PEPSI User's manual

Issue	1.0
Date	March 6, 2020

Contents

1 Revision History

Table 1: Revision history

Issue	Date	Changes	Responsible
1.0	13.01.2020	First version	S. Järvinen

2 About this document

This document describes the design details of the PEPSI spectrograph that are relevant for planning the observations. It also describes in detail how the observations are performed.

3 General information

PEPSI has PI instrument status at the LBT until 2020A. If you wish to observe with PEPSI and have questions beyond the usual, please contact either the PI Prof. Dr. Klaus G. Strassmeier at AIP or Mark Wagner at LBTO. PEPSI is foreseen to operate as a facility instrument by Feb. 1, 2020.

The basic description of PEPSI is given by Strassmeier et al. (2015, AN, 336, 324) and (2018, SPIE, 10702, 12).

4 Planning the observations

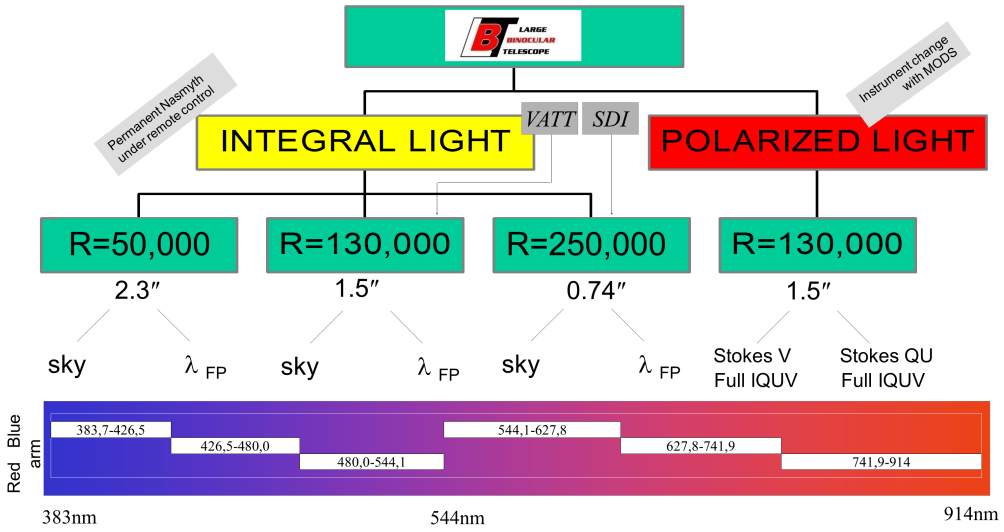


Figure 1: PEPSI observation modes.

4.1 Spectral ranges

The entire spectral range of the PEPSI is from 383 to 912 nm but it **can not** be covered by a single exposure (see, Fig.1 for more details). PEPSI has two arms, blue and red, that cover spectral ranges 383-544 nm and 544-912 nm, respectively. Each arm has three cross-dispersers:

- CD1 383-426 nm in blue arm
- CD2 426-480 nm in blue arm
- CD3 480-544 nm in blue arm
- CD4 544-627 nm in red arm
- CD5 627-741 nm in red arm
- CD6 741-912 nm in red arm

Simultaneously, one can observe one wavelength region in blue and one in red, however, **CDs 3 and 4 can not be used at the same time.**

4.2 Resolution modes

Observations can be done using three different fibers, that is with three different resolutions:

- 100 μm gives R=250,000
- 200 μm gives R=130,000
- 300 μm gives R=50,000

4.3 Exposure times

Exposure time depends on the target, the wanted resolution, and used cross-disperser. Exposure times can be estimated using the exposure time calculator that is available on PEPSI web page.

One can have different exposure times and numbers of exposures for cross-dispersers in blue and in red arm (examples below):

- 30 min in blue, 20 min in red $\Leftarrow$ red is idle for 10 minutes
- 30 min in blue, 2×15 min in red $\Leftarrow$ both are ready around the same time
- 3×10 min in blue, 6×5 min in red $\Leftarrow$ both are ready around the same time, blue likely idle for some minutes due to read-out times (80 sec / read-out)

5 Executing the observations

5.1 Accessing PEPSI Graphical User Interface (GUI)

Observations can be executed either using the PEPSI 4K monitors in the LBT control room or one can observe remotely.

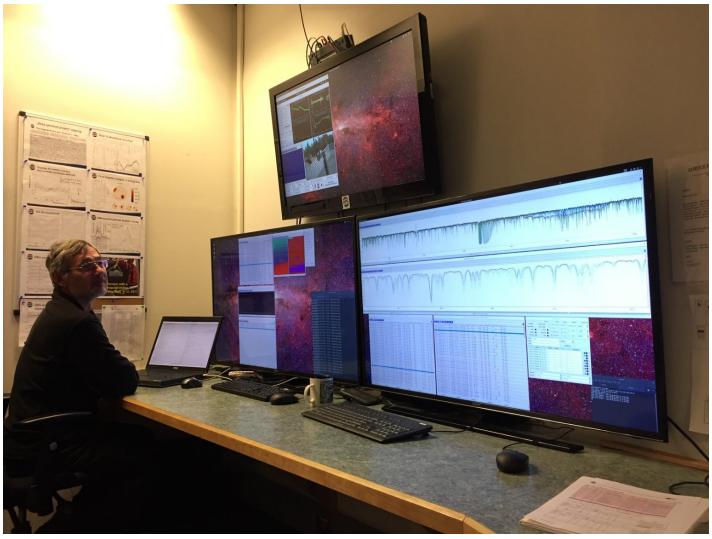


Figure 2: PEPSI computer screens at LBT control room.

In case of remote observing
from Linux machine

- take **VNC** connection by typing in terminal **vncviewer -via ajarvinen@ssh.lbto.org -shared 192.168.164.14:**
- environment (telemetry, see Sect. 7) status can be seen at 192.168.164.14:2
- passwd is given on need to know basis
- in the end, close the connection from the upper corner 'x'

from Mac

- one has to first make a **VPN** connection vpn.lbto.org
- username and passwd are given on need to know basis
- and then take a VNC (with TigerVNCViewer) connection to server alpha.pepsi.lbto.org:1 (or :2)
- in the end, close the connection with Fn+F8, exit viewer and disconnect VPN

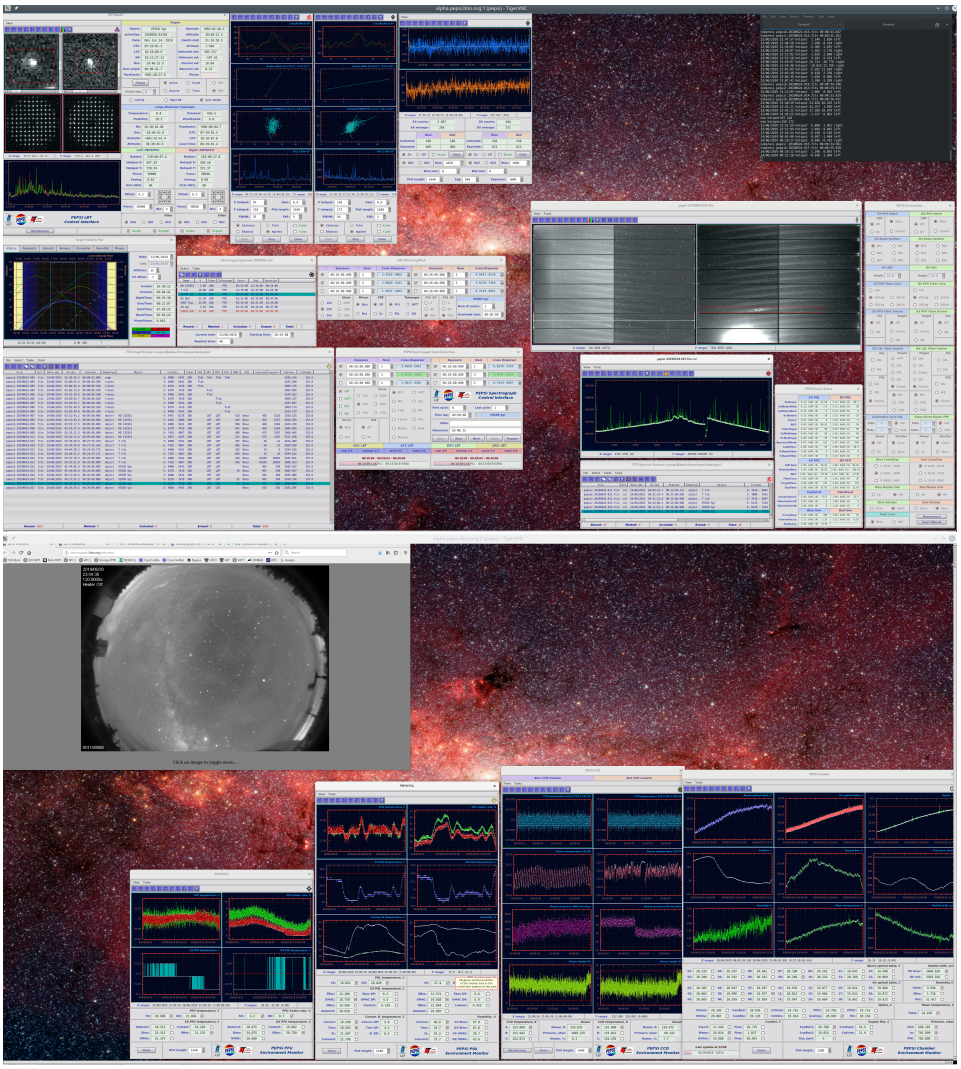
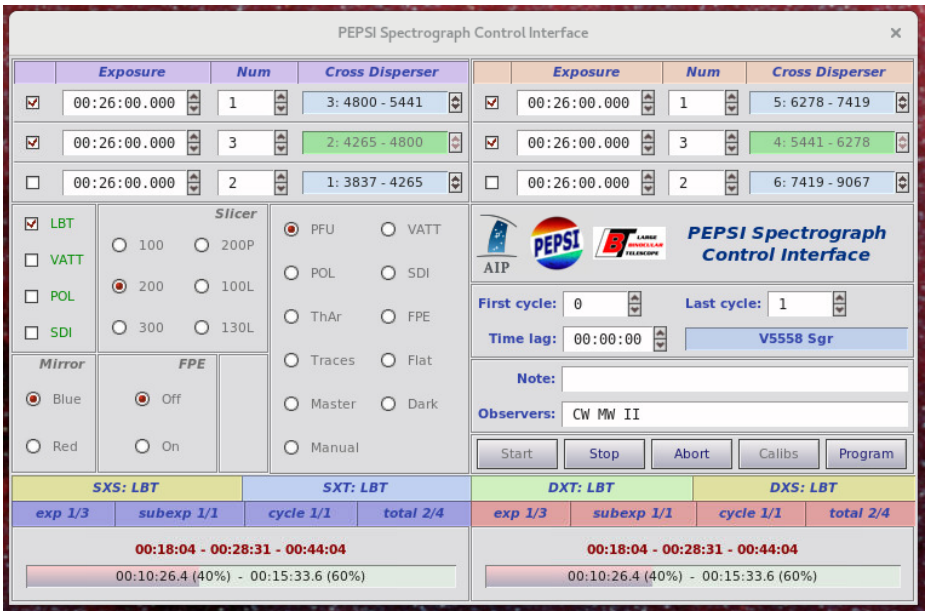


Figure 3: *Top*: VNC view of the user interface (:1). *Bottom*: VNC view of the telemetry (:2).

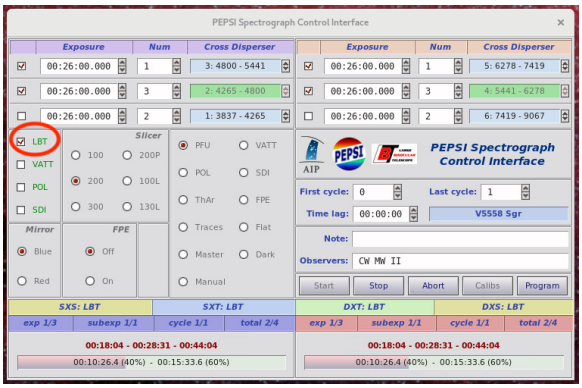
The PEPSI user interface program should be kept running all the time. If it is not running, click Activities in the left upper corner. You should get a menu having PEPSI logo. Click on that logo to open the program. Alternatively one can use a terminal to open it (if no terminals open, open a new one). On **pepsi@alpha** type 'pepsi'.

5.2 Connecting with PFU

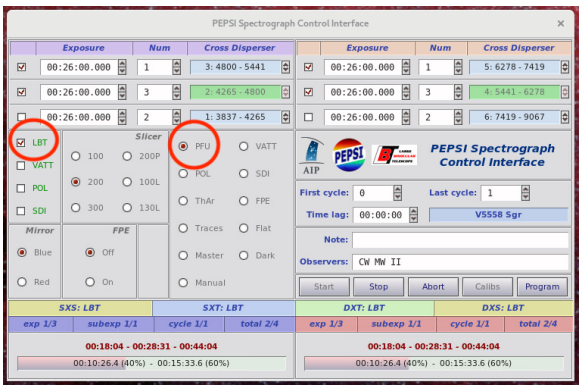
1. Now you should have '**PEPSI Spectrograph Control Interface**' open.
   - In case PEPSI has been used for solar observations (SDI selected) and you have text 'Waiting for Sun' in the 'PEPSI Spectrograph Control Interface', click 'Abort' to be able to start night observations.



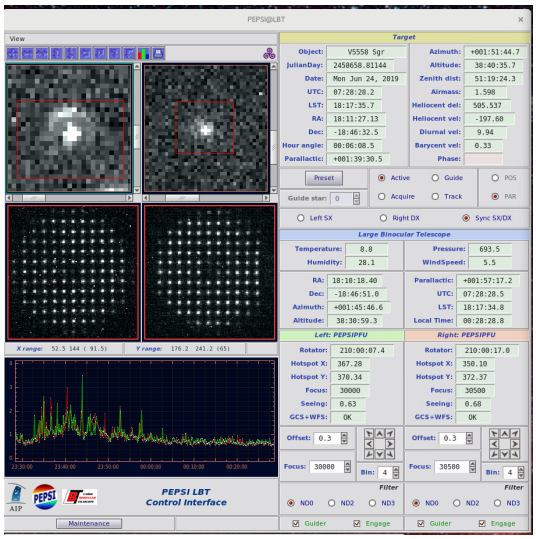
- Click on LBT check button to connect and open '**PEPSI@LBT**':



- Check that PFU radio button is selected:

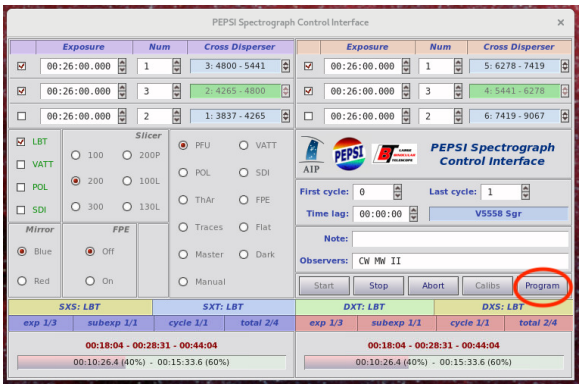


2. A 'PEPSI@LBT' window should appear:



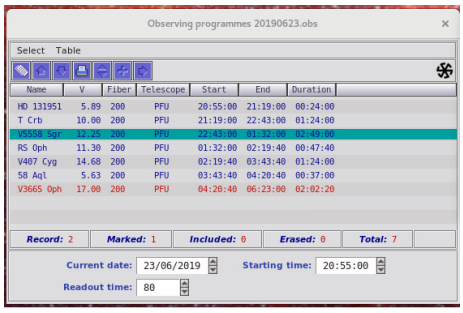
5.3 Selecting and sending targets to LBT

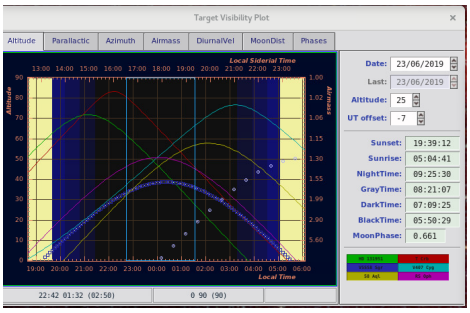
1. Click 'Program' button on '**PEPSI Spectrograph Control Interface**':



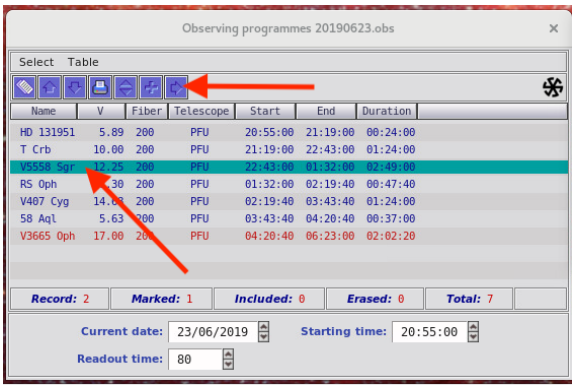
2. When you

   a) **already have an observing program**, a 'Observing Programmes' window and a 'Target Visibility Plot' window opens. If not, go to 'Table' menu, choose 'Open or Close Table' and select the correct one.

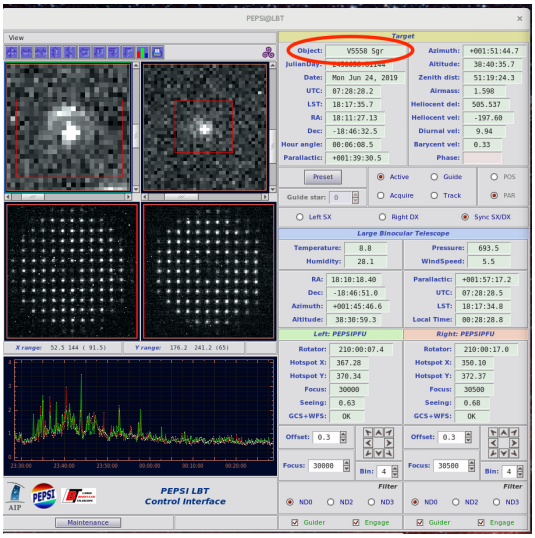


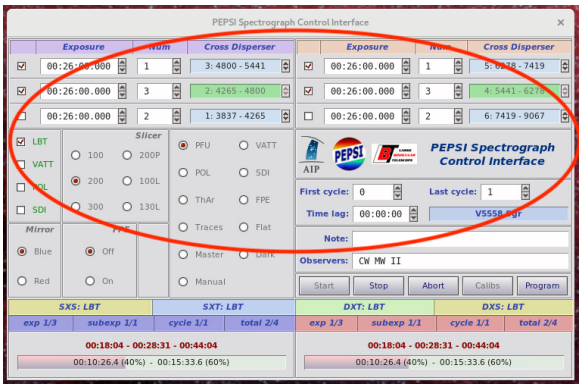


- If GUI had to be restarted, check that the correct program is open (YYYYMMDD.obs)!
- **select the target** (highlighted with teal color) you want to observe and send it to LBT. This does not yet move the telescope! Note that target can be sent already during CCD readout!



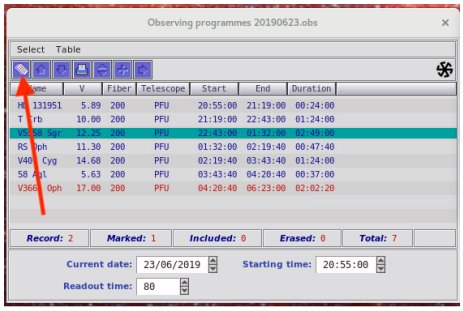
- check that 'PEPSI@LBT' has the same target as you chose, or resend, and check that 'PEPSI Spectrograph Control Interface' changed (target name, selected cross-dispersers, exposure time, etc.) according to selected target. Note that the changes happen only after CCD readout has finished.

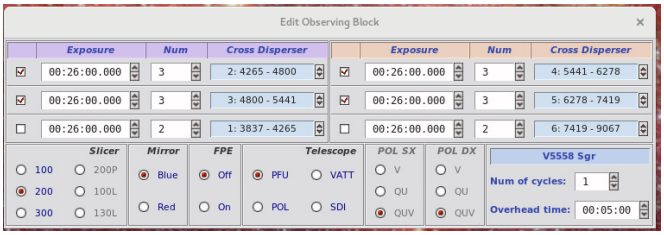




- if you need to change pre-defined exposure times, click 'Edit fields' and a new window pops up and you can make the changes. Note that values in 'PEPSI Spectrograph Control Interface' do not change unless you send the target information again (see A.) You can also change values in 'PEPSI Spectrograph Control Interface' directly, but then the visibility

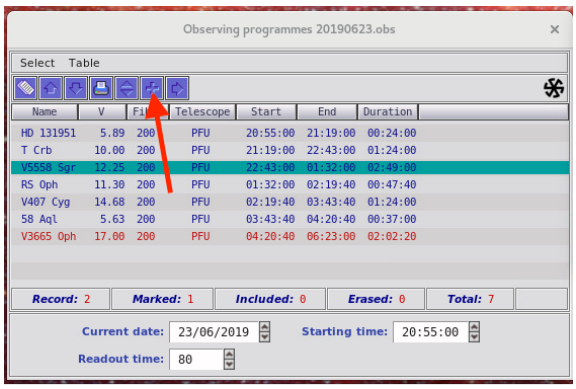
plot does not change and block will not remember the changes made in future.

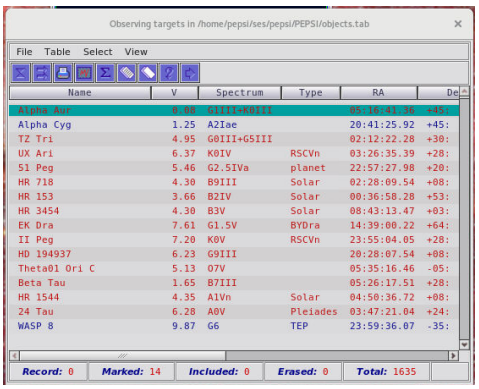




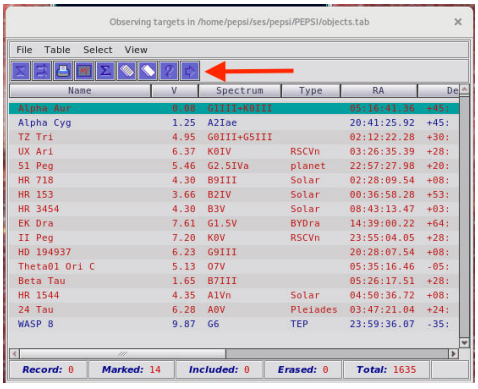
b) **don't have any targets** or you want to change targets

- See Section 4 for additional information!
- click 'add another object' in 'Observing programmes' window and a new window having targets pops up



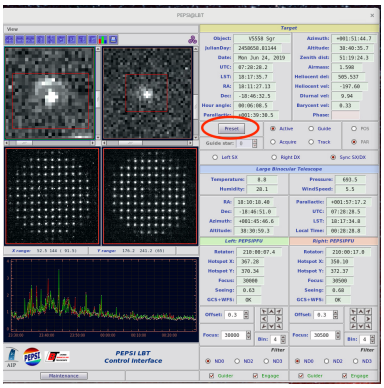


- choose the target and send it to the observing block



- continue as in 2-a.

3. **after the telescope operator gives the permission**, click '**PRESET**'

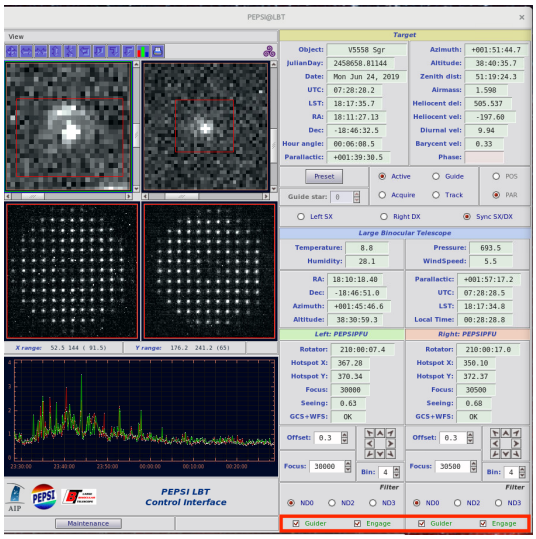


- 'PRESET' to next target can be done already during CCD readout.
- Note that 'Preset' can be done in four different modes, but only the first one should be used unless requested otherwise by the telescope operator:
  - **Active – the normal mode**, uses wavefront sensor and guiding
  - Guide – no wavefront sensor is used, guiding yes
  - Acquire – only points and centres on hot spot
  - Track – only points

5.4 Guiding

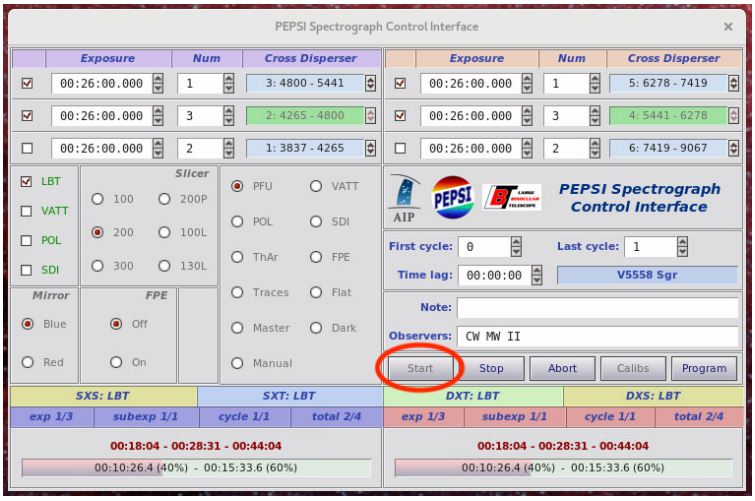
Guiding (and also focusing) is done by the telescope operator. **Do not do anything unless asked.**

- 'Engage' opens the hatches so that the telescope operator can put the star in the position.



5.5 Observing

Start observations by clicking 'Start' in 'PEPSI Spectrograph Control Interface':



If the exposure needs to be interrupted for any reason, use

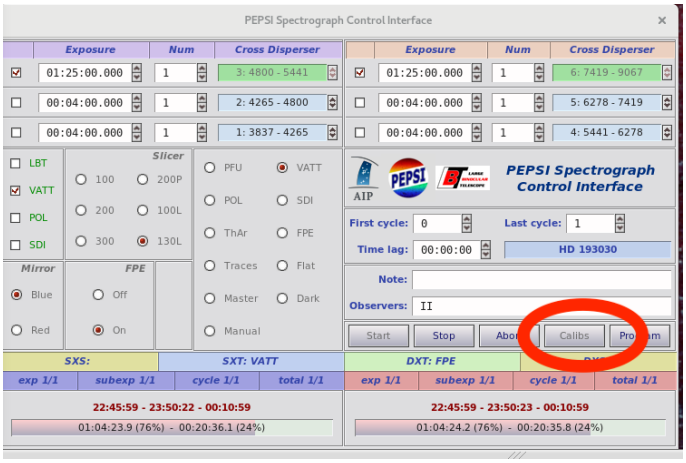
- 'Stop' in case you want to save the data obtained so far
- 'Abort' in case the exposure time was not long enough for useful data

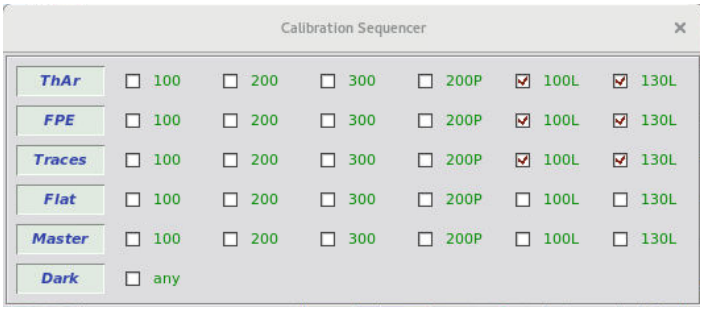
5.6 Calibration frames

After the observing night is over, it is time to take the calibration frames. Check that you have stopped guiding and guider camera is on pause.

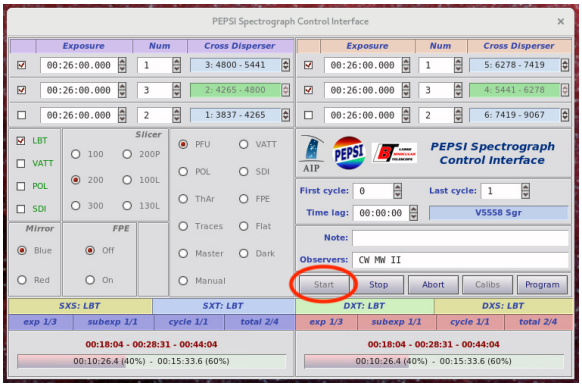
In the 'PEPSI Spectrograph Control Interface' window:

1. Click 'Calibs' button to get a pop-up window:





2. Check that for wanted fiber(s) ThAr, FPE, and Traces are chosen
3. Click ‘START‘ button on Control Interface window:



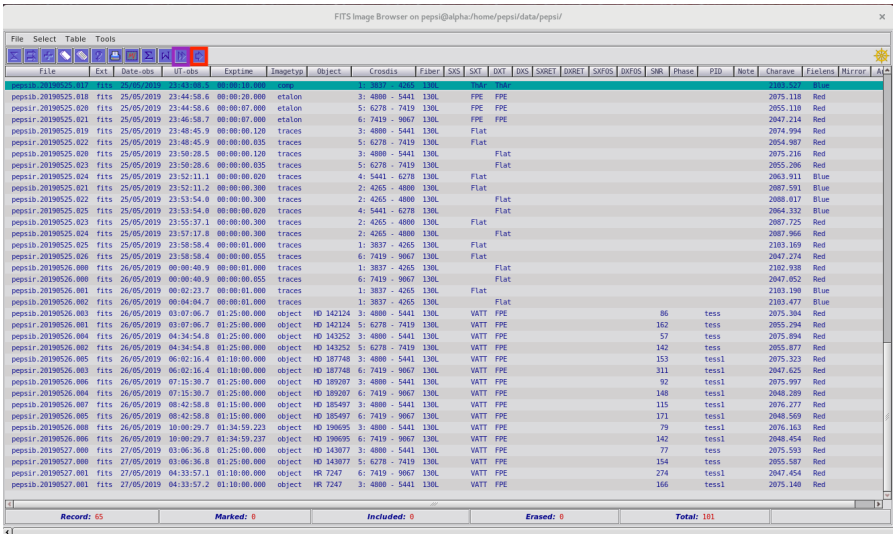
4. When calibration frames are ready, click ‘Calibs‘ again to close the calibration sequencer window and to be able to do anything else.

6 Raw data

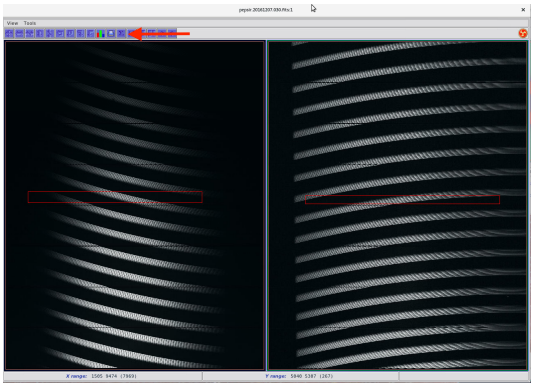
6.1 Viewing obtained spectra

It is good to take a look at the spectra in order to see if you should change exposure times etc.

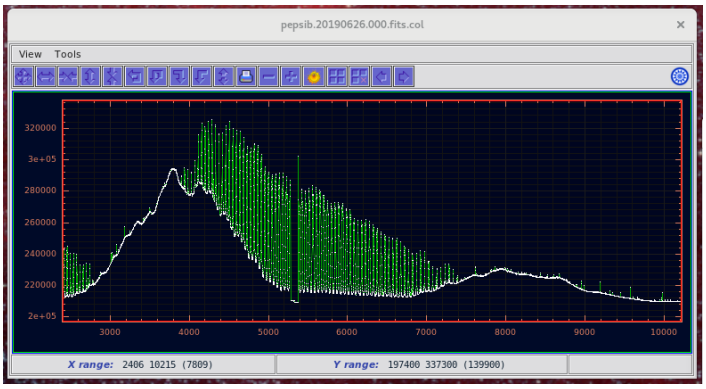
1. Select the spectrum (highlighted with teal colour) you want to look at from 'FITS Image Browser' with Enter or click the arrow icon to send it to 'Spectrum viewer'. One can also look at multiple spectra by selecting them and clicking double arrow icon.



2. The active window in 'Spectrum viewer' has a cyan frame. Select the area you want to look at closer by drawing a red box with, for example, a mouse. To see a summed spectrum from selected area Press 'Enter', or Click the normal 'Sigma' icon (one dimensional cross-cut in horizontal direction) on top of the viewer (the other sigma makes it in vertical direction)

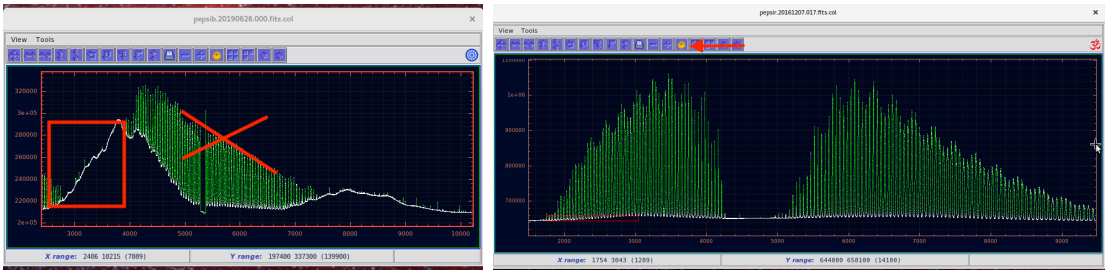


3. Now you have a spectrum plot where you can see the ADUs:

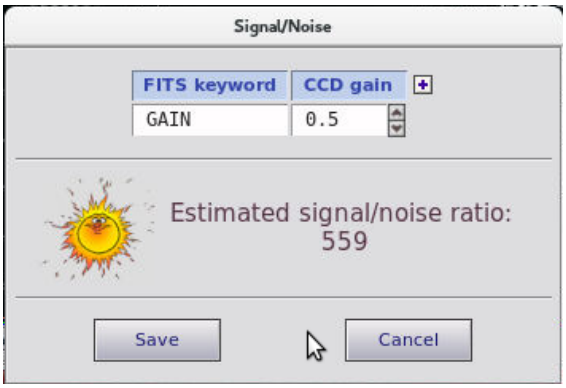


6.2 Estimating signal-to-noise ratio

1. Select an area with mouse from highest continuum values to lowest (don't be distracted by high fabry-perot peaks) and click 'Sun' icon on top of the spectrum viewer:

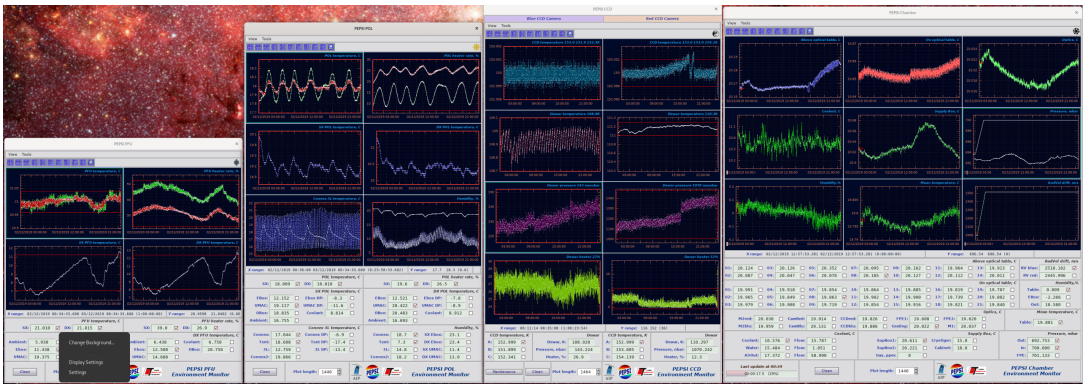


2. You get a pop-up window there the S/N estimate is given, save that information into fits list by clicking 'Save':



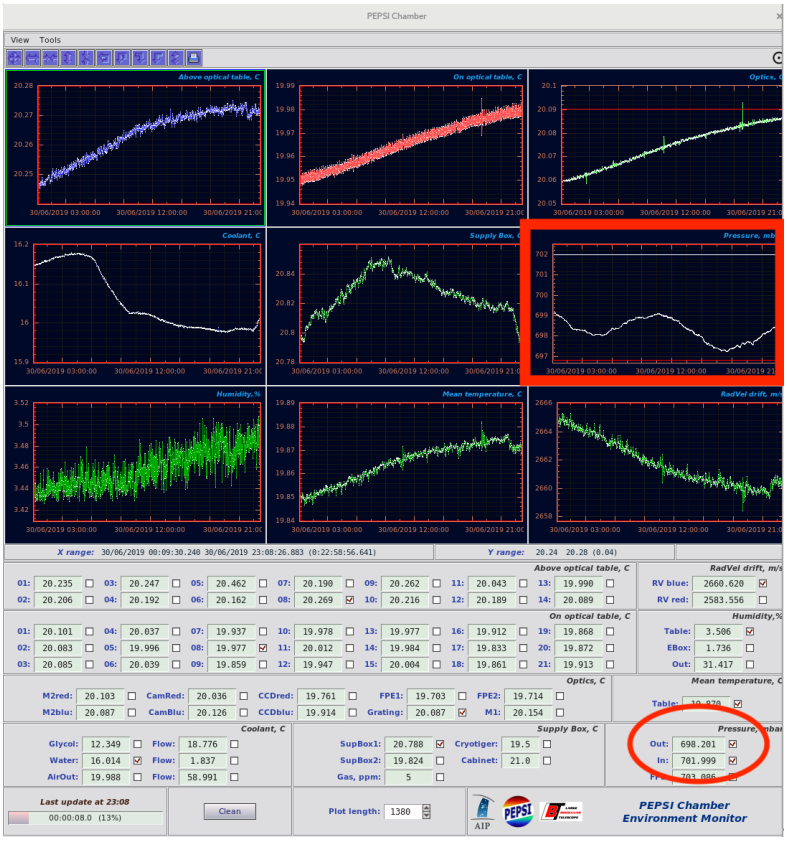
7 Telemetry

It is essential to **check the telemetry** from time to time:

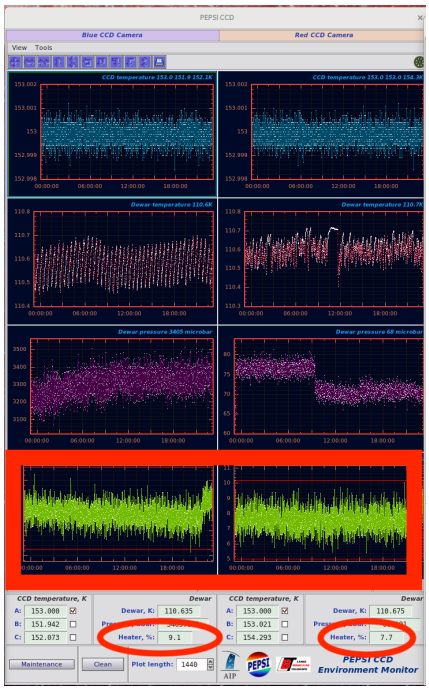


If something is wrong and you are not trained to fix the problem, contact a person who is!

The most important is the 'Pressure' in **PEPSI Chamber** window. If 'In' value has red background, and one sees that pressure curves follow each others, everything is not fine.

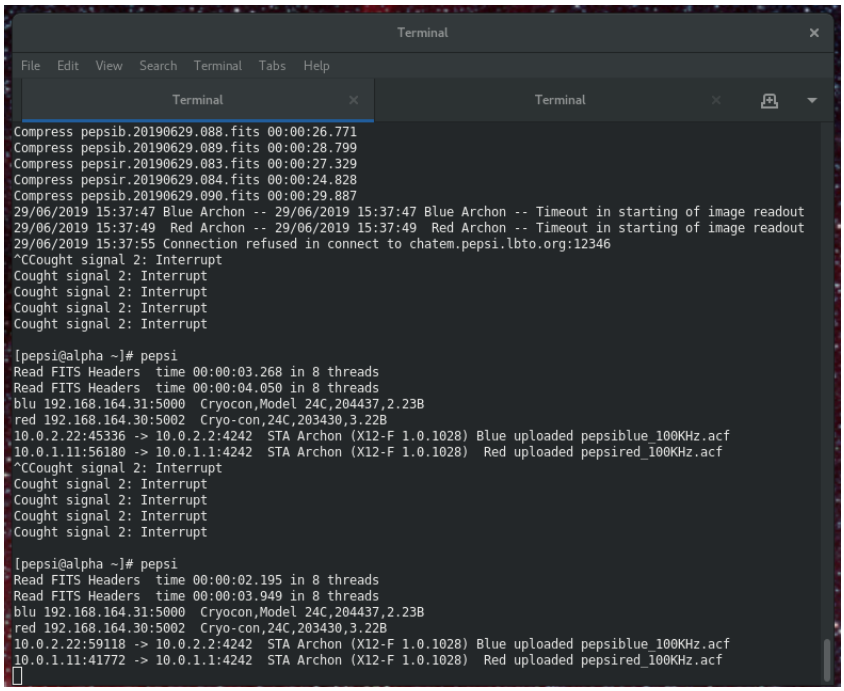


Other important measure is ‘Dewar heater‘ in PEPSI CCD window. If it approaches 0, the dewar pressure rises and pumping is needed.



8 Troubleshooting

Sometimes the software program freezes or even crashes (STA Archon time out). If that happens, find the following terminal



and type Ctrl+c and start all over again.

If terminal gives 'Lost connection with Camera', one can go to 'PEPSI Control Unit' Maintenance, but in order to do that, **you should know what you are doing**.