

APO/GIFS Instrument Factsheet

The Goddard imager and Integral Field Spectrograph (GIFS) has recently been commissioned on the APO 3.5 m telescope. This factsheet presents a high level overview of the GIFS instrument. Please consult the GIFS instrument manual or contact gifs-apo@bigbang.gsfc.nasa.gov for additional information.

GIFS Imaging

The GIFS imaging mode is used for imaging science and target acquisition for the IFS mode. This mode can also be used with a coronagraphic wedge inserted in a focal plane for high contrast imaging.

- **Field of View:** 2.8'×2.8'
- **Filter Complement:** The GIFS imaging filter set is extensive. This includes conventional B, V, R, and I filter imaging, wide blocking filters for the IFS (300-400 Å), and a suite of medium bandpass filters (135 Å for $\lambda < 7000$ Å; 200-300 Å for $\lambda > 7000$ Å). There are several narrowband filters centered on emission lines. Please see the GIFS manual for a table with all of the available filters.
- **Imaging Mode pixel scale:** 0.168"/pixel
- **Comparison to Other APO 3.5m instruments:** The GIFS field of view is smaller than SPICAM, but the filter set is far more extensive.

GIFS Integral Field Spectroscopy

FOV	Arcsec / spaxel	Spectral Bandwidth (nm)	Spectral Sampling (nm)	λ_{cent} (nm)	Spectral Coverage ^a	Mode ^b	Comments/ Lines in Range
-----Green Grism R~1475-----							
7"x7"	0.21	31	0.105	489	474-504	NSG	H β , [O III]
14"x14"	0.42	31	0.105	489	478-504	WSG	H β , [O III]
7"x1.68"++	0.21	107	0.105	489	478-540	NLG	H β , [O III], [O III], Fe XIV, Ar IV, He I, Cl III, Fe III, He II, Ne IV
14"x3.36"	0.42	107	0.105	489	433-540	WLG	H β , [O III], [O III], Fe XIV, Ar IV, He I, Cl III, Fe III, He II, Ne IV
-----Red Grism R~1823-----							
7"x7"	0.21	42	0.144	664	643-685	NSR	H α , [N II], [S II]
14"x14"	0.42	42	0.144	664	645-685	WSR	H α , [N II], [S II]
7"x1.68" ^c ++	0.21	125	0.144	664	575-700	NLR	+ [O I], [S III], FeX, He I
14"x3.36"	0.42	125	0.144	664	575-700	WLR	+ [O I], [S III], FeX, He I

^aSpectral regions adjacent the short spectral ranges may be observed by adjusting the blocking filters.

^bMode descriptors: *N* or *W* for narrow or wide field; *S* or *L* for short or long spectrum; *R* or *G* for red or green band.

^cRequires manual installation of a field stop for IFS mode, and therefore is only available for on-site observers.

Manual IFS field stops: The IFS full-field mode does not require any additional field stops. However, the high resolution mode has longer spectra and requires a stop that reduces the field of view in order to keep the dispersed spectra from overlapping on the detector. There is also a coronagraphic stop that can be inserted at the same location. Since these stops require manual insertion, it is recommended that the observer be present at APO.

GIFS Data Reduction Pipeline: The GIFS instrument can acquire more than 1,100 spectra *simultaneously*. The spectra are dispersed on the detector such that they do not overlap. However, the spectra extraction is complex due to the number of simultaneous spectra. Our team has produced an IDL-based data reduction pipeline that can process raw detector data into 3-dimensional data cubes.

IFS comparison with other APO 3.5m instruments: GIFS unique capability is integral field spectroscopy, which produces a 3D dataset (x,y,λ) . The conventional slit-spectrographs at APO produce a 2D datasets (y, λ) . Previous APO programs have scanned the slit to recreate a 3D data cube which GIFS could acquire in a single observation. GIFS has an intermediate spectral resolution between DIS (lower) and ARCES (higher). The GIFS acquisition has more overhead than DIS, and GIFS requires wavelength calibration observations during night. GIFS commissioning and PI mode observations have been used to study jet launch regions, the ISM in galaxies backlit by QSOS, and emission-line regions of galaxies.

GIFS Control Software Status (Feb 2014)

GIFS is awaiting full integration into the TUI system. GIFS exposures can be executed through TUI, but the GIFS mechanism controls are currently issued using scripts that are executed from the command line. This is not as elegant as the full TUI integration but has been shown to work well and be stable during observations. GIFS is linked with the ICC and the FITS headers have complete telescope and instrument details. The TUI data download feature is now compatible with GIFS.

Possible GIFS upgrades

At this time, there are no GIFS upgrades scheduled for the instrument. The Goddard team is currently characterizing a new photon counting detector that could be integrated with GIFS. This would enable observations in photon counting mode, which could be applied for lucky imaging of bright targets or for higher sensitivity observations on faint targets.

Brief Instrument History

The present GIFS instrument is the reincarnation of the Goddard Fabry Perot (GFP) instrument. The NASA APRA program supported the GIFS upgrade, which matures integral field spectroscopy and photon counting detector technologies. The team working on this instrument has been co-located at NASA Goddard and was led by Bruce Woodgate. The team now includes Michael McElwain, Carol Grady, Bruce Woodgate, James Bubeck, Don Lindler, George Hilton, Tim Norton, Ashlee Wilkins, and John Wisniewski.