FPI+: Focal Plane Imager Plus

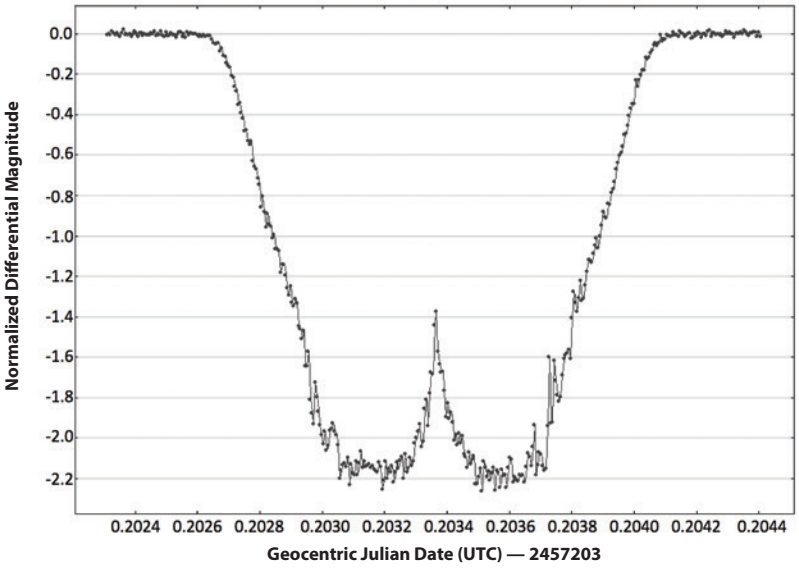
Fast Frame Rate Optical Photometer

Principal Investigator: Jürgen Wolf, DSI

Pluto Stellar Occultation

The 2015 stellar occultation by Pluto of a background star with an r-band of magnitude ~12 was captured by FPI+ as a light curve, showing the decreased signal (in magnitudes) during the event. The central flash in the middle of the light curve confirms the precise position of SOFIA on the centerline of the shadow path, allowing for analysis of the upper atmosphere. This results in a best-fit value for the occultation half-light radius of 1288±1 km (i.e., the radius in the atmosphere at which the occultation light curve drops to half its original flux due to refraction). *(Bosh et al. 2016, submitted.)*

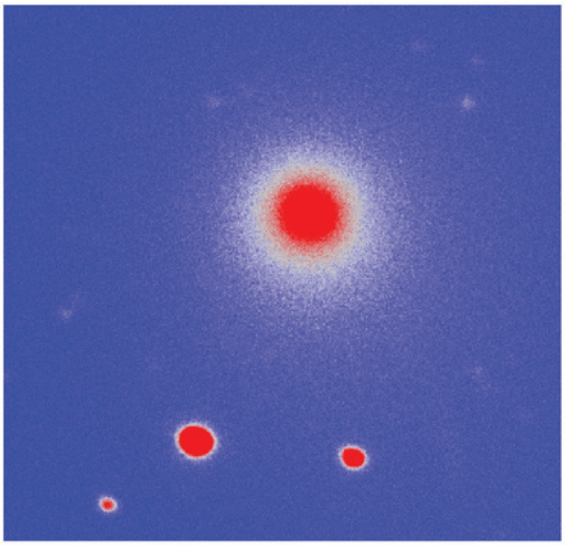
Stellar Occultation by Pluto 2015-06-29
SOFIA FPI+ Data



C2013 US10 Catalina Coma

FPI+ produced an I-band image of Comet C2013 US10 Catalina as part of a combined infrared and visual observation. The comet's coma is nicely visible in comparison to the more compact stars toward the bottom of the image. *(C.E. Woodward et al.)*

I-band Image of Comet C2013 US10 Catalina



Specifications

FPI+ is the upgrade to FPI with a science grade CCD. More than 50% of the light detected onboard SOFIA between 480 nm and 800 nm is transmitted to FPI+, the range at which the camera is most sensitive. The CCD sensor is an e2v CCD 201-20 1024x1024 pixel frame transfer EMCCD with the specifications given in the Optical Properties table *(right)*.

Six spectral filters are available, including five Sloan Digital Sky Survey filters u', g', r', i', z' and a Schott RG1000 near-IR cut-on (Daylight) filter. The Sloan u' filter has a very low throughput (~0.5%) because other optical elements in the FPI+ light path are nearly opaque at this wavelength. There are an additional three neutral density (ND) filters that can be used to attenuate bright stars.

The filters are installed in a double-carousel filter wheel with six positions in each carousel, a list of which is given in the Filter Suite table *(right)*. Filters from Carousel 1 and Carousel 2 can be combined freely with a few exceptions.

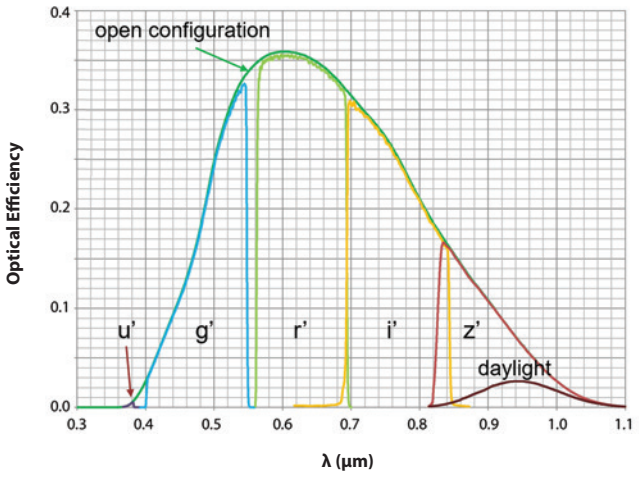
Optical Properties

Field of View	λ Range	Plate Scale
8.7' x 8.7'	360–1100 nm	0.51" per pixel

Filter Suite

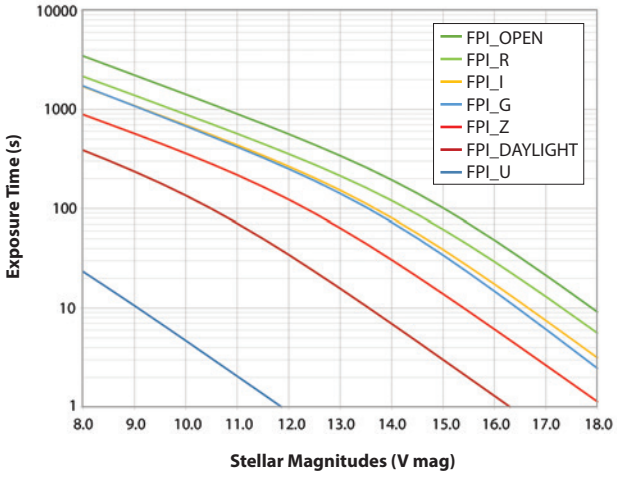
Carousel 1	Carousel 2
OPEN	OPEN
Sloan u'	ND 1
Sloan g'	ND 2
Sloan r'	ND 3
Sloan i'	Daylight
Sloan z'	Blocked

Filter Throughput



Plot of the optical efficiency for five spectral filters and the OPEN FPI+ configuration. The plot includes the calculated SOFIA telescope throughput, the instrument quantum efficiency, and the measured filter spectral response.

Sensitivity



Signal to Noise Ratio for point sources imaged unbinned with FPI+ at t_EXP = 1 sec. Displayed is the OPEN configuration as well as the spectral Sloan filters u, g, r, i, z, and the daylight NIR cut-on filter.