

# Infrared Spectrograph (IRS)

For details and updated information, see the Spitzer Observer's Manual at <http://ssc.spitzer.caltech.edu> or contact the Spitzer Helpdesk at [help@spitzer.caltech.edu](mailto:help@spitzer.caltech.edu)



## Basic IRS Capabilities

The IRS is composed of four modules, with two modules providing "low" spectral resolution ( $R \sim 60-127$ ) over 5.2–38 microns, and two modules providing "high" spectral resolution ( $R \sim 600$ ) over 9.9–37.2 microns (see Figure 1).

## Peak-up Target Acquisition Options

Science targets can be accurately placed in an IRS slit by offsetting from a peak-up target, which can be the science target itself or another object within  $r < 30$  arcmin. Point or extended sources can serve as peak-up targets. The peak-up target should be the brightest object within  $r < 1$  arcmin. Several peak-up modes are available (see Table 1). The primary choice is between an IRS Peak-up using the dedicated mid-IR array integrated into the SL module, or a PCRS Peak-up using the Spitzer Pointing Calibration and Reference Sensor optical array. "No Peak-up" is also an option, resulting in target placement at the intrinsic pointing accuracy of Spitzer.

**Table 1: Summary of Peak-up Target Acquisition Options**

Peak-up Option	Peak-up Array Wavelength Range	Point Source	
		Peak-up Target Brightness Range	Target Placement Accuracy (1-sigma radial, arcseconds)
IRS Peak-up (Blue)	13–18.5 $\mu\text{m}$	F = 5–150 mJy	High (0.4); Moderate (1); Low (2)
IRS Peak-up (Red)	18.5–26 $\mu\text{m}$	F = 15–340 mJy	High (0.4); Moderate (1); Low (2)
PCRS Peak-up	5050–5950 $\text{\AA}$	V = 7–10 mag	0.4
No Peak-up	...	...	1.0

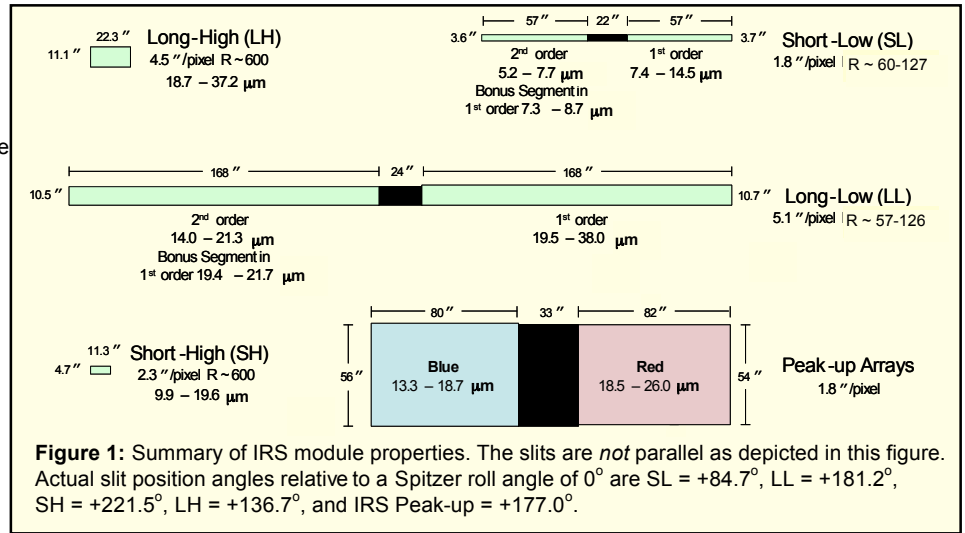
## Astronomical Observation Templates (AOTs)

- Staring** – spectrum of an individual fixed or moving target ("single" option) or spectra of multiple fixed or moving targets within  $1^\circ$  ("cluster" option); the "peak-up only" mode acquires IRS peak-up array images (but no spectra) for target verification.
- Spectral Mapping** – multiple spectra from a 2-D spatial region in user-defined steps parallel and/or perpendicular to one or more slits.
- Peak-Up Imaging** – small field-of-view ( $\sim 1 \times 1$  arcminute) images from the IRS peak-up arrays (see Table 1); supports mosaic mapping and dithering options.

## Peak-Up Imaging Sensitivity

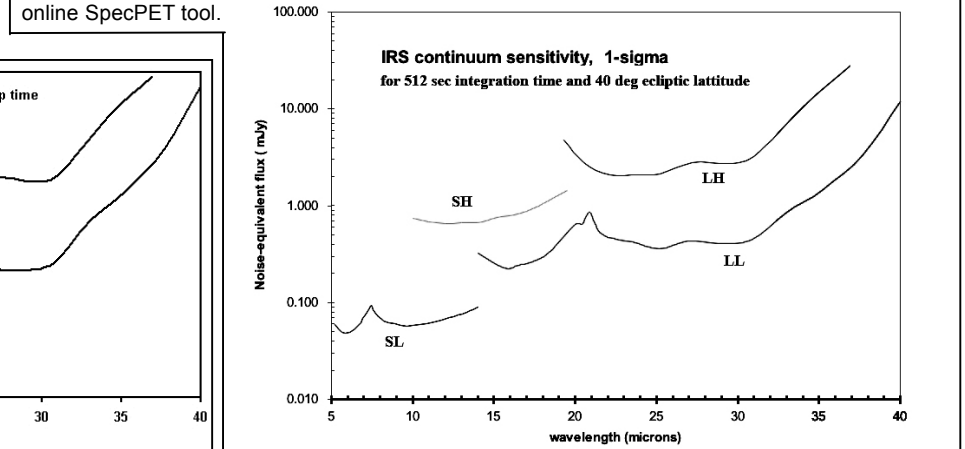
**Table 2: 1-sigma Peak-Up Imaging Sensitivity (in micro-Jy for 6 / 14 / 30 second ramp times)**

Filter	Background:		
	LOW	MEDIUM	HIGH
Blue	115 / 75 / 50	145 / 95 / 65	190 / 120 / 80
Red	180 / 115 / 75	220 / 140 / 95	280 / 180 / 120



## Spectroscopy Sensitivity

**Figure 2: Point source continuum sensitivity plot for the IRS modules showing 1-sigma noise levels in a 512-sec total integration time at an ecliptic latitude of  $40^\circ$  (i.e., medium background – see <http://ssc.spitzer.caltech.edu/obs/bg.html>).** These sensitivity curves are for the faint source case (i.e., shot noise from the target is negligible compared to other sources of noise). Transition to the bright source case (i.e., shot noise from the target is non-negligible) is a function of wavelength and exposure time for each module. From short to long ramp time, the approximate median bright source limit is 50–10 mJy (SL), 130–100 mJy (LL), 540–90 mJy (SH), 620–350 mJy (LH). See the SOM for more information about the bright source case. Extended source sensitivities (within 20%) are ESSC  $\sim 8 \times \text{PSSC}/\phi^2$  MJy  $\text{sr}^{-1}$  and ESSL  $\sim 8 \times 10^9 \times \text{PSSL}/\phi^2$  W  $\text{m}^{-2} \text{sr}^{-1}$ , where  $\phi$  is the linear pixel size in arcseconds (see Figure 1), and PSSC and PSSL are determined from the sensitivity curves shown in the SOM or via the online SpecPET tool.



## Spectroscopy and Imaging Saturation

**Figure 3: Point source saturation limits in spectroscopic mode for the shortest available exposure time (6 seconds) in the medium background case.**

**Table 3: Peak-Up Imaging Point Source Saturation Limits (in milli-Jy for 6 / 14 / 30 second ramp times)**

Filter	Background:		
	LOW	MEDIUM	HIGH
Blue	190 / 90 / 45	190 / 90 / 40	180 / 80 / 35
Red	430 / 210 / 90	420 / 200 / 90	410 / 190 / 80

