KPIC Facility Observing Instructions

Overview

This procedure outlines typical KPIC on-sky science operations for the Phase I Facility Mode. Its goal is to guide the user through taking science data with the instrument in K band using the facilitized Phase I mode of the instrument. It is adapted from the procedure developed and used by the KPIC team in the PI mode, with modifications to simplify unnecessary steps while ensuring reliability and stability.

From a top-level, the procedure strives to:

- **Startup**: Prepare the instrument for on-sky use assuming daytime calibrations have been completed
- **Observing**: Complete an observation of a science target, including on-sky calibrations, measuring throughput, activating tracking on the tracking camera, etc.
- **KPIC Shutdown**: Place the system in a stable "standby" mode after observations and Take NIRSPEC backgrounds after going on-sky (End-of-night script section)

Syntax Overview

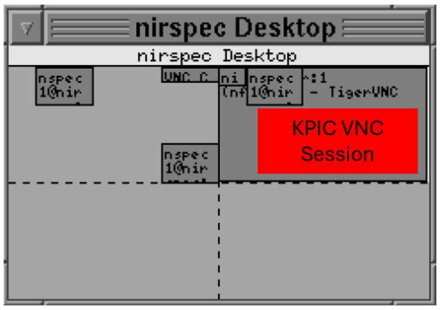
`Orange machine font` is for commands to be sent in a normal NIRSPEC terminal
`Blue machine font` is for commands to be sent in the kpython3 instance in KPIC VNC

The appendices of this document include:

This guide assumes that KPIC FIU has been aligned and calibrated according to the procedure in: KPIC_Facility_Daytime_Calibrations_Procedure.docx.

Startup (to be done ~20 mins before sunset)

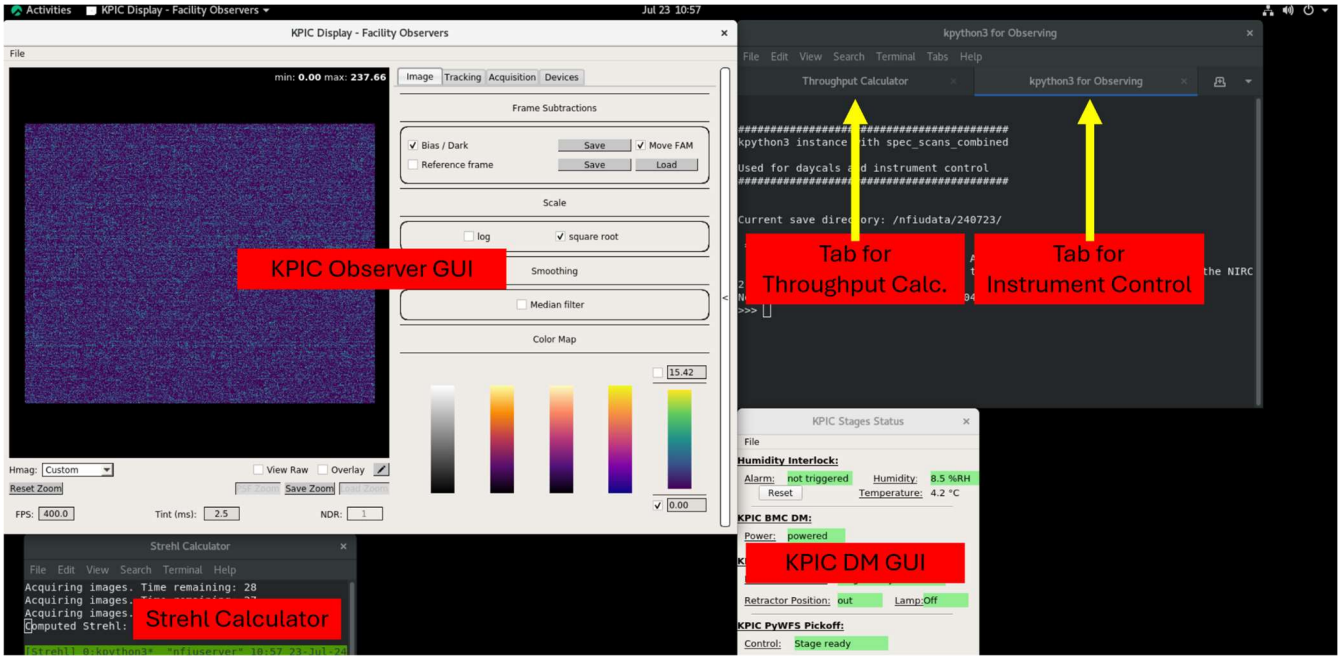
1. Make sure any backgrounds queued after daytime calibrations have completed. If they haven't, stop them in the NIRSPEC Xterm command line with a Ctrl-C. Note the last frame taken in the observing log.
2. Check for an open VNC to the KPIC server (referred to as nfiuserver in this document). **This VNC is usually opened in one of the NIRSPEC VNCs, oftentimes in the "control1"** VNC since we don't usually use SCAM during KPIC observations. Make sure to check the other desktops in the NIRSPEC VNC to make sure the KPIC VNC isn't on a different tab - you can click on the various quadrants of the "nirspec Desktop" GUI (screenshot at right) to check the different desktops.



    a. **If you can't find the nfiuserver VNC, reach out to your SA or OA,** who will know the right VNC session and password to connect.

1. **(This step 2 should very rarely be needed, as the SAs will leave the system set up for you).** If for some reason you need to start the entire system instead, you can start all the KPIC software by running `KPIC_init` in any nfiuserver terminal.
2. Open the KPIC GUIs/Windows needed for nighttime observing **in the nfiuserver VNC**. Open a new terminal, and enter the following command**:** `start_kpic_obs`
    a. This will open various elements as shown in the screenshot below. Check that you have the following elements. If you are missing any, see the instructions in Appendix 7 for information on how to open that one. Otherwise, proceed to step 4.
        i. KPIC Display - Facility Observers GUI
        ii. H-band Strehl Calculator terminal (Note: 0.2 - 0.3 on this calculator is very good)
        iii. Terminal with 2 tabs:
            1. A "Throughput Calculator" tab (Note: 3-5% throughput is pretty good)
            2. A "kpython3 for Observing" tab

iv. “KPIC Stages Status” GUI (KPIC DM GUI)



3. Other helpful VNCs to keep open:
    a. **NIRSPEC control2 (with the Ginga Spec Viewer)**: this window displays the NIRSPEC data and allows us to examine the science data quality
    b. **NIRSPEC telstatus**: this typically has MAGIQ with the starlist for highlighting new targets for the OA, as well as the status of the telescope. You can check if the starlist has the right format via “Load Private Starlist” under “File”
    c. (Optional) **NIRC2 any window**: we need a NIRC2 window to rotate the instrument rotator to do blind offsets of ~2” or more. If your observations require this kind of offset, let your SA know that you need access to a NIRC2 window to rotate the instrument. From the nirc2 prompt, issue any rotator commands, eg. rotate 0 posang. Note that the start of night for AO should have already been run.
    d. When the OA is opening, they will need to **set up the AO as if we were using KPIC or NIRC2** (both should go to the NIRC2 pointing origin for Shack-Hartman), even though the science detector is NIRSPEC.
    e. This can cause confusion if the OA asks “which instrument are you using tonight” as **you do NOT want them to set up the AO for NIRSPAO**.
    f. Once the instrument has been selected by the OA, Run the start of night AO script from Maori.
4. Note: If the first half was a regular NIRSPAO night, you might need to change the NIRSPEC filter settings. Access the NIRSPEC Filter setting in the NIRSPEC Control2 window under the “NIRSPEC instrument control” subwindow by clicking on the “Filter” Button. Set the filter to “Kband-new”

Observing

1. Run the onsky startup script

a. While slewing to the first target (usually wavecal star), run: `kpic_onsky()`
b. It will ask "Ready to turn on DAR? (Y/n) → select "Y"
c. It will then automatically suggest a DM map. If this is the desired DM map, enter 'Y' to accept the map and have it loaded onto the DM. If this is not your desired DM map, then enter 'n' and proceed as follows once the startup script completes:
    i. Locate the latest DM map. This map will always live in '/nfiudata/rtcdata/calibration/BMC/'. It is usually the latest map, with naming convention e.g. '/nfiudata/rtcdata/calibration/BMC/NCPA_map_ds_sf2_230603.npy'.
        1. Note: You can easily list the latest 10 DM maps by entering the following command into a new nfiuserver terminal (not in the Throughput Calculator or kpython3 for Observing tabs): `ll -rt /nfiudata/rtcdata/calibration/BMC/NCPA_map*.npy | tail`
        2. If you are uncertain which map to use, ask whoever ran the daycals (usually the SA for facility mode).
    ii. Create a variable called `dmmap_file,` where `dmmap_file` (string) is the **full path** of the KPIC DM map from day cals. Enter the file name as a string, e.g.

```
>> dmmap_file = '/nfiudata/rtcdata/calibration/BMC/NCPA_map_ds_sf2_230603.npy'
```

    iii. Manually set the DM map with: `>> DM.setSurf(dmmap_file)`

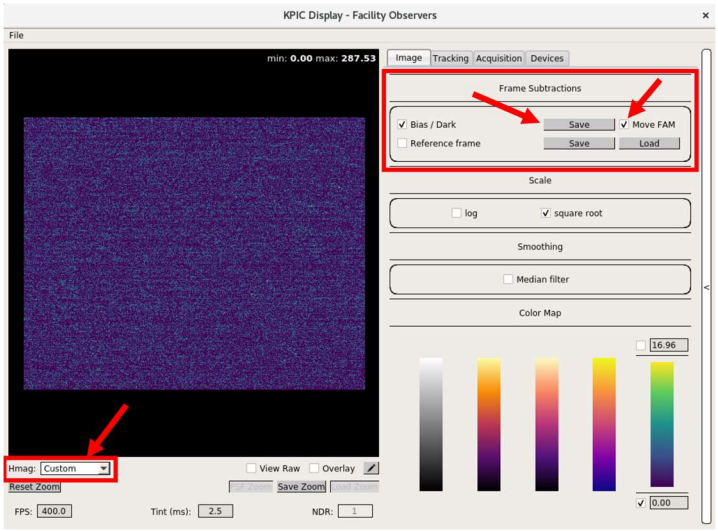
2. Required calibration targets:

a. **Wavelength calibration (MIII star)**: a calibrator star is used for wavelength calibration. A bright giant (III) M type star is ideal because it has numerous deep molecular features (like CO) that can be fitted. Take 2-3 images for **each** of the four fibers.
    i. Example: HIP 81497, HIP 95771, HIP 62944, HIP110882 (depending on the condition, the integration time could be 1.5-30 sec; observers should run a short test exposure to check the condition)
b. **Spectral traces calibration (A0 star):** the location and width of the traces for each fiber and each spectral order is typically derived from observations of an A0 standard star. This A0 star can be the calibrator star for the science target. The smaller number of spectral lines make the trace calibration more robust. Take 2-3 images for **each** of the four fibers (again, observers should run a test exposure to determine the proper exposure time). Calibrating all the fibers even if they are not all used for science will simplify the analysis.

3. Slew to Target

a. **Pick Target from target list in MAGIQ**, right click and highlight it, and ask OA to slew to the target

b. If OA asks, **we want NIRC2 pointing origin (this is also the KPIC pointing origin)**
c. When slewing to target, it is a good time to **take a CRED2 background**.
    i. The CRED2 is the detector used for tracking and keeping the target on the fiber. It is the live image shown in the KPIC display.
        1. The CRED2 operates in H band for K-band science
    ii. Set the CRED2 Hmag close to the star's Hmag using the drop down option at the lower left hand corner of the main KPIC GUI. (see lower arrow in screenshot)
    iii. In the Image tab, make sure the "Bias/Dark" and "Move FAM" checkboxes are



ticked. Then click the "Save" button next to them (see upper right in screenshot). Wait for the background acquisition to complete - you'll know it's done because the Save button is depressed and says "Saving…" until it finishes.
        1. NOTE: (This is very very rare but…) if the star, or its halo or a companion, remain in the field of the CRED2 during the save, you can retake the background manually, following the instructions in Step 4 of Appendix 4.
    iv. Take a new background regularly, either while slewing to each new target or as the sky background conditions require.

4. Prepare to Offset to Companion (optional)

a. If you need to offset the fiber to a companion, now is a good time to look up the offset (may be available from whereistheplanet.com). Write down the Separation and PA. Don't activate the offset yet

5. NIRC2 Rotation (if the companion separation >2.0")

a. While the target slews and if we need to offset by > 2.0" (Sep > 2000 mas), inform the OA we are rotating the instrument rotator
b. Go to a NIRC2 window with an xterm open
c. Type 'rotate [PA] posang' (if you use fibers 1 and 2) **or** 'rotate [PA+180] posang' (if you use fibers 3 and 4) where [PA] is the Position Angle of the offset you want to make (i.e.,

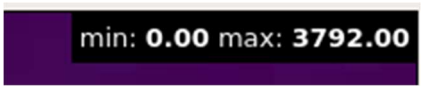
PA of the companion). Note that this can only do either fiber bouncing between 1 and 2 or between 3 and 4, not possible for bouncing between 2 and 4 for example

d. Wait for the rotator to finish (may take a minute), and inform the OA when we are done so they can acquire

6. OA Acquires Target

7. Setup Tracking on CRED2

a. After the OA has acquired the target and closed the AO loops, get the system ready for tracking. **Click on the Tracking tab** and perform the following
b. Check that **DAR Offset is On**
c. Confirm the Hmag of the camera (dropdown on the lower left of the GUI, under the live image) is set to the nearest Hmag of the star we are tracking on.
d. Check that the counts on the CRED2 (tracking camera) are "good".:
    i. A "good" number of counts for the star is ~2,000, and should be displayed in the upper right of the image. However, any value between about 1,000 and 8,000 should be fine (>10,000 is too high).

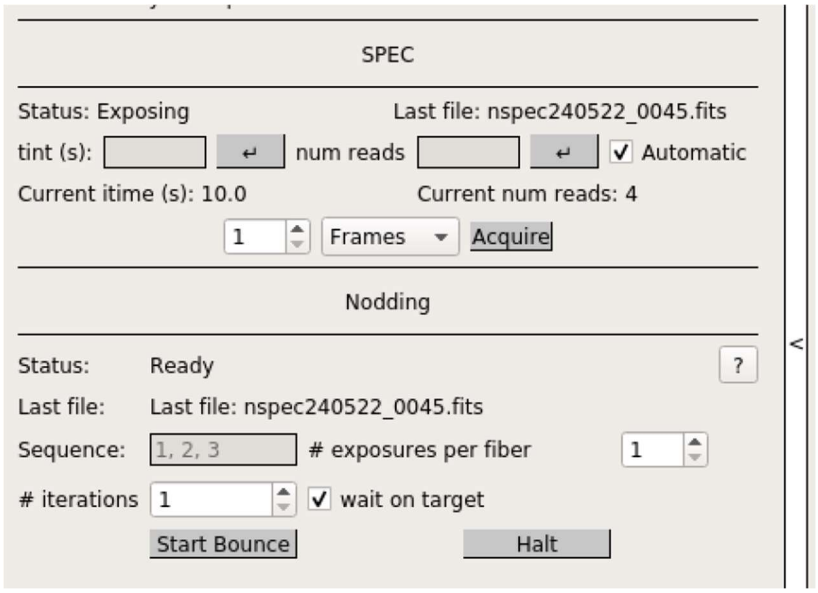


    ii. If the counts are not "good", change the CRED2 Hmag setting until the counts are within range. You might need to use a higher Hmag setting if there are clouds causing extinction, for example. If you are still running into issues, you can increase the number of images that the tracking camera uses to track in the "Tracking" tab.
    iii. Sometimes, under bad weather condition (cloudy, bad seeing, low-wind effect for AO correction, etc), when the offset is large, the star tracking will be out of CRED2. When you are not taking the integration or you think you wouldn't get any flux on the companion, you can try to set "FAM" (Fiber Alignment Mirror) on the "Devices" tab back to center to re-acquire the star
e. If you changed the CRED2 settings since the last time you took a background, take a new one (see step 3c above).
    i. NOTE: it is a good idea to take a background for the CRED2 each time you change the Hmag of the camera, especially when using the higher Hmag values.
f. **Turn on Tracking**. Set the goal in the dropdown tracking menu to a science fiber

8. **Begin acquiring NIRSPEC images of the star** [if desired]

a. On the Tracking tab, check that there are no offsets. The values in the "Distorted" column are zero
b. Click on the **Acquisition** tab. In the "Spec" section, set the NIRSPEC exposure time as desired. (You can also do this in the regular NIRSPEC Spec VNC window with atint)

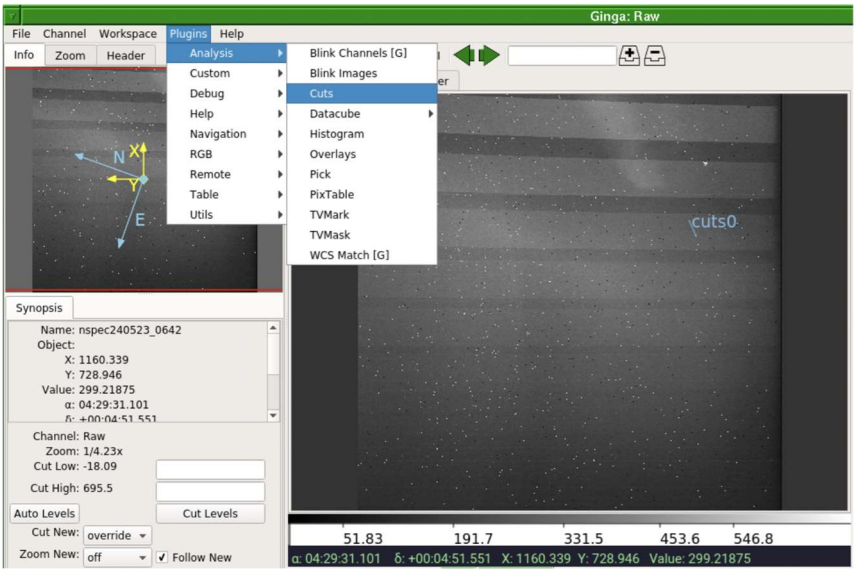
i. In K-band, the exposure time should be fairly short (<= 60 seconds) unless the star is extremely faint (Kmag > 8)



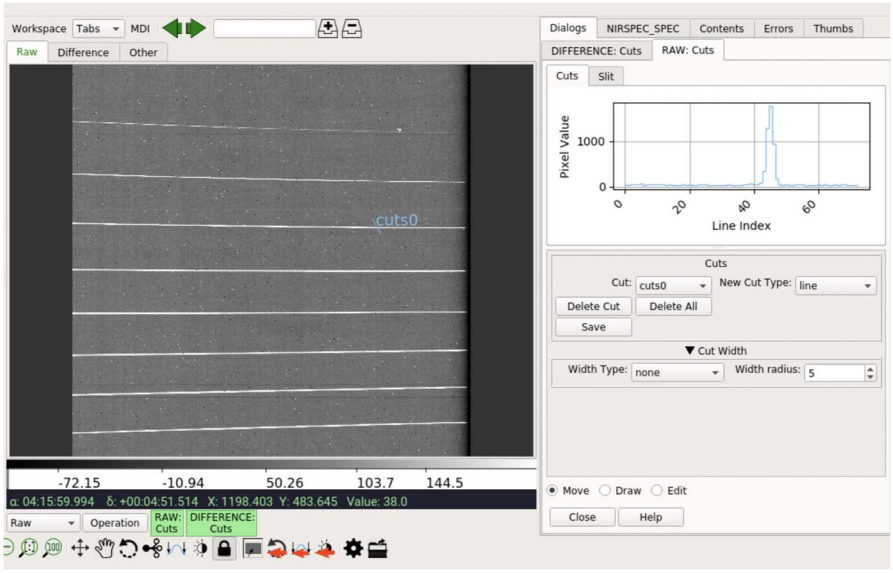
c. (Optional): take a single NIRSPEC exposure using the “Acquire” button to check if the integration time is suitable. After the exposure has completed, in the NIRSPEC VNC with the Ginga GUI (control2, by default), check that:

i. For the star, we want (> 1000 counts for telluric standards and wavelength calibrators) and (< 20000 counts including background) per pixel to have sufficient counts and within the detector linear limit. Adjust exposure time as needed.

ii. An effective way of checking this value is by using the “Cut” tool provided by the Ginga GUI. Under Plugins -> Analysis, select “Cuts” (see screenshot below)



iii. Select “Draw” in the dialogue window, and use your mouse to draw a line across the trace of interest. The plugin will show a pixel count vs line index histogram that is defined by the line you drew



d. Decide which fibers you would like to collect the spectra through. The standard choice is the **two highest throughput fibers determined by the initial telluric standard star . Bouncing the target between two fibers allows for better background subtraction** during data reduction and is the recommended way to use KPIC.

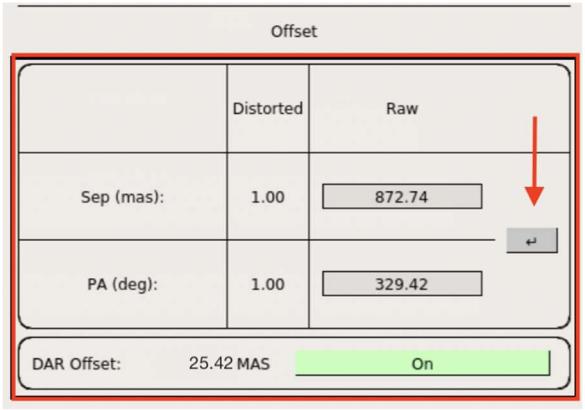
e. In the Nodding section of the Acquisition tab, define which fibers you’d like to collect data on in the **“Sequence” field**.
   i. If you want to collect data on SF1, SF2, SF3, set this to be “1, 2, 3”
   ii. Note that you can set up an ABBA pattern by entering the same fiber multiple times in the sequence, e.g., “2,4,4,2” to do ABBA with fibers 2 and 4

f. Decide on the number of exposures per nod position and the number of iterations (number of times to repeat doing the fiber bounce).
   i. **Total number of frames per fiber = (# exposure per fiber) x (# iterations)**

g. **Click “Start Bounce”** to start the exposure sequence. This will automate the fiber tracking to iterate the star over the desired fibers, as well as take NIRSPEC exposures while the star is on that fiber. The script will stop when the requested number of iterations have been completed or a halt command is encountered
   i. Keep an eye on the exposures to make sure the counts are suitable (> 100 counts and < 20000 counts per pixel).
   ii. Use the halt button to cancel the exposure sequence early. The current exposure on NIRSPEC will finish and the system will be ready for a new sequence.
   iii. If the fiber bounce part of the GUI is not working, you can use a terminal window to perform fiber_bounce:

1. In a new nfiuserver terminal (not the Throughput Calculator or kpython3 for Observing ones) type: `Fiber_Bounce <list of fibers> <# exp per fiber> <# of iterations> --wait`
2. For example, to do a sequence of 3,4,3,4 you would do: `Fiber_Bounce 3,4 1 2 --wait`

9. **Begin acquiring NIRSPEC images of a companion**
   a. In the **Tracking tab**, put in the **Separation and PA of the companion, and click the "⏎" button to apply to offset**

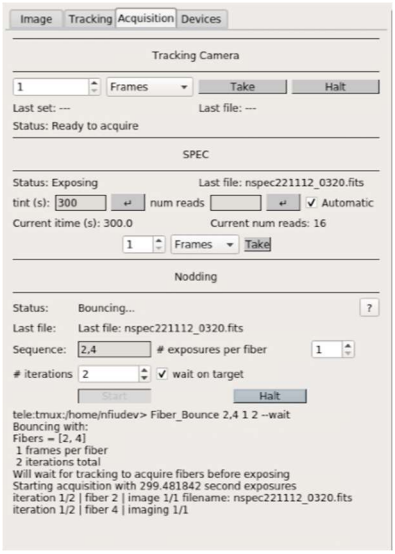


      i. The star should have now moved off the fiber
      ii. If the distorted values are not updating, you may be offsetting such that the star would land off of the camera. Try using a different fiber, or changing the rotator angle to keep the star on the camera.

   b. Wait for the star to be offsetted to the correct position by monitoring the Δx/Δy fields in the Star Info section of the tracking tab (this could take a couple seconds)
      i. If there are issues, try resetting the star to the center of the detector (Devices tab -> FIU -> Fiber alignment mirror -> Center). If you are doing a large offset, check you haven't hit the limit of the Fiber alignment mirror (close to 0 or 10000)

   c. **Click on the Acquisition tab, and set the NIRSPEC exposure time in the Spec section.**

i. You probably want an exposure time between 60 and 600 seconds in K-band. We generally use 600 seconds as a default.



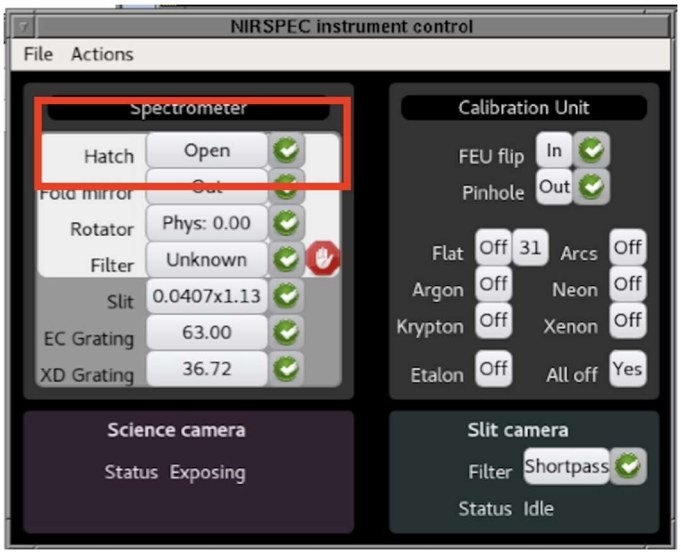
d. **Perform fiber bounce** (see instructions above for how to perform this)
   i. Unlike the star, it is difficult to know exactly how many counts to expect since speckles also leak into the fiber. Just make sure we don't saturate (< 20000 counts per pixel)
e. In order to analyze high-contrast observations of a companion, an empirical spectrum of the host star is needed to model the speckles. This is repeated every 30-60 minutes (e.g., for offsets < 1") by **returning to the host star** to collect stellar spectra. In the Tracking tab, put **0 in for the separation** and click the "⏎" button to return to injecting starlight in the fiber.
   i. Repeat the section above to take the spectra of the star
   ii. For offsets > 1", the speckle field is probably so small you don't need to bother doing this
f. Repeat as needed (collecting companion + star data) until you reach the desired exposure time.
g. Note: for science sequences, we generally also want to collect spectra on a telluric standard for each fiber (every 1-2 hours), unless the host star is also an A0V star itself. It is good to do this before we slew to the science target, but it can also be done afterwards. The procedure is the same as collecting host star data.

10. Before moving to the next object:

a. **Open the tracking loops on the KPIC GUI** before asking the OA to open the AO loops and slew.

KPIC Shutdown

1. Setup KPIC for end of night by entering the command `kpic_offsky(sam_rot_out=)` into the kpython3 session with spec_scans_combined in it (this terminal was called “kpython3 for Observing” if it is still open from the start of night).
    a. If you are **handing over to NIRSPAO observers,** `sam_rot_out = True`. In general, this should be True if this is the last night of a KPIC run. However, if the next night is also a KPIC night, you can leave it as False. **Important: sam_rot_out must be False to keep KPIC fibers in the slit for valid NIRSPEC backgrounds. So, if this is the last night of a KPIC run, remember to re-run kpic_offsky and remove the SAM rotator (by setting sam_rot_out=True) after backgrounds are finished.**
    b. After the backgrounds are finished, you need to close the hatch on “NIRSPEC Instrument control”



    c. Finally, make sure to **close the KPIC Facility Viewer GUI** before logging off.
    d. Depending if this is the last night of a series of KPIC runs or not:
        i. If there is still another KPIC run for the next day, you can simply leave the NIRSPEC GUIs up, and type in a NIRSPEC xterm “newdir” to update the directory for the next day, so the date of observation will be recorded correctly for the next run
        ii. If this is the last night of a series of KPIC runs, you need to run “End of Night Shutdown” script by
            1. Right-click in the background of a NIRSPEC control window to get the pull-down menu.
            2. Select "NIRSPEC Control Menu" --> "End of Night Shutdown"
2. In a NIRSPEC terminal, type into a single command line (based on what integration times were used), e.g.:

```
atint 1.5; goi 10; atint 5; goi 10; atint 15; goi 10; atint 20; goi
10; atint 30; goi 10; atint 60; goi 10; atint 90; goi 10; atint 120;
goi 10; atint 300; goi 10;  atint 600; goi 10
```

The ; allows us to chain commands together. Each command will be executed after the previous one completes. This means you can send this all at once, and then leave, while NIRSPEC takes all the data.

Appendix 0: Default Facility-Mode Stage Positions

While observing on-sky in Phase I Facility-Mode (K-band), the KPIC stages should be in the following positions. Note that the observer GUI (Viewer_Facility) lets you see the current state of all KPIC stages but does not let you move them. The stage labels used below match what the various stages are called in the "Devices" tab of the GUI. If a stage is in the wrong position during Facility Mode observations, notify an SA or OA who will have access to the SA GUI or will know how to move the stage from the terminal.

Stage	**Facility Mode Position**
FIU Tab	
Light Source Retractor	"out"
Pyramid Pickoff	"jband"
Coronagraph	"pupil mask"
ADC Retractor	"out"
Atmospheric Dispersion Corrector	(does not matter)
Fiber Alignment Mirror	"custom"
Track Cam Pickoff	"ds"
Filter Wheel	"h"
Pupil/Focus Changing	"focus"
PIAA	"out" **NOTE: it is okay for the PIAA "more" button to be yellow. We keep the PIAA stage loops open.**
Multiport	"kl bundle"
FEU Tab	
Pupil Steering Mechanism	"kl bundle"
Pupil Steering Mechanism Focus	~2.51 (varies slightly)
Slit Alignment Mirror	"on slit"
Slit Alignment Mirror Rotator	"out"
PD Pickoff	"NIRSPEC" (Power Off)

Appendix 1: Lexicon – Useful acronyms and other terms

CRED2	the KPIC tracking camera
DAR	differential atmospheric correction
DM	deformable mirror
DS	direct spectroscopy
DFB	stage that picks off light from NIRC2 to send to KPIC
DRP	data reduction pipeline
FEU	fiber extraction unit
FIU	fiber injection unit
FSM	field steering mirror (in K2AO) OR fast steering mirror (within KPIC)
GUI	graphical user interface
K2AO	Keck's adaptive optics system, which feeds KPIC
NCPA	non-common path aberrations
NIRC2	Keck's imaging detector
NIRSPEC	Keck's high-resolution spectrograph
PSM	pupil steering mirror
PyWFS	pyramid wavefront sensor
SCAM	a camera we use for aligning to NIRSPEC
SFP	the light source holder at the front of Keck
SHWFS	Shack-Hartmann wavefront sensor
SPEC	camera for NIRSPEC
PD	photodetector located at the output of the bundle for calibrations
VNC	virtual network computing (remote access to desktops)

Appendix 2: NIRC2 Observations (for binary offsetting tests)

a. Navigate to the nircx-control1 VNC window
b. In a nirc2 xterm window, type `modify -s ao obdbname=dichroic` to send light into NIRC2
c. To specify exposure parameters, in a nirc2 xterm, type:
    a. `tint #` to set exposure time (ie. `tint 0.5` for 0.5s exposures)
    b. `coadd #` to specify coadds
    c. `filter (filter_name` to specify filter e.g. `Kp`)
d. Note: For binary offsetting data, we typically take 0.5s exposures with 10 coadds in the BrG filter
e. To take a NIRC2 exposure, type `goi #` in a nirc2 xterm window, where # is the number of exposures
f. To send the light back to NIRSPEC, type `modify -s ao obdbname=mirror`

Appendix 3: Throughput calculation

1. From an nfiuserver (KPIC VNC) terminal, start a kpython3 session: `kpython3`
2. In this kpython3 instance run `import throughput_calculator_newdrp as thpt`
3. Set the base filename for the night, e.g.: `thpt.fluxbase = '/sdata600/nspec6/2022oct11/spec/nspec221011_'` The path/filename will show up on the NIRSPEC PIG GUI on control0
4. Optionally, set `thpt.darkind = [integer index of a dark frame]` This frame will be used for dark subtraction when estimating the throughput. Make sure the integration time corresponds to the exposure you're estimating throughput on. Defaults to None, and doesn't do dark subtraction.
5. Set `thpt.kmag = [kmag of source you're calculating throughput for]` **Remember to update this when you move to a new source!**
6. To calculate the throughput, call: `_ = thpt.frame_throughput(fnum=[file index to calculate)`
7. If the target is bright, you can catch the trace parameters and use them later for fainter objects, e.g.
    a. `>> sf2 = thpt.frame_throughput(fnum=[file index number of bright thing in sf2)`
    b. `>> _ = thpt.frame_throughput(trace_loc=sf2, fnum=[file index number of faint thing in sf2])`
    c. The trace finding is a lot more reliable if run on a bright source (>4k peak counts in NIRSPEC), so it's good to save the trace locations from an initial wave/tel cal star to use for the rest of the night. Since the extraction is a box, it's fine to use the wavecal star for this, but the throughput reported for the wavecal star is likely to be inaccurate due to the SED shape.
    d. The throughput calculation also assumes the source has an A0 SED. If the target is significantly redder (as is common for wavecal sources), the absolute throughput value should be treated with caution.

Appendix 4: Tracking Loop Control

General Notes:

1. To display the status of the Tracking script, connect to the tmux where it is running:
    a. In any terminal, type: `tmux a -t Tracking`
    b. To exit a tmux (such as this Tracking tmux), do Ctrl-b-d within the tmux session (ie. press and hold the “control” key, tap the “b” key, then let go of “control” and tap “d”). This will exit the tmux session without killing the script inside of it.
    c. **Caution**: Do not ctrl-C in this tmux session. This will kill the tracking script. If you do accidentally kill it, press the “on”/”off” button for tracking in the Viewer. This should restart the tracking script. Toggle the button once or twice more to make sure the GUI tracking buttons are synchronized with the new tracking instance.
2. **Make sure to open the tracking loop** (by clicking the On/Off button on the Tracking Tab of the GUI) **whenever there is no light on the CRED or AO loops are open**. For example, when you request that the operator slew to a new target, make sure to open the tracking loop before ideally before the AO loops open.
3. You can reset the tracking settings to their Facility Mode K band default by running `kpic_reset_tracking_for_facility` from a KPIC terminal (not a kpython3 session).
4. It is recommend to take a new background for the CRED2 when you switch to new CRED2 settings. **The procedure for taking new CRED2/tracking backgrounds is:**
    a. Open the tracking loop.
    b. At the top of the “Image”, there is a “Frame Subtractions” section. Make sure that the “Bias/Dark” and “Move FAM” checkboxes are ticked, then hit the “Save” button.
    c. You will see the “Save” button gray out and say “Saving”. Once it goes back to normal, the background is complete and you can start the tracking loop as normal, using the On/Off button in the “Tracking” tab.
5. **On rare occasions, a stellar companion can remain in the CRED2 field of view** and be visible on the detector **during the background subtraction**. This will cause a dark, over-subtracted region in the CRED2 image. You can take a new background to correct this, but this time manually choosing the FAM offset position:
    a. On the “Devices” tab -> “FIU” sub-tab, find the “Fiber Alignment Mirror” (FAM) section. This should be the only device that is controllable and not grayed out.
    b. Move the FAM to a corner of its range where there is no light on the detector. This is done by typing new values for the two entry boxes and clicking the “⏎” button next to them, one at a time. Note that sometimes the entry fields can be finicky, in which case just wait a moment (30 to 60 seconds) for them to recover.
        i. **The FAM range is 10 to 9990. (100, 100) is generally a good position** if the default “background” position used by the auto feature still had light.
    c. Now flip to the “Image” tab. Uncheck the “Move FAM” checkbox and then click on the “Save” button from earlier. Wait for the background to complete.
    d. Once done, go back to the “Devices” -> “FIU” tab. Set the FAM to “Center” using the drop down options. The PSF should come back to the center of the CRED2.
    e. Now you can start the tracking loop again as normal.

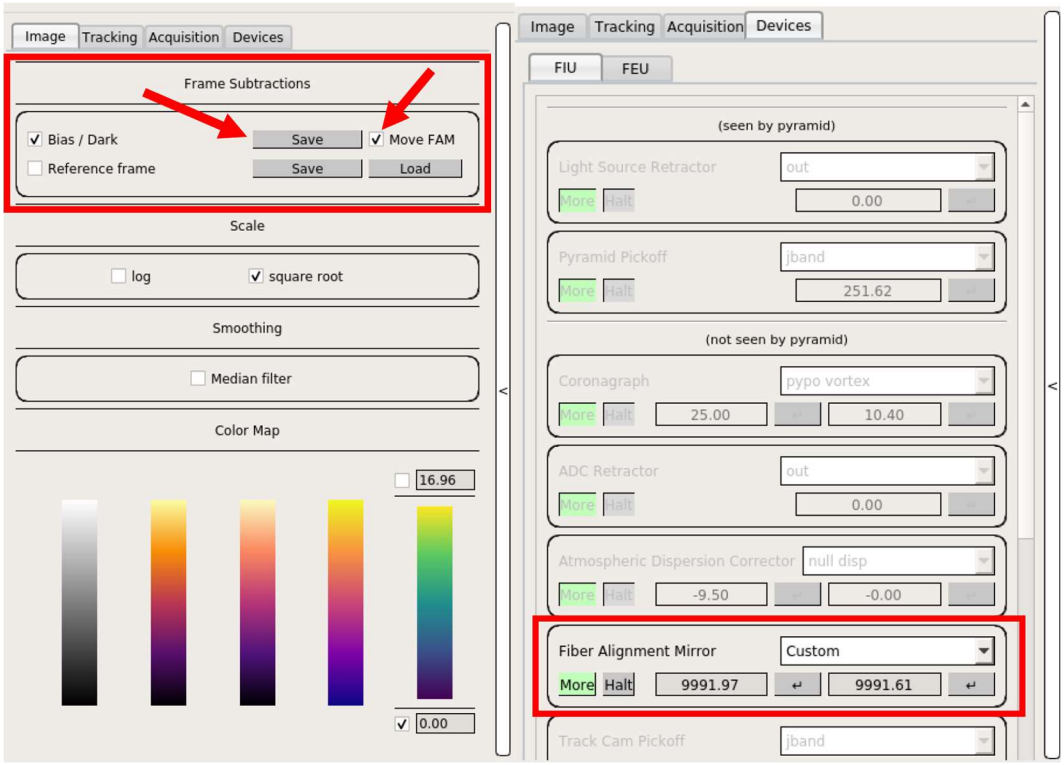
Appendix 5: On-Sky Debugging issues/Troubleshooting:

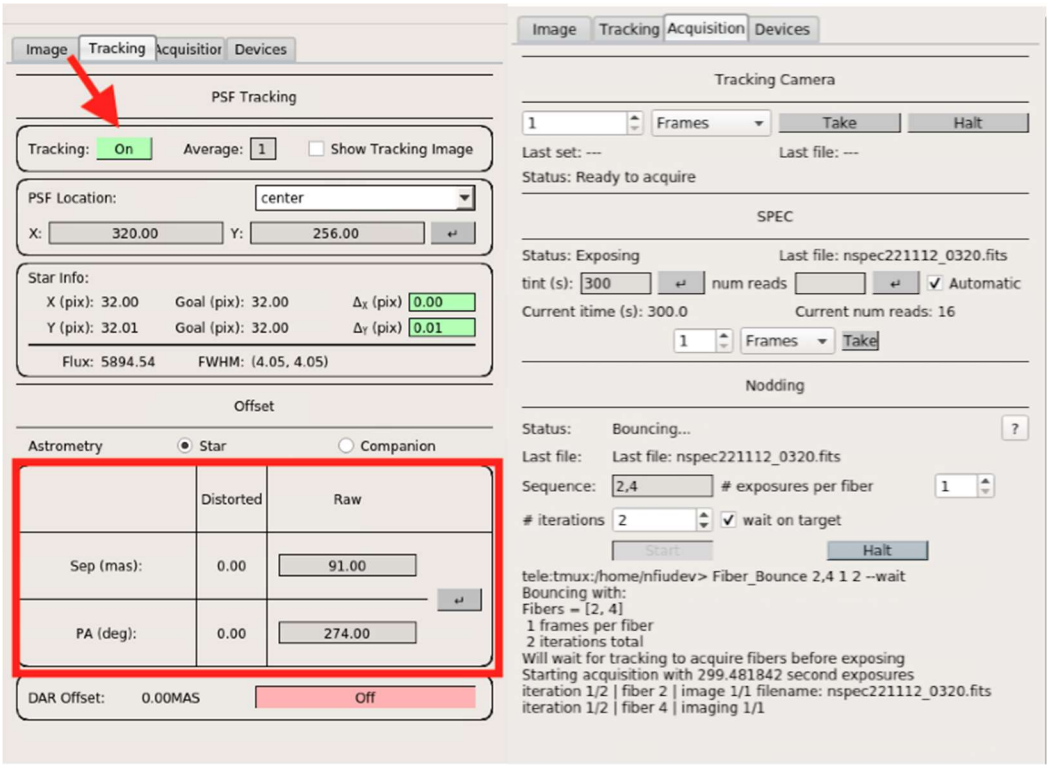
To debug/troubleshoot issues with KPIC while on-sky, see the troubleshooting document here: Link or here

Note that we are still dependent on the AO system, so some issues may be due to the AO system rather than KPIC.

Appendix 6: KPIC GUI Reference Photos

Example KPIC GUI tabs when you want to take CRED2 backgrounds or science exposures





Appendix 7: Opening the GUI and other Elements of start_kpic_obs

This appendix explains how to open the various elements of start_kpic_obs independently of that script. This could be useful if the script fails to open something or if you need to manually re-open one of them.

1. **Open the KPIC Observing GUI** - There are three options for this:
    a. Option 1: Go to Activities (upper left of screen) -> click the KPIC logo
    b. Option 2: Go to Activities -> type “Viewer” into the search bar -> select the “Viewer” option with the KPIC logo
    c. Option 3: enter `Viewer_Facility` into any nfiuserver terminal
2. **Open the KPIC DM GUI**: enter `kpic_pystage_gui` into any nfiuserver terminal
3. **Open the Strehl Calculator**: open a new terminal on nfiuserver and enter `tmux a -t Strehl`
4. Open a **kpython3 instance for instrument control**: open a new terminal on nfiuserver and enter `kpython3 -i -m spec_scans_combined`
5. Open a terminal for **computing throughput**: (see Throughput calculation section)
    a. Note that 3-5% throughput is pretty good