Newton was right

The photon is a particle

Experiments with LCD – CRT flat screens
and
different formats of slits

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Experiments with LCD screens-CRT.

Introduction

In 12 pages, I present the results of experiments with slits and flat screens.
In the first 9 LCD screens, which generate polarized light, and in the last 4 CRT screens, unpolarised light.

 # Pages 2, 3, 4. The photos show us, ***it could not be otherwise***, the diffraction of the light through the edges of the slits in vertical strips, in the case of vertical slits. Three-colour or single-colour strips according to the frequencies of the incident light. A diagram that is already known from previous experiments, **Book I**.

 # Pages: end of 3 and beginning of 4. With horizontal orientation of the slits, we can see que the light multi-frequency is not diffracted in strips colour due to the polarisation of the light. It gives rise to white horizontal strips. If the light is of a single frequency, colour, in horizontal strips of said colour.

 # On page 4, we can see photos, ***a delight***, the result of changing the orientation of the slits and coloured strips in the screen.

On **page 5 and at the beginning of page 6, we interpret the results of the LCD-LED screen**

 # On page 6, at the end, and on page 7, ***we carry out an interesting experiment that allows us to confirm the foregoing results by means of successive diffractions.***

From **page 8,** we show the photos and explain results with **CRT**. The differentiating characteristics are: unpolarised light and the technique to achieve the colour.

Y… Newton was right

Experiments with slits and other devices, using as a light source an LCD / CRT screen.

Characteristics of the light source and limitations:

- The light that comes from the LCD screen is polarised. The plane of polarisation is horizontal. Perpendicular to the plane of the screen.
- The light that comes from the CRT screen is not polarised.
- We consider the section of the screen and the manner of producing the colours on interpreting the results.
- The experiments must be done at a short distance.
- The apertures are not usable due to the luminous intensity.
- The slits are made of aluminium (0.1 mm) and metal slits (0.5 mm). Single, double or triples
- The liquid crystal or led screens have the same characteristics. It is only noted in the quality of the images obtained.
- The results photographed with a digital camera, can be observed directly.

Experimental diagram.

We place a sheet of cardboard or black card parallel to the LCD/Led screen. In its central part, we open a small vent in which the place the slits. The results of the observations are the photos that we show, which were taken to an appropriately programmed digital camera. They must be taken at a short distance from the slits and the increases chosen that do not distort the results. To achieve the white or coloured screen, I have used Word, changing or not changing the colour of them. To do so, I have inserted a rectangle, filling it with different colours.

Unlike the experiments with linear light or Sp, we placed the slits directly on the vent. Unless we use variations of slits: S-D, D-S, D-D. The flat screens are made up of pixels and each pixel is a rectangle made up of contiguous vertical segments of a DSl/green/blue colour. That is, the function the first single slit performs with other light sources is now given us on the flat screens. Be it of the liquid crystal LCD or Led type, the pixels are manufactured in the same way. The CRT I use is a screen equipped with a shadow-masking tube, rounded phosphorus, attached to a glass plate.

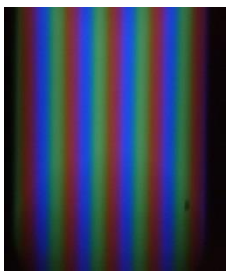
The light that exits the screen is **linearly polarised** on a horizontal plane, perpendicular to the plane of the screen. Easy to verify with an analyser.

LCD screen light source, slits in position vertical. Orientation Perpendicular to the plane of polarisation of the emergent light.

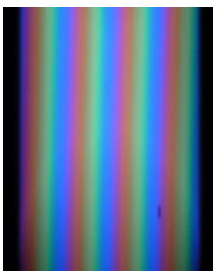
Single slits. The slits are at short distance from the screen and have appropriate conditions to obtain in the laboratory a valid semi-darkness. **Photos.**

@ 0.1 mm slit, the first two. Small increases.

Led screen

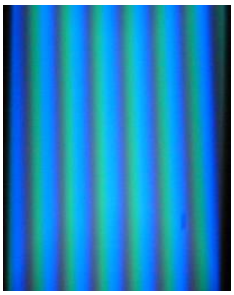
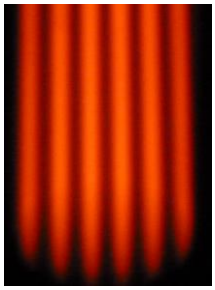


LCD screen



The only difference is the greater or lesser definition of the colours. Otherwise, they have the same format.

@ Same slit with the screen (LCD) blue background, DSl. We see that the blue background does not eliminate the green. The DSl background does eliminate the remaining colours.

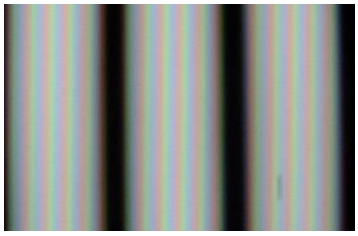
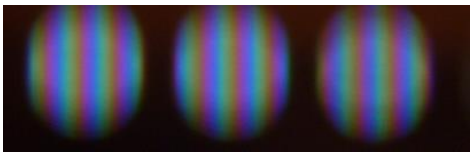
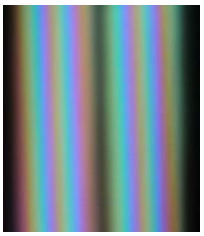
Experiments with double slits. Photos.

The slits are at short distance from the screen and have the appropriate conditions to obtain in the laboratory valid semi-darkness.

@ 0.1 mm double slits. 0.1mm separation. Led and LCD screen.


Experiments with triple slits. LCD. Photos.

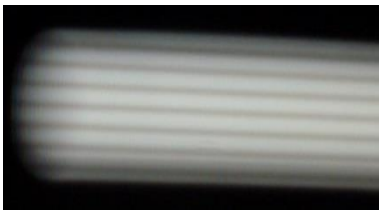
@ Triple slits: width of 0.5 mm separated 5 mm, length 3 cm / width of 0.1 mm separated 5 mm, length 2 mm. **The image on the right,** corresponds to the format: SSl (0.5mm) → DSl (0.1mm) + Ob.

Due to the distance between the slits, their images come out separated. When the separation of the slits is lesser, they are superimposed.

Experiments with LCD screen light source, slits in a horizontal position. Orientation parallel to the polarisation plane of the emergent light.

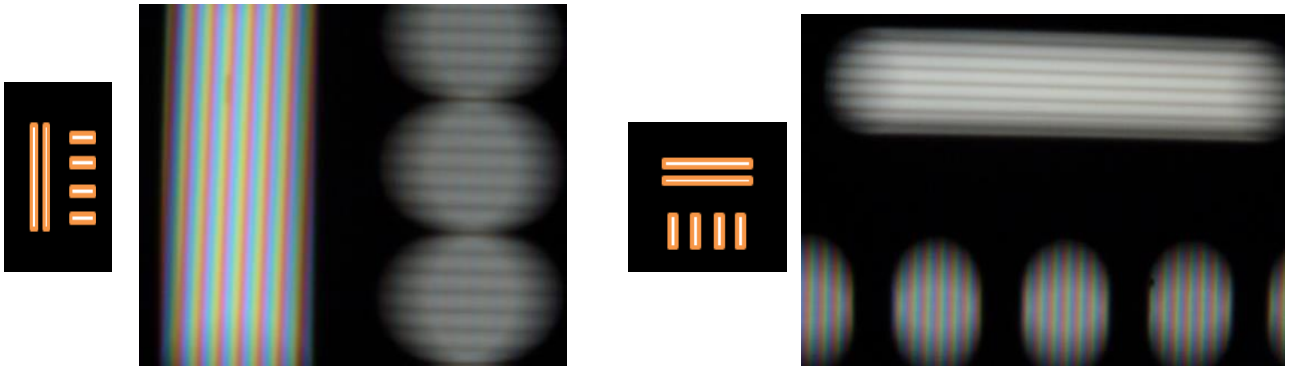
If the observation is made with a horizontal slit, there is no separation of colours and in there appear strips of a pearly white colour separated by other very narrow and slightly darker ones. That is, it does not separate, it fuses the colours to give the colour white and the dark lines correspond to the separation in the pixels of the section of the screen.




Horizontal orientation

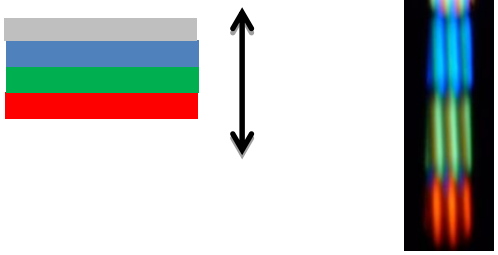
Vertical orientation

Both results are observed together if we have a double slit (0.1 mm) and three 0.1 mm slits X 2 mm. Circles in the photo due to the diffraction in the edges, are rectangles.



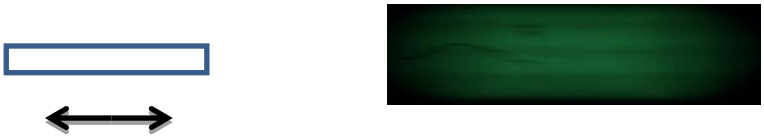
LCD screen. Single slit (0.1 mm), coloured strips. Different orientations

=> Four colours horizontal strips: W- Bl-G-R.



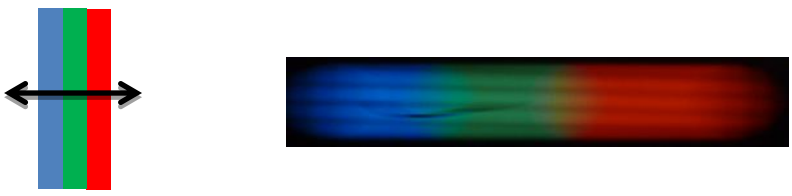
=> Colour blue, format per diagram:

=> Colour green, format per diagram:



=> Colour DSl, format per diagram:

=> Four colours vertical strips: Bl-G-R. Format per diagram:

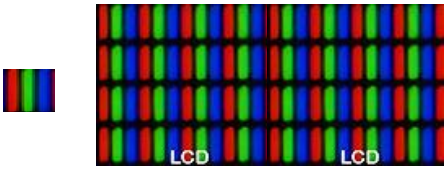


Theoretical interpretation of the results obtained

I. LED and LCD flat screen light source

Be it of the liquid crystal LCD or Led type, the pixels are manufactured in the same way, the only thing that varies is the later illumination of the plates. The light that exits the screen is **linearly polarised** on a horizontal plane, perpendicular to the plane of the screen. Easy to verify with an analyser.

For the research we are only interested in the generalities that occur in the results of the experiments carried out. In the figures, we see how it has a pixel screen section.



The manner of achieving white light and colours on the screen, is explained in the corresponding texts.

Comments:

A. The light coming from the screen is generated by segmented and vertical coloured lines that give rise to white light. The vertical slits separate the colours due to the diffraction of the photons, due to the electrons of the edges.

B. Due to the manner of producing white light, an initial slit is not necessary, as occurs in other linear light sources or Spb. The slits may be placed nearer or further from the screen. Having been observed with a digital camera and with the necessary increases, the decomposition is observed. Let's remember that the light produced is completely polarised.

C. If we photograph a white or coloured flat screen with a camera digital, we obtain a white or coloured photo, regardless of the increases we use. We observe nothing of interest.

D. If we place single/double slits in front of the camera of a width of 0.5 mm to 0.1 mm and **vertical orientation**, we obtain the following effects:

1. Fused vertical strips with separation of the colours of the section.

2. The greater the number of strips the narrower the slit or the slit is double.

3. There is no dark horizontal separation, the section of pixels there is. That is, the strips are continuous in the vertical direction. This effect is due to the diffraction caused by the edges of the slit on the photons. P. 1, 2

4. If the screen is single-coloured, the strips are, too. P. 3, 4.

5. If we use fused horizontal strips of different colours we can observe that the strips in the photos follow the format of the screen section, R/G/Bl. An effect that is due to the diffraction caused by the edges of the slit on the photons. P. 2, 3.

6. To obtain horizontal strips of different colours, I use WORD: Insert one rectangle, two, three,… and fill them with different colours.

7. The photographic images are equal on both types of screen. The difference is a greater definition of the colours and intensity in the Led. It should not have been otherwise.

E. If we place single/double slits in front of the camera of a width of 0.5 mm to 0.1 mm and **horizontal orientation**, we obtain photos with the following characteristics:

1. Horizontal strips of a milky White colour separated by darker lines.

2. There is no separation of colours in the pixels of the section/screen.

3. The dark horizontal lines correspond to those that horizontally separate the section.

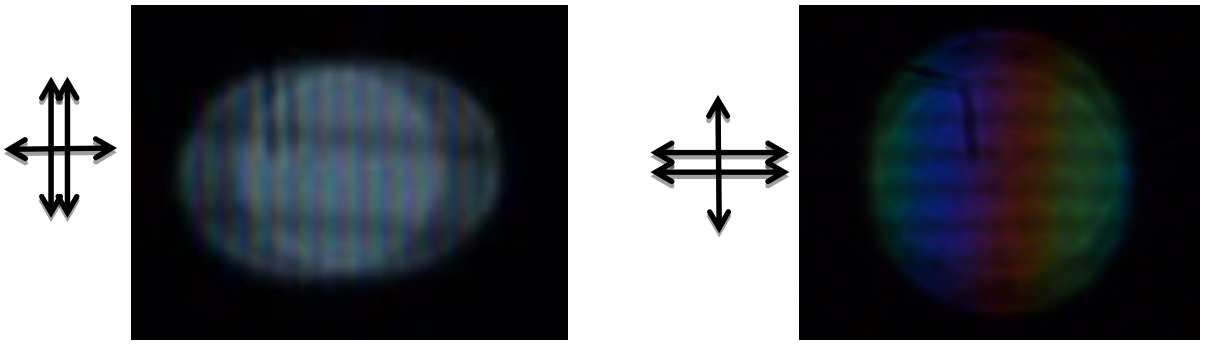
4. The polarisation of the photons and the orientation of the edges of the slit causes these to not be diffracted. In consequence, the strips are white.

***We can verify all of this in the photos on pages 2-3 and simultaneously observe the results of the vertical/slits and horizontal/slits*.**

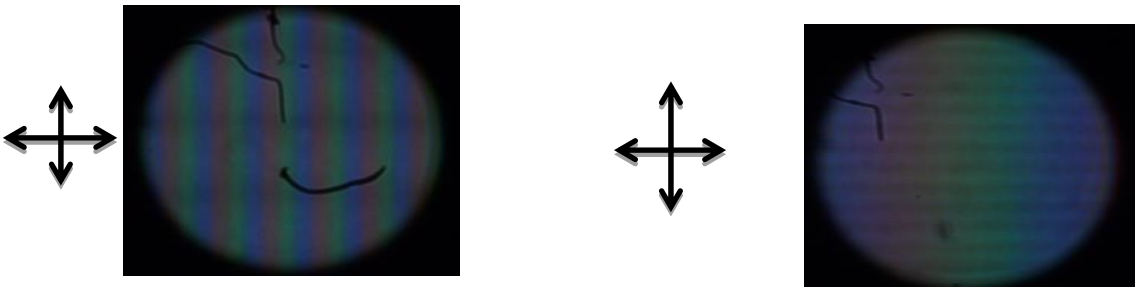
F. If we place single/double slits in front of the camera with a width of 0.5 mm a 0.1 mm and **horizontal / vertical orientation**, vertical / horizontal, we have:

Formats and photos:

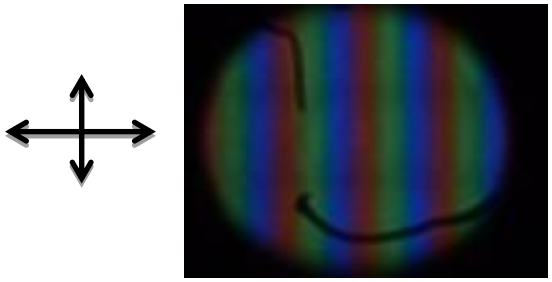
I. H/S/S + V/D/S → Camera. 0.1 mm S # V/S/S → H/D/S → Camera. 0.1 mm S.



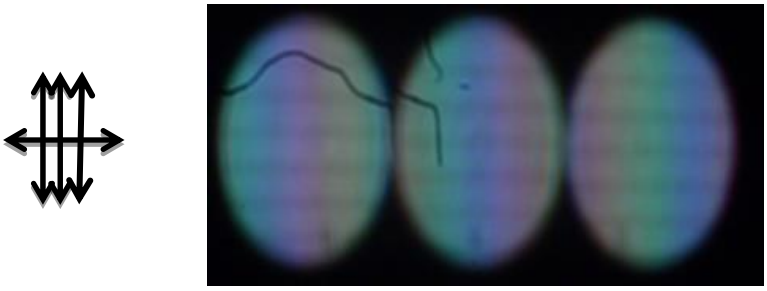
II. H/S/S + V/S/S => Camera. 0.5 mm S # V/S/S + H/S/S → Camera. 0.5 mm S



III. H/S/S, (0.5 mm) + V/S/S (0.1mm) => Camera



IV. H/S/S + R/ T/ V => Camera. 0.5 mm S.



Interpretation of results.

I. **H/S/S → V/D/S**. The first horizontal slit no produce diffraction of the light, that comes from the screen, in vertical strips of colour R/G/Bl. It gives rise to pearly horizontal strips. This diffraction does not change the polarisation of the photons.

The second double slit diffracts and separates the photons, according to their frequency, into vertical strips: R/G/Bl. Since it is a double slit, we can observe the superimposition of the two slit diffractions. That is, it gives the same results, with unimportant nuances, as the screen + vertical slit sequence.

The vertical strips have superimposed on them horizontal dark strips. These correspond to the separations of the pearly strips caused by the first, they do not break the continuity of the vertical ones and they are seen as a shadow on the colours.

II. V/S/S → H/S/S. Having analysed the photo we know that the first slit (V) diffracts the polarised light into fused vertical strips R/G/Bl.

The second double horizontal slit cannot cause, due to the polarisation and its orientation, a new diffraction. It makes the horizontal strips wider with the same colours, giving rise to fewer, but wider, strips. We continue to observe horizontal dark separation lines in the screen pixels.

We see the superimposition, double slits, which due to the format are vertical.

III-IV. Photos explicable with what is written in **I and II**.

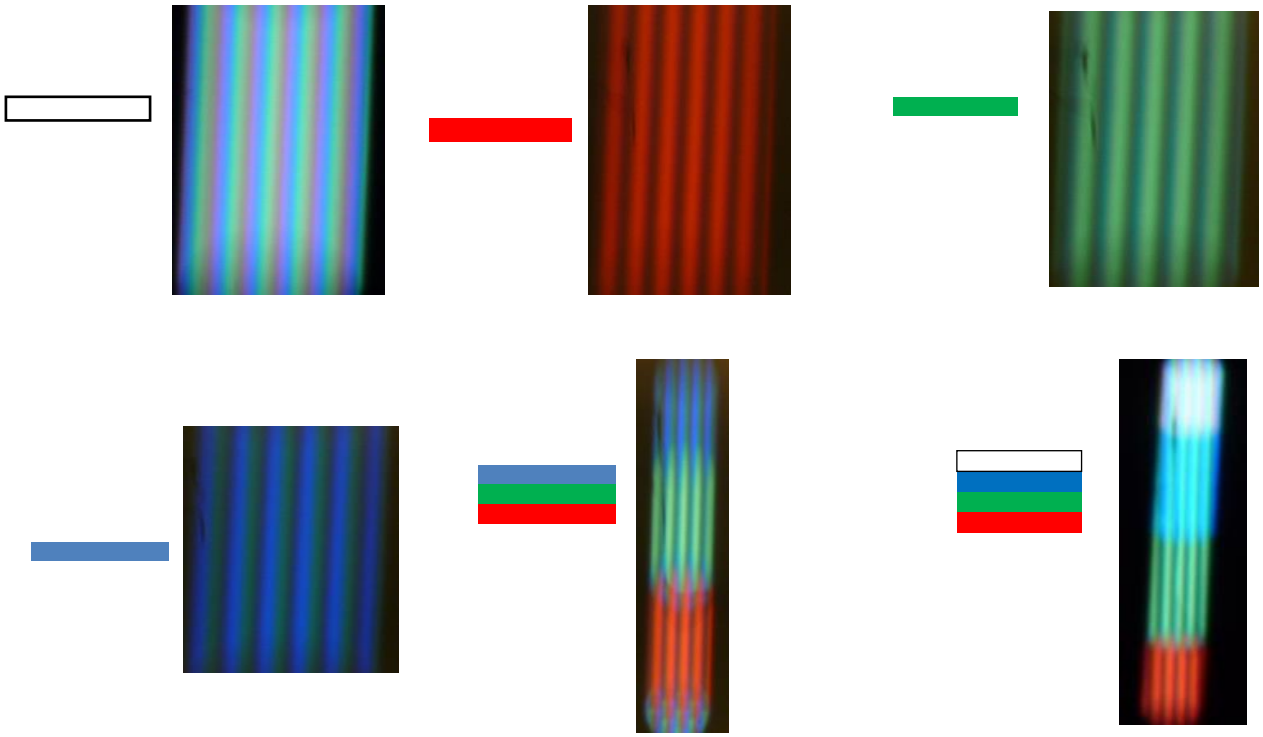
One ought finally to highlight that the black strips that appear on the photos are not diffractions. It is a deterioration of the camera.

Experiments with slits, using as a light source CRT screens.

CRT model used. *Proview DX-997N.* 19-inch monitors. The screen is equipped with a shadow-masking tube (colour), which is attached to a glass plate.

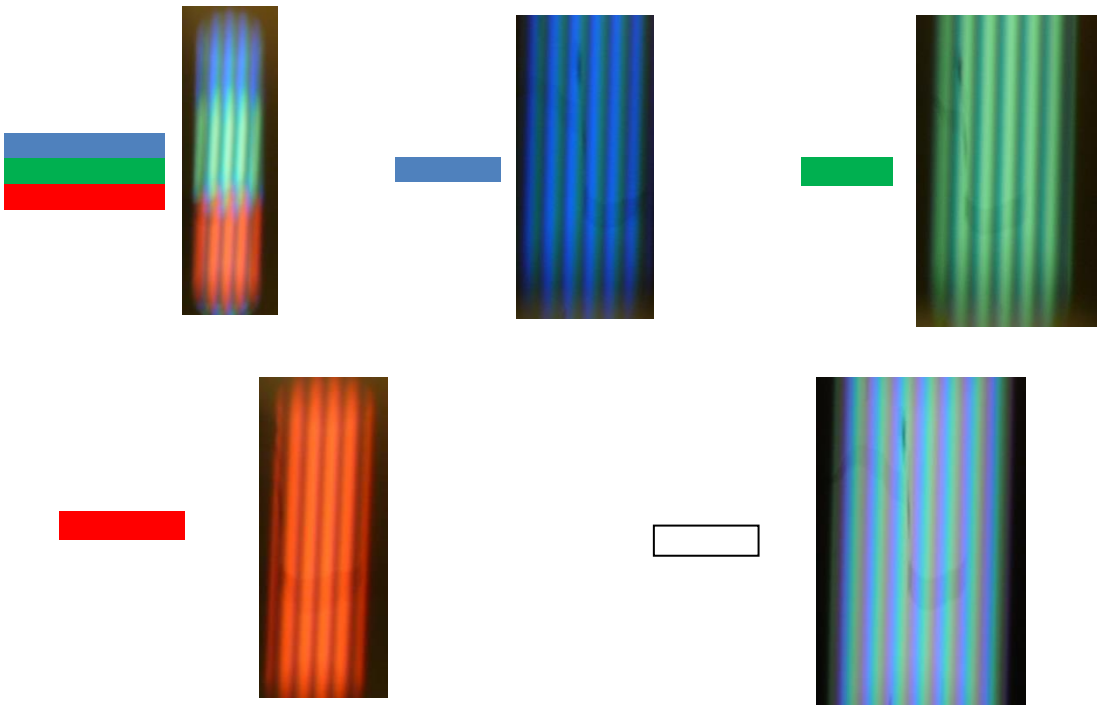
What is set out on page one is valid. What most stands out is that the light coming from a CRT screen, is not polarised.

@ Experiments with single 0.1 mm vertical slit. Colour of the screen on the left.

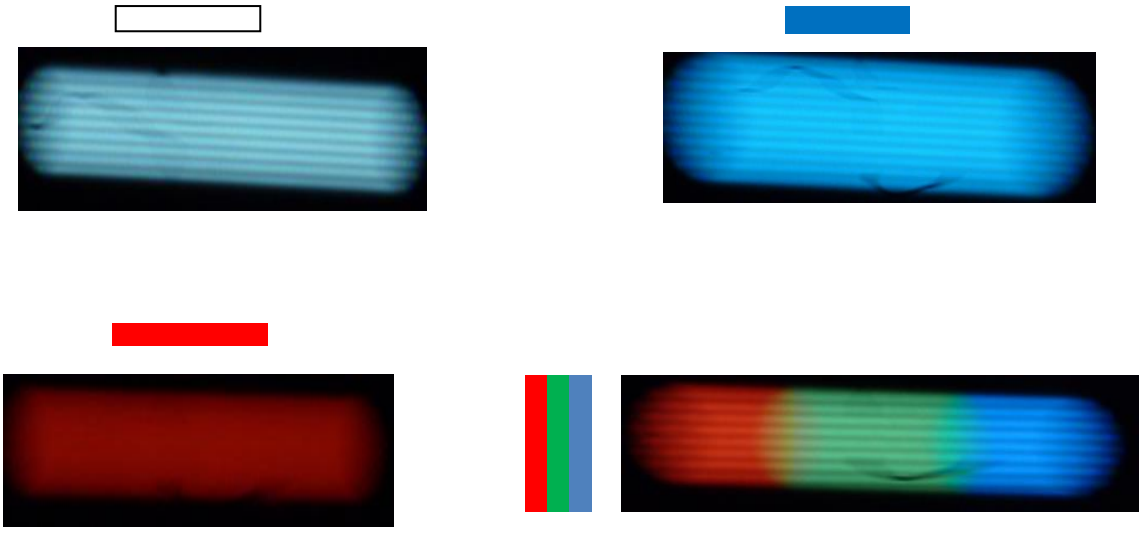


Experiments with double 0.1 mm vertical slit.

Colours of the screen and photographic result:



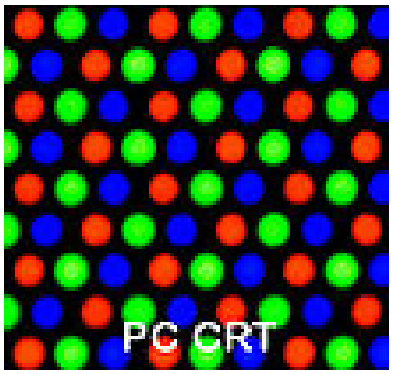
@@ Experiments with single 0.1 mm horizontal slit.
With the horizontal slit and colours indicated on the left of the photos, we obtain:



Interpretation of the results obtained with CRT.

Cathode ray tube screen, CRT. Format.

I have carried out the experiments using a 19" Proview DX-997N model CRT monitor.
The screen is equipped with a shadow-masking tube which is attached to a glass plate.
Characteristics of the colour screen:



For the colour screens, the electron beams (from three different cathodes) each impact on a point with a specific colour: DSl, green and blue (RGB). The three colour points are called **triad** (or *trio of points*).
The blue phosphorus ones use zinc sulphide, while the green ones use zinc sulphide and cadmium sulphide. The DSl ones are difficult to create and are made of a mixture of yttrium and europium, or gadolinium oxide.
However, these phosphorus ones are so close to each other that the eye does not manage to separate them enough to be able to differentiate the; see a single colour made up of these three colours. If you wish, try pouring a small drop of water on the glass of your screen: the drop will enlarge the phosphorus ones and thus you will be able to see them.
Moreover, to prevent the blurring effect (when an electron that is going to strike a green phosphorus one, it instead impacts on a blue one), a metal grille called a **shadow mask** is placed in front of the phosphorus layer to guide the electron current.
It is important to remember that the light coming from a CRT screen <u>is not polarised.</u>

Interpretation of results.

A. From the observation of the photos obtained, using single vertical slits p. 4, we discovered that the slit causes diffraction of the photons and their separation of frequencies into vertical strips R/G/Bl, if the screen is white. If the screen is coloured (a single frequency) the diffraction causes separated strips of the same colour.
Due to the manner of generating the colours, the photos are not as clear, nor is the separation of colours (frequencies) as precise as in a LCD screen.

B. The same can be seen in the double vertical slit photos. The comments in section A are valid.

C. In the experiments with single horizontal slits, the light of the screen is not polarised, it does not generate a pearly effect in the diffraction horizontal strips. In the photos, p.5, we can see horizontal strips:

- Of a blueish colour if the light is white

- Of the screen colour used.

These results continue to illustrate that the diffraction of the photons is caused by the electrons of the atoms that make up the edges of the slit:

 # Vertical slit = diffraction in vertical strips.

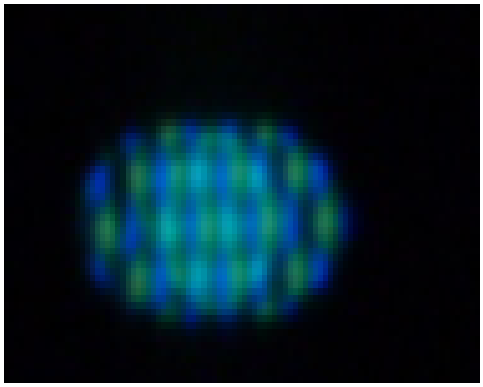
 # Horizontal slit = diffraction in horizontal strips.

D. If we experiment with single/double slits with a width of 0.5 mm a 0.1 mm and **horizontal / vertical orientation and different formats**, we have:

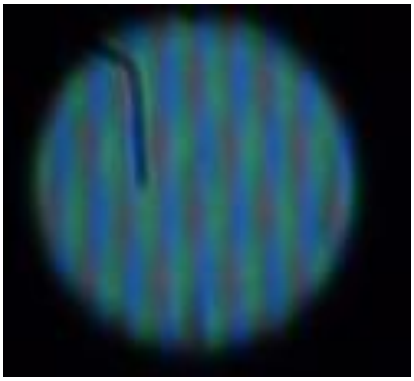
Double 0.1 mm vertical slit

Double horizontal slit 0.1mm

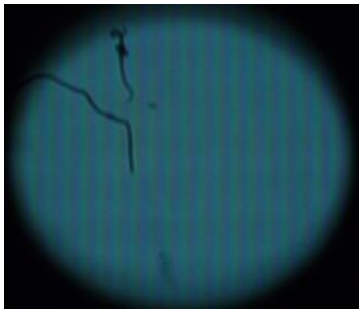
***** H-S-S. (0.1mm) + V-D-S. (0.1mm)



***** H-S-S.(0.5mm) + V-S-S.(0.1mm)



H-S-S.(0.5mm) + V-S-S. (0.5mm)



We discuss the photographic results:

→ R-D-V. (0.1mm): diffraction in R-G-Bl vertical strips

→ R-D-H. (0.1mm): diffraction in blueish-coloured horizontal strips. The light is not polarised and this is the result.

→ R- S-H. (0.1mm) + R-D-V.(0.1mm): diffraction through the first slit superposition diffracted through the second. We can see the coloured points of the section.

→ H-S-S. (0.5mm) + V-S-S. (0.1mm): diffraction through the first slit, diffracted through the second. We can see the coloured points of the section.

→ H-S-S. (0.5mm) + V-S-S. (0.5mm): diffraction through the first and second slit. We have an image as if it were of a single slit on the screen.

Interesting observations for the interpretation according to theory.

A slit oriented horizontally means that the greater dimension is the horizontal. In this case, the diffraction gives rises to horizontal strips of a blueish colour.

If the second slit has a vertical orientation, the greater dimension is the vertical, we observe in the photos that:

The results of the diffraction again separate the colours and the coloured points of the section can be seen, there are no strips. In the format with 0.5mm slits, the final photo they can.

We make the corpuscular interpretation of the results, coherent with the theory, in Volume IV.

The electrical fields of the atoms at the edges of the slits cause these results. Experiments may be carried out with greater precision. The results would be the same. Do the waves and associated things have an alternative valid explanation?

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