Manual Optical MultiChannel Analyzer.

The Optical multichannel analyzer can be used to measure intensity spectra. The system consists of a Princeton 1460 dataprocessing unit (=A), a multifiber optical guide (=B), a monspec 27 Jarrell-Ash monochromator (=C), and an EGG-Parc 1412 silicon photondiode array detector (=D). In order to take reflection spectra you need a light source and some simple optics to focus the beam and hold sample and multifiber optical guide. A Bausch and Lomb quartz-tungsten light source (=E) is available as well as an optical rail (=F).
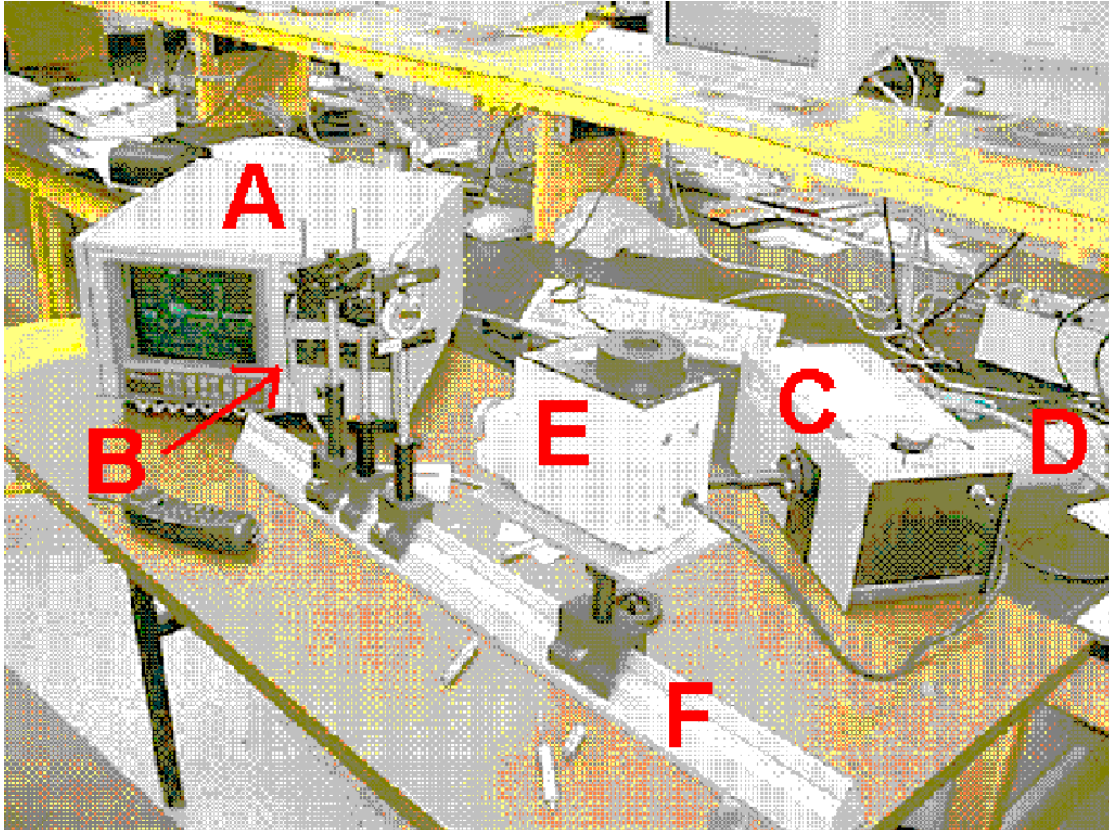
The principle of the measurement technique is sketched in Fig. 2. The to be analyzed light is caught by the multifiber and guided to the entrance slit of the monochromator. The width of the entrance slit is 25 micron. If the to be analyzed light is very weak it is best to remove the entrance slit. Removing the entrance slit will lower the wavelength resolution, but will increase the signal to noise ratio of the measured intensity. It is not recommended to remove the slit if you measure a discrete spectrum with narrow peaks. The monochromator contains a grating that will create a rainbow on the output slit of the monochromator. At the output slit the light intensity is measured by a 1024 element array detector. Each photodiode is 25 μm wide and 2.5 mm high. The total length of the array is 2.705 cm. The data-processing unit will scan the array and measure the complete intensity spectrum without adjusting the grating in the monochromator. So fast measurements can be made with this system.

The monochromator contains three gratings that can be selected with the grating turret knob on top of the case. The following three gratings are installed:

1. A 600 g/mm with a 450 nm blaze. This grating is most suitable to do measurements from 300-900 nm. The grating will cause a dispersion of 6 nm/mm on the output slit. So the 27.05 mm array detector will see approximately 162.3 nm. This grating is recommended if you would like to analyze a very small part of the spectra and you would like to have a lot of detail. For example if you are looking to the shape of certain peaks.
2. A 150 g/mm blaze holographic grating suitable for the range from 200-800 nm (most sensitive in the UV part of the spectrum). The grating will cause a dispersion of 24 nm/mm on the output slit and thus the array detector will see a wavelength interval of 649.5 nm.
3. A 150 g/mm 1000 nm blaze with a dispersion of 24 nm/mm. This grating is recommended for measurements in the infrared part of the spectrum (615 nm 1800 nm).

As the monochromator is based on a grating, peaks at λ will be echoed at 2λ, 3λ, 4λ, etc. in the spectrum.Those echoes originate from the higher order diffracted beams. Although the higher order diffracted beams in general have a lower intensity, they still can be observed in the spectrum. So the maximum wavelength range you can measure is from λ_{min} to $2*\lambda_{min}$, where λ_{min} is the shortest wavelength appearing in the used light beam (BE careful as this is NOT the lowest setting of the monochromator or the lowest λ in your graph on the screen). This λ_{min} is determined by the light source you use and the used lenses. It can be increased by the use of filters. It does not depend on the grating you use.

If you select another grating you have to change also the setting of the monochromator and the calibration factors in the software. The setting of the monochromator can be changed with the wavelength counter crank on the side of the box. The calibration factors used by the software can be changed by selecting on the main menu the "calibration" option. After this choose "calibr. Coef.". The A0 is the starting point of the X-axis and the A1 the number of nm/photodiode.
The table below gives recommended settings.

Grating [#]	Monochromator Setting [nm]	A0 [nm]	A1 [nm/detector]	Range [nm-nm]
1	215 nm	563.6	0.148	563-715
1	127 nm	380.3	0.148	380-532
1	100 nm	324.9	0.148	325-476
2	15 nm	180.2	0.5935	180-786
3	10 nm	615.6	0.5935	615-1222

Depending on the incident light for some of those settings long wavelength echoes at 2*wavelength and 3*wavelength will appear in the spectrum. This is caused by the partial overlap of the 1st, 2nd and 3rd diffracted rainbows. Caution should be taken with the interpretation of the data.

Intensity, reflection, or transmission measurements:

1. Integration Time:

When doing a measurement make sure that you choose your integration time wisely. It can be changed by choosing "Data Acquisition" in the main menu. This brings you to the Data-Acquisition menu. Choose "Exp.Time". If you choose a too long exposure time the diodes will get saturated and the graph will be a flat horizontal line at the saturation value of the detectors. If you choose a too short exposure time the graph will look very noisy.

2. Background Light Correction:

The influence of the background light of the room can be corrected for. In order to do this block the light beam and take a measurement. You would like to measure in the "Live-mode". If the spectrum looks ok you choose "stop". Select "Store Data". Select "Bkg. Set". Choose "Live" for the background that has to be used. Select "Aquire Data". Unblock the light beam and change the data-processing mode to "Live-B" (this means the current signal minus the background. In order to do a complete background correction it is necessary that the background is measured with the same integration time and the same room illumination. The data can be stored by choosing "store data" followed by "Disk store" from the data acquisition menu. Filenames on OMA are numbers. Only the raw data is saved. So even if your plot shows the measured data corrected for the background illumination, the saved file will contain the non-corrected data.

3. Transmission measurements:

For transmission measurements first measure the spectrum of the background illumination. Store this data in file 1. Next measure the spectrum of the incident light beam. Store this data in file 2. Next place your filter in the light beam and measure the intensity of the transmitted light. Store this data in file 3. Now go to back to the main menu and select "disk operating system". Choose "delete file". Type "1:F4.DAT" followed by an <enter>. This will delete file 4 if it exists. Go back to the main menu. Select the "Curve calculations menu". Type in "1:F4=(1:F3-1:F1)/(1:F2-1:F1)". The "1:" stands for drive 1 and can be omitted if it is the default drive. Above line will calculate the transmission spectrum and store that in file 4. Return now to the main menu. Select XY-plotter. Choose "Curve Select" and "Plot source". Select "File" and type in the filename, i.e. 4 followed by an <enter>. If necessary push the autoscale button under the display.

The 5.25" floppies can not be read by a PC-computer. Transfer of data has to be done the following way:

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Use the following settings:

Grating 1:

For HeNe lines (632.8 nm):
- Place the Monochromator at 215 nm.
- Use the following calibration parameters for the software: A0=563.6 nm; A1=0.148 nm/detector. This will give you a spectral range of 563.6-715 nm.

For Argon laser lines (457.8 nm)
- Place the monochromator at : 127 nm
- Use the following calibration parameters for the software: A0=380.8 nm; A1=0.148 nm/detector. This will give you a spectral range of 380.8-532.2 nm

Grating 2:
- Put Monochromator at 15
- Use the following calibration parameters for the software: A0=180.2 nm; A1=0.5935 nm/detector

Grating 3:
- Put Monochromator at 10.
- Use the following calibration parameters for the software: A0=615.6 nm; A1=0.5935. This will give you a spectral range from 615 nm to 1222 nm.
- If you would like to measure farther in the infrared, place the monochromator on 10+X and use for the calibration parameters A0=615.6+8*X nm and A1=0.5935 nm/detector. All settings except for this one have been tested by bandpass filters at 632.8 nm and 457.8 nm.

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