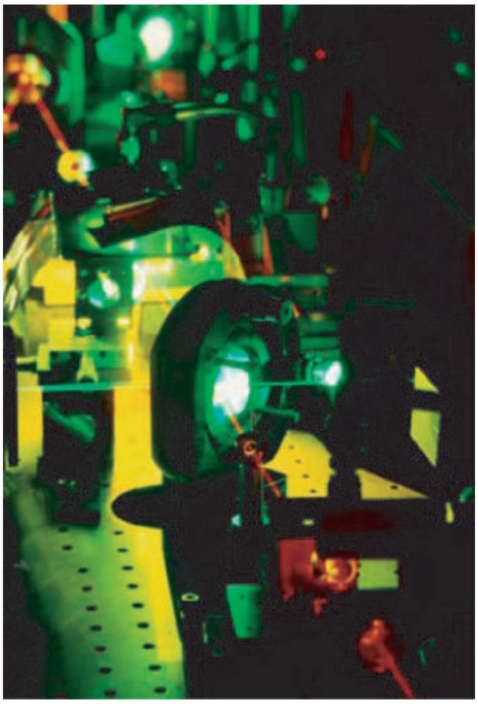
Production Line F

# F Education Systems

Products Categories — NEW New Products — BEST Best Seller

Education Systems



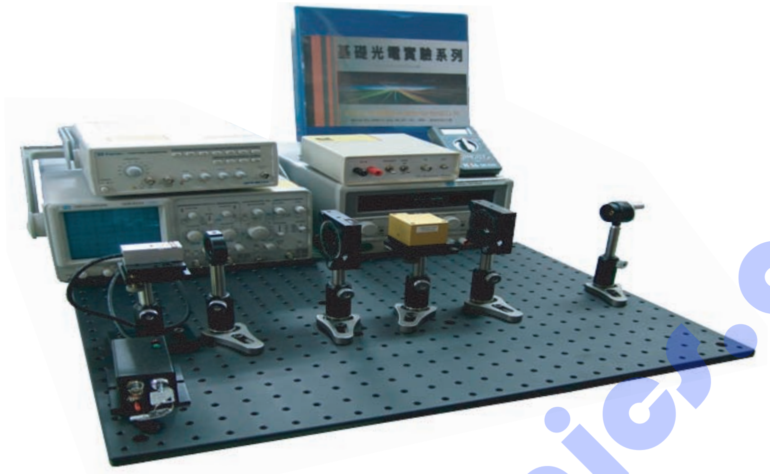


## The characteristic of education experiment module :

- Complete optic education experiemnt course for an academic year
- Each experiement can stand alone for operation simultaneously
- The experiment would be described very detail by operation manual
- English or Chinese version available
- OP Mount technology supporting team provides total solution service for education users
- The technology for education experiment of OP Mount Instrument Inc. is transferred by National Tsing Hua University in Taiwan
- The product is convenient for operation and improved for optimum by OP Mount Instrument Inc

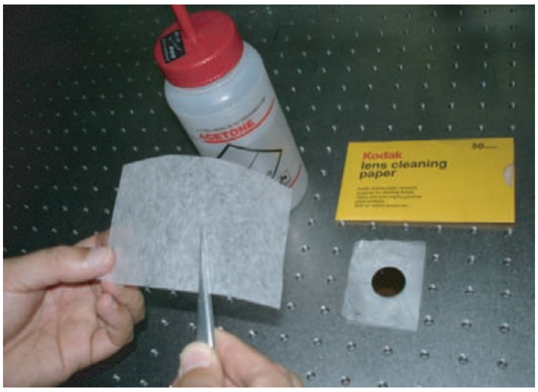
# Modern Experimental Optics

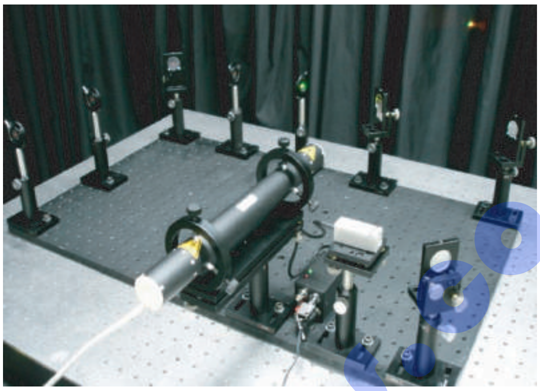




1. Beginner's Optics Module
2. Snell's Law Reflection and Refraction
3. Polarization of Light
4. Lens Aberration
5. Thin-lens Imaging
6. Michelson / Mach-Zehnder / Sagnac Interferometers
7. Etalon Interference
8. Coherence Theory of Light
9. Diffraction
10. Grating Monochromater
11. Principle of Optical Waveguides
12. Fourier Optical Education System
13. Electro-Optic Amplitude Modulation
14. Acousto-Optic Modulation
15. Non-critically Phase-Matched Second Harmonic Generation
16. Quasi Phase-Matched nonlinear wavelength conversion
17. Optical Parametric Generation
18. Raman Scattering

# Basics of Experimental Optics



## Application

- Lens / Mirror Cleaning Laser Alignment

## Purpose of the Experiment

The design of this basic experiment is to assist a novice in optics to get familiar with handling optical components and aligning an optical path. The experience learned from this experiment is also helpful to stay alert for laser safety and avoid damaging optical components.

## Lens / Mirror Cleaning

This part of experiment teaches the proper way of cleaning lenses and mirrors by using lens papers and several solvents.

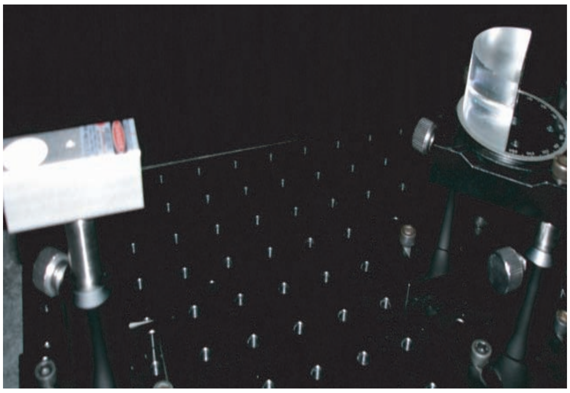
## Laser Alignment

This experiment is divided into two parts. The first part of the experiment is to align a red laser beam into two longitudinally separated apertures by using two orthogonally tuned mirrors. The second part of the experiment is to co-propagate a green laser with the pre-aligned red laser beam.

If an optical material is cut into a prism shape, the dispersion of the material can be determined with great accuracy by measuring the minimum deflection angle of the prism over a spectral range. This experiment demonstrates such a refractive index measurement technique.

EDB-02

# Snell’s Law Reflection and Refraction



## Application

- Snell's Law Reflection and Refraction
- Minimum Deflection Angle of a Prism
- Total Internal Reflection

## Purpose of the Experiment

This experiment demonstrates Snell's law of refraction and reflection, from which one measures the refractive index of a material.

## Saell’s Law of Reflection

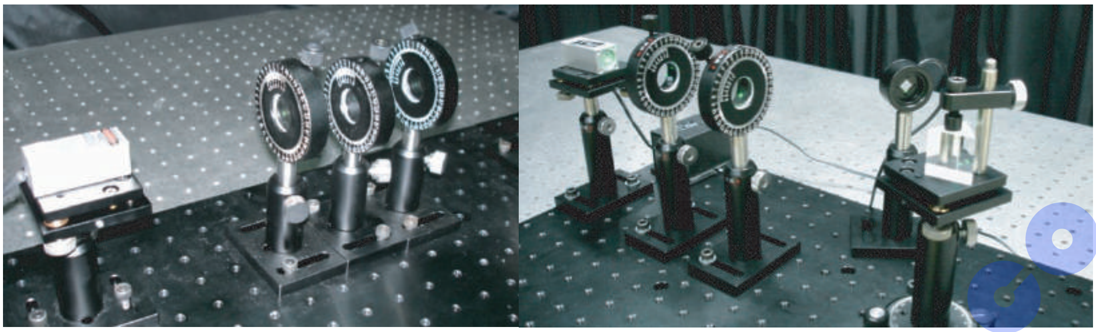
A fixed laser beam is incident on a rotating mirror and the scanning angle of the reflection beam. Also, it is twice the rotation angle of the mirror.

## Total Internal Reflection

A laser beam is directed into the center of an acrylic half-cylinder atop a rotation stage. One confirms Snell¡¦s law of reflection and refraction from the angles of the incident, reflected, and transmitted beams. When the incident angle is larger than the critical angle, total internal reflection in the acrylic cylinder occurs.

# Polarization of Light





## Application

- Malus's Law
- Polarization Control Using Polarizer and Waveplate Brewster Angle

## Purpose of the Experiment

This experiment illustrates the polarization of light, the use of waveplates for polarization control, and the polarization-dependent reflection of light from a material.

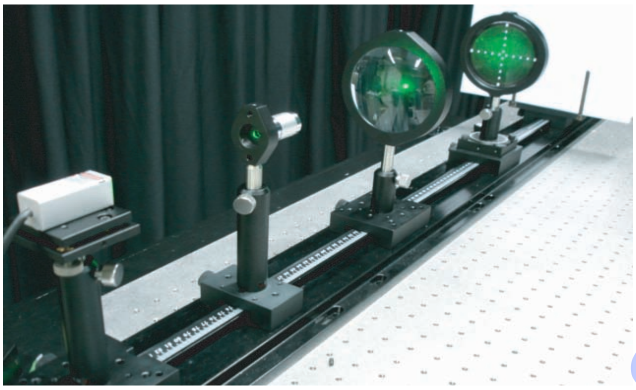
## Description of the Experiment

This experiment starts with the investigation of Malus's law, which states that transmittance of a linear polarized light through a polarizer is the square of a cosine of the relative angle between the polarization direction and the transmission axis of the polarizer.

In the second part of the experiment, one employs a half-wave plate to rotate the polarization direction of a linearly polarized laser beam and a quarter-wave plate to produce elliptically and circularly polarized light. The transmission and reflection of light from a material depends on the polarization of the incident light. In this experiment, one measures the intensity of reflected light from a glass material upon which a p- or s-polarized laser is incident. From the measured data, the Brewster angle of a p-polarized incident laser on a glass can be determined.

# Lens Aberration

Optical Tables
Stages
Optical Mounts
Components
Motion Systems
Education Systems
Lasers
Optics & Crystals
Other Equipment



## Application

- Spherical Aberration, Coma, Astigmatism

## Purpose of the Experiment

Observation of those aberrations associated with a spherical lens, including spherical aberration, coma, and astigmatism.

## Description of the Experiment

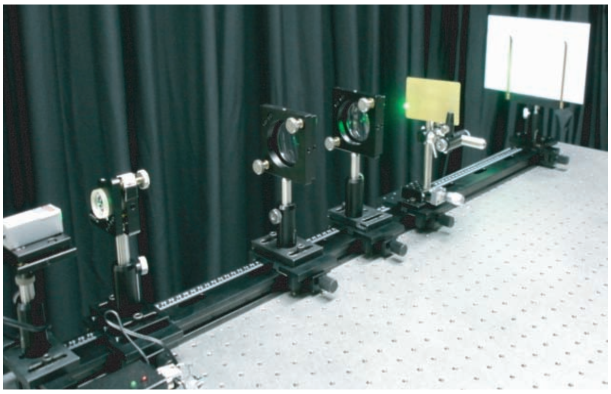
The spherical aberration experiment employs a large aperture spherical lens following a slide with transparent dots at different radial distances. An expanded, collimated laser beam is incident on the slide and the large-aperture lens to illustrate variation of focal points from light rays emitting from radial positions.

The second experiment shows a typical coma pattern by imaging an off axis point source through a lens following a slide with concentric transparent rings.

The third experiment is to illustrate astigmatism of a spherical lens, which allows the measurement of the circle of least confusion between two focused lines formed by the tangential rays and the sagittal rays through a rotated lens.

# Thin-lens Imaging





## Application

- Knife-edge Focal-length Measurement
- Single-lens Imaging
- Laser-Beam Expansion
- Two-lens System

## Purpose of the Experiment

The primary purpose of this experiment is to teach the principle of a single imaging lens and a multi-lens imaging system. This experiment also teaches the basic skills of creating an expanded and collimated laser beam, and measuring the focal length of a lens by using the knife-edge technique.

## Description of the Experiment

Laser beam expansion:This technique is often needed in optics experiments. In this experiment, we use a negative lens and a positive lens to form a confocal telescopic system. Expansion ratios of different focal-length combinations are verified in the experiment.

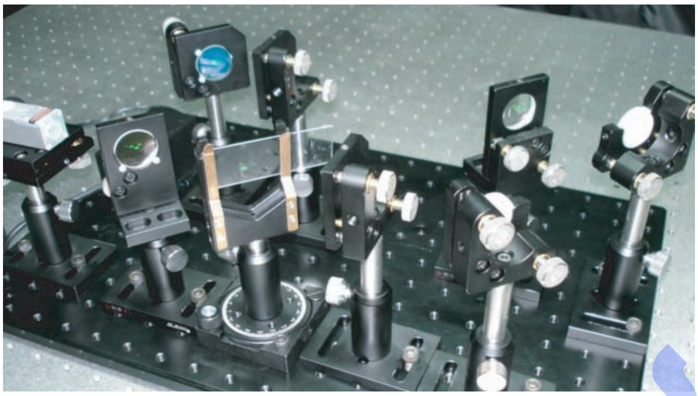
The knife-edge technique is a classic means for measuring the focal length of a lens. A unique knife-edge assembly is designed for measuring the focal lengths of several positive lenses.

Single-lens imaging: This part of the experiment verifies the imaging formula of a thin lens.

Measurement of the focal length of a negative lens: This part of experiment is accomplished by imaging the virtual image formed by the negative lens through a positive lens with a known focal length. The focal length of a negative lens is deduced from successive uses of the single-lens imaging formula.

# Michelson / Mach-Zehnder / Sagnac Interferometers





## Application

- Minimum deflection angle of a prism
- Total internal reflection
- Mach Zhender Interferometer

## Purpose of the Experiment

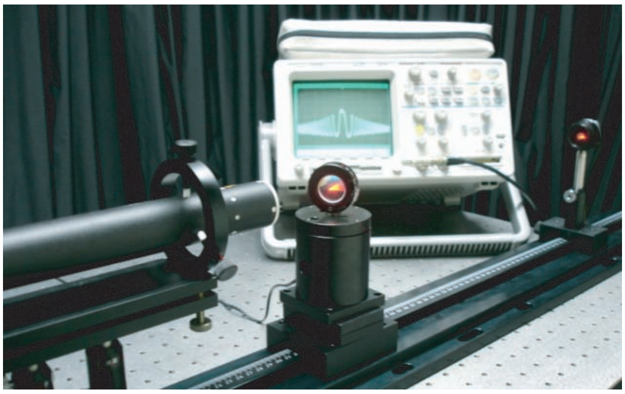
This experiment demonstrates Snell's law of refraction and reflection, from which one measures the refractive index of a material.

## Total Internal Reflection

This experiment teaches step-by-step procedures for setting up a Mach Zhender interferometer, a Sagnac Interferometer, and a Michelson interferometer. To obtain clear concentric interference patterns at the output, the wavefront of the optical wave in one interferometer arm is deliberately adjusted differently from that in the other interferometer arm. A Mach Zhender interferometer is used to demonstrate complimentary interferometer patterns at its two output ports. As a common-path interferometer, a Sagnac interferometer is used to illustrate a much stable interference fringes compared with those from the other two interferometers. In the end, a glass plate is inserted into a Michelson interferometer and a Mach Zhender interferometer for precise refractive index measurements.

# Etalon Interference







## Application

- Refractive index Measurement Using Etalon Fringes
- Etalon Finesse Measurement

## Purpose of the Experiment

This experiment teaches basic principles of optical interference and resonance by characterizing the interference fringes and finesse of an etalon. What to be learn from this experiment includes the concept of free spectral range, Fabry-Perot resonator, resonator bandwidth, and spectral selection.

## Description of the Experiment

This experiment is divided into two parts; the first part is to illustrate the interference fringes from an Etalon and the second part is to measure an Etalon's finesse.

**Part I.** Etalon Interference Fringes

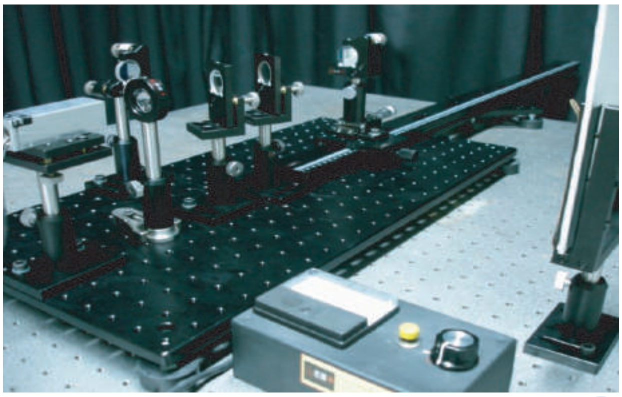
A diffused He-Ne laser beam is incident on an Etalon followed by a focusing lens. On the focal plane, one observes and characterized an interference pattern with concentric rings. The refractive index and thickness of the Etalon are correlated with the experimental data.

**Part II.** Etalon Finesse Measurement

Etalon finesse is an important index for spectral selectivity. In this experiment, a collimated He-Ne laser beam is incident on a spinning Etalon. From the oscilloscope trace of the transmitted laser intensity, an Etalon's free spectral range and finesse are deduced.

EDB -08

# Coherence Theory of Light



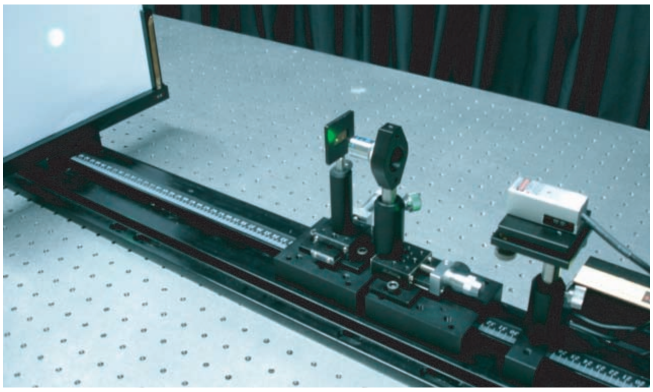
## Application

- Minimum deflection angle of a prism
- Diode-Laser Coherence Length
- LED Coherence Length
- White-Light Interference

## Purpose of the Experiment

Optical coherence manifests itself in optical interference. This experiment teaches the temporal coherence of light waves by observing time-shift interference fringes of several light sources in a Michelson interferometer.

# Diffraction



## Application

- Fresnel Diffraction
- Fraunhofer Diffraction

## Purpose of the Experiment

Optical diffraction is a classical test on the wave-like nature of light. This experiment teaches Fresnel diffraction, of which the diffraction pattern is influenced by the wavefront at the diffraction aperture, and Fraunhofer diffraction, of which a plane-wave model is used at the diffraction aperture and the observation screen.

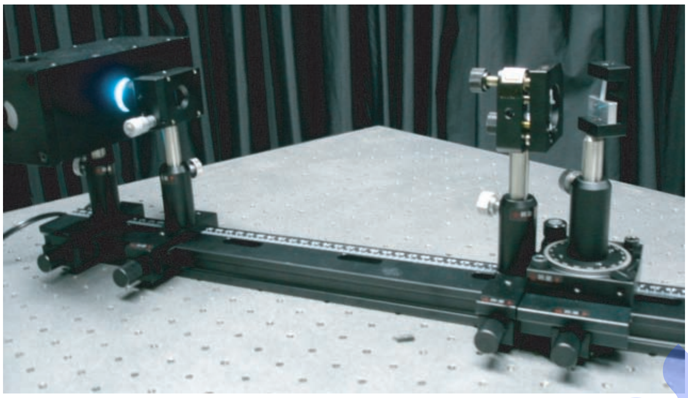
## Description of the Experiment

Fresnel Diffraction,a quasi point wave is first generated from a strongly focused laser beam and then is incident on circular apertures of different radii. By varying the distance between the aperture and the point source, one is able to observe several diffraction orders of the Fresnel diffraction on a fixed screen. With different-radius apertures in the experiment, an experimenter is able to learn the importance of a spherical wavefront in generating Fresnel diffraction.

Fraunhofer diffraction is a kind of far-field diffraction and its diffraction pattern is the Fourier transform of the diffraction aperture. A series of circular and rectangular apertures are used in this experiment to verify the far-field diffraction theory. The dimensions of the apertures are deduced from the measured diffraction patterns.

# Grating Monochromater





## Application

- Grating-Period Measurement
- Grating Monochrometer

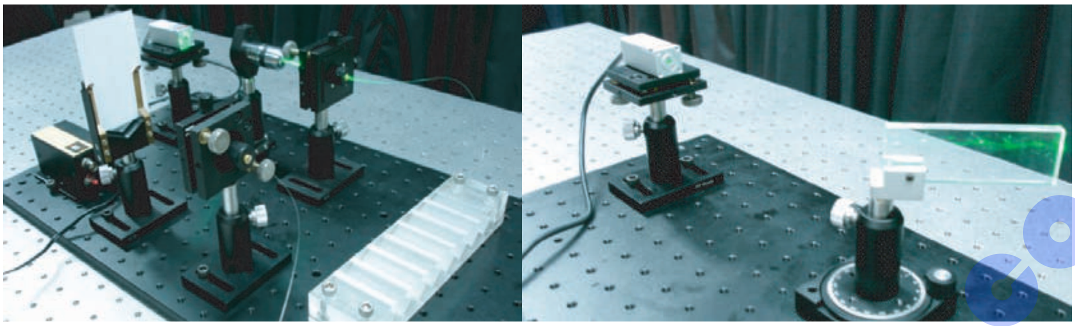
## Purpose of the Experiment

An optical grating is an optically dispersive element and is often used for spectral measurements or dispersion processing of optical waves. This experiment teaches the basic principle of optical diffraction from a grating and the functioning principle of a grating monochrometer.

## Total Internal Reflection

This first part of the experiment employs a laser of a known wavelength to observe diffraction orders from an optical grating. From the incidence and diffraction angles of the laser beam, one can deduce the period of the optical grating from the grating equation. The second part of the experiment utilizes the optical grating measured in the first experiment to construct a Littrow grating monochrometer. The spectral lines of a mercury lamp are identified in the monochrometer with a specified resolution.

# Principle of Optical Waveguides



## Application

- Numerical Aperture of a Waveguide
- Waveguide-Loss Measurement
- Fiber-Mode Observation

## Purpose of the Experiment

Optical waveguides are widely used in optical signal processing and transmission. The most notable application of an optical waveguide is the fiber communication. This experiment teaches basic properties of an optical waveguide, including the numerical aperture, optical coupling, waveguide attenuation, waveguide modes, and so on.

## Description of the Experiment

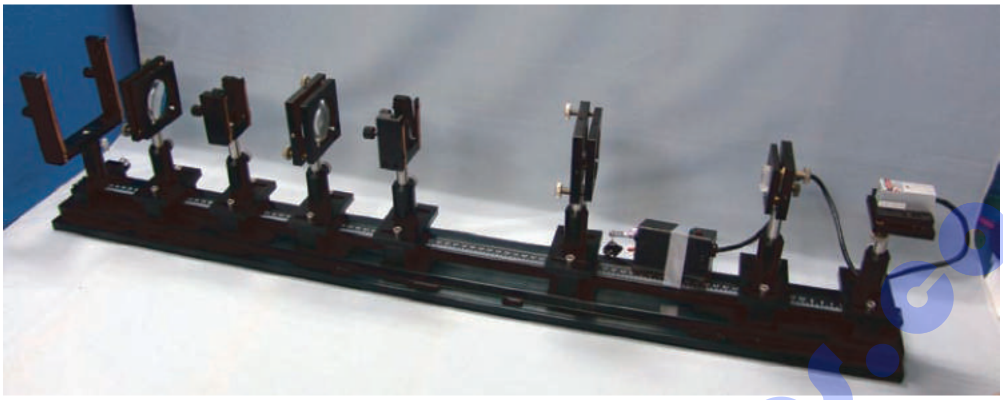
The first part of the experiment is the measurement of the numerical aperture of a planar waveguide. One determines the numerical aperture of the waveguide by observing the sudden loss of the optical beam when increasing the incidence of a laser beam.

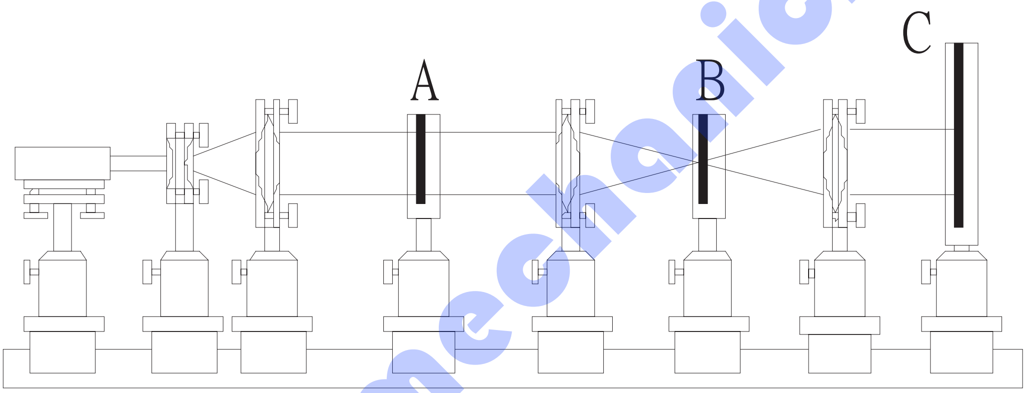
The second part of the experiment is the measurement of optical coupling loss at and optical attenuation in a optical fiber. Through this experiment, one also practices coupling a laser beam into an optical fiber.

The third part of this experiment is to observe and select waveguide modes in an optical fiber. The mode selection is achieved by using a mode attenuator.

# Fourier Optical Education system








## Purpose of the Experiment

How does the discussion object spatial frequency and use it to control the imagery the quality with the shape.
Carries on simple optics image processing using the Fourier optics theory.

## Total Internal Reflection

This experiment discusses how is the subject and object spatial frequency are, and uses it to control the imagery, shape and quality. This subject seeks a specific profile, the harmonic frequency is the same concept in the Fourier optics theory mentioned that object all has the specific intensity pattern and may transform for the relative spatial frequency distribution. In this experiment laser is shone by the thunder the object slide. Transforms the lens, the affiliation by hereafter to inspect its spatial frequency the distribution In transforms the lens in the focal-plane to present. The affiliation by holds controls in this focal-plane the light We then may control the imagery the content and the quality.

# Electro-Optic Modulation



# Acousto-Optic Modulation

## Purpose

The purpose of this experiment is to learn about Electro-Optic Modulation. In this experiment we will measure the half-wave voltage of a transverse amplitude modulator made from a 1-mm-thick LiNbO3 crystal, and find out the modulation depth of the modulated signal.

## Important Goals of This Experiment

- To learn the basic concept of the Electro-Optic (Pockels) effect
- To learn how to determine the transmitting axis of a polarizer
- To measure the half-wave voltage of the Electro-Optic modulator
- To modulate the laser beam by using the Electro-Optic modulator at a ~kHz frequency and measure the modulation depth at different frequencies.
- To observe 2-f modulation and its modulation depth.

## Application

Communication, LCD display, Phase/intensity modulation, Gas sensing, Laser power adjuster, Polarization controller, etc.

## Purpose

This project illustrates spatial light modulation using an Acousto-Optic modulator. Experimentalists will be able to observe different laser diffraction angles and efficiencies as a function of acoustic frequency, intensity, and laser wavelength. Through this experiment, one understands acousto-optics as the functioning principle of a spatial light modulator.

## Important Goals of This Experiment

- To find the Bragg angle versus acoustic frequency.
- To observe multiple diffraction orders in the Raman-Nath regime.
- To determine the figure of merit of an Acousto-Optic crystal from experimental data.

## Application

Communication, LCD display, Phase/intensity modulation, Gas sensing, Laser power adjuster, Polarization controller, etc.

EDC-03

# Noncritically Phase-Matched Second Harmonic Generation

EDC-04

# Quasi Phase-Matched Nonlinear Wavelength Conversion

## Purpose

In this experiment, we will conduct second harmonic generation (SHG) of a 1064-nm Nd:YAG laser in a MgO:LiNbO3 crystal with a Non-critically Phase-Matched configuration. The temperature tuning curve and the conversion efficiency of the SHG process are to be measured. Students will learn the basic theory of nonlinear optics during the experiment.

## Important Goals of This Experiment

- To learn the basic concept of birefringence phase-matching condition in a nonlinear optical process.
- To measure the temperature tuning curve of the Noncritical Phase-Matched SHG.
- To measure the nonlinear conversion efficiency and determine the nonlinear optical coefficient of the MgO:LiNbO3 crystal.
- To observe the polarization characteristics of the fundamental and the SHG waves.

## Application

Communication, Laser pick-up head, Frequency doubler, etc.

## Purpose

In this experiment, we will be demonstrating the Quasi-Phase-Matched (QPM) second harmonic generation (SHG) in a LiNbO3 crystal, whose ferroelectric domain is periodically reversed every coherence length. Such a LiNbO3 crystal is so-called Periodically Poled Lithium Niobate (PPLN). We will access the first and the third order QPM phase-matching condition and measure the temperature bandwidth of the QPM SHG process.

## Important Goals of This Experiment

- To learn the basic concept of QPM phase-matching condition.
- To measure the temperature tuning curve of the QPM SHG.
- To measure the nonlinear conversion efficiency and determine the nonlinear optical coefficient of the PPLN crystal.
- To observe the polarization characteristics of the fundamental and the SHG waves.
- To know the importance of the grating period of the PPLN crystal.

## Application

Communication, LCD display, Phase/intensity modulation, Gas sensing, Laser power adjuster, Polarization controller, etc.

EDC -05

## Optical Parametric Generation

### Purpose

Optical Parametric Generation is an important process for producing wavelength tunable coherent radiations.

Optical parametric generation is actually a parametric amplification process in which vacuum noise photons are amplified to a power levelcomparable to the pump power.

In this experiment, we will be performing optical parametric generation (OPG) from a 1064-nm pumped Periodically Poled Lithium Niobate (PPLN) crystal.

We will measure the wavelength-tuning curve of the OPG outputs for different temperatures and/or different PPLN periods in comparison with the theoretical Tuning curve.

EDC -06

## Stimulated Raman Scattering

### Purpose

Raman scattering is a useful technique for spectroscopy, wavelength conversion and for optical signal amplification.

Raman scattering is an inelastic scattering process in which a scattering photon loses and deposits some energy to a host material and the scattered photon has a photon energy different from the scattering one.

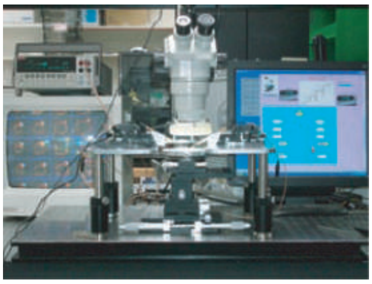
The purpose of this experiment is to achieve stimulated Raman scattering in a silica fiber and measure the Raman gain of a silica fiber.

The pump laser is a 1064-nm passive Q-switch laser.

# Probe Station Module



## *Basic-BPVN-00*



**Including**

Microscope / XY stage (Manual) / XYZ Probe Station / 4 inch vacuum sucker / Magnetic base/Probe Station Board / binocular microscope / Machine Board

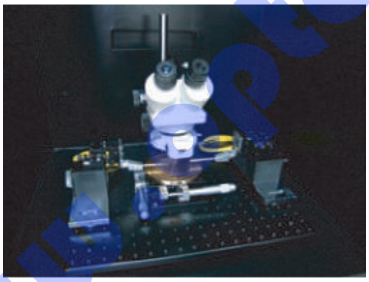
**Optional**

Active Optical table/ Probe Module Isolation Box / Vacuum Pump / Temperature- controlled Vacuum Sucker / Cold water machine / Optical fiber / Any kind of measurable sample clamp / Any type of cable adapter (Triaxial to Triaxial, Triaxial to Coaxial, Coaxial to Coaxial)

**Application**

LED Wavelength Measurement / LED Light Intensity Measurement / Laser Diode Measurement /Photo Diode Measurement / IC Measurement / Circuit Board Measurement

## *Advanced 4 inch -BPVN-02*



**Including**

Microscope / XY Stage(can change to motorized control) / Z Stage(can change to motorized control) / θaxis rotary stage / XYZ Probe Station / 4 inch(8 inch) vacuum sucker / Probe Station Board / Microscope + CCD / CCTV System / Machine Board / Measurement Software / Measurement Instrument (Keithley Model 2400) / Probe Module (Triaxial , Coaxial)

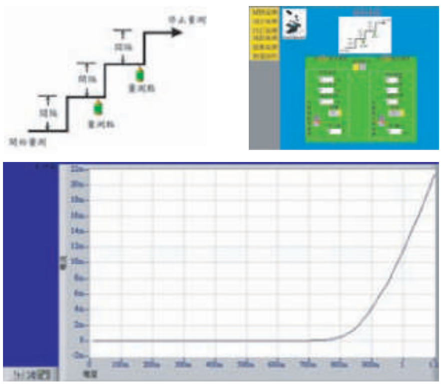
**Optional**

Z axis Stage( Manual) / Measurement Software / Measurement Instrument (Keithley Model 2400) / Active Optical Table / Probe Module Isolation Box / CCVT System / Vacuum Pump / Temperature - controlled Vacuum Sucker / Cold water machine / Any kind of measurable sample clamp / Any type of cable adapter (Triaxial to Triaxial, Triaxial to Coaxial, Coaxial to Coaxial)

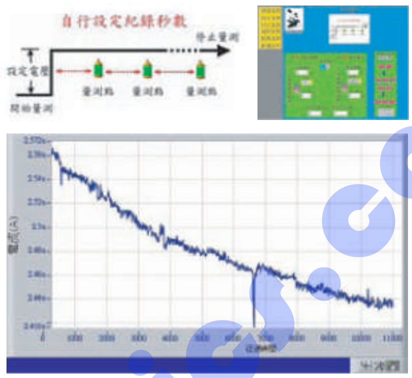
**Application**

LED Wavelength Measurement / LED Light Intensity Measurement / Laser Diode Measurement /Photo Diode Measurement / IC Measurement / Circuit Board Measurement

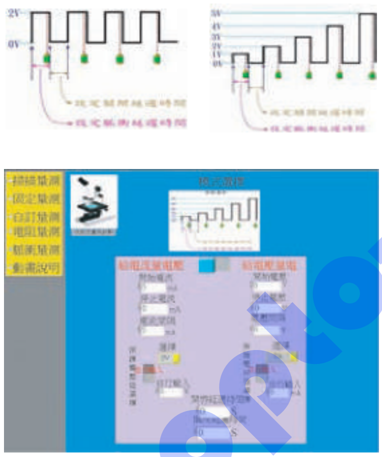
## 1 Scanning Measurement



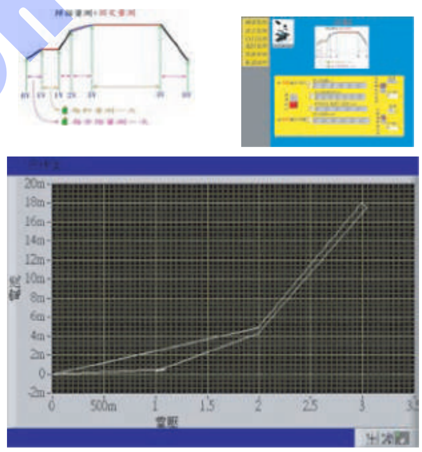
## 2 Fixed Measurement



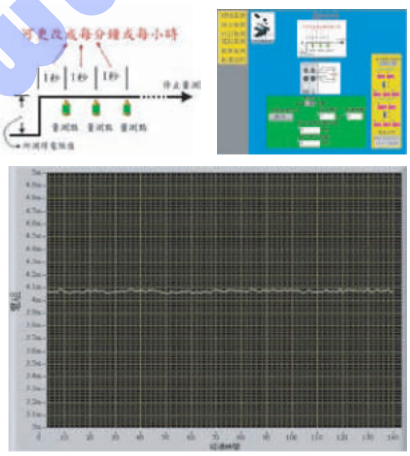
## 3 Pulse Measurement



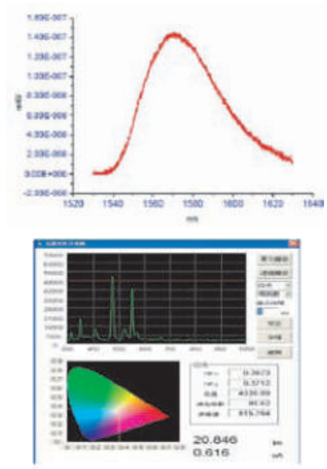
## 4 Customize Measurement



## 5 Resistance Measurement



## 6 Spectrum Measurement





Optical Tables
Stages
Optical Mounts
Components
Motion Systems
Education Systems
Larers
Optics & Crystals
Other Equipment