# PACS Unchopped Spectroscopy

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## Why not chopping ?

**It is impossible to chop beyond 6 arcmin.**

So, in case of extended sources or crowded fields, the only alternative is using the unchopped mode. Remember also that with a large chopper-throw only the central pixel is usable in pointed observations because of distortions.

**Unchopping is more time efficient than chop-nodding.**

However, it is very difficult to correct the signal for the varying response of the detector. So, only the strength of the line and not the underlying continuum can be precisely estimated. Also, the imperfect knowledge of the RSRF affects the reduction of unchopped data.

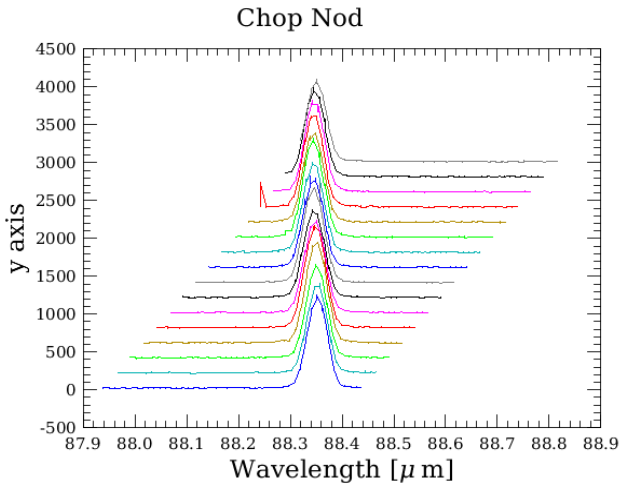
*Users are discouraged to use unchopped modes whenever it is possible to use chop-nod modes.*

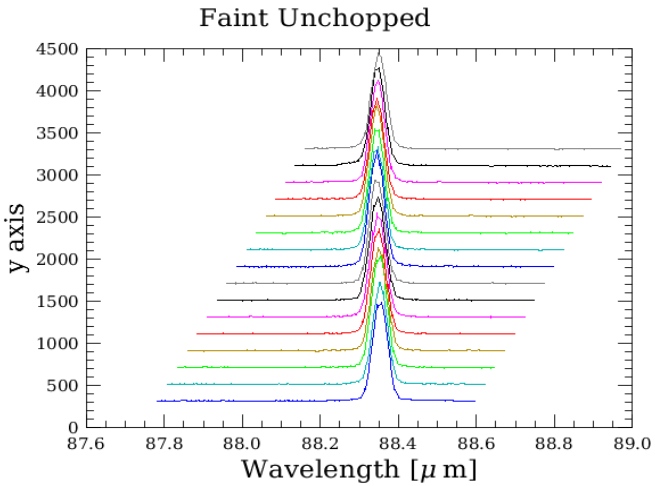
## NEW MODE !!!

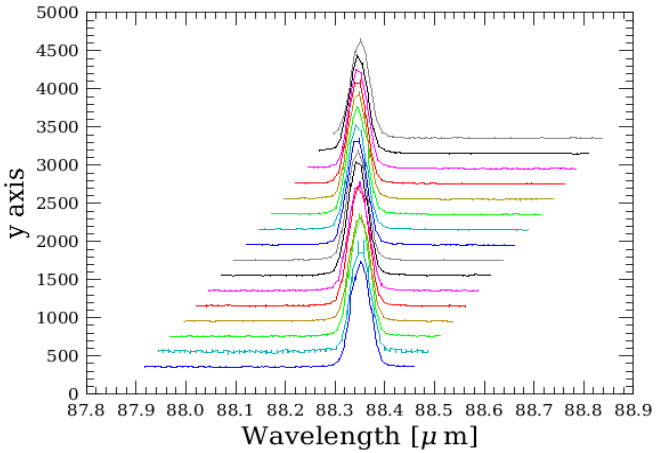
With this call (AO2), a new unchopped mode is available. This new mode, called **"bright line mode"**, allows one to save up to 30% of the time by cutting the wavelength range by 30%.
This makes sense only with bright lines since in other cases it is difficult to estimate the underlying continuum to evaluate the strength of the line.
The user is discouraged to adopt this mode when the line is not detected at least at a 10-sigma level.

# Wavelength coverage

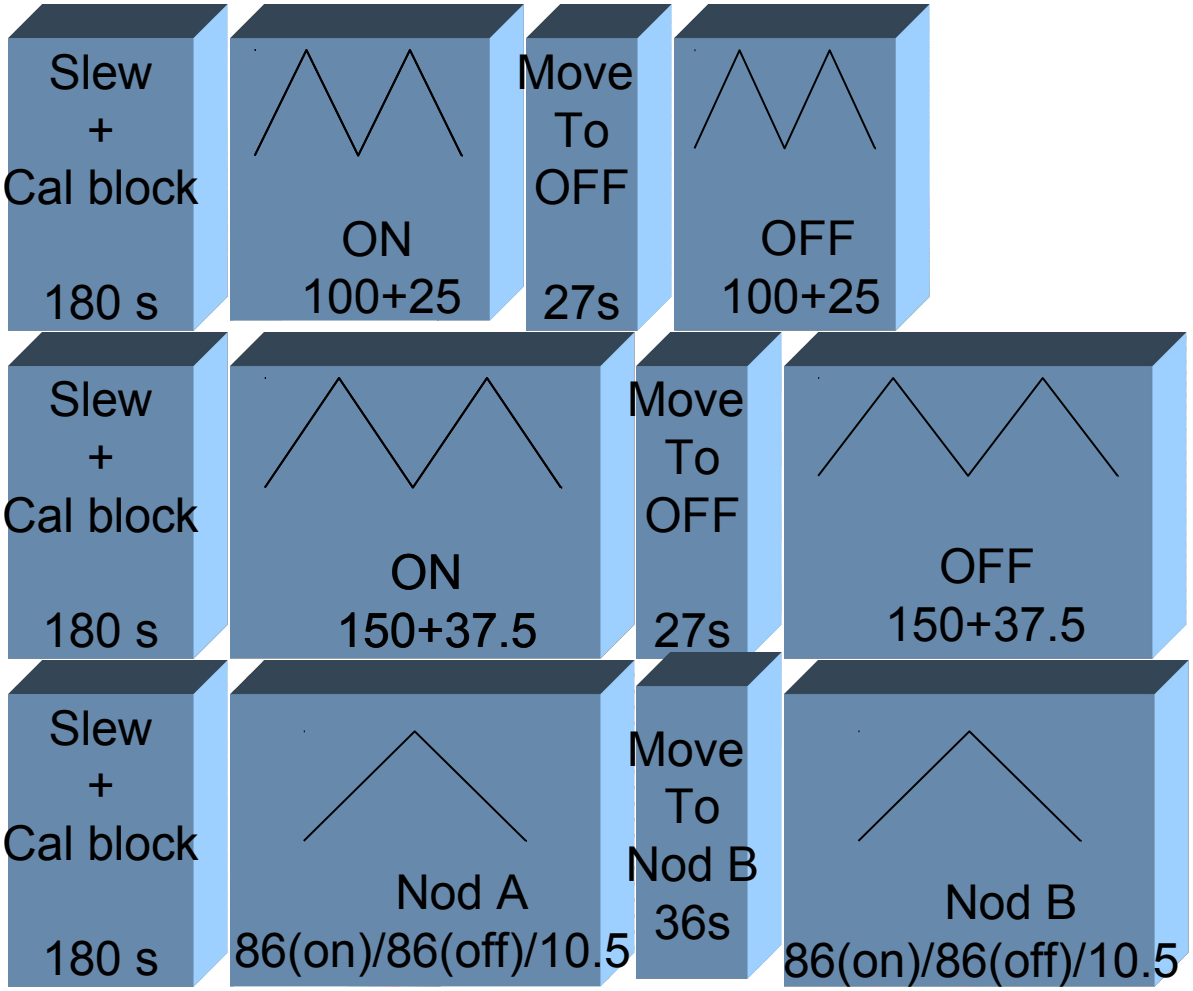
Standard unchopped has the largest coverage. The bright mode is similar to chop-nod.



# Time efficiency comparison

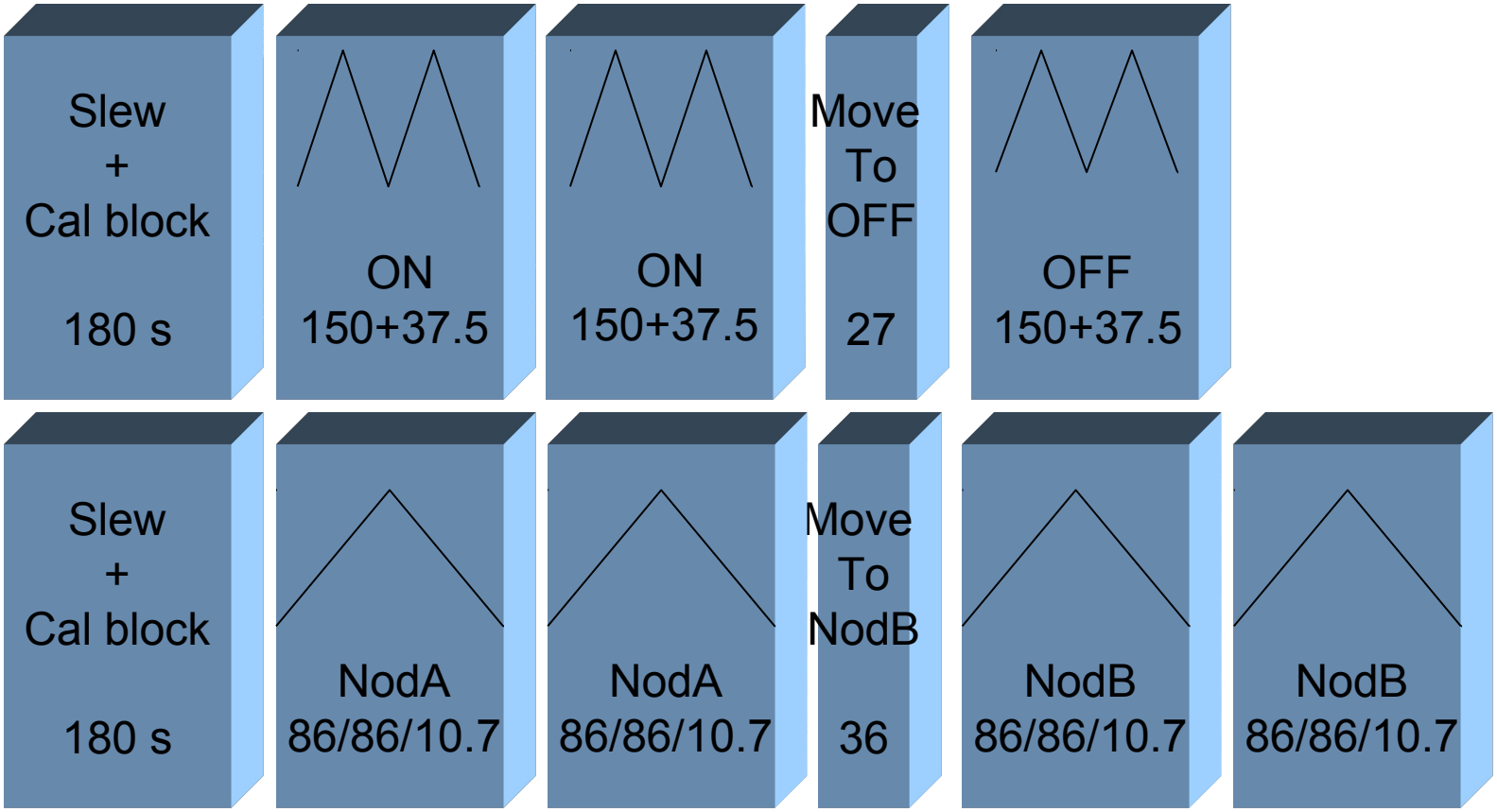



Unchopped bright

Unchopped

Chop-nod

# When repeating a scan, the off can be executed only once.



# Pointing and raster modes

Two different strategies are possible:

a) **pointed observation**: on-source is followed by an off-source observation. The user can repeat the on more times than the off.

b) **mapping observation**: the user can choose the frequency of the off-source observation. It is recommended to have an OFF at least every 30 minutes.

# OFF position

In principle, if interested only in the strength of the line, the OFF position is superfluos. However, there are at least two reasons for which it is recommended to have OFF positions:

a) **correction of RSRF inaccuracies**

Scaling the off to the on signal and subtracting it corrects for the RSRF imperfections.

b) **spatial flat field**

In case of a mapping observation, a good flat-field can be obtained using the OFF observation.

## Typical errors

Default values are dangerous !

a) **forget to define the OFF offset**

The default is OFF by offset and it is set to 0, which means at the center of the observation

b) **forget to define the frequency of OFF in mapping**

The default is an OFF every 2 raster position, which is usually too much and inflates unnecessarily the length of an observation. In case of small maps (e.g. 3x3) one OFF at the end is enough. Otherwise, for large maps, a solution can be one OFF at the end of each row.

# The challenge

Find the most efficient way to observe a C+ line (157.7μm) in the nucleus of an extended object at 10:10:45 + 11:10:20, redshift = 0.01, peakFlux = 3 Jy, width = 250 km/s, continuum = 1 Jy.

Check if the line is unresolved ...
Remember that: $R=\lambda/FWHM$, $v[km/s]=c*FWHM/\lambda$
For flux: $\Delta v = c * FWHM/\lambda^2$

$$F[W/m^2] \sim fluxPeak[Jy]\ \Delta v[Hz]\ 10^{-26}$$

In the following, you can see how to prepare an observation and to check execution time and SNR.

# Where to find more

Hspot manual

http://herschel.esac.esa.int/Docs/HSPOT/html/hspot-help.html

PACS observer's manual

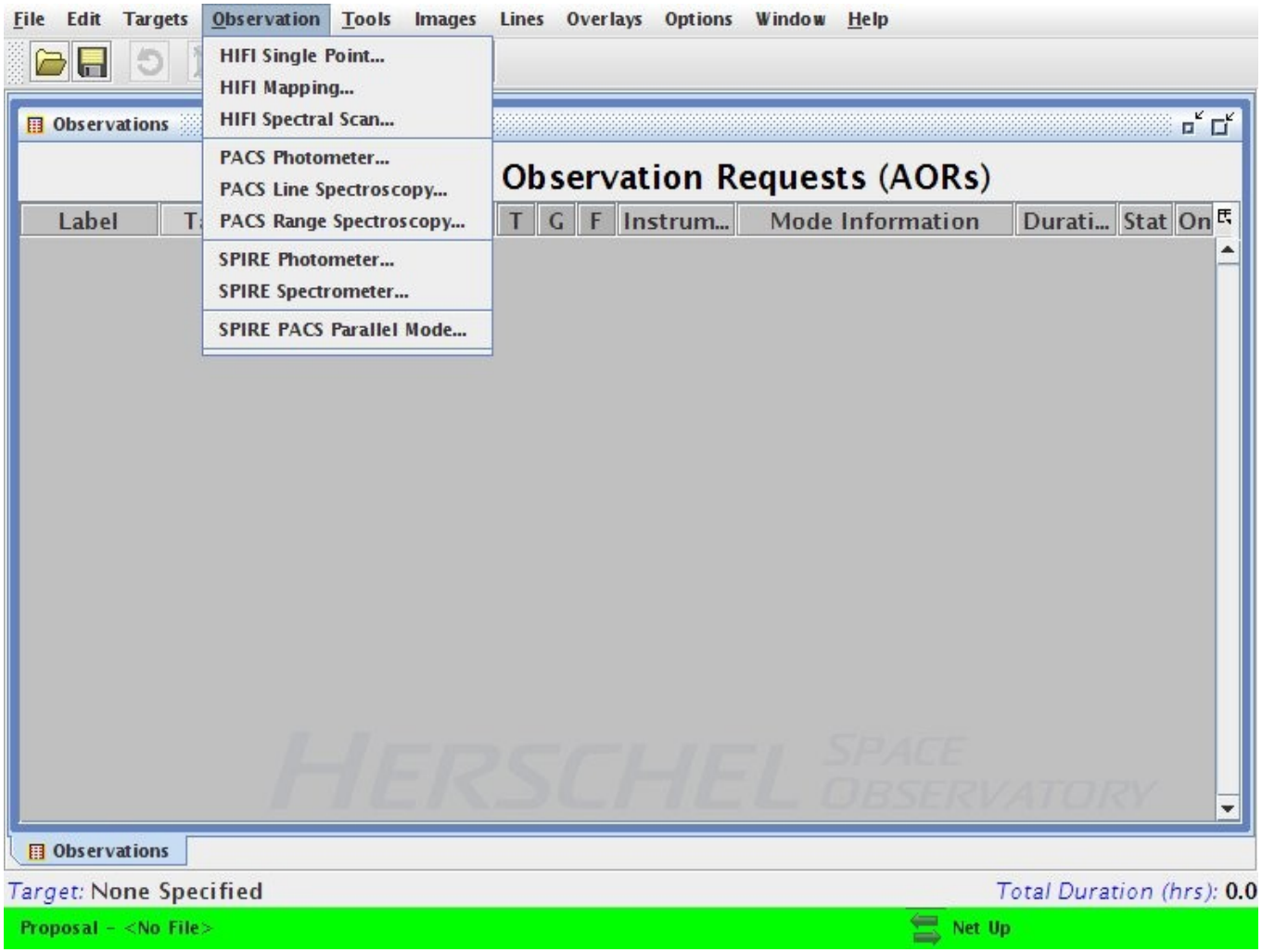
http://herschel.esac.esa.int/Docs/PACS/html/pacs_om.html

Release notes

http://herschel.esac.esa.int/AOTsReleaseStatus.shtml#ReleaseNotes
http://herschel.esac.esa.int/twiki/bin/view/Public/PacsAotReleaseNotes

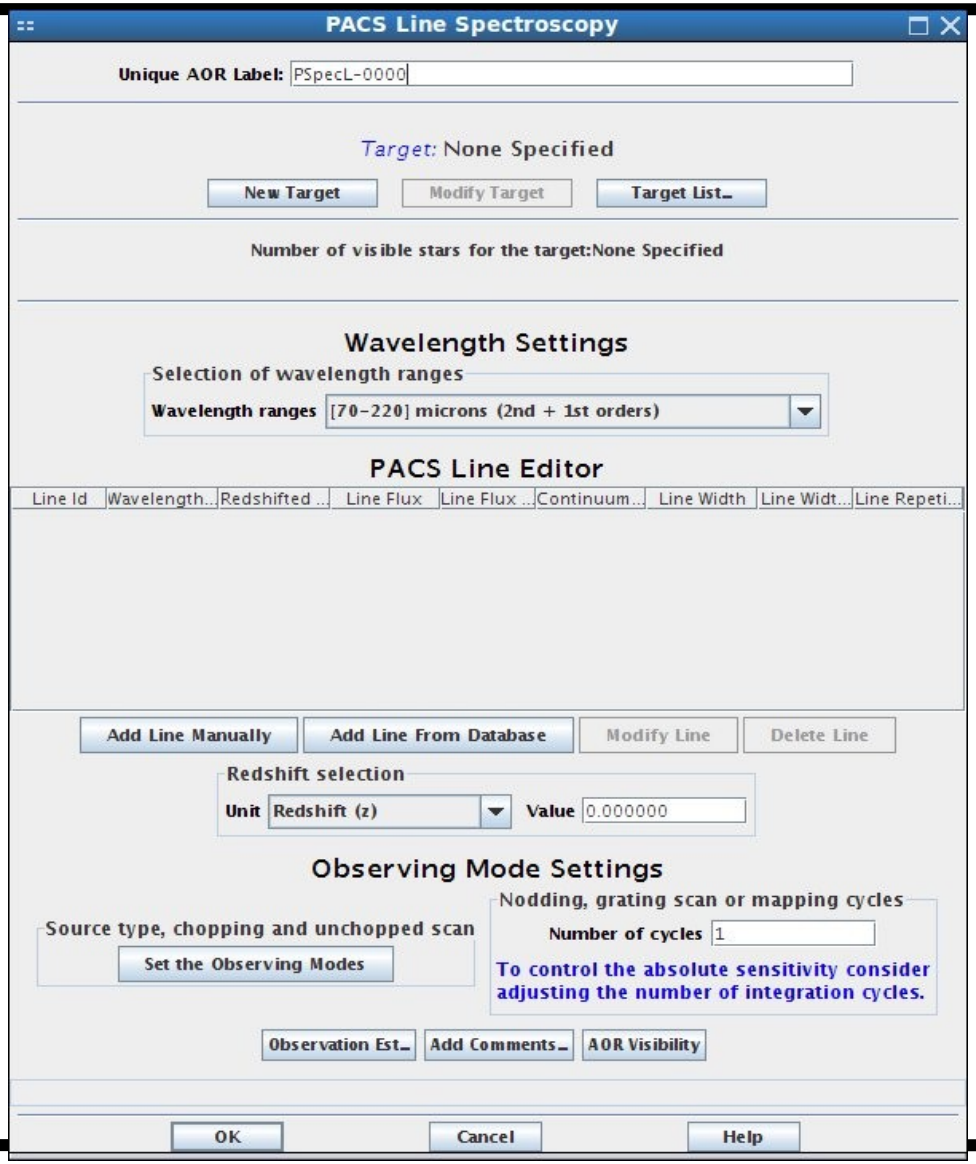
# How to do it

Choose the observation mode.



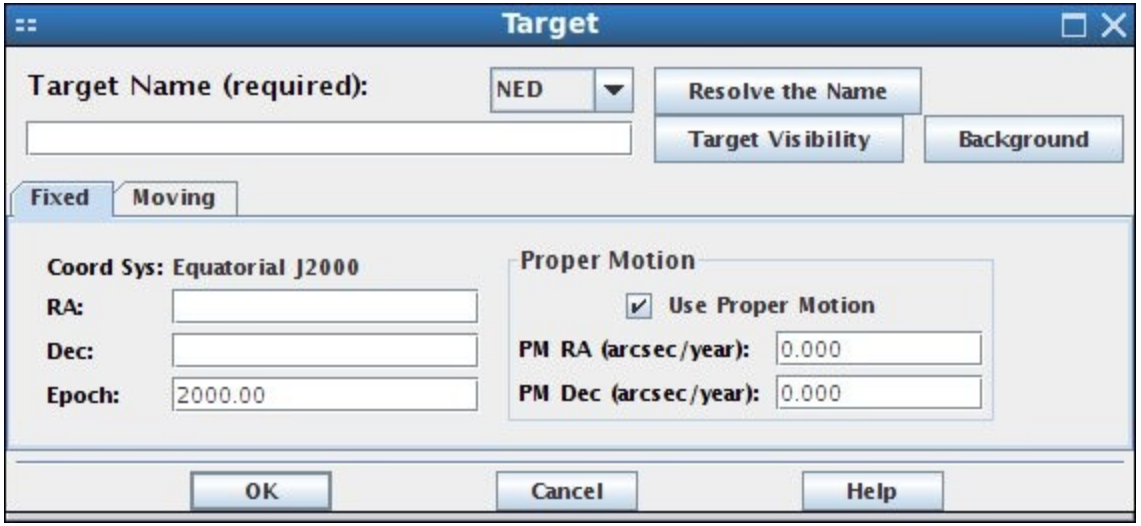
# How to do it

Set the AOR label
and click on "new target"
to select your target.



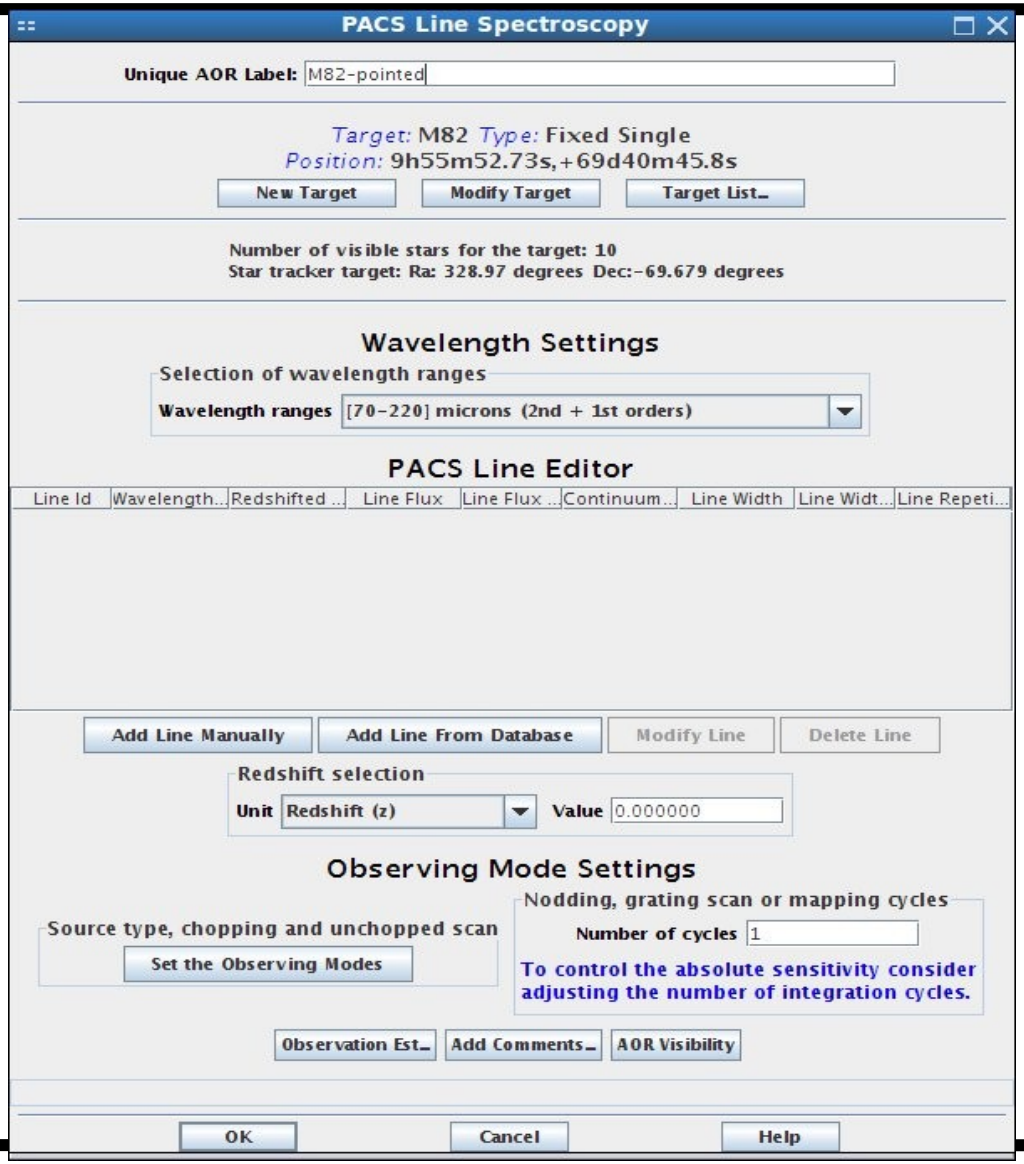
# How to do it

Choose the target name. If it is a known object (by NED of Simbad) can be resolved. Otherwise, insert the coordinates.



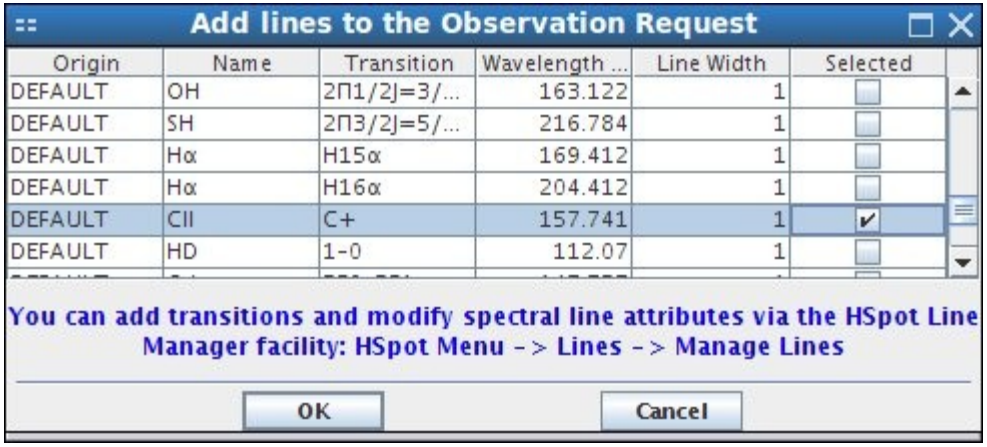
# How to do it

Now, name the AOR and select the line(s) to observe. Lines can defined manually or selected from a list.



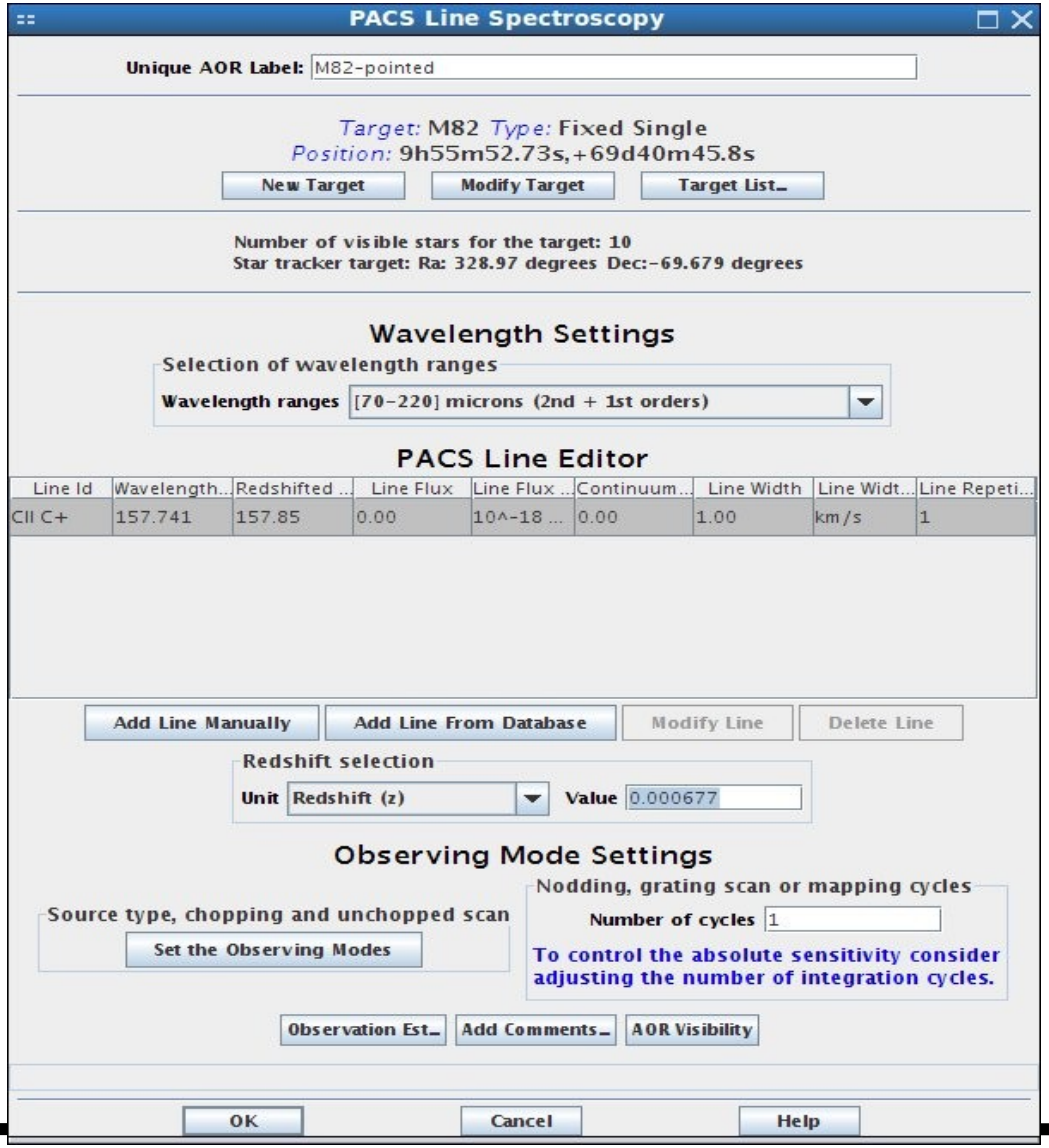
# How to do it

When using the line database, select a line by checking the box.



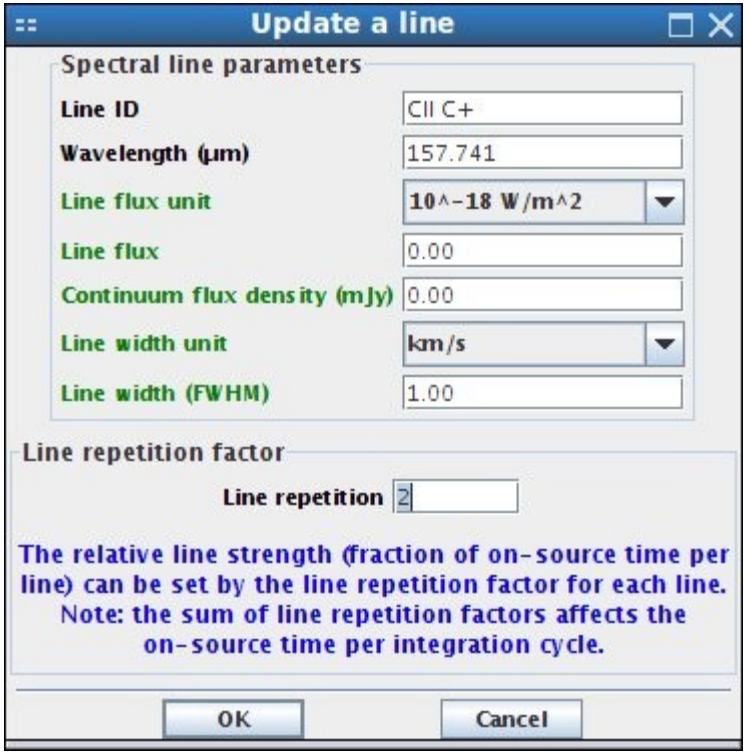
# How to do it

The selected line appears on the list. It is now time to assign the redshift. To change the number of repetitions, double click on the line.



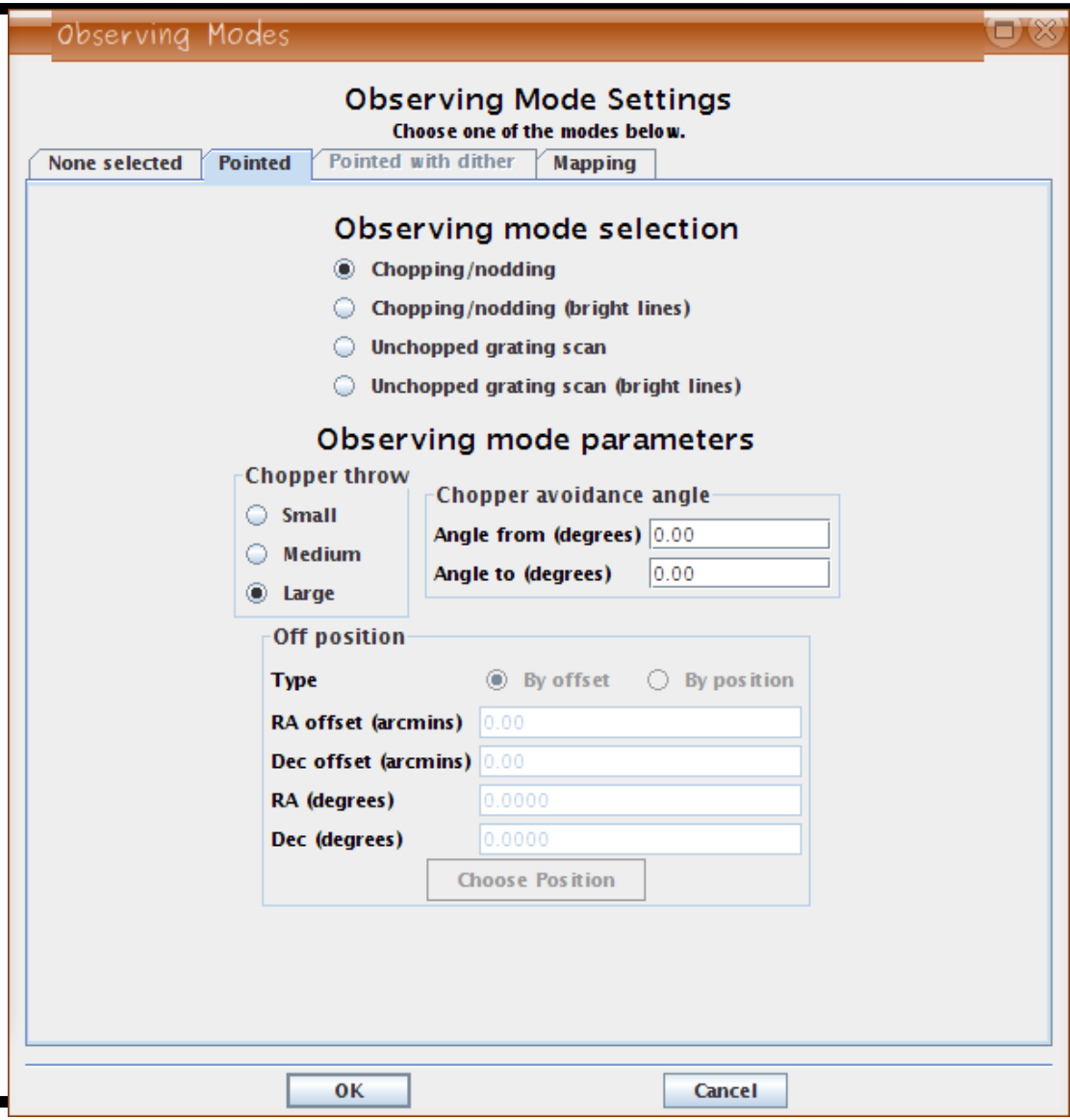
# How to do it

In this pop-up window it is possible to set the flux of the line and other features. It is also the place to define the number of line repetitions.



# How to do it

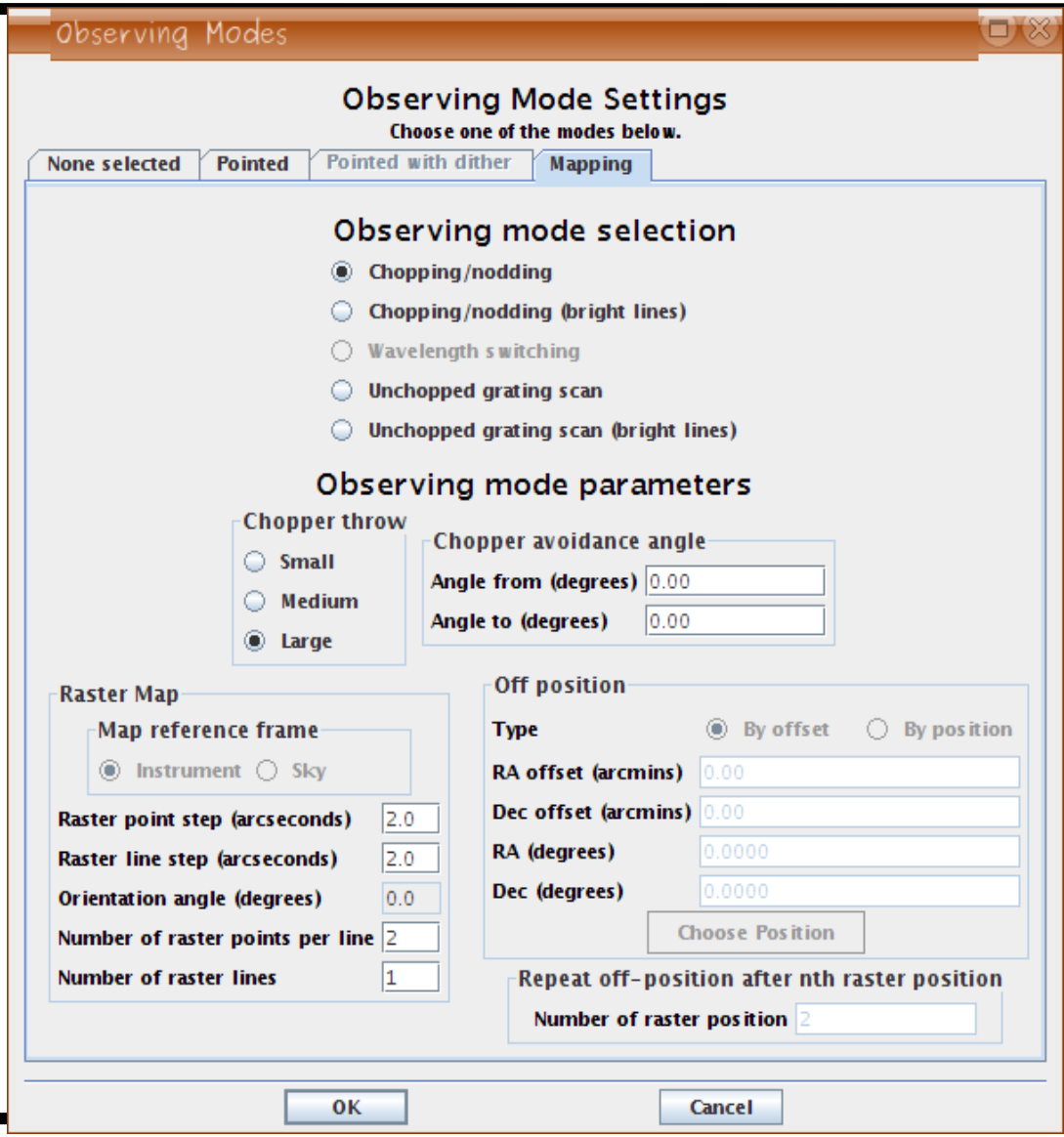
It's time to select the observing mode. Clicking on Pointed, you can select between the two unchopped modes. Then, select the off either by offset or by specifying the position.



# How to do it

If the Mapping mode is selected, one has to choose also the steps and the frequency of the off position.

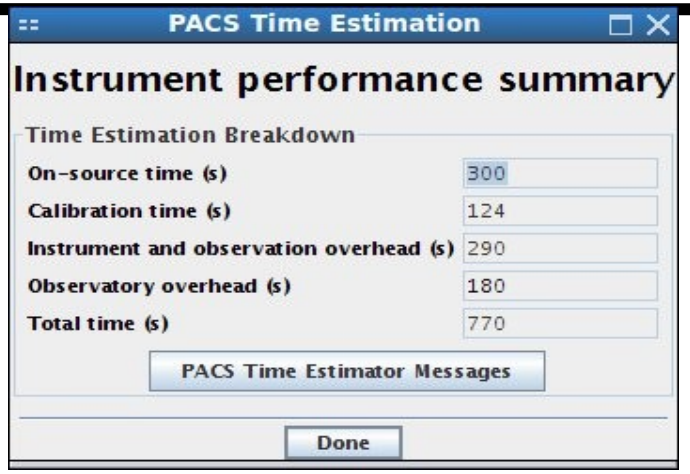
The default is on OFF after two raster positions, usually too much !



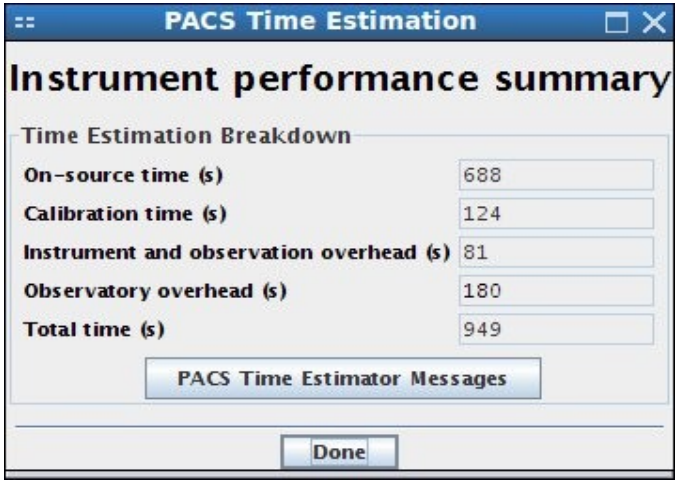
# How to do it

Once the planning is completed, it is possible to make some checks, like computing the total time of the observation.

Note that the on-time source in chop-nod includes the time spent in the off position.
In unchopped mode, the off position time is included in the overhead.




Unchopped scan

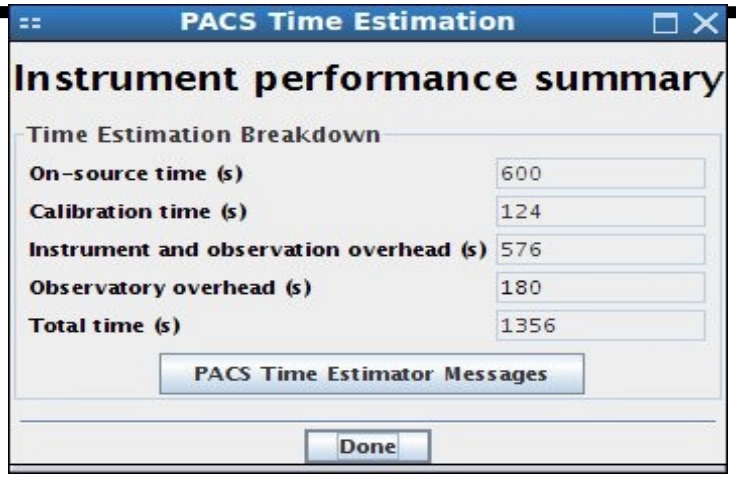



Chop-nod

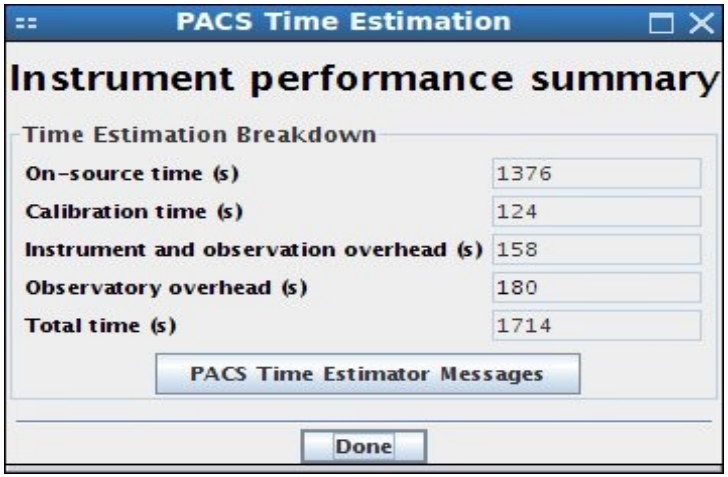
## How to do it

It is possible to repeat an observation without retaking the calibration block.
In the AOR window, just Change the number of cycles.

In this case, with two cycles and repeating the line twice, It allows to have two OFF positions observed in unchopped scan. Obviously the overhead will be bigger than repeating the line four times.




Unchopped



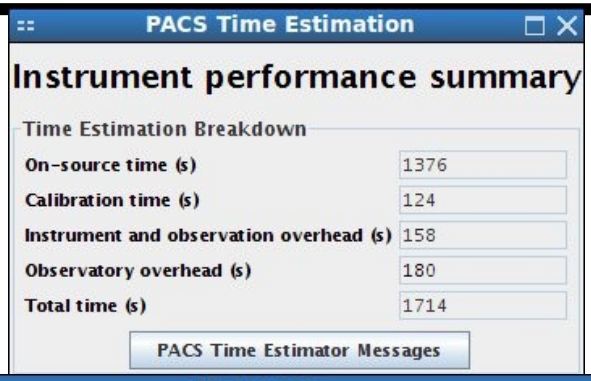

Chop-nod

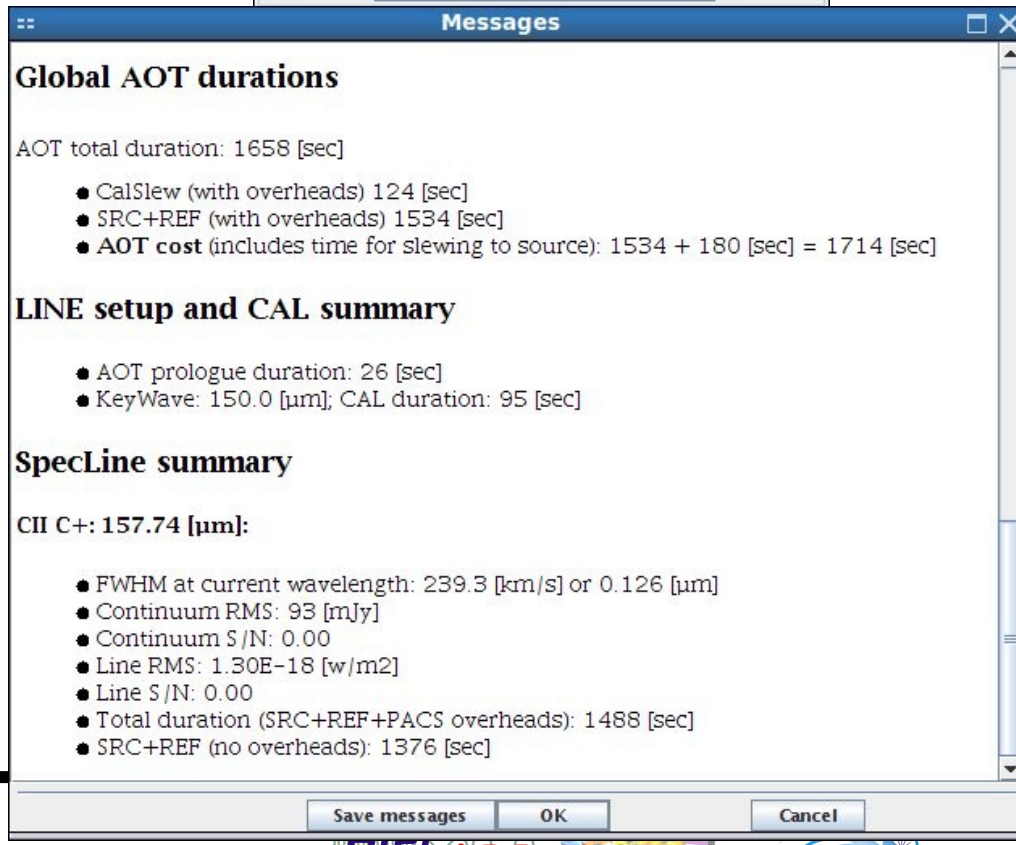
# How to do it

Additional information is available by pressing the "PACS Time Estimator Messages"

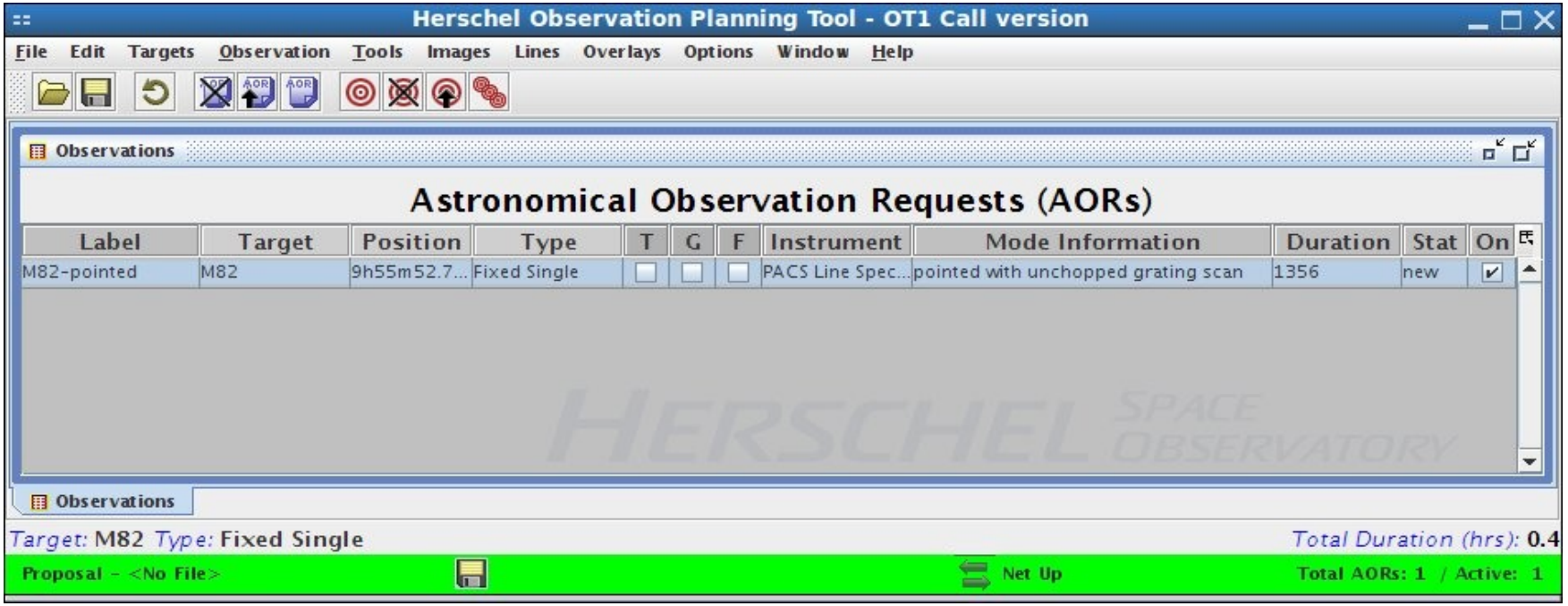
If the line flux entered is correct, the SNR of the line will be displayed.

This can help in comparing different techniques of observation.



# How to do it




Once satisfied with the AOR, click OK in the AOR window and a line with the new AOR will appear in the main window. To save, go under "File" and "Save AOR(s) and Target(s).