САМАРСКИЙ УНИВЕРСИТЕТ
SAMARA UNIVERSITY

Кафедра лазерных и биотехнических систем
Самарского университета

Оптические элементы

Введение в специальность 12.03.05

Лекция 3

Артемьев Дмитрий Николаевич

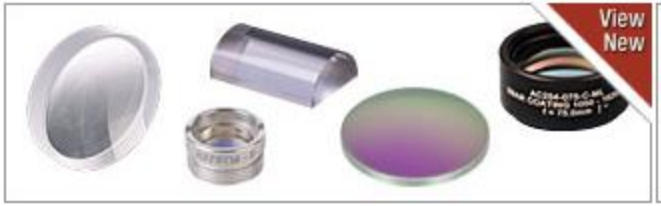
Оптика

Optics

Welcome to Thorlabs; below you will find links to optical components and systems, a subset of our entire line of photonics products. All single element optical components can be found under the optical elements link with the exception of optical components that have polarization properties since they have a separate link. Multi-element systems like beam expanders and objective lenses as well as interferometers, fiber collimators, reference cells, modulators, and other optical devices can be found by choosing the optical systems link. Thorlabs also manufactures an extensive line of free-space and fiber optic isolators; stock items ship the same day that they are ordered while our custom orders benefit from our streamlined design and manufacturing process, which minimizes lead time.

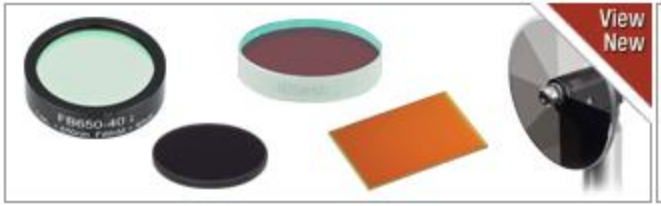
Оптические элементы

Lenses

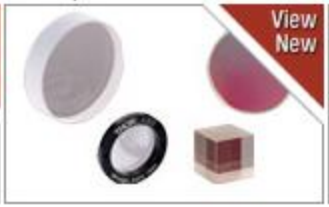


Mirrors

Filters



Beamsplitters

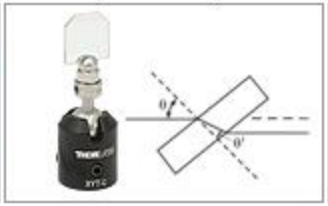


Prisms

Windows

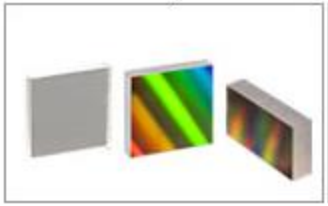
Diffusers

Beam Displacement Optics

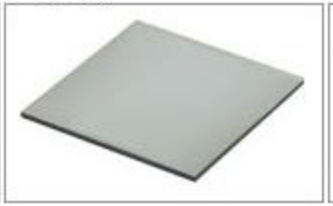


Test Targets, Calibration Targets, & Reticles

Diffraction Gratings



Holography Plates



Glass Cells

Линзы

Spherical Singlet Lenses

Aspheric Lenses

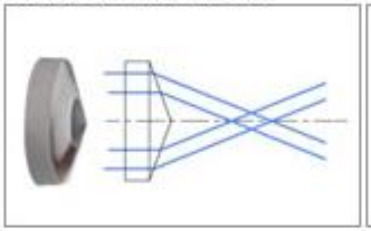
Achromatic Lenses

Cylindrical Lenses

Powell Lenses

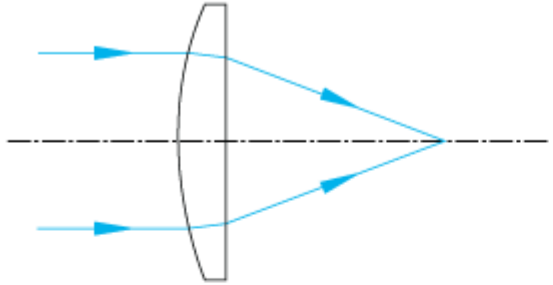
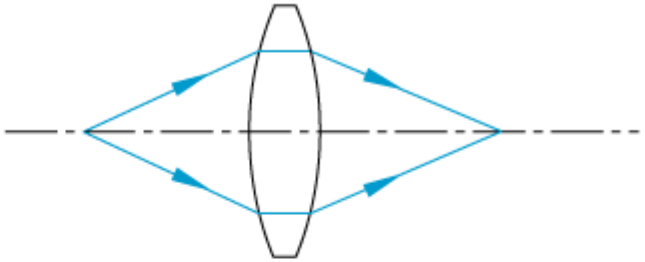
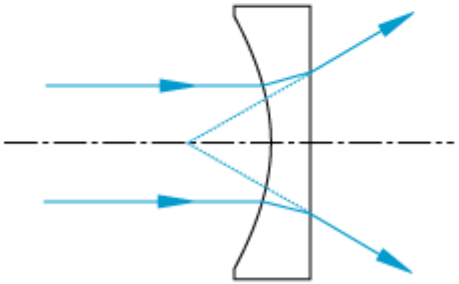
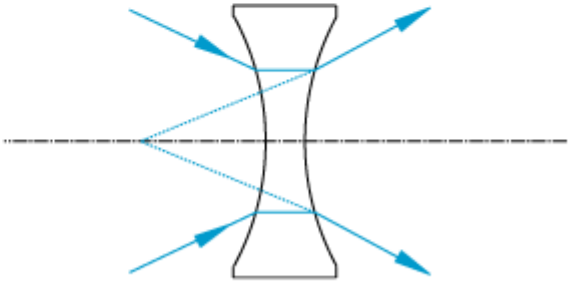
Air-Spaced Doublets

UV Fused Silica Axicons



ZnSe Axicons

Сферические линзы

Positive Lenses	
Plano-Convex Lenses	**Bi-Convex Lenses**
	
Plano-convex lenses are best used where one conjugate distance is more than five times the other conjugate distance. The performance of this lens shape is best for an infinite conjugate ratio (focusing collimated light or collimating a point source).	Bi-convex lenses perform best when one conjugate distance is between 0.2 and 5 times the other conjugate distance. The performance of this lens shape is best when the object and image distances are the same.
Negative Lenses	
Plano-Concave Lenses	**Bi-Concave Lenses**
	
Plano-concave lenses are best used when one conjugate distance is more than five times the other conjugate distance. They introduce negative spherical aberration and can be used to balance the positive spherical aberration introduced by positive focal length singlets.	Bi-concave lenses have a negative focal lengths and are commonly used to increase the divergence of converging light.

Сферические линзы

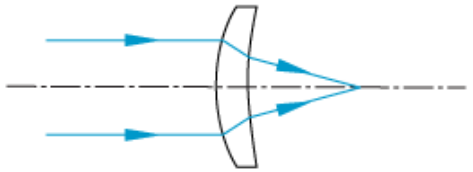
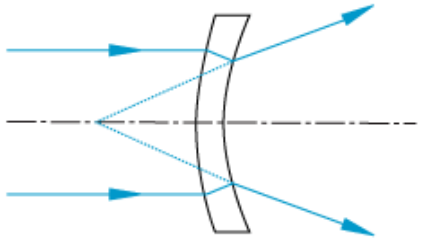
Meniscus Lenses	
Positive Meniscus Lenses	Negative Meniscus Lenses
	
Positive meniscus lenses are typically used in cominbation with another lens in a compound optical assembly. When used in this configuration, a positive meniscus lens will shorten the focal length and increase the numerical aperture (NA) of the system without introducing significant spherical aberration.	Negative meniscus lenses are typically used in combination with another lens in a compound optical assembly. When used in this configuration, a negative meniscus lens will increase the focal length and decrease the numerical aperture (NA) of the system.

Figure 2 shows the performance gains that can be achieved by using multi-element lens systems. A single element plano-convex lens with a focal length of 100 mm produces a spot size of 240 µm (Figure 2a). In addition, the single lens introduces 2.2 mm of spherical aberration, defined as the distance betwen the marginal focus (where rays on the very edge of the lens focus) and the paraxial focus (where rays in the center of the lens focus). By combining two plano-convex lenses with focal lengths of 100 mm, for an effective focal length of 50 mm, the focused spot size is decreased to 81 µm and the spherical aberration is reduced to 0.8 mm (Figure 2b). An even better option, however, is to combine the f=100 mm plano-convex lens with a positive f=100 mm meniscus lens. Figure 2c shows the results: the focused spot size is reduced to 21 µm and the spherical aberration is reduced to 0.3 mm. Note that the convex surfaces of both lenses should be facing away from the image point.

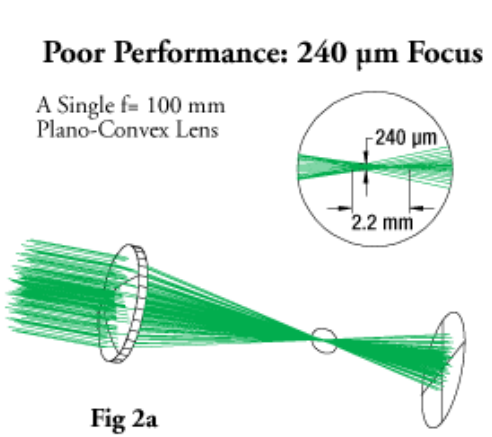


Fig 2a

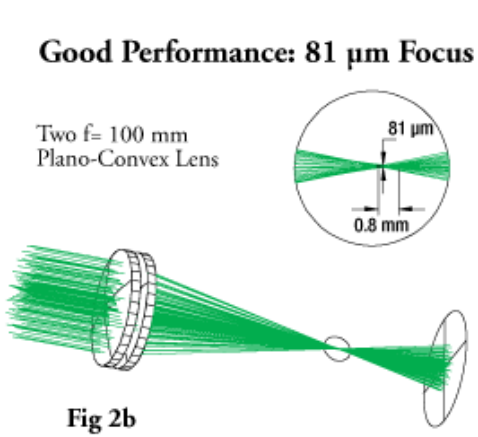


Fig 2b

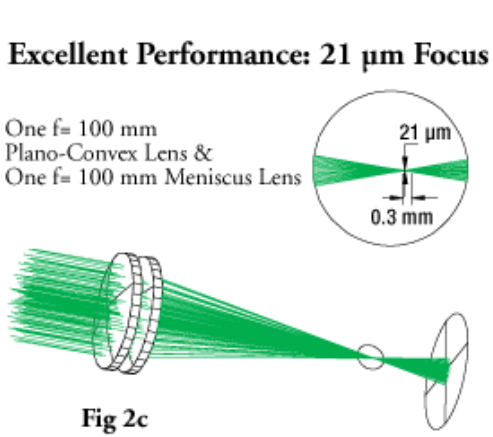
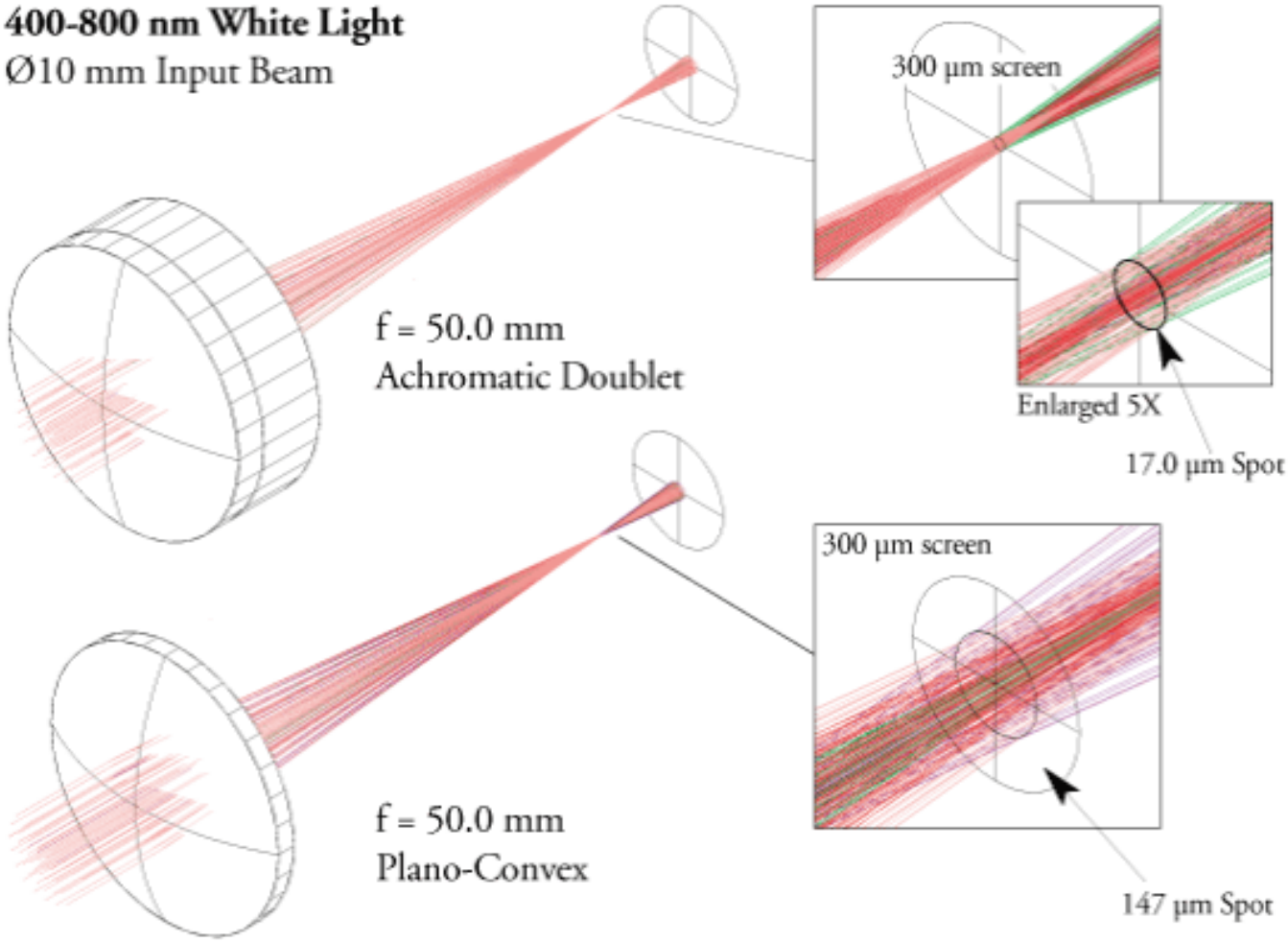
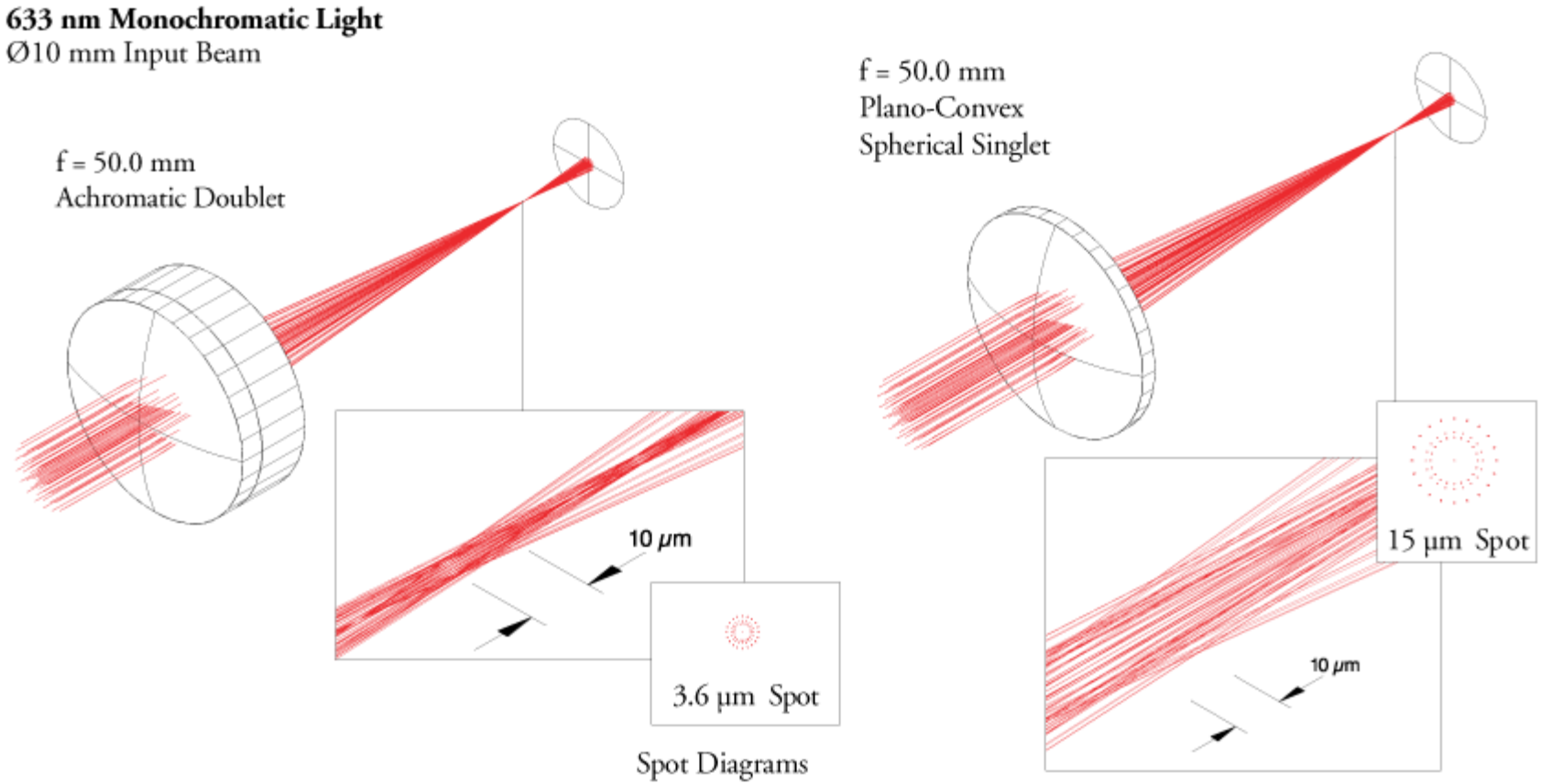


Fig 2c

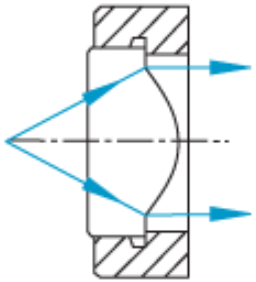
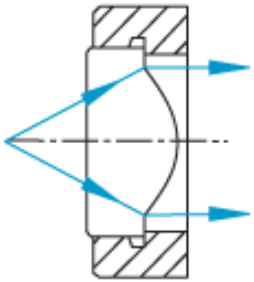
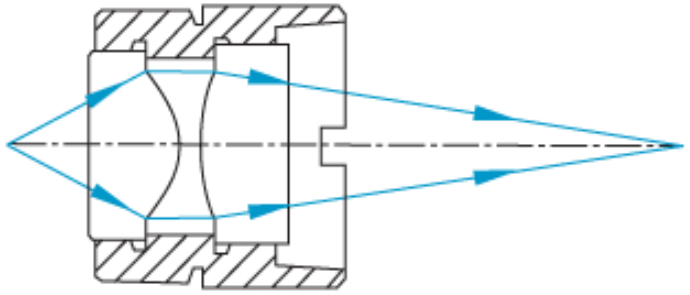
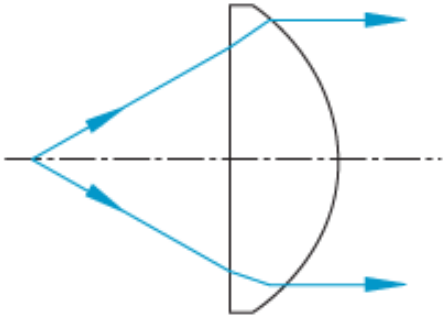
Ахроматические линзы



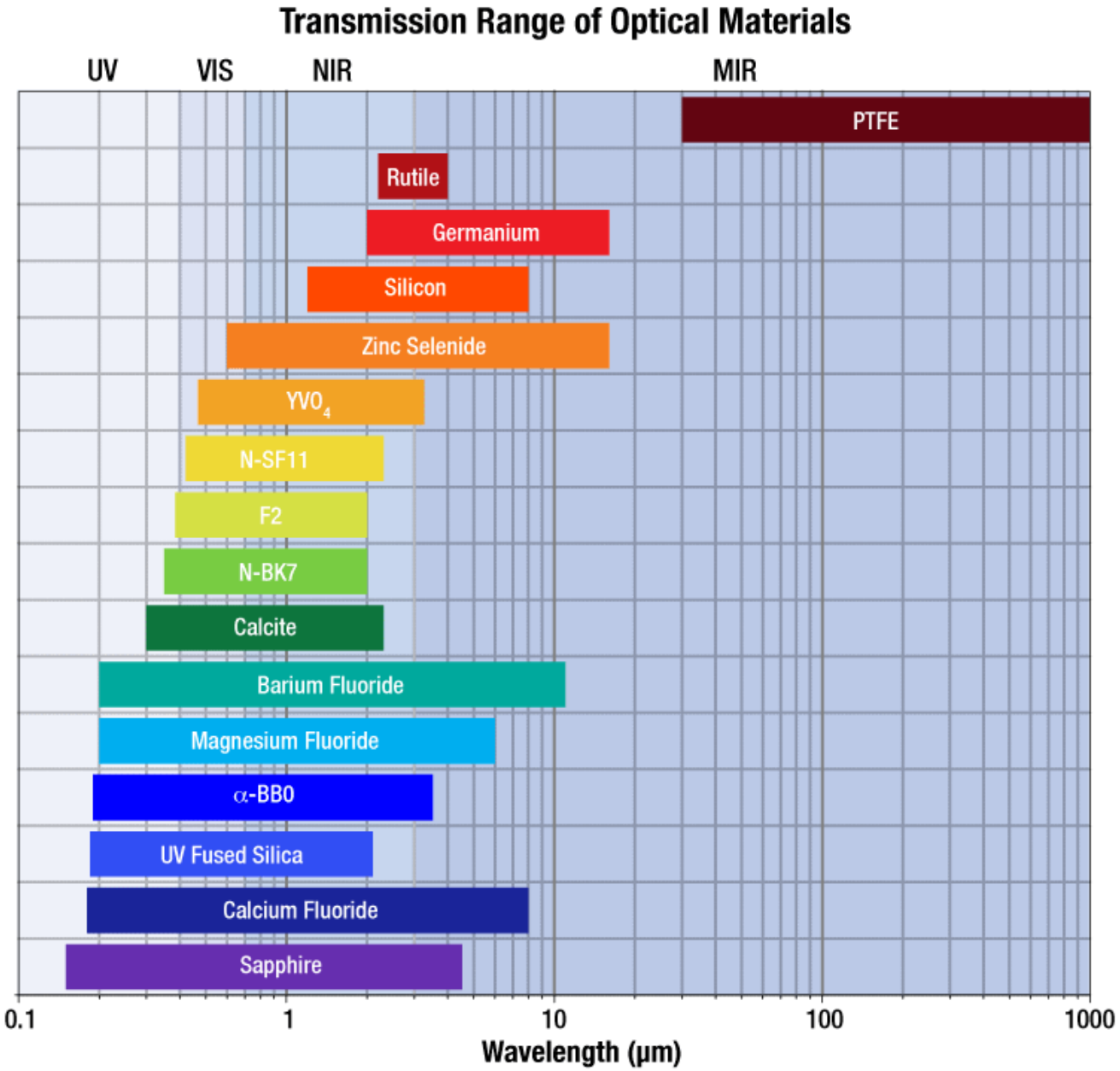
Ахроматические линзы



Асферические линзы

Aspheric Lenses	
Aspheric Lenses	**Aspheric Collimators**
	
Aspheric lenses focus or collimate light without introducing spherical aberration into the transmitted wavefront. Molded aspheric lenses are economical and available in both glass and plastic. For better performance, precision polished aspheric lenses introduce substantially less wavefront error and are offered with larger diameters.	Aspheric collimators are designed to collimate divergent light with diffraction-limited performance. We offer fixed focus and adjustable focus fiber collimators as well as laser diode collimation tubes.
Aspheric Lens Pairs	**Aspheric Condensers**
	
Aspheric lens pairs are designed for near aberration-free finite conjugate imaging. These pairs are ideal for image relay and magnification systems.	Aspheric condensers are designed for high-efficiency illumination applications. They offer reduced spherical aberration with large apertures and low f-numbers. They are ideal for collimating light from a lamp or LED.

Оптические материалы



Зеркала

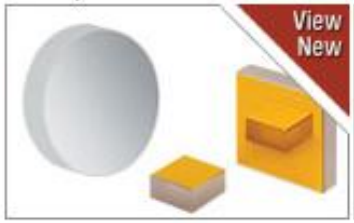
Broadband Dielectric Mirrors

Laser Line Mirrors

Ultrafast Mirrors

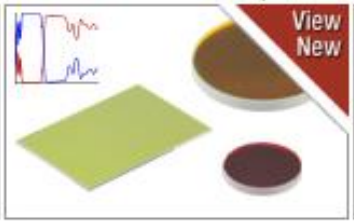
Plano Mirrors, Back Side Polished

Plano Metallic Mirrors: Round and Square

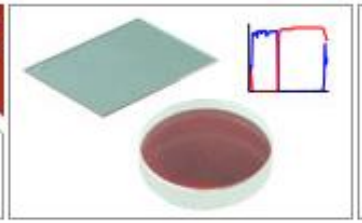


Crystalline Supermirrors

Dichroic Mirrors / Beamsplitters

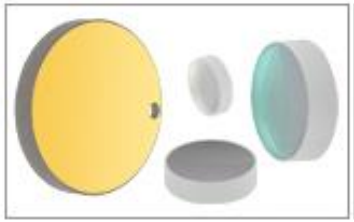


Hot / Cold Mirrors

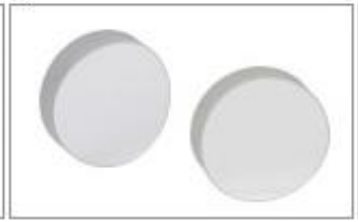


Harmonic Beamsplitters for Nd:YAG

Concave Mirrors

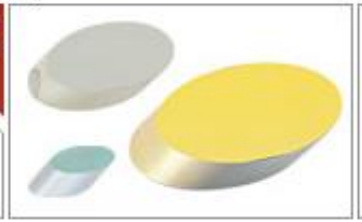


Cylindrical Concave Mirrors



Off-Axis Parabolic Mirrors

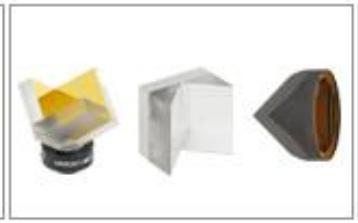
Elliptical Mirrors



D-Shaped Mirrors

Right Angle Prism Mirrors

Retroreflector Mirrors



Mirror Blanks

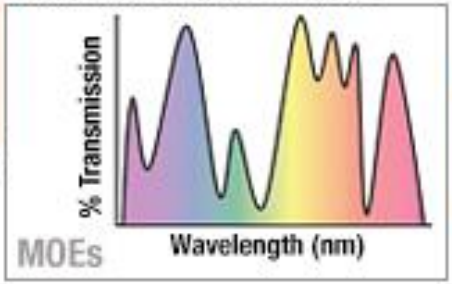
Mirror Systems

FiberBench Mirrors

Фильтры

Spectral Filters

Multivariate Optical Elements



Colored Glass Filters

Neutral Density Filters

Double Linear Polarizer Variable Attenuator

Spatial Filters

«Специальные» фильтры

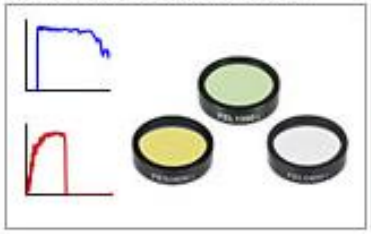
UV/Visible Bandpass & Laser Line Filters

NIR Bandpass & Laser Line Filters

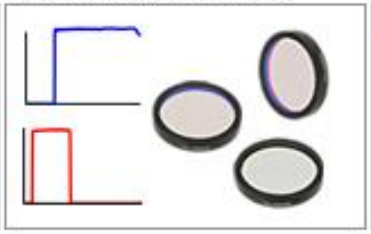
IR Bandpass Filters

Premium Hard-Coated Bandpass Filters

Edgepass Filters (Longpass and Shortpass)

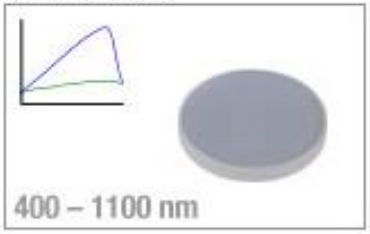


Premium Edgepass Filters

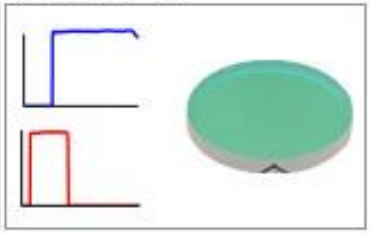


Notch Filters

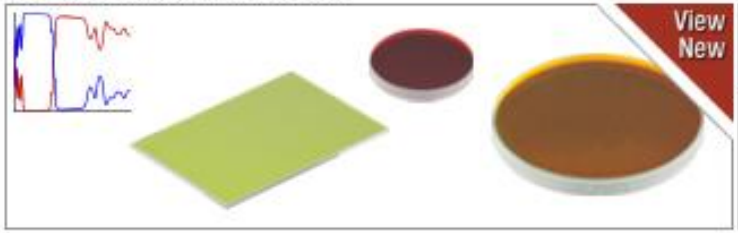
Response-Flattening Filters for Si Photodiodes



IR Blocking Filter



Dichroic Mirrors / Beamsplitters



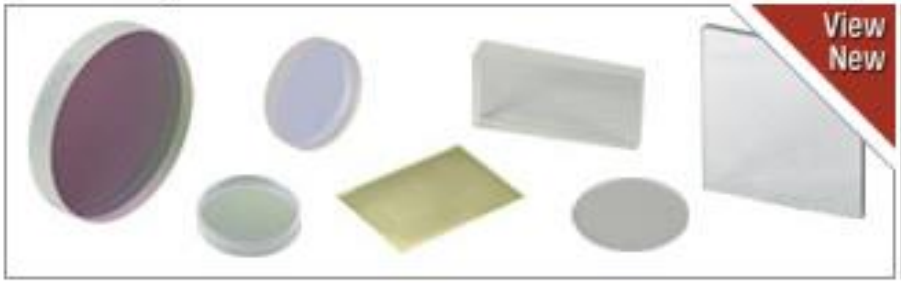
Fluorescence Imaging Filter Sets

Microscope Cubes with Pre-Installed Filter Sets

Dichroic Color Filters / Kit

Разделители пучка

Plate Beamsplitters

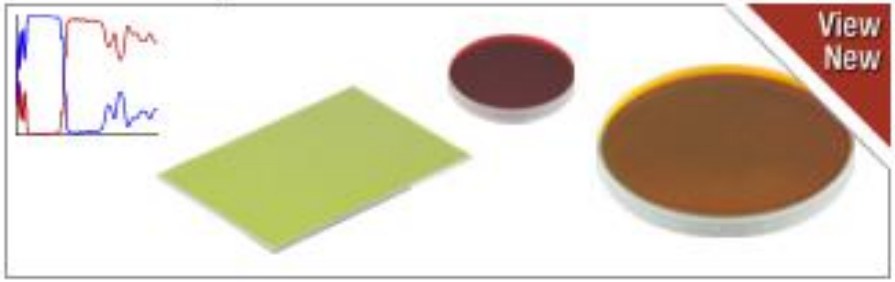


Cube Beamsplitters

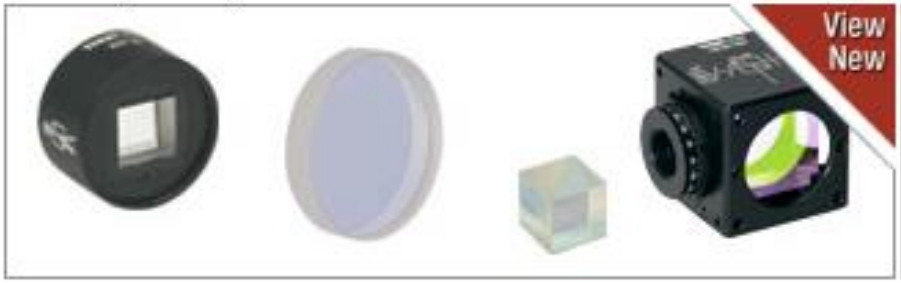
Pellicle Beamsplitters

Cube-Mounted Pellicle Beamsplitters

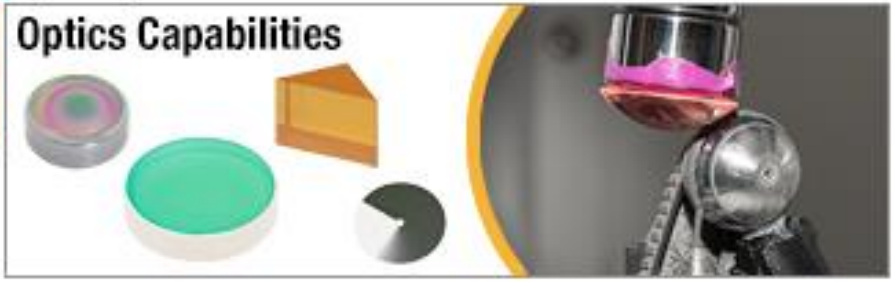
Dichroic Beamsplitters



Polarizing Beamsplitters

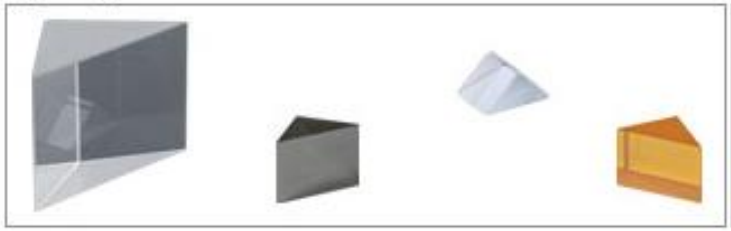


Optics Capabilities

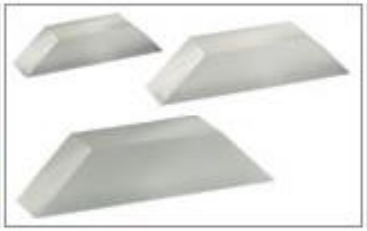


Призмы

Right-Angle Prisms



Unmounted Dove Prisms



Mounted Dove Prisms

Roof Prisms

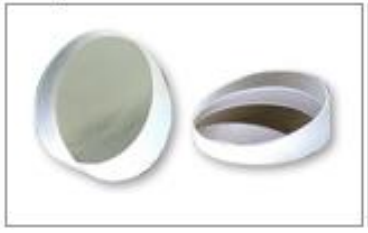
Retroreflector Prisms

Unmounted Penta Prisms

Mounted Penta Prisms

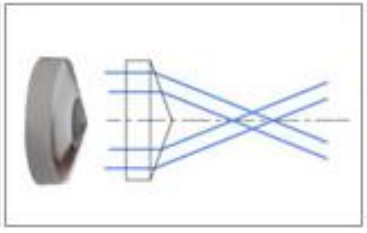
Coupling Prisms

Wedge Prisms



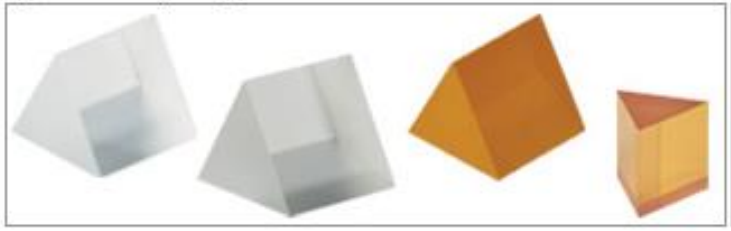
Anamorphic Prism Pairs

Rotationally Symmetric Prisms, UVFS



Rotationally Symmetric Prisms, ZnSe

Equilateral Dispersing Prisms



Dispersion Compensation Prism Pairs

Pellin Broca Prisms

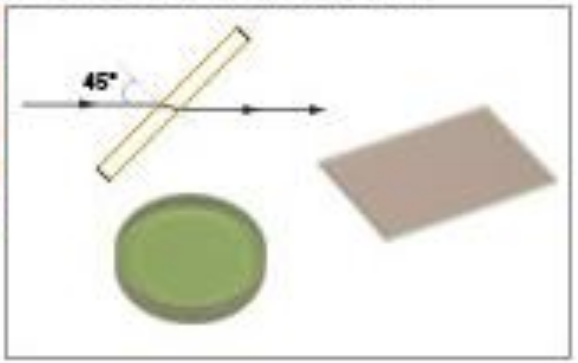
Fresnel Rhombs

Окна

Flat Windows

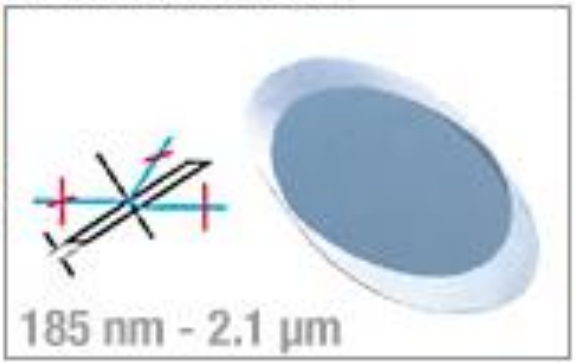
Wedged Windows

45° AOI UVFS Windows



High-Vacuum CF Viewports and Windows

Brewster Windows



Optical Substrates

Калибраторы

Resolution Test Targets

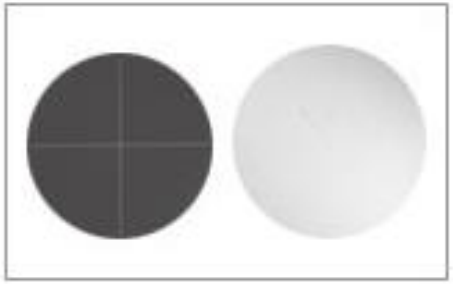
Distortion Test Targets

Slant Edge MTF Target

Fluorescent Slides and Disks

Calibration Targets

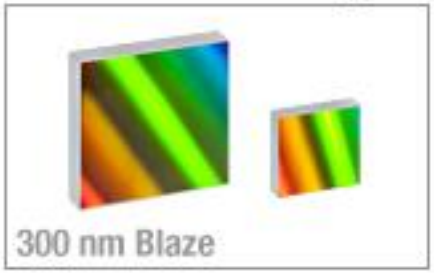
Reticles



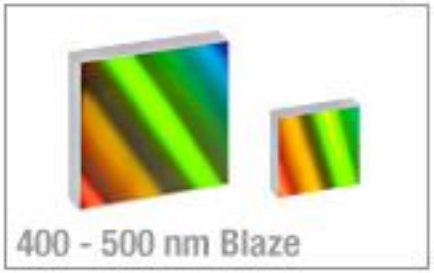
Annular Aperture Obstruction Targets

Дифракционные решетки

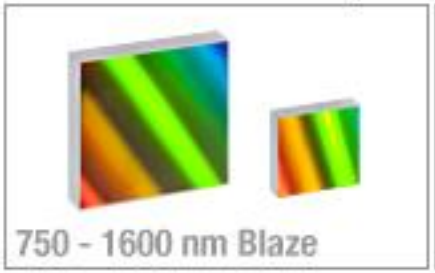
UV Ruled Reflective Gratings



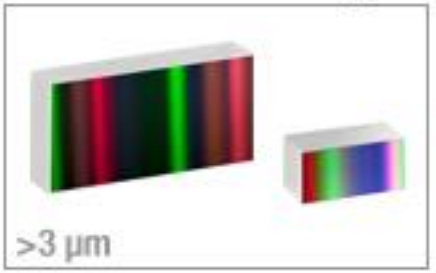
Visible Ruled Reflective Gratings



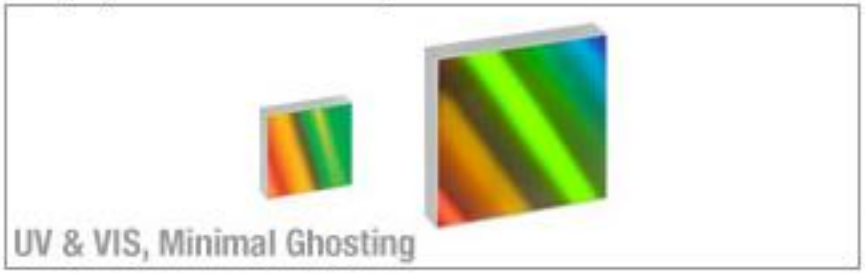
NIR Ruled Reflective Gratings



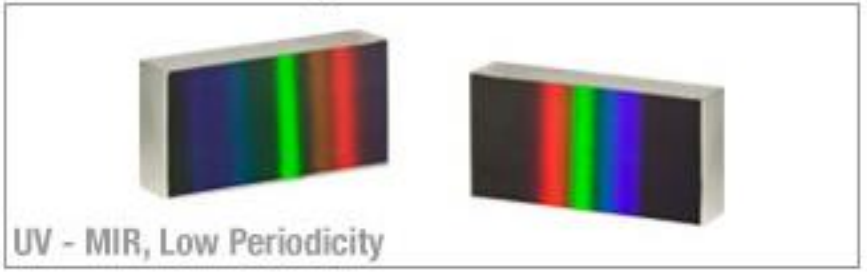
MIR Ruled Reflective Gratings



Holographic Reflective Gratings

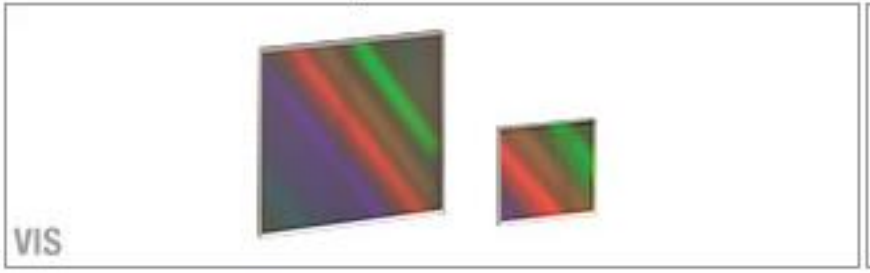


Echelle Reflective Gratings

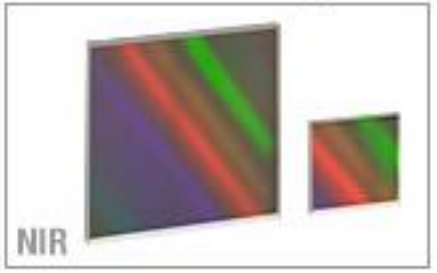


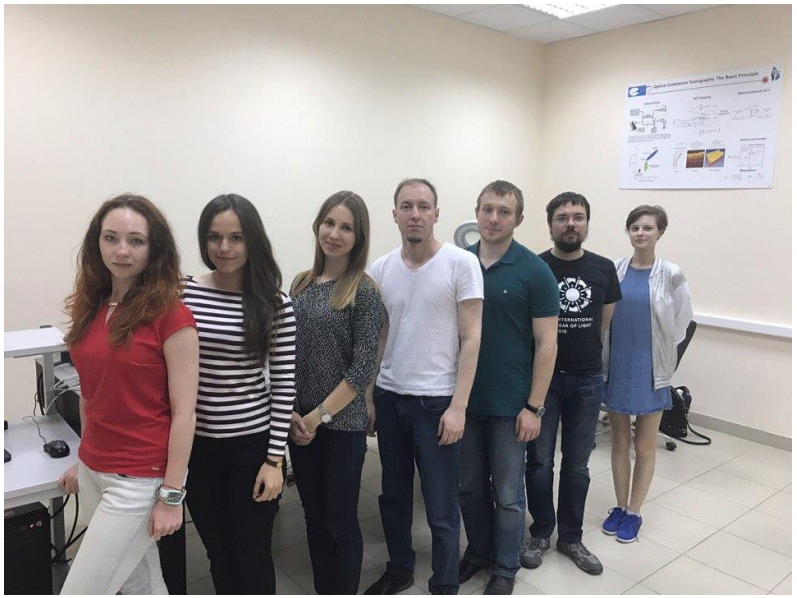
UV Transmission Gratings

Visible Transmission Gratings



NIR Transmission Gratings





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