

TUNABLE LASER SOURCE



The TLS allows for fast and wide wavelength selection from the stable and powerful Leukos supercontinuum sources. Indeed, new developments in super-continuum white laser technology allow the full VIS-NIR wavelength range to be produced by a single source. The available spectral range goes from UV to NIR with a bandwidth as low as 0.3 nm. A large tuning range makes highly precise and accurate wavelengths selection easily achievable. An ideal calibration tool for instrumentation labs as well as for telescopes.

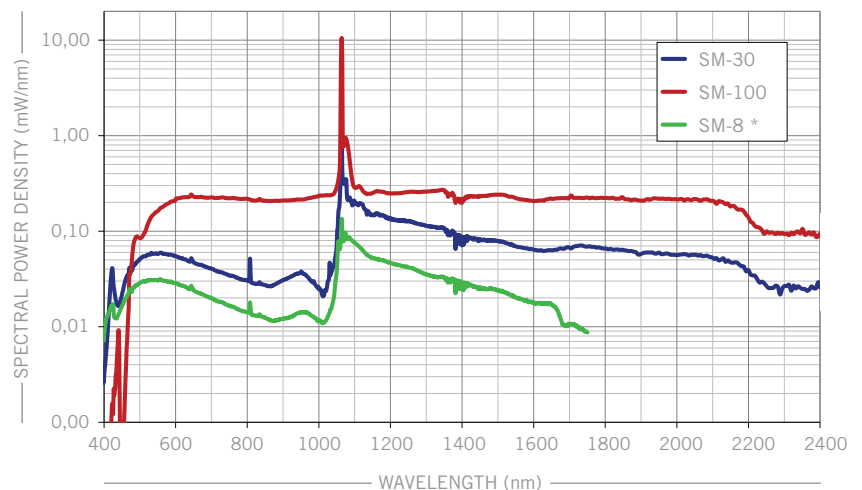
*STANDARD PRODUCTS	Spectral Range (nm)	Bandwidth (FWHM) (nm)
TLS 850	715-1000	0.4
TLS VIS-2	400-1000	2
TLS SWIR	1000-2300	4

*Custom tuning ranges and bandwidths are available.

TECHNICAL SPECIFICATIONS

Bandwidth (FWHM)	0.3 to 4 nm depending on wavelength
Wavelength Absolute Accuracy	0.1 nm (FWHM = 0.3 nm)
Wavelength Relative Resolution	0.05 nm (FWHM = 0.3 nm)
Operating Temperature	10 to 40°C
Storage Temperature	5 to 50°C
Software	PHySpec included or ActiveX drivers
Computer Connection	USB 2.0 (compatible 1.1)
Power Supply	100 - 240 V , 50 - 60 Hz

TYPICAL SPECTRUM OF LEUKOS-SM



* SM-8: Spectrum plot from 350 nm to 1750 nm due to measuring equipment limitations.

CHARACTERIZING GPI CORONAGRAPH WITH A NEAR-INFRARED ADJUSTABLE SOURCE

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The Gemini Planet Imager (GPI) is an astronomical instrument developed by a consortium of institutions (LLNL, AMNH, Université de Montréal, HIA, UCLA, JPL, and UCSC) that will be commissioned at Gemini South in 2012. The primary scientific aim of the instrument is to detect young giant planets in nearby star systems. GPI will directly image the planets and obtain low-resolution spectroscopy allowing physical characterization of their otherworldly atmospheres. GPI will rely on complementary techniques to reveal planets 10 million times fainter than their parent stars; high-order adaptive optics that correct the atmospheric turbulence in real-time, a coronagraph that eliminates 99% of the coherent starlight, an integral field spectrograph that will give a low-resolution spectrum for every field position and data post-processing techniques.

TESTING GPI CORONAGRAPH

The apodized-pupil Lyot coronagraph used in GPI relies on the interplay that diffraction imposes between the pupil and image planes to efficiently remove coherent starlight (see Figure 1) while revealing faint, nearby, planets. As it is central part in GPI's planet-search technique, testing the coronagraph proved crucial to predict the instrument's on-sky performances. The American Museum of Natural History built a testbed that replicates GPI's coronagraph to measure its performances under controlled environment. This optical table testbed reproduced all key components of GPI's coronagraph, including half-toned pupil masks and focal plane mask, producing an image of the residual light on an infrared camera. The practical implementation of the testbed involved a beam launcher illuminating, with a collimated beam, a pupil-defining stop on a mirror. This pupil was then re-imaged on a half-toned mask, the coronagraph's first element.

Finding a light-source for testing the coronagraph proved challenging, as it required three characteristics. First, as coronagraphs are devices that remove light very efficiently, one needs a powerful source for sufficient light to leak-out of the device to efficiently measure its performance. In the sky, GPI will observe some of the brightest stars with Gemini South Telescope's 50 m² collecting aperture. Furthermore, the light source must be collimated as to be focused into a diffraction spot similar to that produced by GPI's adaptive optics. Finally, as coronagraphs are based on diffraction, their light-rejection efficiency varies with wavelength. One requires a nearly achromatic source that could be tuned across most of GPI's wavelength domain (astronomical near-IR; 0.95-2.4 μm) to fully characterize its performance.

Many light sources match one or two of these requirements; lasers are strongly collimated and many types of near-IR lasers would be powerful enough for the proposed test, but none is tunable over such a large wavelength domain. Gratings and prism-based monochromators are tunable over a large domain, but have neither the power nor the collimated beam required for the coronagraph characterization. Photon etc's tunable laser source was chosen as combining all three of the above requirements. It was injected into the beam launcher through a monomode fiber and provided a tunable narrow-band (10 nm) light source across the GPI wavelength domain.

RESULTS

Figure 2 illustrates the sensitivity measurements of GPI's coronagraph across the astronomical H band (1.50-1.80 μm). At the wavelengths it is most efficient (i.e. 1.60 and 1.65 μm), GPI's coronagraph allows the detection of a source less than a million times fainter than the diffraction core of the unmasked star at a separation of only 0.35". This would be sufficient to detect a planet only slightly more massive than Jupiter around a 100 million year old Sun-like star. This sensitivity will be further increased by an order of magnitude by data processing techniques. The performances at 1.50-1.55 μm are significantly poorer. These results are in agreement with performances predicted by a detailed Fresnel propagation analysis of the coronagraph.

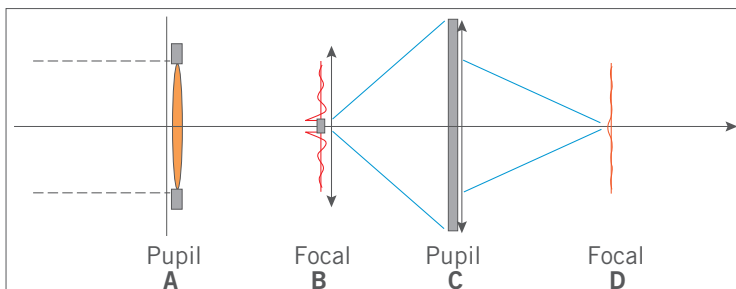


FIGURE 1 : Basic setup of an APLC with its entrance pupil and soft-edged mask (A), its first focal plane with a mask to remove the diffraction core (B), its second pupil plane and mask (C) and the science focal plane (D).

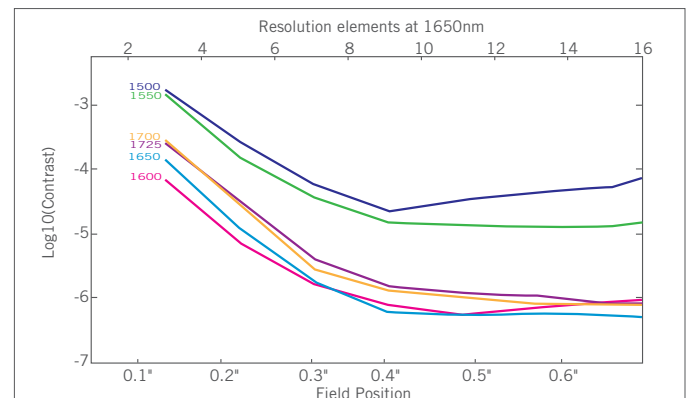


FIGURE 2 : Contrast at six wavelengths ranging from 1.5 to 1.78 μm; contrast on the short wavelength side of the bandpass is markedly poorer.