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GREGOR: Manual: Taking data with HiFI

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Signatures & Approval

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1	15.11.17	L. Kleint, C. Kuckein	New Document	
2	29.05.18	J. Palacios	New HiFI optical setup, Updates: added comments on software use, Figures with the updated HiFI optical setup	Fig 1, 3, pg 3,4
3	5.6.18	C. Kuckein L. Kleint	added that both cams should be running; to delete aborted scans; pg suffix	various
4	18.7.18	L. Kleint	added additional procedure to copy data to /instruments in case of failure of e.g. finland	Sect. 3
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7	10.8.19	L. Kleint	added how to log out user, password-less teamviewer access works again.	

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1 Scope

This document describes how to take data with HiFI. HiFI is a fast broad-band imager which takes data below 500 nm (or below 650 nm if the blue pentaprism is replaced with a mirror) with frame rates from 47 Hz (full frame) to 135 Hz (small FOV).

2 Startup procedure

HiFI has two sCMOS cameras (marked with red arrows in Figure 1), which are accessible by removing the black cover near the back of the observing room.

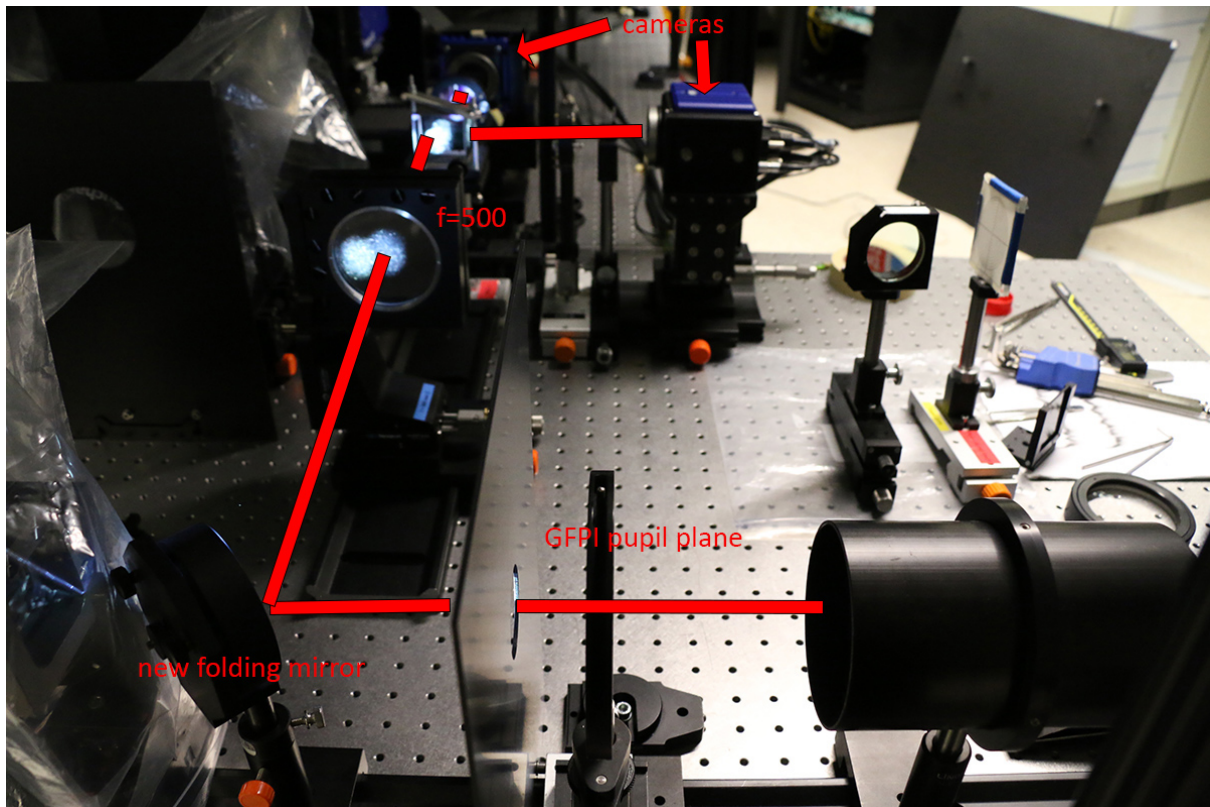


Figure 1: HiFI setup at GREGOR

Switch on both cameras by moving the switch on their back to „ON“ (red arrow in Fig. 2)

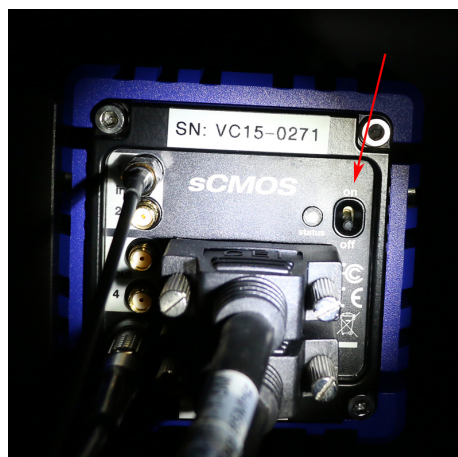


Figure 2: Location of ON/OFF switch

Prefilters

If desired, exchange the prefilters (red arrow in Fig. 3). Make sure to verify the prefilters before your observations, the labels may not be updated by everybody. Available prefilters include G-band (430.7 nm), blue continuum (450.5 nm) and Ca II H broad and narrow (396.8 nm). Any filter below ~ 500 nm can be used (or if using the folding mirror instead of the blue pentaprism: any filter below 650 nm). There is a narrow-band Ca II H filter in the „fridge“ at the VTT.

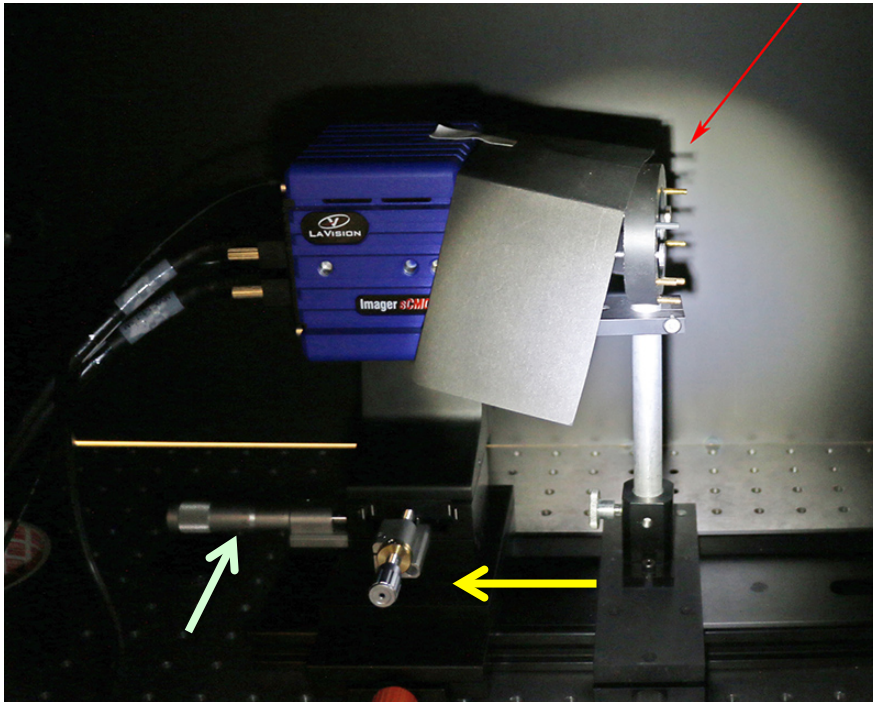


Figure 3: Location of prefilter (for camera with straight beam). The setup in front of the 2nd camera is identical.

The boxes of the most used filters are shown in Fig. 4. They are usually located in the fridge at VTT, often at the bottom left. Sometimes they are at GREGOR in the GFPI cabinet. Please take only the filters that you require to GREGOR and leave the others in VTT. The narrowband filter for Ca II H is called "396.8, FWHM 0.12, T=17.1, WO#58537-1" and is located in a box with other (non-HIFI) filters. You can find the number of the box by checking the filter list, which is located in the room with the fridge.

When you mount the filters, make sure the more reflecting side faces the Sun and if you have never mounted filters before, rather ask the assistant for help. Do not tighten the filter mount too much! Always use gloves when mounting filters and even then, do not touch their surfaces, but only their edges. Once the filter is mounted, please use the label maker (located in the IKEA shelf in the observing room) to label the mount properly.



Figure 4: Boxes of commonly used HiFi filters

The exact distance of the prefilter to the camera is not critical, try keeping it approximately constant to what it was before and rather closer to the camera than further away. If you see reflections on the image later, tilt the prefilter slightly. The black cover protects against stray-light. There may be a ND filter in the beam, which may need to be removed for certain filters if the counts are too low. The counts on both cameras should be roughly the same (within a few 1000 counts). The cameras saturate at 64000 counts. Ideally, you want to have counts in the range of 40000 – 60000 counts. The cameras take simultaneous data with the same exposure time. There is an ND wooden filter box with the AIP logo. Please only use these ND filters (a combination of them is enough for any setup) and do not place them in other boxes. Even though the beamsplitting cube is labeled 70/30 we were not able to see this ratio when testing different filters. We found it splits more like T60/R40 near CaK and 50/50 near 500 nm.

Using the program

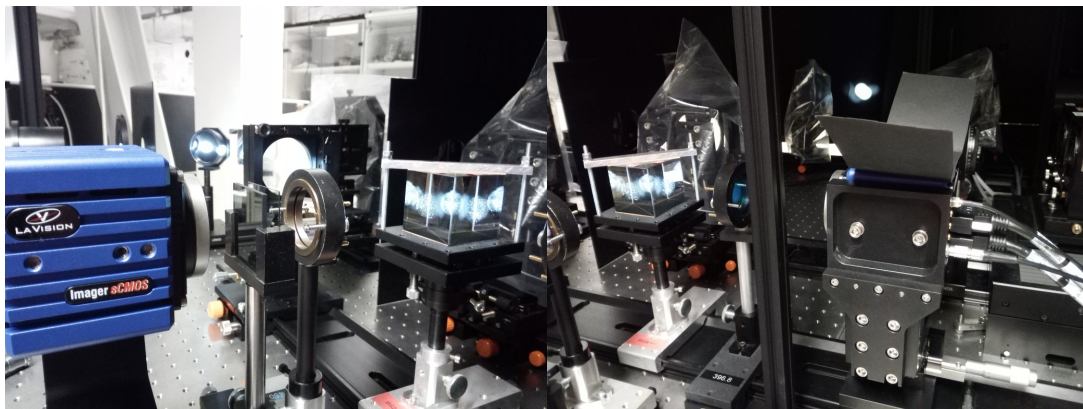


Figure 5: Images showing Camera 2 (left) and Camera 1 (right). The beamsplitter and prefilters are also visible.

The HiFi computer is always running (do not switch it off). It is located in the back of the observing room. Switch on the monitor. Start the program „Davis 8.3“ (red arrow in Fig. 6). Do not use Davis 8.4, that version is only for testing a new camera.

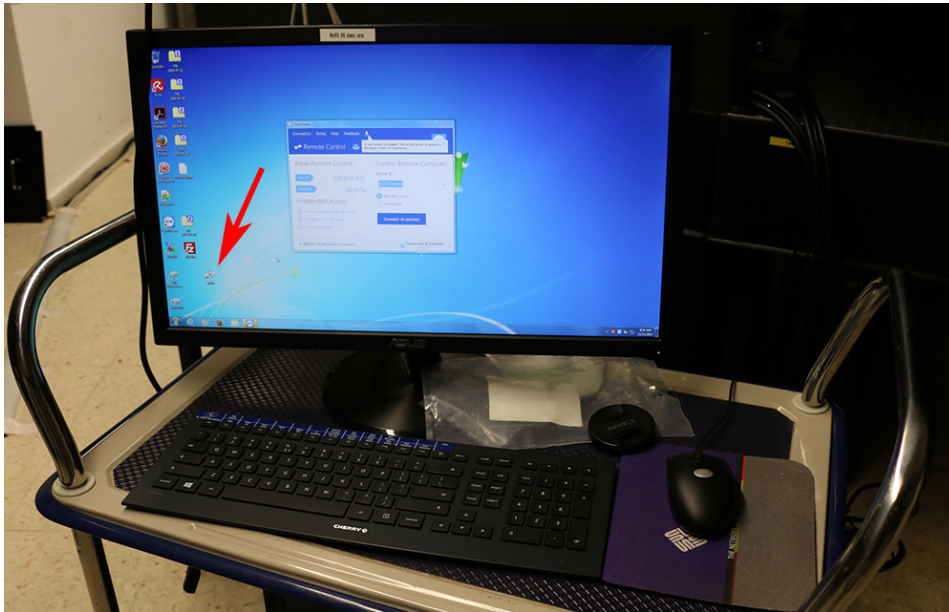


Figure 6: HiFI control computer

Click on Login on the window (see Fig 7).

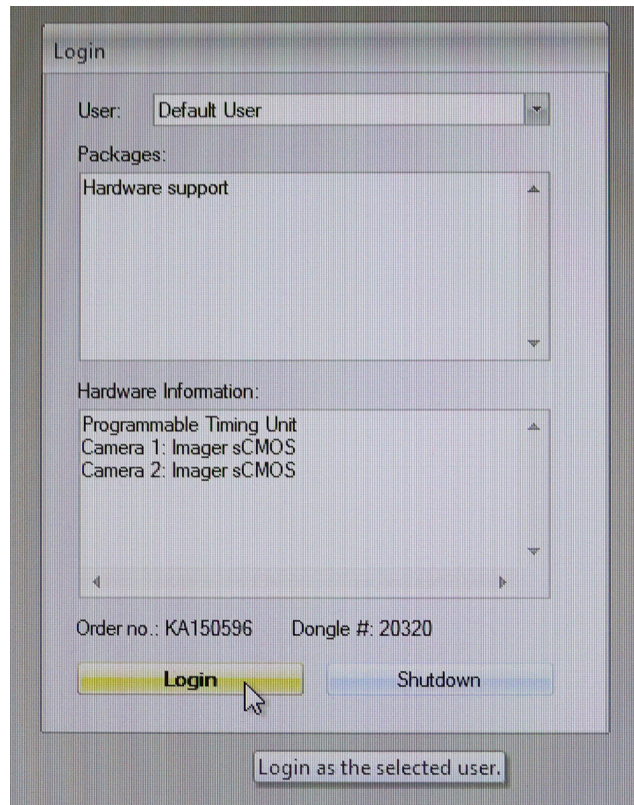


Figure 7: First window after start of Davis

click on „New“, which creates a new project with today’s date stamp (Fig. 8). Use the provided standard format of the project name (not your own name; this is crucial to run the data reduction pipeline sTools) and select “Imaging”. Always create a new project when changing filters.

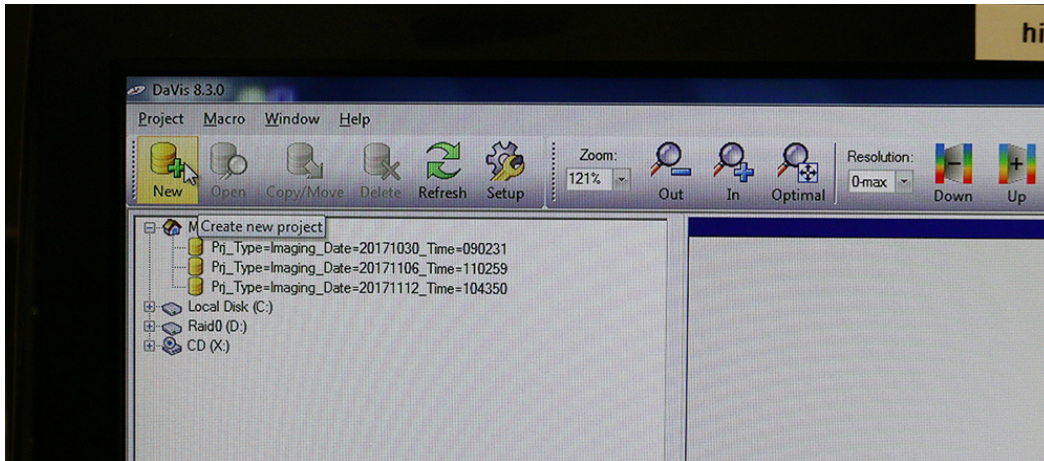


Figure 8: Click on New to start a new project

Click on „Recording“ (Fig. 9). This only opens a menu, it does not save any images yet.

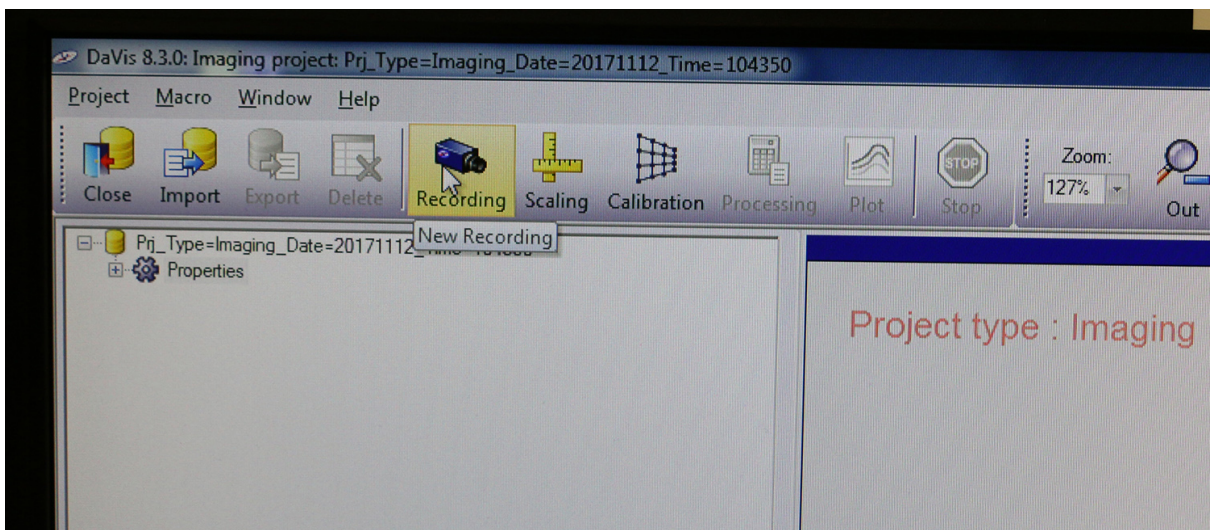


Figure 9: To get to the recording page, click "Recording"

Take a single image by clicking on the camera icon (Fig. 10). This is required to be able to display images from both cameras in the next step.

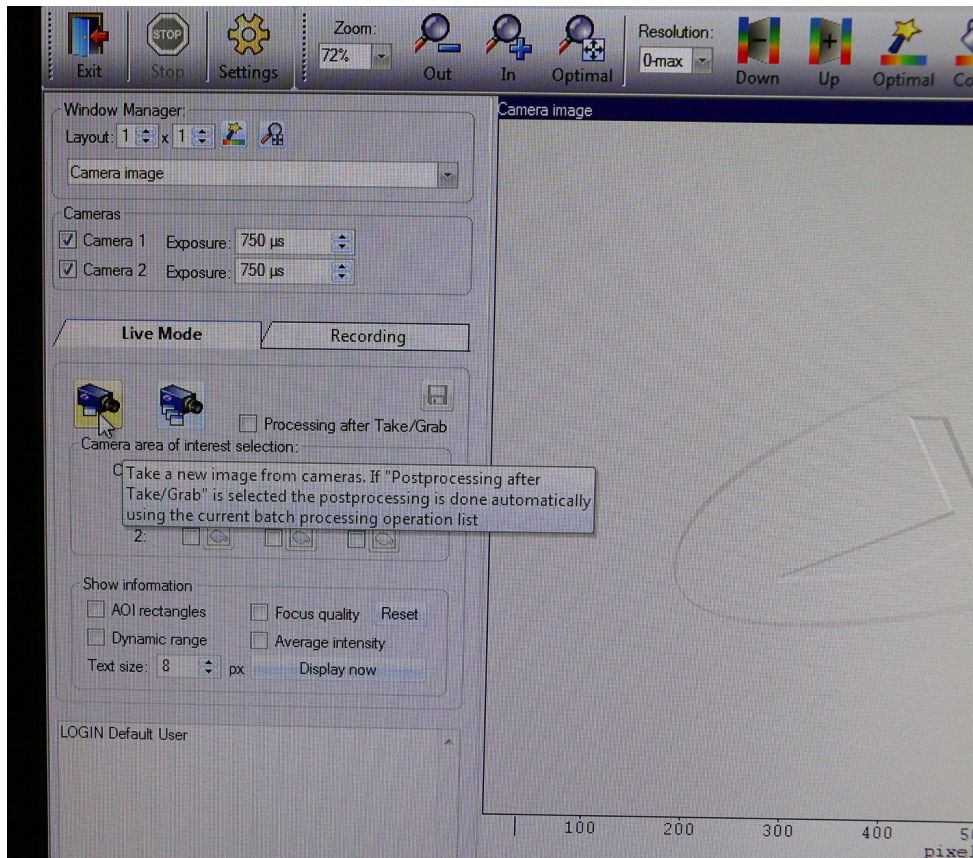


Figure 10: Take a single image by clicking the left camera icon

Right-click on the empty space on the right of the image. Select „Multiframe view“ from the dropdown menu. This will display the second HiFi camera on the right (Fig. 11). Always use this method for live view, otherwise DaVis may freeze.

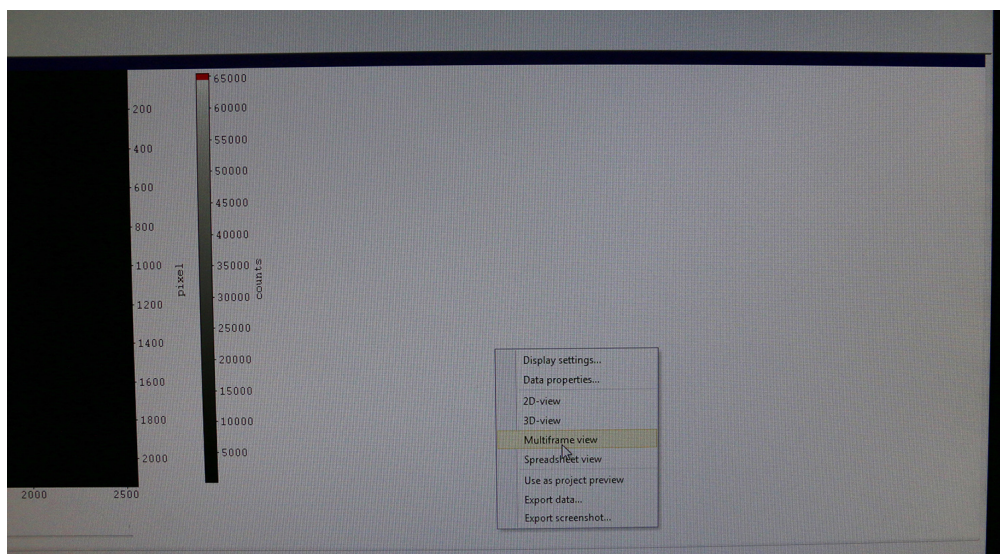


Figure 11: To display the second camera, select multiframe view.

You are now ready to display/save data (Fig. 12). Continuous displaying works with the right camera button (need to click STOP in the upper horizontal menu to stop the live view).

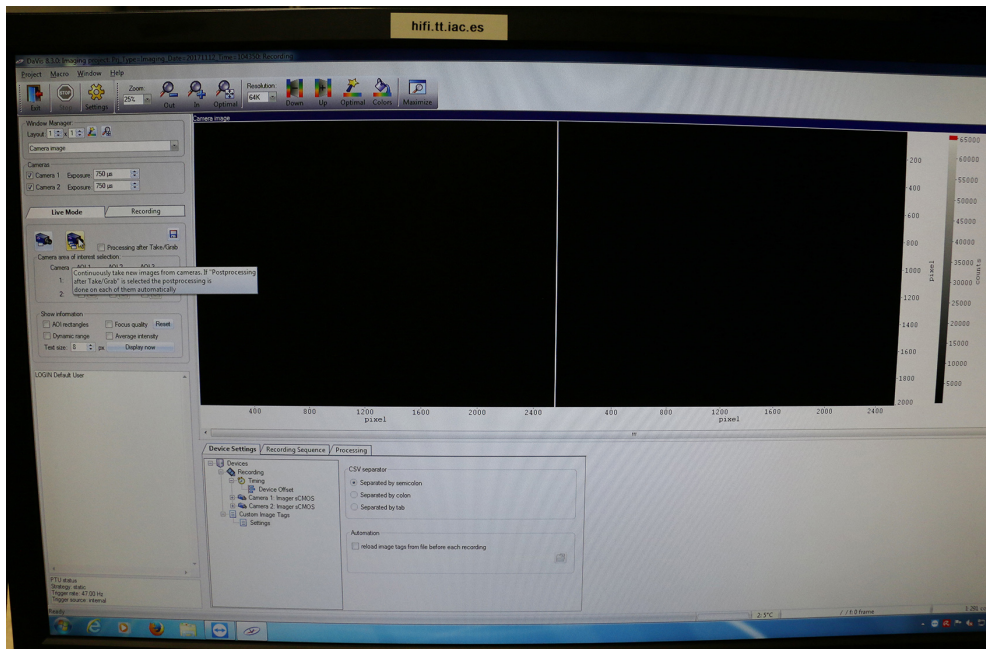


Figure 12: The second camera icon is for continuous image display (in my case there was no light, that's why both images are black)

Focusing

The different prefilters have different thicknesses, which leads to focus changes. Additionally, the cameras may not be centered perfectly. To prepare the final setup execute the following steps:

- Ask the assistant to lock the AO on the target. Make sure the AO mode offset is applied (it usually is automatically unless you changed it beforehand).
- Run the live view in HiFi
- Zoom in to see the middle target image in HiFi (see Fig. 13). Now shift the cameras along the rail either manually or using the micrometer screw (green arrow in Fig. 3), depending on the distance you need to change, until the target is maximally focused. You should be able to resolve the last element of group 5 (at 396 nm) or the second to last element of group 5 (at 450 nm) (red arrow in Fig. 13). "Resolve" means that you should be able to tell that there are 3 bars in that element.
- perform the focusing for both cameras.

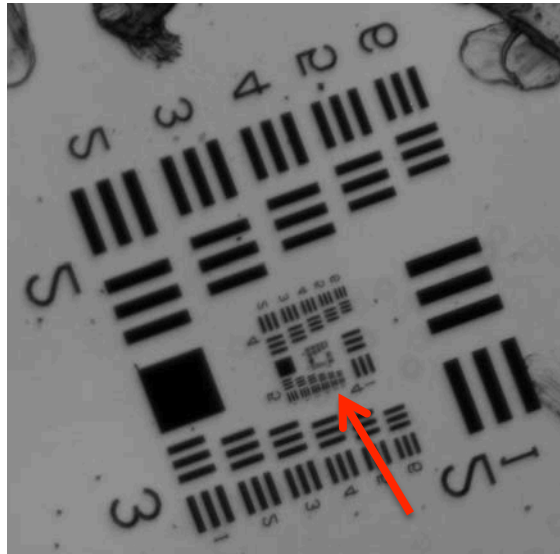


Figure 13: Image of a target. The red arrow points to the group that should be resolved at 396 nm after proper focusing.

Centering the cameras

- Ask the assistant to lock the AO on the small or medium pinhole.
- Use the cursor in the HIFI GUI to find pixel $x=1280$, $y=1080$. This is the center of the sCMOS chip. The pinhole should be centered in this location.
- Move the cameras laterally and in height until the pinhole is at the above coordinates (± 20 pixels). They can be moved laterally using the screw indicated by the yellow arrow in Fig. 3. Moving in height is more difficult: on the lower side of the camera there is a hole for a small Allen wrench. In the HIFI cabinet, there is an Allen wrench which fits, or one can also use an Allen wrench from the tool boxes.

Recording

To record data, switch from the „live mode“ tab to the „recording“ tab (Fig. 14). Set the exposure times (on top left, not visible in image) and frame rates (in Device Settings -> Timing, see red arrow in Fig. 14). Make sure the same value is set in trigger rate and recording rate. The recommended values can be found on the HiFI checklist. Be careful with the maximum frame rate (set to 47 Hz at full frame) because of image artifacts at higher rates. The blue arrow shows where to change the filename. Select “Specify” and add the correct suffix according to the checklist.

The allowed suffixes are:

_sd science data
_ff flatfield
_dk dark
_df flatfield defocused
_tg target
_ph small pinhole
_pl large pinhole
_pg pinhole grid (formerly “open 2” position on filter wheel)

If using another suffix, the pipeline will not work and good luck reducing the data.

To display live images while recording, but at the expense of a slower cadence, select “Settings”-> “Recording Sequence” -> “Image Acquisition” -> Tick “Show images when recording”. If not using live-view during recording, make sure to check for overexposure regularly.

You can display this screen in the 3rd floor observing room with Teamviewer. Teamviewer should be open on both computers (HiFi and 3rd floor). There are two options for access:

- 1) On the HiFi computer the teamviewer dialogue box contains a login id and password. Please use that password to access it via the third floor computer. Please be aware that every time Teamviewer is closed on the HiFi computer its password changes.
- 2) Without a password: There is a list of computers on the flight station. Clicking on them opens the teamviewer without requiring a password.

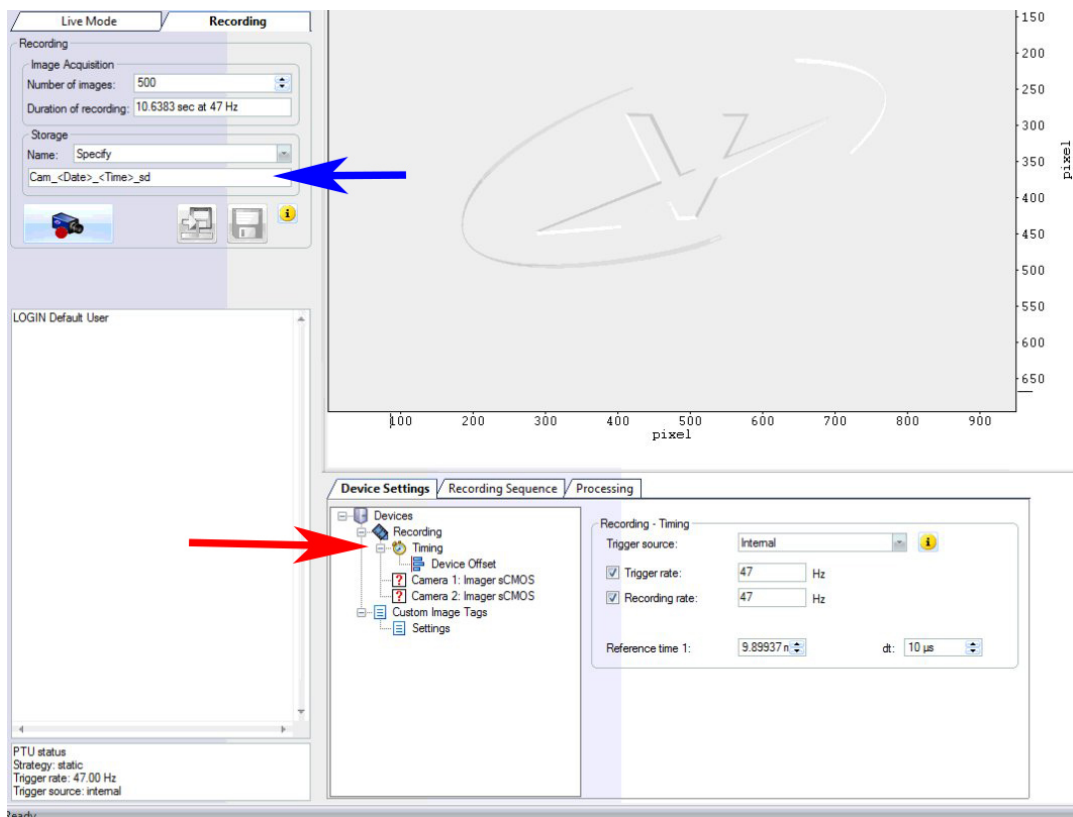


Figure 14: Recording tab. Blue arrow: specify suffixes here. Red arrow: Specify frame rate here.

To set up details of the recording (number of repetitions, which DAVIS calls “loops”), select the “Recording sequence” tab. Then click on “Recording sequence” text (red arrow in Fig. 15) and then click on the second icon from the left (blue arrow).

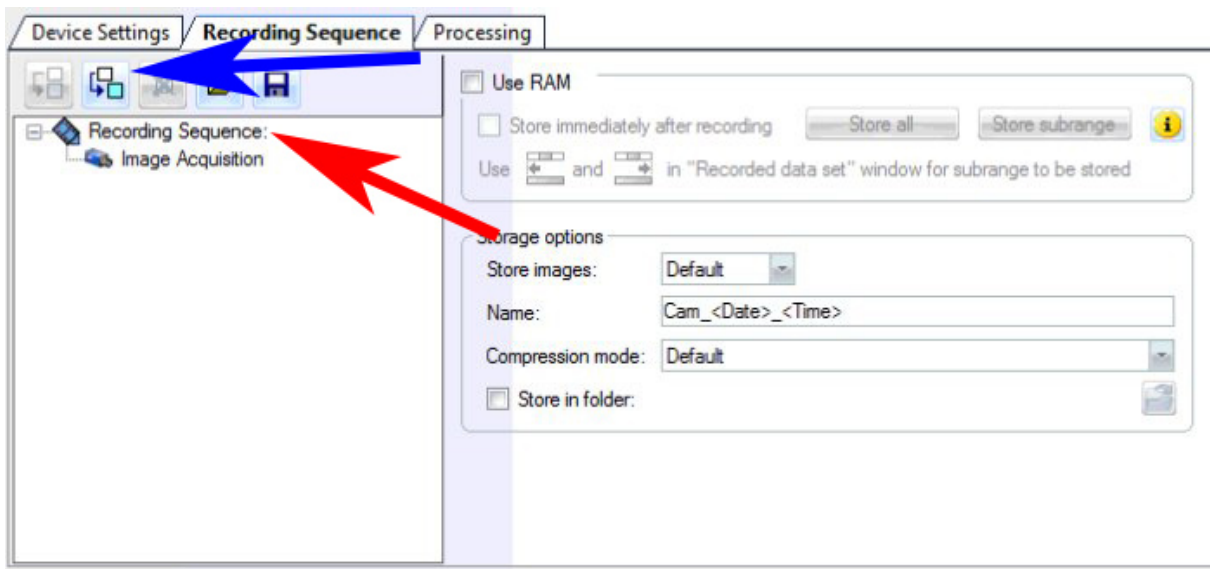


Figure 15: Setting up the number of repetitions

A new window will open (Fig. 16). There select the “Scanning” tab and click on “Loop” (-> OK).

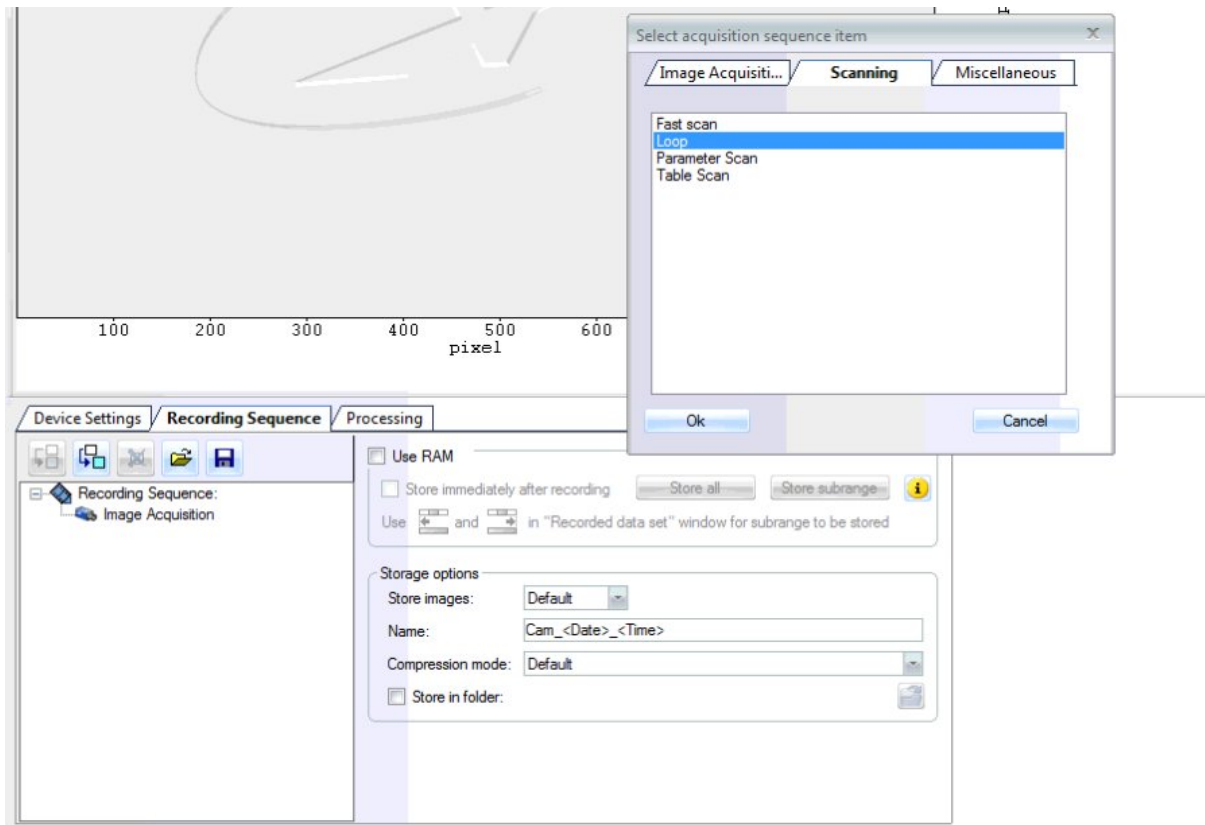


Figure 16: Select Scanning and Loop

Now click on “Loop” (see Fig. 17) and specify the number of repetitions (here 10). Do not forget to set the loops to 1 when taking calibration data. When this is done, just click on the button with the camera and the red dot in the Recording tab.

Each loop creates a new directory with the number of images that are specified in Fig. 14. If you do not know in advance how many loops you want to run, set the number of loops to a high value and you can stop the recording anytime by clicking on the red stop sign in the upper left. An error message may appear, but you can continue normally. Please immediately delete aborted data sets as they can be a problem for the data reduction pipeline.

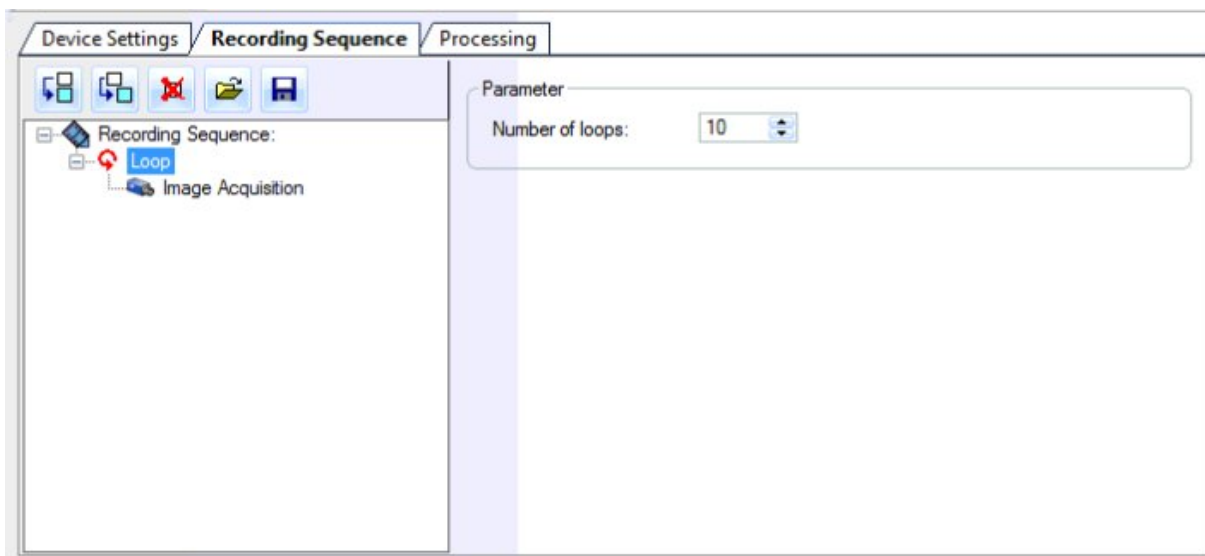


Figure 17: Setting the number of loops

Please bear in mind the following tips for successful HiFi data:

- Use the **predefined suffix extensions** depending on the data you are taking. They are in the HiFi checklist! This is crucial for the data reduction pipeline sTools. Otherwise the pipeline will not work.
- Follow the recommended amount of images and frame rates of the HiFi checklist.
- Recommended counts for good image restoration are in the range of 40000 – 60000 counts (64000 counts is the saturation limit which needs to be avoided).
- If you prepare for recording, adjust the number of loops and HIFI complains that there is no disk space left, this usually means that you entered a too high loop number. HIFI will calculate the required space before starting the acquisition and will give an error if the user entered a scan that would exceed this space (in total about 4 TB).
- Every day after observing with HiFi you need to transfer the project to /instruments.
- Both cameras should be switched on and take data at the same time (use the same exposure times). Otherwise the data reduction pipeline will not work.

When the observations are finished, quit the program first and then switch the cameras off. Do not forget to turn off the HiFi cameras daily.

3 After the observations

File Transfer

- Data are stored in the local D:. Transfer the project directory with RAW data and the corresponding .exp file (takes ~ hours). We highly recommend to transfer the project directory to /instruments/hifi following these steps:
 - use Windows Explorer
 - connect to [\\jane\it\instruments](#) (enter)
 - Dialogue appears
 - enter your username (not observer) in the format username@tt.iac.es
 - enter YOUR password (not the observer password)
 - copying is only possible within the same Explorer window
- In case the above does not work: try WinSCP or Filezilla to transfer.
- If you are not prompted for a username and password when you start your campaign and would like to use your own (otherwise there will be permission issues accessing data on /instruments), carry out the following steps
 - close all Windows Explorer windows
 - open a Command Prompt on the HIFI computer. Type: net use * /DELETE
 - open the credential manager (via windows search). Delete any profiles if there are any. Afterwards you should be asked for a password when using the above procedure.

Data Reduction

- Files are written in *.im7 format, one can obtain fits files after performing the frame selection.
- To reduce the data, install the sTools pipeline and the osllib IDL routines, e.g. in your home directory. Connect to the computers KANG or KODOS to run the pipeline (they are faster than HATHI). The pipeline seems to require being in the tt.iac.es domain.
- Reduce data using the sTools pipeline: stools_main_gui.pro (start stools_gui_main) → HiFI → fill in missing information. The level0 data should be in /instruments/hifi/ after copying them from the HIFI computer. One has to select the correct directory with a single click in the right window and then clicking OK (otherwise stool crashes and you will not know why).
- The pipeline should run automatically. If it crashes, it will restart from the beginning. The version in /home/kleintl/stools_ver204 has this changed and checks if a given reduced file exists (based on the filename) and if yes, skips redoing e.g. darks, flats etc.
- Store reduced data (FITS files) on /dat/yourusername/hifi/yyyymmdd/level1/
- The pipeline will select the best 100 images of the 500-image bursts and store them (dark and flat-corrected) as fits extensions. This means there are 200 extensions per fits file, 100 for each camera/wavelength. This value can be changed in the variable nbest in stools_hifi_science_frames.pro (before starting the reduction!).
- If stools crashes during the target alignment, try increasing the variables db and n by a factor of 2. The version in /home/kleintl/idl/stools_ver204 is modified to (theoretically) not crash even if the alignment is completely off.
- The pipeline currently does not align both science wavelengths and does not speckle-reconstruct the data. The alignment parameters are saved during the pipeline, but not applied to the science data, so contact AIP if you need explanations on applying the alignment. To speckle-reconstruct the data, contact AIP for guidance.

Ideally create the output directory: /date/yourusername/hifi/yyyymmdd/level2/ for speckle-reconstructed data.

If you do not have sTools, download the latest version from the gregor.aip.de website → members → sTools. You might need some additional libraries like solarsoft. In that case or if you need any other help regarding HiFI or sTools please contact people from AIP (Christoph, Carsten, Meetu or Horst).

AIP stores all reduced HiFI data in their archive at gregor.aip.de. Please let the AIP people know when you have reduced the data and remember to give “read” permissions to the folders. Thanks!