McPHERSON

Model 2035 Double Spectrometer
Additive or Subtractive Mode

GENERAL DESCRIPTION

The Model 2035 Double is configured by joining two individual instruments into a double spectrometer with either additive or subtractive dispersion. The double additive monochromator includes mechanical linkage of two sine drives and wavelength control via a single motor, high resolution scan drive. The stepper drive is interfaced for operation via a PC.

Double spectrometers are used for a variety of applications which require extremely low levels of scattered or stray light. The most popular applications include:

- **Additive Double Spectrometer**
  Source / Detector Standardization
- **Subtractive Double Spectrometer**
  Raman Spectroscopy
  Photoluminescence

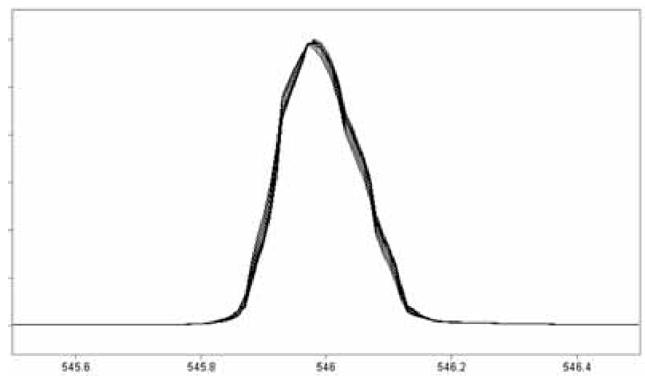
HIGH PERFORMANCE OPTICAL SYSTEM

Model 2035 focal length is 0.35 meters and the double spectrometer can be configured for additive/dual dispersion or non-additive / subtractive dispersion. Optically and mechanically coupled Czerny-Turner spectrometers are equipped with choice of ruled or holographic gratings to suit the application. Spectrally agile, the model 2035D features an all first surface optical system (Al+MgF2 coatings) for complete UV-VIS-NIR response.

LOW STRAY LIGHT

Stray light is frequently characterized by laser sources and instruments equipped with holographic gratings. This approach yields impressively small numbers and yet, is not very pertinent for many applications. Using a laser source and measuring at 10 bandpasses from a laser line describes Raman or weak luminescence experiments but does not address source and detector characterization applications. The latter frequently employ broadband and/or continuum sources.

Model 2035D Additive Mode Double Spectrometer



Repeatability of Nine Scans at Hg 546.1 nm

SPECIFICATIONS

(with 1200 g/mm grating, where applicable)

Focal Length	(2X) 350 mm
Aperture Ratio	f/4.8
Wavelength Range	185 - 1300 nm (175 nm with N_2)
Wavelength Accuracy	± 0.07 nm *Vis* ± 0.25 nm *UV-Vis-IR*
Repeatability	± 0.005 nm *Vis* ± 0.02 nm *UV-Vis-IR*
Grating Exchange	± 0.02 nm, single grating removal and insertion
Bandpass	0.1 - 4 nm, varies with slit width
Tracking	Linear with slits ≥ 75 um
Stray Light	< 8.0×10^{-6} (NPL procedure) < 1.2×10^{-8}, 10 nm from 632.8 nm (100 um slits)

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SPECIFYING STRAY LIGHT

The United Kingdom's standards organization, National Physics Laboratory (NPL) defined this procedure for specifying stray light when continuum sources are used. Scattered light is measured at a particular wavelength with and without a particular long pass filter in front of the slit. Depending on wavelength and filter used, the ratio of the background signal — with and without the filter — was between 0.3 - 1.3 X 10^{-5}. Scatter represents less than 0.0015% even with a continuum source entering the instrument. NPL requirements specify better than 0.05%.

Wavelength	with filter	w/out filter	Percent Stray Light
340 nm	$4*10^{-10}$	$4.8*10^{-5}$	0.0008
350 nm	$3.8*10^{-10}$	$2.9*10^{-5}$	0.0013
400 nm	$1.6*10^{-9}$	$5.2*10^{-4}$	0.0003

Stray light figures for 2035D additive monochromator using 100 Watt Tungsten source. Entrance slit 100 µm, intermediate slit 100 µm, and exit slit 200 µm. Slit height of 4 mm. Photomultiplier high voltage of 950 volts.

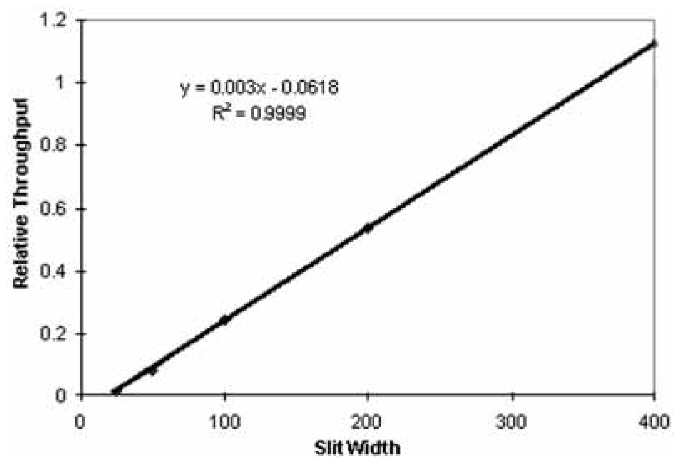
BEST TRACKING

Tracking is determined by and measured as a function of slit width and throughput. It is an expression of the wavelength synchronization between two spectrometers. Instruments are scanned at a variety of slit widths until it can be determined where throughput deviates from linearity.

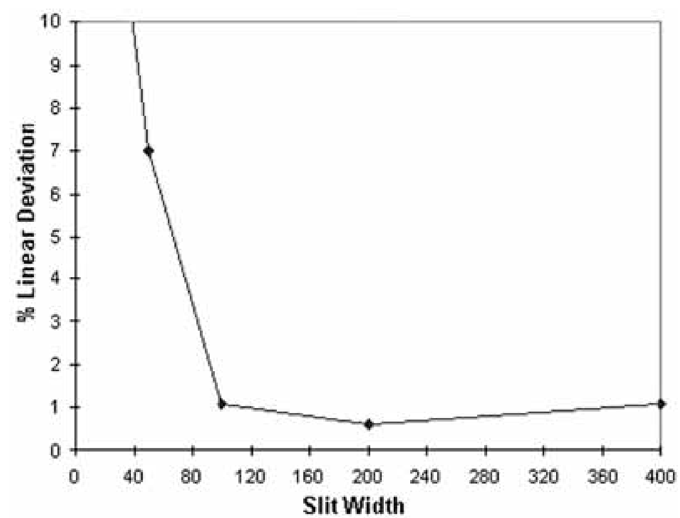
A plot of double monochromator throughput versus slit width is shown. The data is fit to a straight line (best fit linear equation: y = 0.003x -0.0618, R^2 is 0.9999). Tracking between monochromator 1 and monochromator 2 begins to show deviations of 1% from the best fit when slits are set to 90 microns. Percent linear deviation is also plotted versus double monochromator slit width. In this representation, the deviation from linearity when slits are set below 90 microns are evident. At slit widths of 65 microns the 5% percent deviation from linearity is reached.

The minimum tracking slit width can be improved over specific spectral regions (UV, Vis, NIR), However, care must be taken to optimize instrument performance in the region of interest.

Subtractive mode double spectrometers require that two stepper motors are used — one for each instrument. In these systems optimal tracking is accomplished by software correction. If so desired, additive mode spectrometers may also be operated by two stepper motors allowing the additional software correction.



Plot of relative throughput of Model 2035D double monochromator versus slit width. Linear equation is best fit straight line of experimental data points.



Percent linear deviation versus slit width. Tracking wavelength is zero order and the minimum tracking slit width (deviation ≤ 5%) is 65 microns.

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