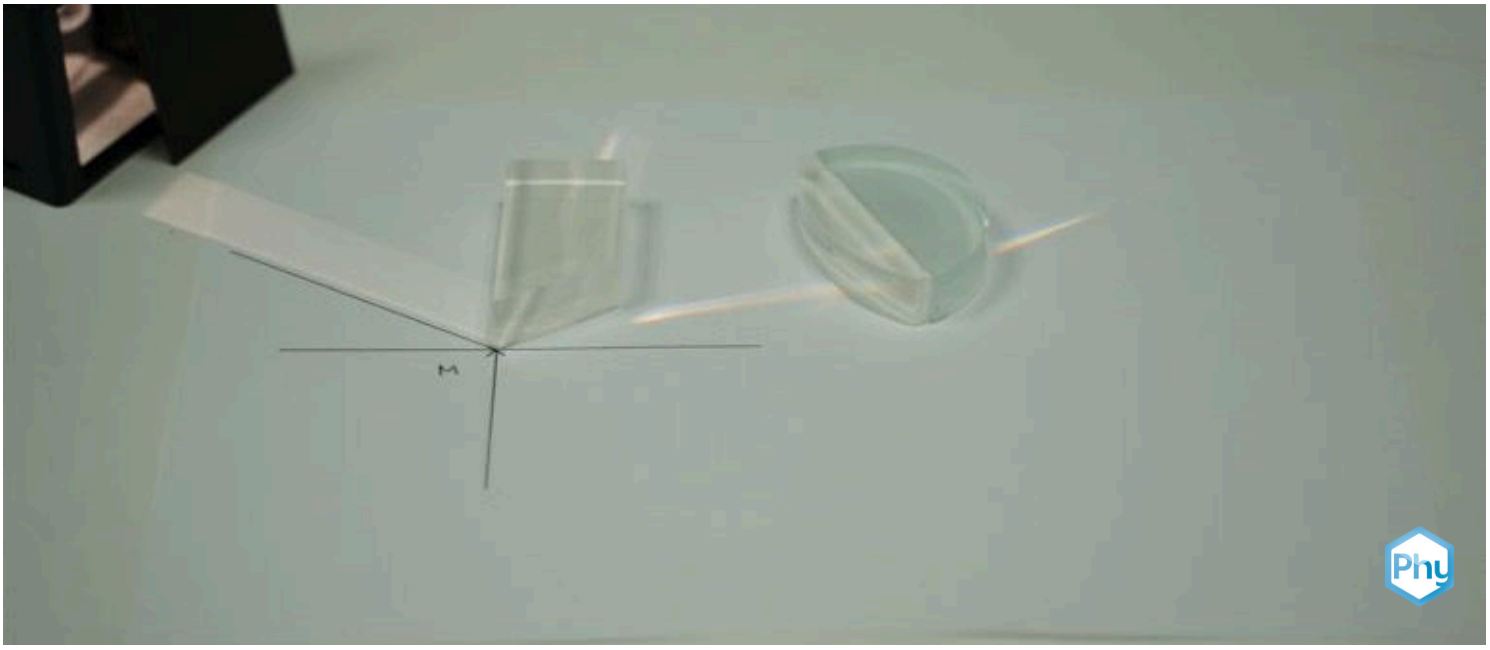
Reunification of spectral colours



Physics | Light & Optics | Light & Colour

Difficulty level	Group size	Preparation time	Execution time
easy	2	10 minutes	10 minutes

This content can also be found online at:

http://localhost:1337/c/5f4e6b6a38db8d0003265a08

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Teacher information

Application

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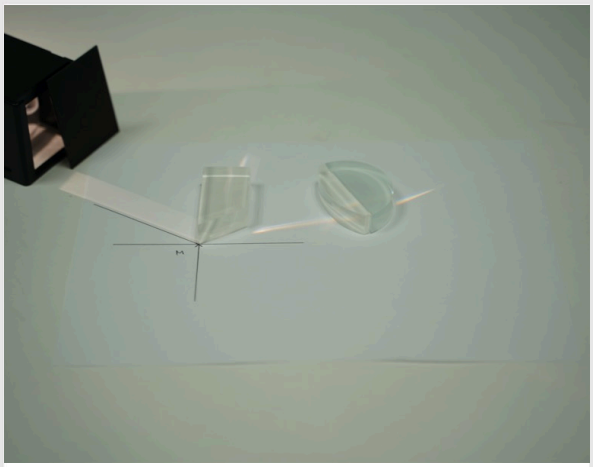

Experiment set-up

In this experiment, the students investigate the possibility of reuniting coloured light into white light. In addition to consolidating their knowledge of the dispersion of light on a prism, this will lay the foundation for understanding additive and subtractive colour mixing, without which many technical-optical phenomena known to the students cannot be explained (colour television, colour pictures, colour printing, etc.).

This experiment proves the correctness of Isaac Newton's idea about the composition of white light from different colours.

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Other teacher information (1/3)

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Scientific principle

The crosshairs and the auxiliary line for fixing the light box are necessary to achieve reproducible test setups that are as error-free as possible. When adjusting the light beam by turning the light box slightly, the teacher may need to be assisted.

In this experiment, the use of the single slit diaphragm was deliberately avoided in order to obtain light-intensive spectral colours that are also emotionally appealing to the students. In order to ensure that the continuous, unrefracted portion of the light does not interfere with the large light box opening, the light box opening is covered at the side, e.g. with half a single slit diaphragm or with a piece of paper. If the supplementary accessory for colour mixing (Order No. 09806-00) is available, the door panel contained in it can be used to appropriately limit the light box opening.

Other teacher information (2/3)

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Scientific principle

The observation of the reunion should be made in the area of the focal plane of the lens combination, since only there the white color impression occurs. Beyond the point of reunification, the colored light beams disperse again, but in an opposite color arrangement.

Note

The double semi-circular cuvette (09810-06) filled with water on both sides can also be used as a collecting lens.

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Other teacher information (3/3)

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Learning objective

The students should understand the principle of additive and subtractive colour mixing and combine this with their knowledge of light dispersion.

Tasks

Investigate the possibility of the reunion of white light, which is decomposed with a prism.

Safety instructions

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The general instructions for safe experimentation in science teaching apply to this experiment.

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Student Information

Motivation

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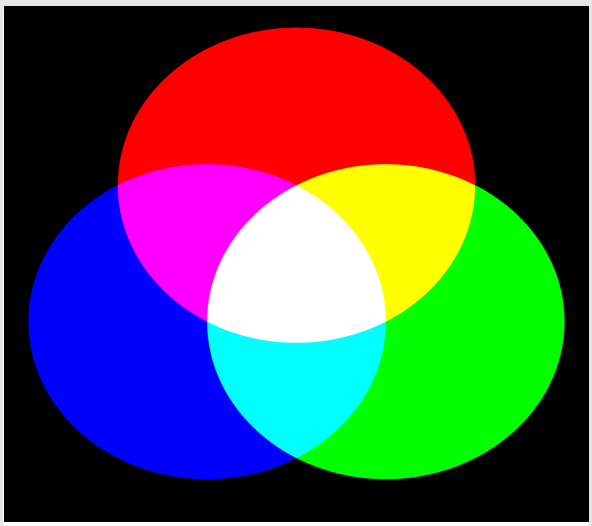

Additive colour mixing

Did you know that coloured light, when you mix it, appears white again? This phenomenon is called additive colour mixing. On the other hand, it is called subtractive color mixing when black appears by superimposing several colors.

Both are also called the union of spectral colors. These phenomena are used, for example, to create colours on television, and are also used in colour printing.

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Tasks

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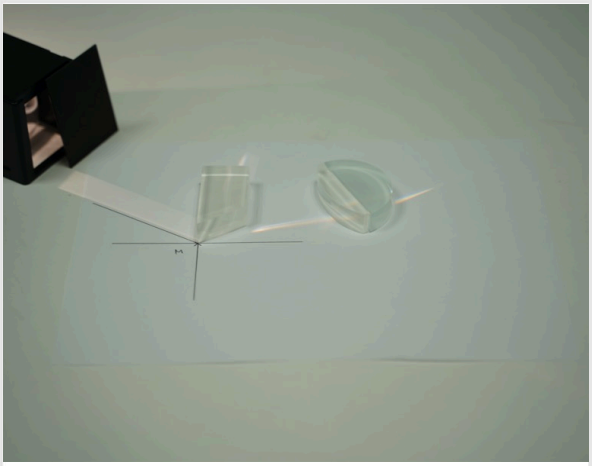

Experiment set-up

Investigate the possibility of the reunion of white light, which is decomposed with a prism.

Additional is required:

- White paper (DIN A4)
- Protractor
- Ruler (approx. 30 cm)

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Equipment

Position	Material	Item No.	Quantity
1	Light box, halogen 12V/20 W	09801-00	1
2	Block, semicircular	09810-01	1
3	Block, trapezoidal	09810-02	1
4	Block,planoconvex lens,fl+100mm	09810-04	1
5	PHYWE Power supply, 230 V, DC: 0...12 V, 2 A / AC: 6 V, 12 V, 5 A	13506-93	1

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Assembly - Attention!

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Make sure that the trapezoidal model body does not change its position when moving the light box.

Set-up

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Fig. 1: Draw a right-angled line cross in the left third of a sheet and mark the intersection with M. Mark the vertical line 6 cm above M.

At the intersection M of the lines, draw an angle of 28° and draw a guide line.

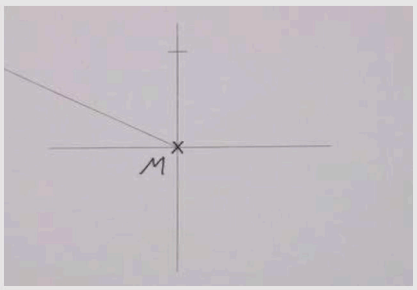
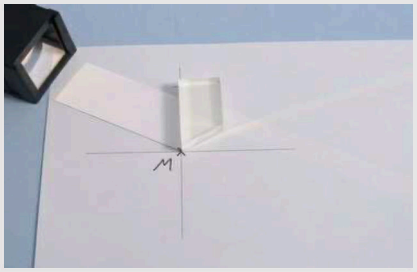


Fig. 2: Place the trapezoidal model body (roughened side down) on the vertical line between M and the mark. Draw the outline of the prism

Place the light box with the lens side but without the aperture diagonally above the model body.



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Procedure (1/3)

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Fig. 3: Connect the light box to the power supply unit (12 V ~)

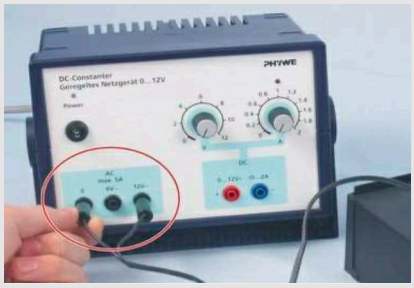
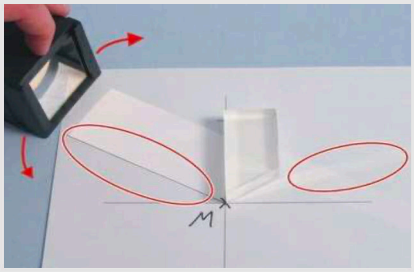


Fig. 4: Now move the light box until the lower shadow boundary is identical to the auxiliary line, observe the refracted light beam leaving the prism and correct the position of the light box by carefully rotating it if necessary. It is correct if the refracted light beam appears completely coloured and the violet part is also visible.



Procedure (2/3)

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Fig. 5: Cover about half of the opening of the light box so that the light only emerges from the sloping surface of the prism. Which colours can be observed? Write down your observations in the table in the protocol.

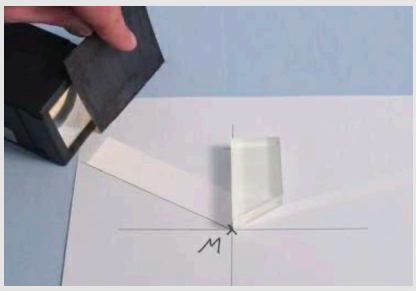
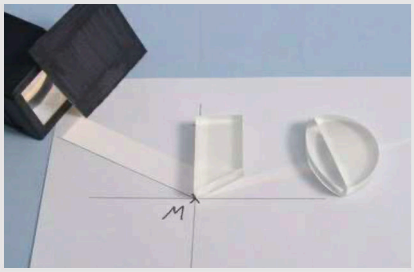


Fig. 6: Place the convex lenses with their flat surfaces next to each other in the colored refracted light beam as shown in Figure 6. Observe the course of the refracted light beam before and after passing through the lens combination and note your observations in the table.



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Procedure (3/3)

Fig. 7: Before entering the lens combination, stop out the red part of the colored light beam by holding a paper strip in front of the lens.

Watch the change in the combined colors and note your observations in the log.

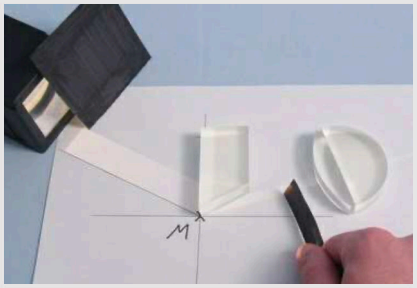
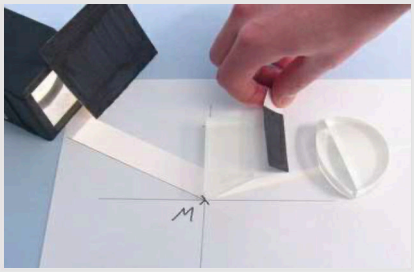


Fig. 8: Repeat this process, but now fade out the blue part of the spectrum before the lens combination.

Switch off the power supply and remove the model bodies from the paper.



Report

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Table

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Write down your observations in the table.

Experiment set-up	Observations
Light path without lens combination	
Lens combination in the light path	
Fading out the red area	
Blanking of the blue area	

Evaluation - Question 1

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What happens to white light when it passes through a prism?

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Evaluation - Question 2

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What changes occur when the colored light beam passes through a convex lens?

Evaluation - Question 3

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Why does a change in the color impression result when colors are faded out of the spectrum?

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Evaluation - Question 4

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Can coloured light be reunited?

Evaluation - Task 5

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Is a mixed colour, which is obtained by masking a spectral colour, further decomposable by dispersion?

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Task 1

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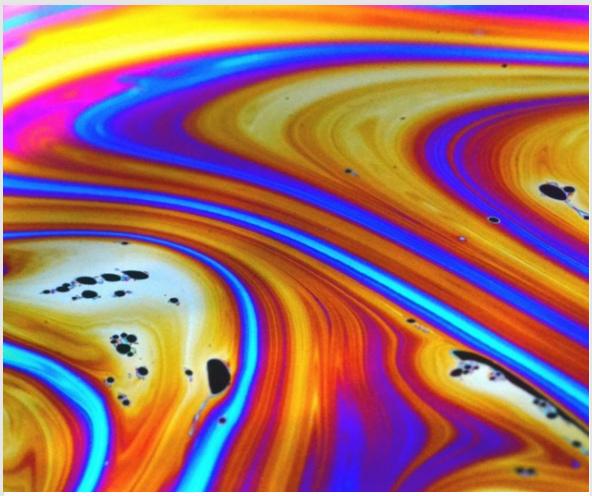
In additive colour mixing, light of different colours is directed to several points and overlaps.

○ True ○ Wrong

Check



Colours

Task 2

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Which of the following mechanisms is the union of spectral colours based on?

- ☐ Colors on smartphone displays
- ☐ Colour television
- ☐ Rainbows

Check

Rainbow

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Task 3

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Different colours are created through:

- molecules of different sizes
- distinct wavelengths

Flower field

Slide	Score / Total
Slide 23: Additive colour mixing	0/1
Slide 24: Unification of spectral colours	0/2
Slide 25: Colour formation	0/1

Total amount 0 / 4

Solutions | Repeat | Exporting text

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