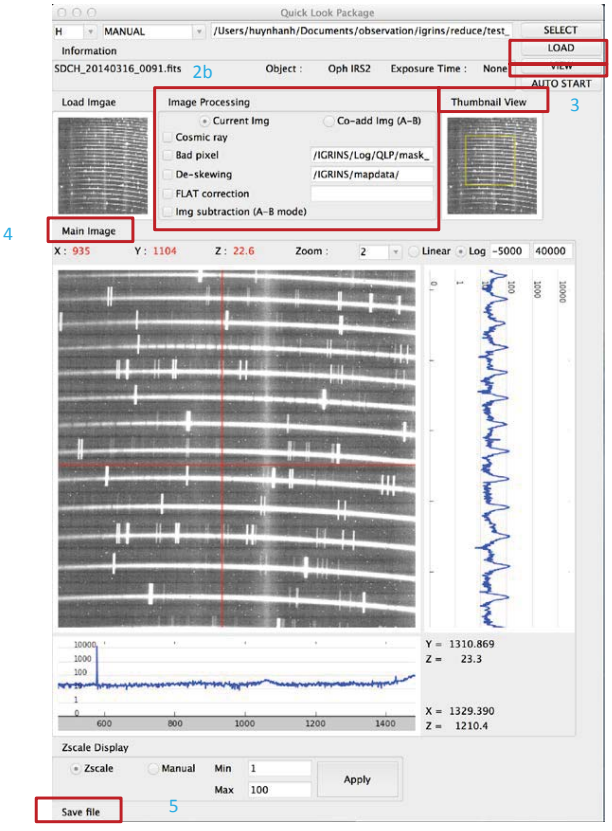
    ap_xx = xx

    ap_yy = yy + 1D polynomial fitting (xx, apmap-coefficient)
- **Outputs**
  - wave = interpolate from (points = [pxx, pyy], value = iwave, griddata = [ap_xx, ap_yy])
  - Coefficient = 2D polynomial fitting (xx, yy, wave)

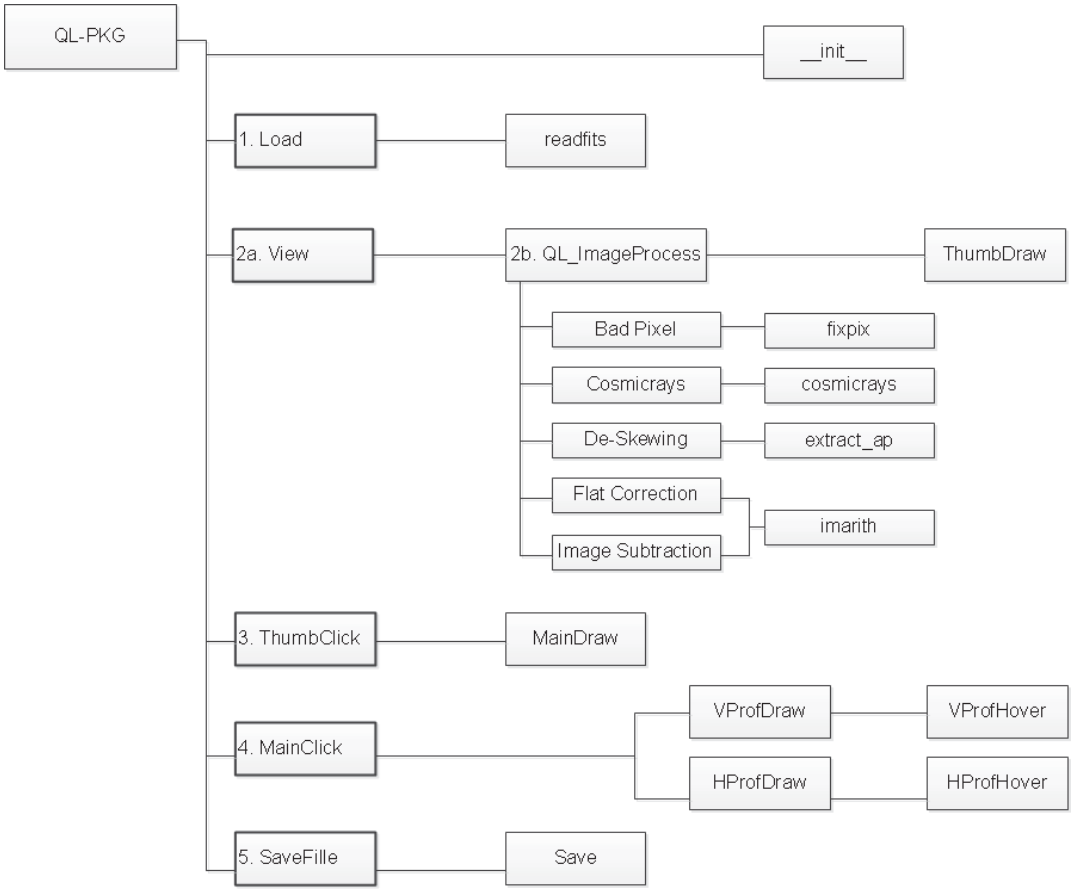
  Coefficient output file is in mapdata folder, filename (eg, apwav_H_03_02.001.dat …)

  The output coefficient is used for transform wavelength from the raw image.

Quick Look GUI



Function Mapping Diagram of QL-PKG



Function in QL-PKG

Function	Parameter	Explanation	Source	Destination
Load	None	Display the object image in the load image view	QL-PKG	QL-PKG
View	None	Display the load image object	QL-PKG	QL-PKG
QL-ImageProcess	master	Function to choose the options for image processing	QL-PKG	QL-PKG
ThumbDraw	None	Display the load image in the thumbnail view	QL-PKG	QL-PKG
ThumbClick	event	Click on the thumbnail image view to see the zoom image in the main image view	QL-PKG	QL-PKG
MainDraw	None	Display the zoom image from the thumbnail image	QL-PKG	QL-PKG
MainClick	event	Click on the main image view to see the vertical and horizon profile of zoom image	QL-PKG	QL-PKG
VProfDraw	None	Drawing the vertical profile of the zoom image	QL-PKG	QL-PKG
HProfDraw	None	Drawing the horizon profile of the zoom image	QL-PKG	QL-PKG
VProfHover	event	Display y-position and value from the vertical profile spectrum	QL-PKG	QL-PKG
HProfHover	event	Display x-position and value from the vertical profile spectrum	QL-PKG	QL-PKG
Save	None	Save the final image	QL-PKG	Storage

Variable primitives in QL-PKG

Variable name	Explanation	Type
self.band	Band observation H- or K-band	String
self.filepath	File path folder	String
self.object	Object name	String
self.exptime	Exposure time	String
self.cosmicray_flag	Correction Cosmicray task	Int
self.badpixel_flag	Correction badpixel task	Int
self.badpixel_path	File path folder for bad pixel task	String
self.deskew_flag	Correction de-skew task	Int
self.deskew_path	File path folder for de-skew task	String
self.flatcor_flag	Correction flat correction task	Int
self.flatcor_path	File path folder for flat correction task	String
self.imgsub_flag	Subtraction A-B mode	Int
self.imgsub_path	File path folder for subtraction A-B mode	String
self.x	X-position value in main image	String
self.y	Y-position value in main image	String
self.zoom	Zoom image	Int
self.scaling	Scaling image	String
self.scaleMin	Minimum scale	String
self.scaleMax	Maximum scale	String
self.vx	X-value at mouse-pointer of vertical profile spectrum	String
self.vy	Y-value at mouse-pointer of vertical profile spectrum	String
self.hx	X-value at mouse-pointer of horizon profile spectrum	String
self.hy	Y-value at mouse-pointer of horizon profile spectrum	String

Appendix. Interface QLP-DTP

Operation Scenario Mapping Diagram of QL-Pkg and DT-Pkg

Initial QL-Pkg

1. Create socket connection between DT-Pkg and SC-Pkg
   - DT-Pkg send RA_offset and DEC_offset values to SC-Pkg
2. Image taking
   - SC-Pkg taking images from the observer
   - The taking images will store to storage
3. Create socket connection between DT-Pkg and QL-Pkg
   - Open QL-Pkg (H- and K-band) from DT-Pkg
   - QL-Pkg open images from storage, analysis image and define for next exposure observation

Initial QL-Pkg