# HSpot Quick Start Guide
# HSpot 7.0
# (Herschel Legacy Version)

HERSCHEL-HSC-DOC-2190

Version 1.0

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# Contents

# 1. Why should I still use HSpot?

HSpot was Herschel uplink software, used to prepare observations and to submit them to the database for execution. As Herschel ran out of helium cryogen on April 29th 2013, obviously this database is now frozen and there is no need to prepare any more observations. However, HSpot has many useful functionalities of which the following are just a few: it can be used to retrieve proposals and their observations; it can be used to examine how an observation was executed; it can be used to examine the sky background in the region of a particular observation and it can be used to overlay numerous catalogues onto executed observations to see what catalogued sources were in the Field-of-View of an observation.

# 2. Validity of this version of HSpot

## 2.1 Caveats

**First and foremost**: we know that not all HSpot functionalities that worked during flight Operations still work now and we cannot guarantee that other HSpot options will not suddenly cease to function in the future, as links change, servers fail and are replaced and everything just gets older. This version of HSpot – Hspot 7.0 – is offered "as is" and has had very little maintenance since 2014. We offer an alternative, virtualised version of HSpot (HSpot 8.0), for users that has been futureproofed as far as we are able to do it.

Many things are effectively "hard-wired" into HSpot via the Spot Core that is used by Spitzer, as SPOT, the Spitzer tool for proposal handling. The SPOT software was supplied to ESA, by IPAC, under a NASA-ESA agreement and the Spot Core of HSpot maintained by NASA. This Spot Core composes about 80% of the total code in HSpot. The Spot Core version that was used to generate the HSpot 7.0 build back in late 2013 is now quite old. We are aware of some small changes since then that have affected this Spot Core. In particular, the servers at JPL that return the NAIF ID for Solar System Objects have since moved from http protocol to https and so, the call to these servers returns an error in HSpot 7.0. In addition, operating systems change rapidly and, even in Operations, with an important quantity of dedicated support available, it was hard to ensure that HSpot would work on all OS/platform combinations. In particular, we found that there were so many flavours of Linux available, that different Linux platforms interacted in different ways with the HSpot code, on occasion creating errors that were difficult to remove. A second issue is that, for historical reasons, the installer is built around a particular software – InstallAnywhere – linked to a particular OS/platform combination, with no guarantee that it will work on later OS versions or on new platforms: this has proved to be a problem in particular with Windows. A third issue is that HSpot is Java-based, which has created issues with Mac, as Mac will only support HSpot if Java 1.6 is installed on the computer (changes in Java make later versions incompatible with HSpot): HSpot is bundled with Java 1.6, if your Mac has a newer Java version installed it will override the Java that is bundled with the installer.

In a post-Operations environment, with very limited resources, maintaining HSpot operational, preparing new builds and new installers that include the many small patches in the Spot Core that have been released to fix issues that have arisen, is simply beyond the resources available to HSC, hence the decision to supply too the virtualised version of HSpot (HSpot 8.0) that is platform independent and which *does* include some small, but significant additional patches.

## 2.2    Why use HSpot 7.0 rather than 8.0?

HSpot 7.0 is essentially the same as the virtualised version of HSpot (8.0). If you have still got HSpot 7.0 installed on an old computer, you may feel comfortable with it and prefer not to run virtualised software. However, we cannot guarantee that functionality will not deteriorate further with time and we fully expect it to do so. That said, HSpot 7.0 is simple to run and user-friendly, does not require many resources from your PC, and offers the user control over the presentation of the screen that is not so easy to retain in a virtualised version hence, if it still works on your computer, it is worth running it there.

## 2.3    Supported software versions

- Windows: Windows 7 and earlier
- Linux: Solaris and 32 and 64-bit Linux. A special installer is available for work with SPIRE AORs.
- Mac: Only compatible with Mac OSX machines with java 6 platform installed. Java SE 6 is available on 64-bit, Intel-based Macs only.

For all other OS/platform combinations you should use the virtualised version of HSpot (HSpot 8.0), which will run on any OS/platform combination.

## 2.4    Problems with access to external catalogues

HSpot needs to be able to open particular ports to be able to access external catalogues for retrieving images or to plot overlays. An inability to access a catalogue such as Skyview or NED may indicate simply that you are working behind a firewall that refuses access to a particular port. Try accessing the same catalogue from home and see if the error repeats: if it does, the access protocol for the catalogue has been changed since the HSpot build was made and the link is definitively broken.

# 3. Downloading the Installer

Go to the following link and select the appropriate version to use:

ftp://ftp.sciops.esa.int/pub/hspot/HSpot_download_v7_0_0.html

# 4. Installation

Installation varies somewhat between platforms. For Windows 7 and Mac the installation process is very similar. Linux installation has important differences with the other two.

## 4.1 Linux

Linux installation differs quite significantly from Windows or Mac and also depends on the flavour of Linux used. Four different Linux installers are offered: for 32-bit, 64-bit and Solaris machines and a special installer for working with SPIRE observations.

(a) Decide which flavour of installer is the appropriate one for your machine.
(b) Right click on the link for the installer and select "Save As..." to save in the directory of choice.
(c) Run the installer: from the directory where you have saved the file. For example, for the 32-bit Linux version: type sh HSpot_v7.0.0_linux32_Installer.bin

### 4.2 Mac

Mac installation is almost identical to Windows (which we describe in detail below). The main difference is that Mac downloads a zipped installer that you must unzip before installation. Once unzipped, you double-click on it to continue installing.

### 4.3   Windows 7

a) Click on the windows installer link to download the installer
b) In the pop-up, click on "Run" if you want to install it immediately, or "Save As" to save the installer to a specified location to be installed later.
c) Some anti-virus may try to block running of the installer as it is an executable. HSpot is certified virus free. Follow the instructions to run the installer anyway.
d) The installer will offer various options for where to store the program and for cache management. In 99.9% of cases you can ignore these and just accept the default. It is important though to select where you want to place the HSpot icon on your computer for ease of use.
e) When you reach the following screen, click on "Install" to finalise installation
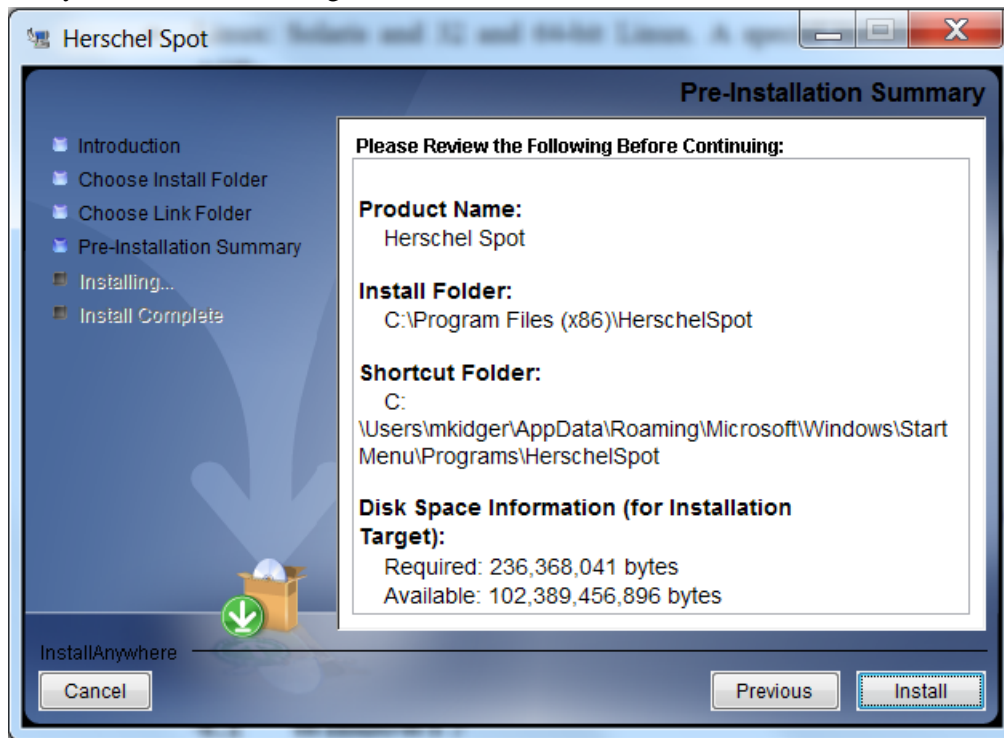


## 5. Launching HSpot

- In Windows and Mac, just double-click on the HSpot icon that the installer has created.
- In Linux, you must launch the application by typing: ./runHerschelSpot from the installation directory. HSpot can be run as a background task.

# 6. Getting started

When you open HSpot you will get a blank main window, as shown below. This is the equivalent of an artist's blank canvas, with the astronomer the artist. Across the top of the window you have a series of dropdown menus. Scan across them with the cursor to see which options each offers. In the Help menu at the extreme right you can click on "Overview" to get access to the user manual: most options have tooltips and a Help button that gives full details of use of the option.

Most of the Menu options are now of limited value, as you are not going to be able to prepare new observations or proposals, although there is nothing to stop you doing this to learn how different observing strategies would have worked on a particular object.

The most likely things that you are going to want to do are:

1. Read in a set of executed AORs (Herschel observations).
2. Retrieve a proposal.
3. Look for what observations were executed in a particular area of sky.
4. Look at how an observation was executed.
5. Look at what catalogued sources fall within the field of a particular observation.
6. Look at the sky background in the area of an observation.

Let's look at how to do each of these in turn.



## 6.1    To Read in a list of AORs

To do this you must have an AOR file (*.aor extension) on your local disk or on a pendrive. An AOR is *Astronomical Observation Request*: an XML file with instructions that told the observatory how to execute a requested observation. This was received at the Herschel Science Centre and later converted into the detailed commanding that was uplinked to the spacecraft.

- Click on the File option
- Select Read AOR(s) and Target(s)
- Select the directory and AOR file to read in. HSpot will show you a preview of the first 15 observations so that you can check that it is the correct file before loading
- You can load more than one AOR file if you wish. HSpot will store and display all the AORs

If the list of AORs is large and only those with a certain instrument or sub-instrument interest you, you can select, delete (and restore) AORs using the options in the Edit menu.

Click on the ![icon] icon and HSpot will automatically generate a list of unique targets from the AOR file that can be saved to disk.

The preview window, target list and main window with loaded AORs are shown below. Each column is sortable by clicking on the header.
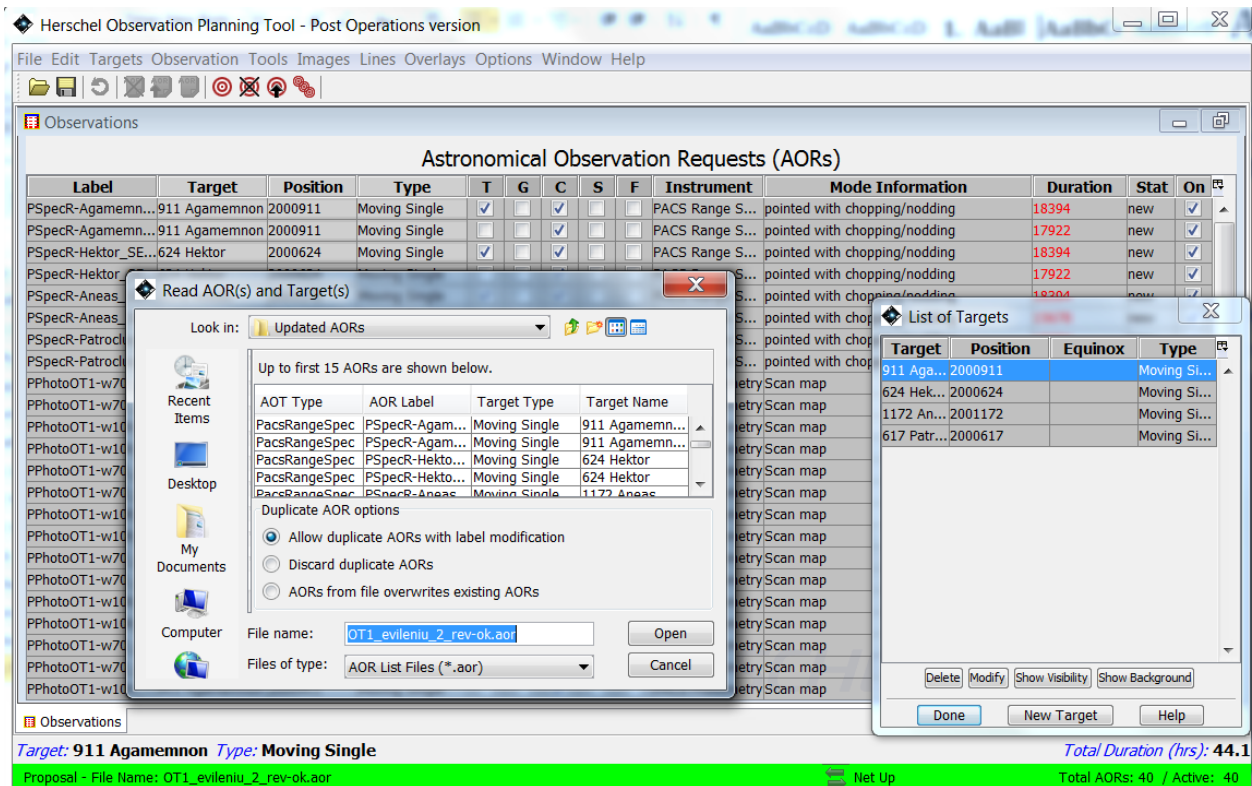


For fixed targets the main table and the target list will give the coordinates defined for the centre of the AOR. For moving targets, the NAIF ID will be shown. To understand the meaning of other columns, check the HSpot User Guide.

## 6.2    To Retrieve a Proposal

Several methods are available giving different results according to your access rights to a proposal.

**Summarising**: all users have limited access to all proposals, but only the Principle Investigator [PI] of a proposal, people to whom he or she has given specific access rights, and a small number of people with special access privileges at HSC can access all information for any given proposal.

To load a proposal you must have previously deleted, using the Edit menu, any AORs that you had loaded previously. The most useful options for proposal retrieval are:

- *To view an accepted proposal* – you must know the exact proposal name. Select the File dropdown menu and, within it, Retrieve Accepted Proposal. Give the proposal name: e.g. KPOT_tmegeath_2. This will show you the proposal abstract and give you the option to load the AORs, but not the science case. **Any user can access any accepted proposal in this way**.

  This option is interesting because you can see the status of each of the AORs. In the "Stat" column to the right of the AOR table you will see "scheduled" if the observation was executed successfully, "failed" if execution failed for any reason, "rejected" if the Time Allocation Committee (TAC) did not approve a particular AOR for execution, "released" if the AOR was made available to the mission planners, but could not be scheduled before End of Helium (EoH) and, occasionally, "accepted" if an observation had been approved by the TAC, but had not been released yet to the mission planners for scheduling by EoH.

- *To load a proposal that you submitted*, or to which you were given access rights by the PI of the proposal, select the Tools menu and click on the Proposal Submission Tool option, which opens a new window. Select the Submit menu within the tool and Retrieve Submitted Proposal from HSC. You will be asked to enter your username and password as a registered Herschel user and offered a dropdown menu with a list of proposals to which you have access rights. Click on the desired proposal to load the AORs and to see the proposal as submitted (this does NOT retrieve the science case).
- *To retrieve the science case for a proposal that you submitted,* or for which you have been given access rights, follow the same steps as the previous option but, in the Submit dropdown, select Retrieve Proposal Documentation. Again, you must submit your credentials and will only be allowed to access proposals for which you have access rights. Select the parts of the proposal that you wish to retrieve: the core, is the science case; the cover, is the cover sheet with the proposal summary; the AOR summary is a summary table of AORs. The program will return a PDF that you must save to disk. It will NOT retrieve the AORs.

## 6.3   Look for what Herschel observations were executed around a particular position in the sky

While Calls for Proposals were still active HSpot offered a simple option to check to see what proposed observations lay around a particular target position. The idea was to allow users to check for potential duplicating observations before submitting a proposal and to overlay them on the astronomer's own draft AORs. This could be done from the Overlays drop-down menu. **This option no longer functions**.

As an alternative, we direct observers to [ESA Sky](ESA Sky).

## 6.4   Look at how an AOR was executed

A particularly useful functionality of HSpot is that it allows a user to see how an observation was executed using a simple animation. As an example, we take the pair of AORs for field 297_0 from KPOT_smolinar_1.

When you have retrieved and marked the AORs to display you must display the field of view and superimpose the AOR on it. HSpot offers a wide range of image catalogues such as DSS, 2MASS and IRAS, as well as SkyView and NED.

Choose a field image to display. This should be at least as large as the AOR that you want to plot. Note that DSS images are limited to 15x15 arcminute field, 2MASS to 500x500 arcseconds and IRAS to 5 degrees (sometimes you can get around these size limitations to a degree by using the SkyView catalogue which, often, offers somewhat larger fields).

- For the 2°x2° tiles of the Galactic Plane in KPOT_smolinar_1, we need a field of at least 3.5° diameter as Parallel Mode observations map a much larger area than the 2x2° overlap between PACS and SPIRE, so the IRAS 60 micron images are best suited for this.

  Go to the Images dropdown in the top menu and pick "ISSA/IRIS image".

  Select the IRAS : IRIS 60 micron image.

  Select the field of view – in this case 4 degrees is a decent compromise between the resolution and the observation size, so I define 4 degrees.

  Select the zoom level – this is a case of trial and error: on my laptop for a 4 degree IRAS field 4x zoom is about right to see the full image.

  Click on "OK".

- For a moving target, HSpot will query you about the date and time of the observation as it needs to calculate a position for that moment in time to display the observation correctly.  For a fixed target you will receive the same query at the next stage. Put in the date and (for Solar System objects) the mid-time of the exposure and click on OK. HSpot will plot the field of view with the track of the target marked on it. A cross marks the position of the object at the exact mid-time of the integration.
- Now you also want to overlay the AOR(s). Select the AOR(s) to plot from your AOR table by clicking on them. If you have scan and cross-scan of a field you may wish to plot both to see the zone of overlap.
- In the "Overlays" dropdown in the top menu, select "AORs on images…". If you have a moving target HSpot will ask you to confirm that the target is plotted. Click on "Yes".

  For a fixed target the position did not change with time, but the field orientation did and hence the orientation of the AOR on the sky background, did – if you know the exact date of execution you should enter it, if not, click on a Full Visibility window and HSpot will select the mid-time of that window as default, which is usually quite close to reality, although you will notice that, with two viewing windows each year the AORs, when displayed, will tilt in opposite directions when displayed on the image background.

  The AOR will be displayed, as below with a set of control for each AOR at the right. Click on the 🔲 icon for one of the AORs and you will get the view that we show below, with a table of individual positions of the detectors as it scans. Note that the field of view of PACS (red) and

SPIRE (green) are plotted separately as they cover different fields of view so, for scan and cross-scan, we will have four overlays of individual maps, with only the central 2x2° area covered by all four maps.

You will see that the pop-up that is displayed lists the field centres for each of the positions of the arrays and has two buttons marked "Animation" and "Animation w/ Trail". Press the former and HSpot will animate the observation, scan position by scan position, repeating the sequence of positions for as many repetitions as was defined in the observation (this is particularly informative in the case of Parallel Mode). If you select "Animation w/ Trail", HSpot will show how the observation is built up.
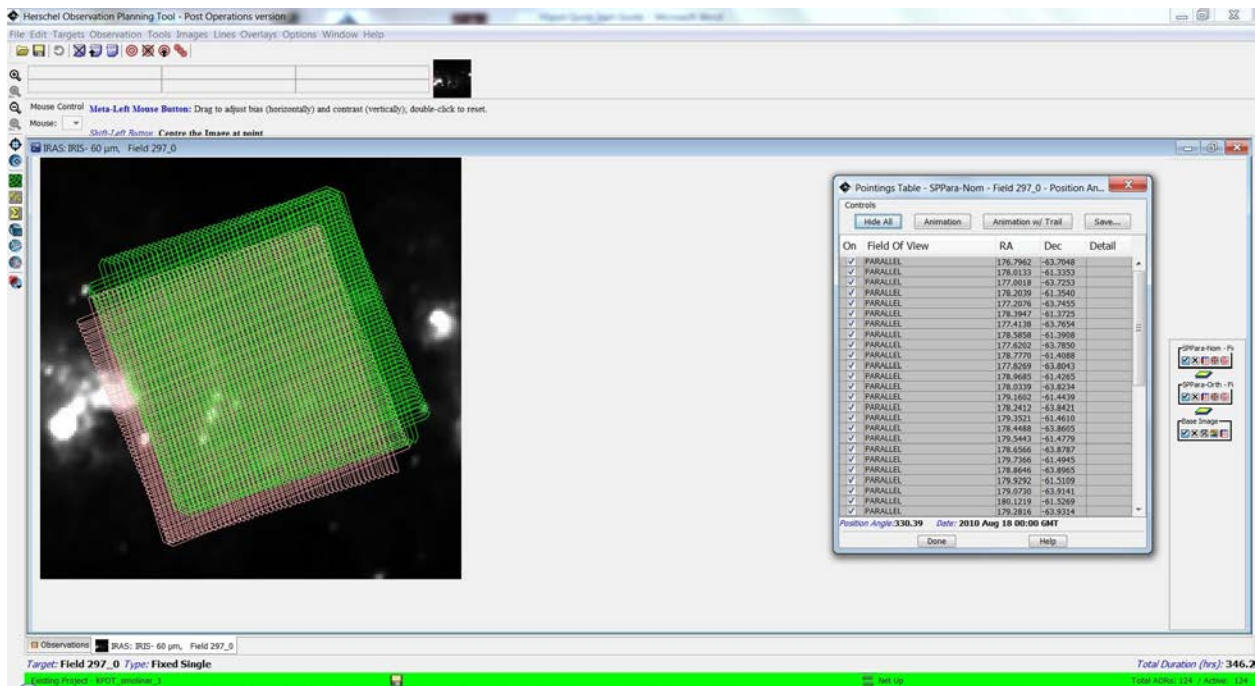


## 6.5    Look at what catalogued sources fall within a field of view

Sometimes it is particularly useful when looking at some Herschel data to know what catalogued sources lie in your field of view. You can pick a target from your target list, display an image of the field, overlay the Herschel observation and then ask HSpot to mark sources in that field from a range of source catalogues including 2MASS, IRAS and AKARI. You can also query the data for these sources to obtain positions and fluxes.

Here is an example of how it might be used. I have retrieved an AOR from the proposal TOO_mkidger_5, a PACS scan map along the track of Comet C/2010 X1 (Elenin). Are there any bright 60 micron sources that I might expect to detect in the background of this moving target that would contaminate my observation?

When you have retrieved your AOR, display the field of view and superimpose the AOR on it. HSpot offers a wide range of image catalogues such as DSS, 2MASS and IRAS, as well as SkyView and NED.

- Choose a field image to display. This should be at least as large as the AOR that you want to plot. Here, we pick a 2 degree IRAS 60 micron field as most appropriate.

  Go to the Images dropdown in the top menu and pick "ISSA/IRIS image".

  Select the IRAS : IRIS 60 micron image.

  Select the field of view – in this case 2 degrees is a decent compromise between the resolution and the observation size, so I define 2 degrees.

  Select the zoom level – this is a case of trial and error: on my laptop for a 2 degree IRAS field 8x zoom is about right (you have a zoom button on the left side-bar to zoom in further, if required).

  Click on "OK".

- For a moving target HSpot will query you about the date and time of the observation as, logically, HSpot needs to calculate a position for that moment in time to display the observation correctly (for a fixed target the position would not change with time, but the field orientation and hence the orientation of the AOR on the sky, will, so the date when an observation was executed is still important even for fixed targets). In this case, I know that my observation started at 19 October 2011, 03:54:09UT and had duration 11092s, so I need to plot the position of the comet at the mid-time of the observation – 1h 32m 26s – later. In other words, at 05:26:35UT. Put in this date and time and click on OK. HSpot will plot the field of view with the track of the comet marked on it. A cross marks the position of the comet at the exact mid-time of the integration.

- Now you also want to overlay the AOR(s). Select the AOR(s) to plot from your AOR table by clicking on it/them. If you have scan and cross-scan of a field you may wish to plot both to see the zone of overlap.

- In the "Overlays" dropdown in the top menu, select "AORs on images…". HSpot will ask you to confirm that the target is plotted. Click on "Yes". The AOR will be displayed, as below.
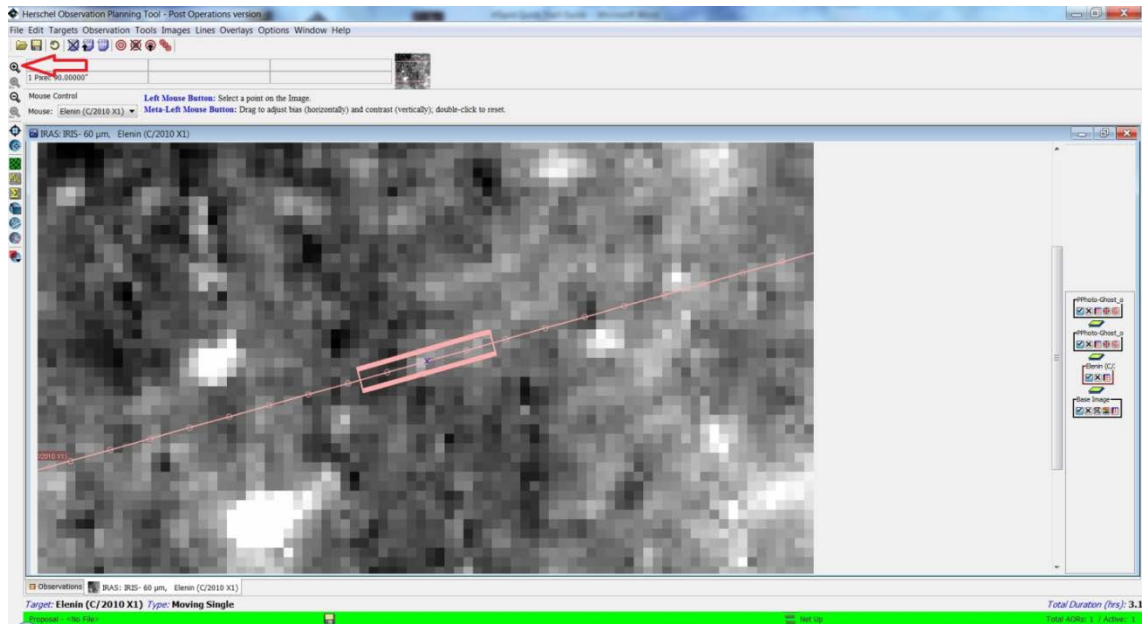
- Finally, you want to display the known sources in the field of view. In the top menu click on "Overlays" to see the options [**Note**: *several of these catalogues are not under our control and may fail without warning for their own inscrutable reasons if their configuration has been changed at source since this version of HSpot was built*]. Suppose we wish to know what AKARI sources lie in our field of view. Click on "Cataloges from AKARI". A pop-up will appear asking you to define the search parameters (instrument, search radius). For AKARI we can choose FIS or IRC. Click on "OK" and HSpot will calculate what sources (if any) are in the field of view that has been chosen and will overlay them on the plot. You may find (as in this case) that there is no coverage of this field with the chosen catalogue, so you may wish to try another, such as the IRAS Faint Source Catalogue instead. Click on the 🔲 icon that appears on the right of the window underneath the plotted catalogue and you will get a listing of sources.
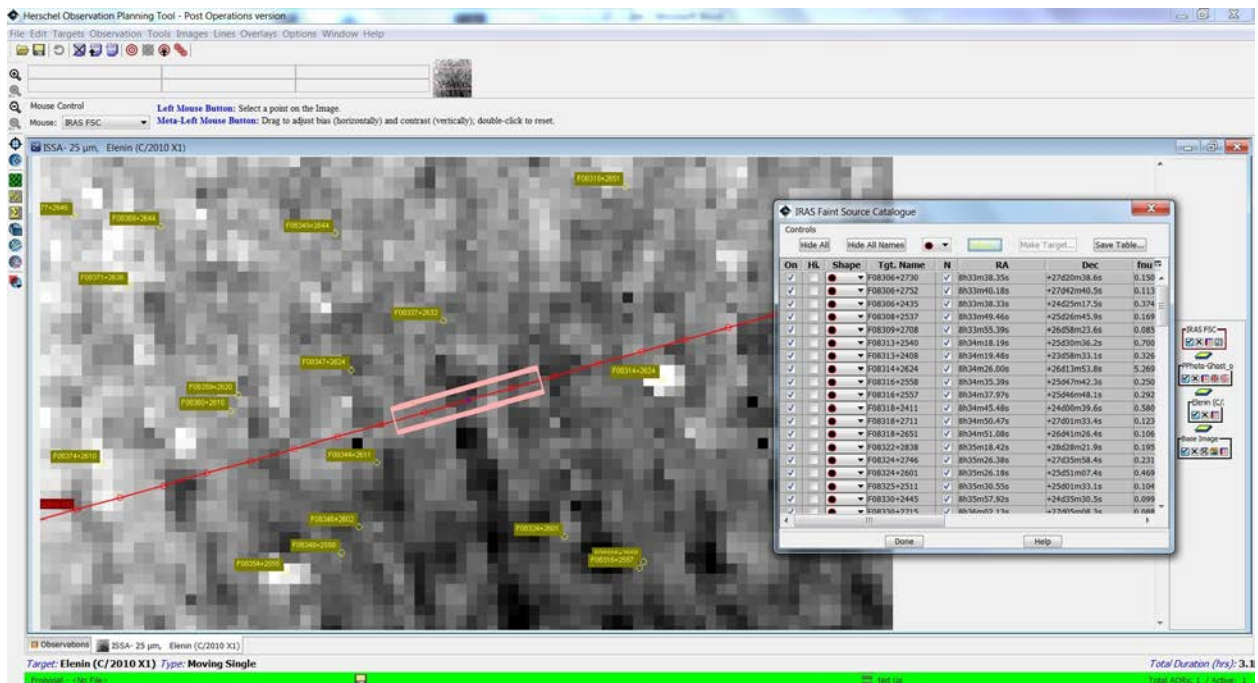
The table allows you to toggle on and off source names and to configure the symbol used to mark sources. By expanding the table you see the name of the source in the catalogue, its coordinates, flux and quality information in each band, etc.

## 6.6    Look at the sky background for an observation

In contrast to SPIRE, for which the background in images is cross-calibrated with Planck and good to about ±10%, a disadvantage of PACS maps produced by Herschel pipeline data is that they are subjected normally to high-pass filtering, so the background is normalised to zero. In other words, unless specifically required, large-scale background structure is (quite deliberately) filtered out in PACS maps. This also means that PACS pipeline products can, confusingly, show negative fluxes at some points in the observed field.

HSpot allows you have a look at the sky background around a map at 60 and 100µm in an AOR footprint and even to estimate it. There are several simple ways that you can do this. There is also a background estimator that will give a global estimate of *average* background between 55 and 672µm.

1.  First and simplest – follow the instructions above to plot a background image from IRAS at 60 or 100µm (corresponding closely to the PACS "blue" and "green" channels) and overlay the AOR of interest on it. Move the cursor around the area covered by the AOR. At the top of the screen, just below the top menu, you will see that HSpot displays the flux (in MJy/steradian) on the pixel marked by the cursor, as well as the absolute and relative coordinates of the position.

2.  Slightly more sophisticated – With the same IRAS background image displayed. Click on the icon on the left sidebar. This enables the cursor to define a profile across the image. Left click on the image where you want to start the slice across the image and, keeping the mouse pressed, draw out the line and release it where you want the slice to end. HSpot will draw a profile of

calibrated flux along the line that is defined. You can save both the tabulated data and the plot of the profile.

3. More sophisticated – HSpot can perform basic aperture photometry on either a background image (or, for that matter, a reduced Herschel observation that you have read into HSpot and displayed).

   Click on the Σ icon on the left-hand sidebar. Click on the image where you want to centre the aperture and draw out the cursor. HSpot will draw a configurable circular aperture on the image and, on releasing the cursor, will draw the aperture and present a pop-up with a summary of photometry, as shown below.
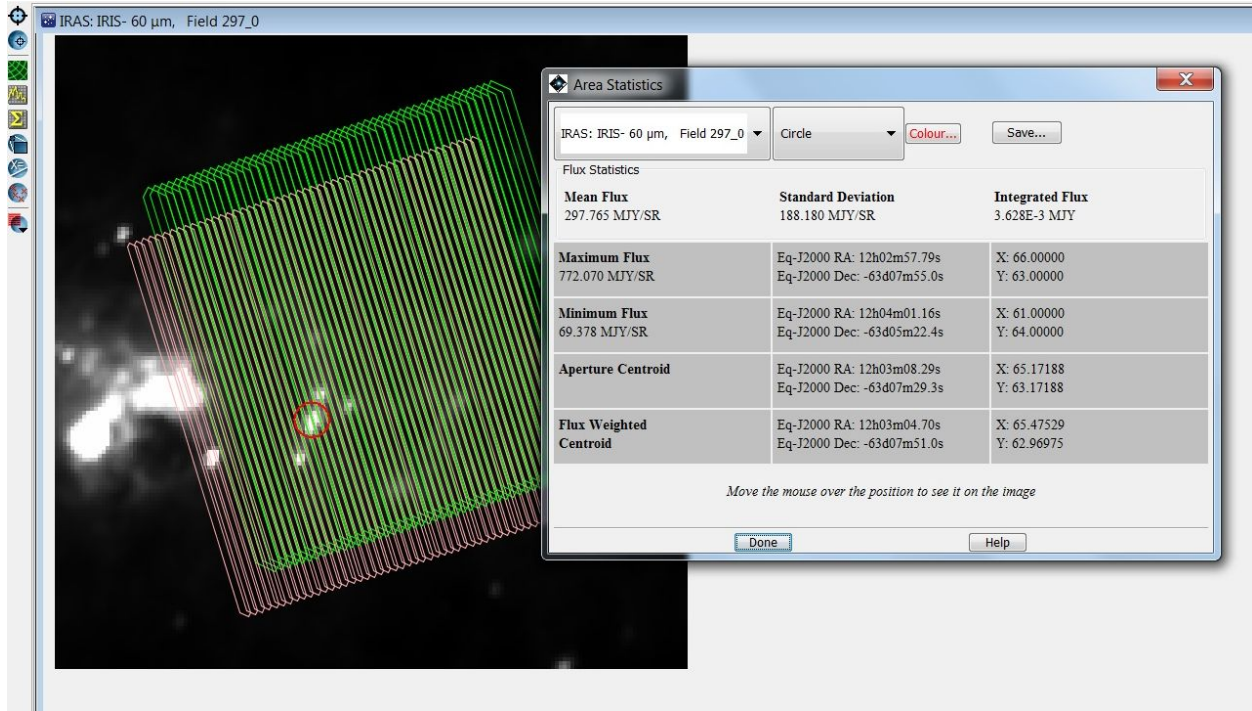


To calculate an average background estimate between 55 and 672μm:

Click on the target of interest in the target list for a proposal that you have already read in, or enter the target name manually using either the bullseye icon in the top menu or the "Targets" drop-down menu. In the "Targets" pop-up dialogue you will see an option to calculate the background. Click on this. A "Background Dialogue" pop-up will open. Give the wavelength of interest and click on "Estimate". The target visibility pop-up will open: give the date and time that the observation was made. The background estimator will return an estimate of average background values in this area of the sky, as shown below:
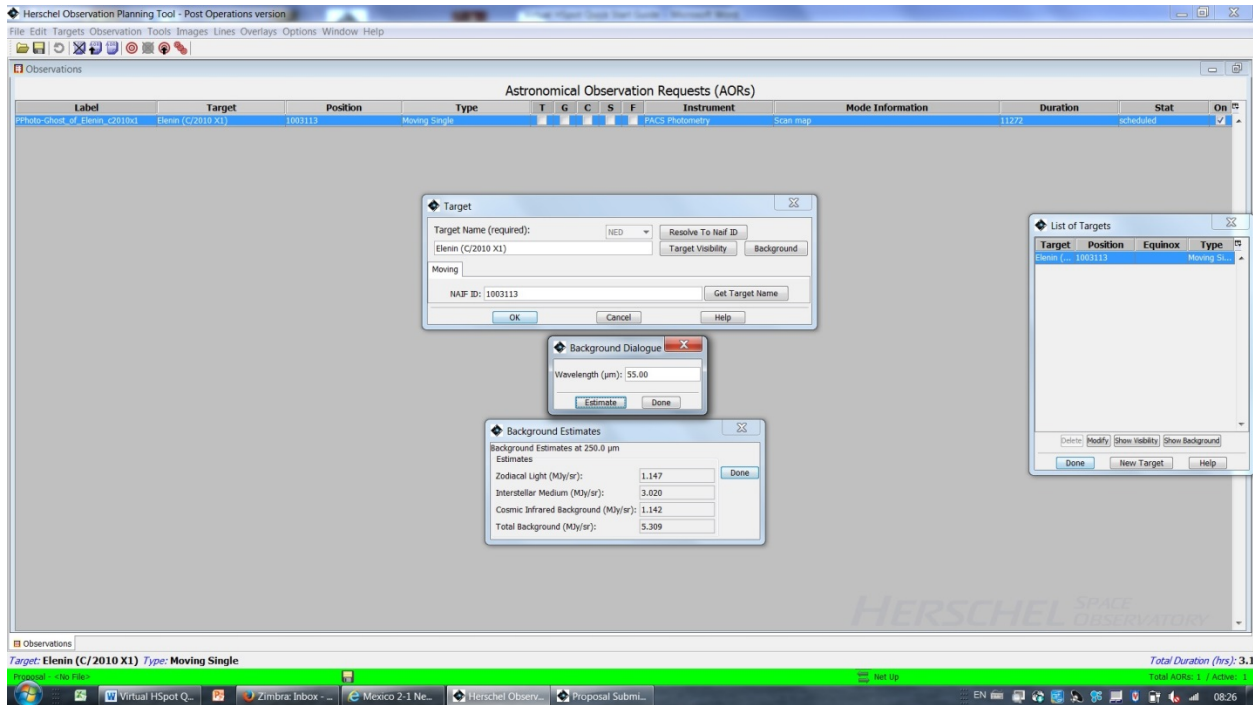
## 7. Non-functioning options

Apart from the options such as proposal submission that have no utility now (proposal submission has been blocked since the end of the mission and the database frozen) here are a few options that we know have failed in HSpot 7.0.0, such as name resolution to NAIF ID. In the Overlays menu, we know that the HEASARC option fails for reasons that we do not really understand, however, this is an external catalogue that is outside our control. However, there are also options that *only* fail from behind firewalls because they require a particular port to open that the firewall will not permit: access to NED catalogues is a case in point – I can access this option from home, but not from my office. You should check that any such failures that you find are not due simply to a firewall blocking access.

## 8. Further Reading

There is a detailed user manual for HSpot with complete information on all aspects of HSpot.

## 9. Credits and acknowledgements

### 9.1 HSpot Development and Maintenance

HSpot has been a development that has been largely based on the SPOT tool created by the Spitzer Science Center for observation planning and proposals for NASA's Spitzer Space Telescope. We are extremely grateful to the original SPOT developers.

The work of adapting Spot for Herschel's needs was largely the development work of one person, Andrew Bonfield, at ESTEC. Andrew's contribution to HSpot was vital over the years of initial

development of HSpot. From June 2007 to May 2008 the work of maintaining HSpot was taken over by Kevin Phipps, who then handed over to the HSC Software Maintenance Team until the end of Operations, in particular, the HSpot custodians Rafael Andres and Antonio Villacorta, assisted by Fran Vallejo and Jon Brumfitt. Some additional work during post-Operations to patch the Legacy version of HSpot was carried out by Jon Brumfitt.

## 9.2    Virtual HSpot Development

The initial version of Virtual HSpot (HSpot 8.0.0) was developed by Paolo Pesciullesci at HSC. The job of taking Virtual HSpot from being a development version to being the reality of a user release has been undertaken by Jon Brumfitt at HSC.

## 10.    Conclusions

The Use-Cases above illustrate some of the ways that an astronomer with Herschel data may still find HSpot useful as a starting point for analysis. More sophisticated software is, of course, available but HSpot remains a simple, user-friendly way of familiarising yourself with Herschel observations.