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

Basic IRS Capabilities

The IRS is composed of four modules, with two modules providing "low" spectral resolution (R ~ 60–127) over 5.2–38 microns, and two modules providing "high" spectral resolution (R ~ 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 _m	F = 5–150 mJy	High (0.4); Moderate (1); Low (2)
IRS Peak-up (Red)	18.5–26 _m	F = 15–340 mJy	High (0.4); Moderate (1); Low (2)
PCRS Peak-up	5050–5950 Å	V = 7–10 mag	0.4
No Peak-up	…	…	1.0

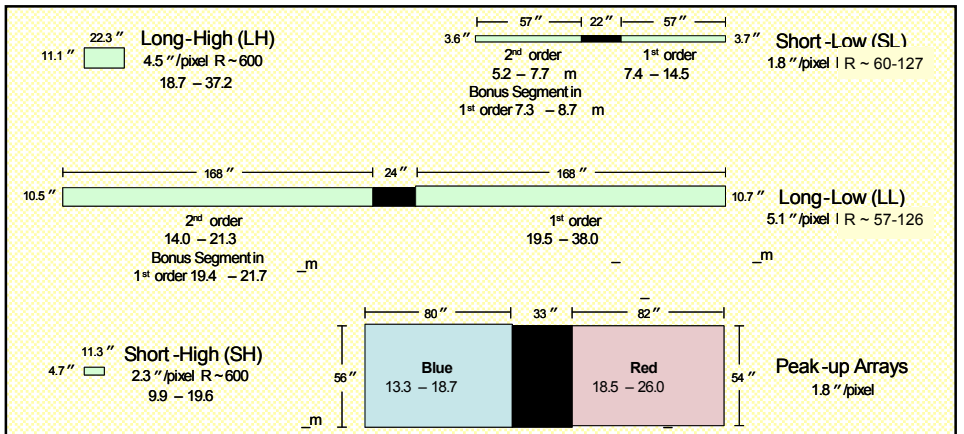


Figure 1: Summary of IRS module properties. The slits are *not* parallel as depicted in this figure. Actual slit position angles relative to a Spitzer roll angle of 0° are SL = +84.7°, LL = +181.2°, SH = +221.5°, LH = +136.7°, and IRS Peak-up = +177.0°.

Astronomical Observation Templates (AOTs)

1) ***Staring*** – spectrum of an individual fixed or moving target ("single" option) or spectra of multiple fixed or moving targets within 1° ("cluster" option); the "peak-up only" mode acquires IRS peak-up array images (but no spectra) for target verification.
2) ***Spectral Mapping*** – multiple spectra from a 2-D spatial region in user-defined steps parallel and/or perpendicular to one or more slits.
3) ***Peak-Up Imaging*** – small field-of-view (~1x1 arcminute) images from the IRS peak-up arrays (see Table 1); supports mosaic mapping and dithering options.

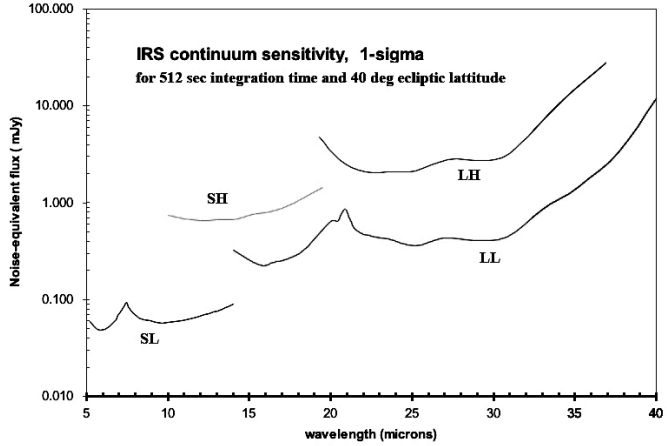
Peak-Up Imaging Sensitivity

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° (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 ~ 8 _ PSSC/ϕ^2 MJy sr^{-1} and ESSL ~ 8 _10^9 _ PSSL/ϕ^2 W m^{-2} sr^{-1}, where ϕ 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 / 100	420 / 200 / 90	410 / 190 / 80