About the refraction of light in relation to curvatures

Introduction

The law of refraction (not diffraction) of light, which would much later come to be known as Snell's law was first accurately described by the scientist Ibn Sahl at the Baghdad court in 984. In the manuscript On Burning Mirrors and Lenses, Sahl used the law to derive lens shapes that focus light with no geometric aberrations.[1][2]

The effects of refraction of light were first carefully observed and characterized by Francesco Maria Grimaldi, who also coined the term diffraction, from the Latin diffringere, 'to break into pieces', referring to light breaking up into different directions. The results of Grimaldi's observations were published posthumously in 1665.[3][4][5] Isaac Newton studied these effects and attributed them to inflexion of light rays. James Gregory (1638–1675) observed the refraction patterns caused by a bird feather, which was effectively the first refraction grating to be discovered.[6] Thomas Young performed a celebrated experiment in 1803 demonstrating interference from two closely spaced slits.[7] Explaining his results by interference of the waves emanating from the two different slits, he deduced that light must propagate as waves. Augustin-Jean Fresnel did more definitive studies and calculations of refraction, made public in 1815[8] and 1818,[9] and thereby gave great support to the wave theory of light that had been advanced by Christiaan Huygens[10] and reinvigorated by Young, against Newton's particle theory.

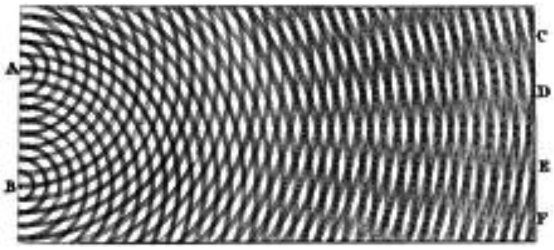


Fig. 1, Thomas Young's sketch of two-slit refraction, which he presented to the Royal Society in 1803.
https://en.wikipedia.org/wiki/Diffraction

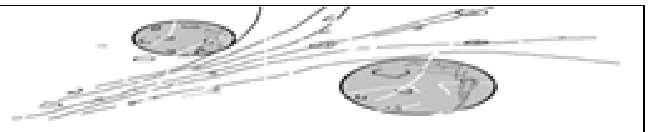
Since the introduction of laser light the refraction of light can be observed in a more accurate way.

When we look closely we see that the patterns do not suggest wave patterns. It becomes obvious that the phenomena are –in our opinion- cause by scattered light particles due to the influence of curvatures of specific atoms that are present in the material needed to create the used slits. Figure 1 can also be seen as an image of the curvatures that that exist at the edges of the slits (A and B). The curvatures are –in our opinion- caused by the electrons that surround the atoms of the used material to create the slits.

These curvatures follow the characteristics as described in the article published on the internet by Gerhard Jan Smit and Jelle Ebel van der Schoot on November 20, 2016 (www.dbuniverse.org).

A direct consequence of the described idea is that different materials will give a different refraction pattern. This seems indeed the case.

In this article we will first describe the electron shells around nuclei, followed by the description of the phenomena “light refraction”. We end with a few conclusions.

A cloud of meteorites floating between two planets.	

Electron shells around nuclei

In chemistry and atomic physics, an electron shell, may be thought of as an orbit filled with electrons that are circling around a nucleus. The closest shell to the nucleus is called the s-shell, followed by the p-shell, then the d-shell, the f-shell and the g-shell and so on further and further from the nucleus.

Each shell consists of one or more subshells, and each subshell consists of one or more atomic orbitals (See Madelung rule for more details [12]).

Each subshell is constrained to hold $4\ell + 2$ electrons at most, namely ($\ell = 0, 1, 2, 3$ ….):

- Each **s** (sharp) subshell holds at most 2 electrons;
- Each **p** (principal) subshell holds at most 6 electrons;
- Each **d** (diffuse) subshell holds at most 10 electrons;
- Each **f** (fundamental) subshell holds at most 14 electrons;
- Each **g** (next in alphabet after f) subshell holds at most 18 electrons.

https://en.wikipedia.org/wiki/Electron_shell

Table 1: Shells around specific nuclei

Atomic number (z)	Element	Subshell (electrons in subshell), Madelung energy ordering rule	Amount of subshells according to Madelung [12]	Amount of shells only looking at s, p, d, f
3	Lithium	$1s^2\ 2s^1$	2	1 (s)
4	Beryllium	$1s^2\ 2s^2$	2	1 (s)
6	Carbon	$1s^2\ 2s^2\ 2p^2$	3	2 (s, p)
11	Sodium	$1s^2\ 2s^2\ 2p^6\ 3s^1$	4	2 (s, p)
12	Magnesium	$1s^2\ 2s^2\ 2p^6\ 3s^2$	4	2 (s, p)
13	Aluminium	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^1$	5	2 (s, p)
19	Potassium	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^1$	6	2 (s, p)
20	Calcium	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2$	6	2 (s, p)
22	Titanium	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^2$	7	3 (s, p, d)
26	Iron	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^6$	7	3 (s, p, d)
29	Copper	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^9$	7	3 (s, p, d)
30	Zinc	$1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^{10}$	7	3 (s, p, d)

Table 2: Filling orbitals (orb.) according to Madelung energy ordering rule

Filling orbitals (orb.) according to Madelung energy ordering rule [12]

(N: total amount of electrons, E: element)

Orb.	$1s^2$	$2s^2$	$2p^6$	$3s^2$	$3p^6$	$4s^2$	$3d^{10}$	$4p^6$	$5s^2$	$4d^{10}$	$5p^6$	$6s^2$	$4f^{14}$	$5d^{10}$	$6p^6$
N	2	4	10	12	18	20	30	36	38	48	54	56	70	80	86
E	He		Ne		Ar			Kr			Xe				Ra

Note that Helium, Neon, Argon, Krypton, Xenon, Radon and Organesson are noble gasses. They all have in common that the p-orbital is completely filled with electron or in case of Helium completely empty.

Madelung rule: https://en.wikipedia.org/wiki/Aufbau_principle#The_Madelung_energy_ordering_rule

Light refraction

The sketch (fig. 2) shows the setup for a refraction experiment using a single slit. Notice the broad central maximum, and the equally spaced, successively weaker maxima on either side.

Fig 2. Setup refraction experiment
http://www.animations.physics.unsw.edu.au/jw/light/single-slit-diffraction.html#1

In the following figure (fig. 3) multiple slits are used.

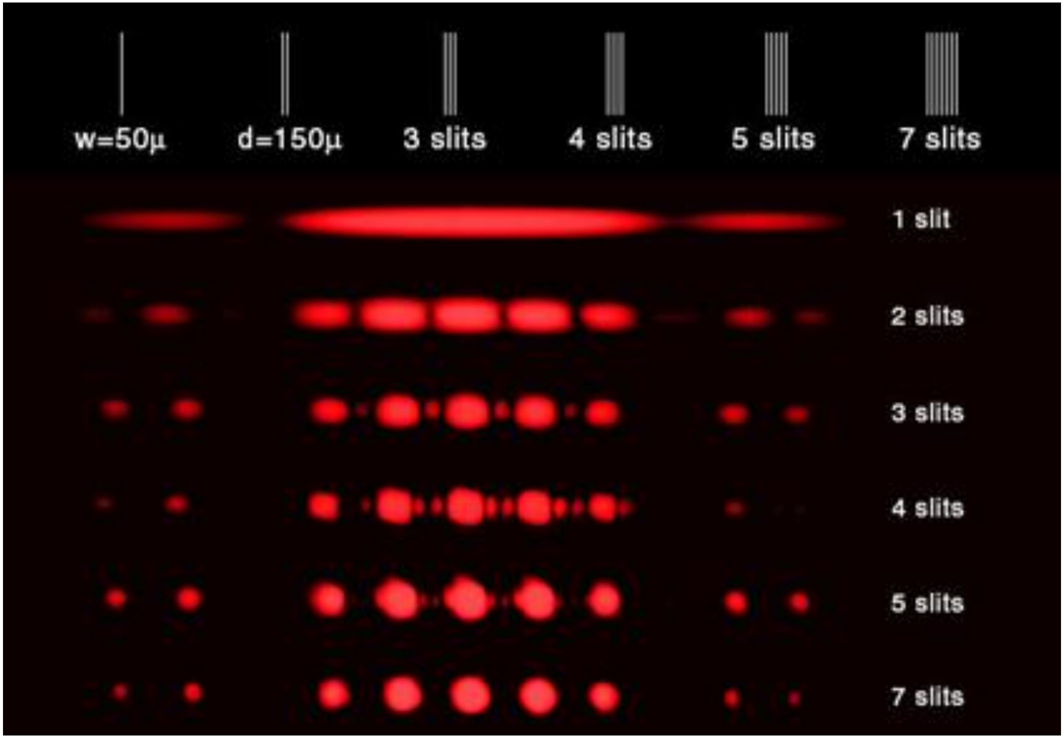


Fig. 3 The effect of multiple slits /aluminium slide
Slit width 50u (50 microns/0.0019/2 thousandths of an inch). Separation between the slit 150u (150 microns/ 6 thousandths of an inch)
https://www.thegearpage.net/board/index.php?threads/tighter-punchier-bass-than-nos-tung-sol-6v6gta.1625877/page-2

The separation between the slits in the used slide (fig. 3) is so narrow that the beams of light will behave as one beam of light (see fig. 4) although 7 slits are used.

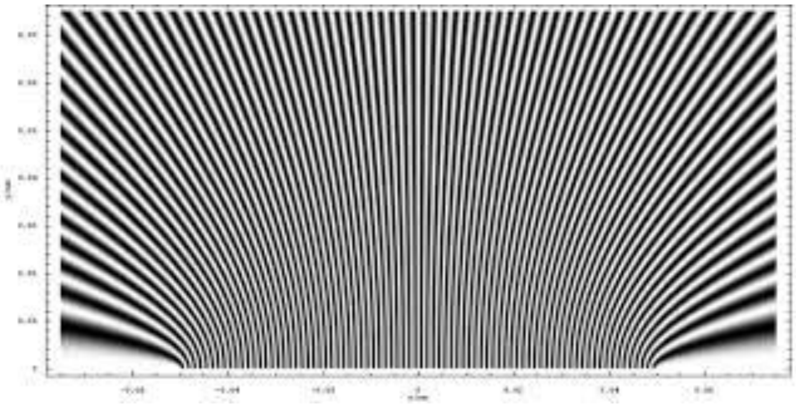


Fig. 4 Images of beams of light through a slide with multiple slits
https://en.wikibooks.org/wiki/Waves/Double_slit_Diffraction

Every slit gives the same pattern [(• •)n • • • • • (• •)n]. In this: n=1, 2, 3 …. The beams leave the slits as is shown in figure 5. Every beam holding the described pattern. The effect of the use of more slits is that the pattern gets more clear (better resolution).

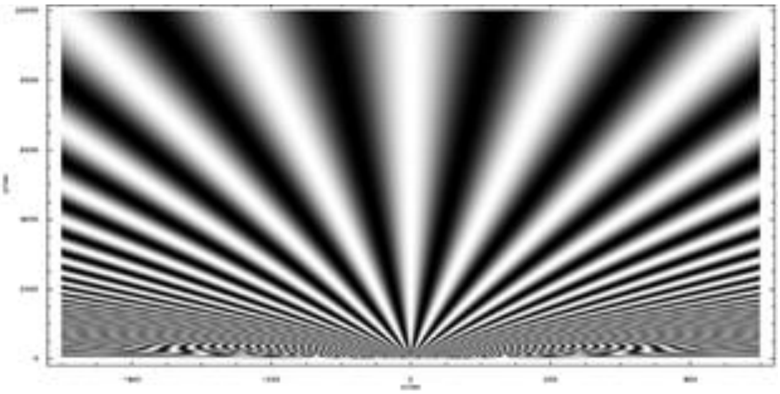


Fig. 5 Images of beams of light through a slide with multiple slits
https://en.wikibooks.org/wiki/Waves/Double_slit_Diffraction

We recognise (fig. 3) 5 dots in the middle and on the left and on the right there is a repeating pattern of 2 dots. Another characterising of the same image is: <u>1 dot in the middle and on the left and right side a repeating pattern of 2 dots.</u>

Fig. 6 Images the pattern caused by monochrome light through a slide with multiple slits

In our opinion the pattern is caused by the bending of photons in a discrete pattern caused by the curvature of electrons that circle in discrete orbitals around nuclei on the edge of the used slits.

This means that the material of the slides (creating the slits) is responsible for the found pattern. The slides consist of aluminium.

In table 1 can be found that aluminium has two kinds of orbitals (s and p). These orbitals are responsible for the bending of the photons in the monochrome light beam.

Explanation refraction pattern (fig. 6):

- The one dot in the middle is caused by the photons that are attracted equally from both sides of the slit. These photons will go straight forward and hit the screen in the middle (if the slits are broad the central dot will become more dominant);

- The first dot on the left side -of the middle of the screen- is caused by photons that are bended by the s-orbital* of the aluminium nucleus on the left side of each different slit;
- The second dot on the left side -of the middle of the screen- is caused by photons that are bended by the p-orbital* of the aluminium nucleus on the left side of each different slit;

- The first dot on the right side -of the middle of the screen- is caused by photons that are bended by the s-orbital* of the aluminium nucleus on the right side of each different slit;
- The second dot on the right side -of the middle of the screen- is caused by photons that are bended by the p-orbital* of the aluminium nucleus on the right side of each different slit;

- The repeating pattern (2 dots, both left and right) is caused by cumulating curvatures of present aluminium nuclei. The cumulating curvature of the s-orbitals* are responsible for the repeating inner dots. The cumulating curvature of the p-orbitals* are responsible for the repeating outer dots. This pattern will fade out while further removed from the centre of the screen.

*The choice for s- or p-orbital is an assumption.

Conclusions

1. With the introduction of laser light the refraction of light can be shown in an accurate way.
2. We can recognise a clear pattern through the use of a monochrome light beam.
3. In our opinion the pattern is caused by the bending of photons in a discrete pattern caused by the curvature of electrons that that circle in discrete orbitals around nuclei on the edge of the used slits.
4. In our opinion the found patterns do not suggest a wave pattern.
5. In our opinion the found patterns are cause by scattered light particles due to the influence of curvatures of specific atoms that are present in the material needed to create the used slits.
6. We predict that the use of a material like titanium, iron, copper or zinc will lead to the following refraction pattern:

   [(•••)n ••••••• (•••)n]. In this: n=1, 2, 3 ….

7. We wonder.

Gerhard Jan Smit, Jelle Ebel van der Schoot, April 5, 2017, Nijmegen

With special thanks to Eva D. van der Schoot

(Version 1.2 (adjustment 10/4/2017 concerning the material of the used slit in fig. 3)

References

1. Wolf, K. B. (1995), "Geometry and dynamics in refracting systems", European Journal of Physics 16: 14–20.
2 .Rashed, Roshdi (1990). "A pioneer in anaclastics: Ibn Sahl on burning mirrors and lenses". Isis. 81 (3): 464–491. doi:10.1086/355456.
3. Francesco Maria Grimaldi, Physico-mathesis de lumine, coloribus, et iride, aliisque adnexis … [The physical mathematics of light, color, and the rainbow, and other things appended …] (Bologna ("Bonomia"), (Italy): Vittorio Bonati, 1665), pp. 1–11: "Propositio I. Lumen propagatur seu diffunditur non solum directe, refracte, ac reflexe, sed etiam alio quodam quarto modo, diffracte." (Proposition 1. Light propagates or spreads not only in a straight line, by refraction, and by reflection, but also by a somewhat different fourth way: by diffraction.)
4. Jean Louis Aubert (1760). Memoires pour l'histoire des sciences et des beaux arts. Paris: Impr. de S. A. S.; Chez E. Ganeau. p. 149.
5. Sir David Brewster (1831). A Treatise on Optics. London: Longman, Rees, Orme, Brown & Green and John Taylor. p. 95.

6. Letter from James Gregory to John Collins, dated 13 May 1673. Reprinted in: Correspondence of Scientific Men of the Seventeenth Century …, ed. Stephen Jordan Rigaud (Oxford, England: Oxford University Press, 1841), vol. 2, pp. 251–255, especially p. 254.
7.Thomas Young (1804-01-01). "The Bakerian Lecture: Experiments and calculations relative to physical optics". Philosophical Transactions of the Royal Society of London. Royal Society of London. 94: 1–16. doi:10.1098/rstl.1804.0001.. (Note: This lecture was presented before the Royal Society on 24 November 1803.)
8. Augustin-Jean Fresnel (1816) "Mémoire sur la Diffraction de la lumière, où l'on examine particulièrement le phénomène des franges colorées que présentent les ombres des corps éclairés par un point lumineux" (Memoir on the diffraction of light, in which is examined particularly the phenomenon of colored fringes that the shadows of bodies illuminated by a point source display), Annales de la Chimie et de Physique, 2nd series, vol. 1, pages 239–281. (Presented before l'Académie des sciences on 15 October 1815.)
9.

- Excerpts from Fresnel's paper on diffraction were published in 1819: A. Fresnel (1819) "Mémoire sur la diffraction de la lumière"] (Memoir on the diffraction of light), Annales de chimie et de physique, 11 : 246–296 and 337–378.
- The complete version of Fresnel's paper on diffraction was published in 1821: Augustin-Jean Fresnel (1821) "Mémoire sur la diffraction de la lumière" (Memoir on the diffraction of light), Mémoires de l'Académie des sciences de l'Institut de France, 5 : 339–475. (Summitted to l'Académie des sciences of Paris on 20 April 1818.)

10. Christiaan Huygens, Traité de la lumiere … (Leiden, Netherlands: Pieter van der Aa, 1690), Chapter 1. From p. 15: "J'ay donc monstré de quelle façon l'on peut concevoir que la lumiere s'etend successivement par des ondes spheriques, … " (I have thus shown in what manner one can imagine that light propagates successively by spherical waves, …)(Note: Huygens published his Traité in 1690; however, in the preface to his book, Huygens states that in 1678 he first communicated his book to the French Royal Academy of Sciences.)
11. Why do electron shells have set limits ? madsci.org, 17 March 1999, Dan Berger, Faculty Chemistry/Science, Bluffton College.
12. Erwin Madelung 1881-1972". Goethe-Universität Frankfurt am Main. 12 December 2008. Retrieved May 8, 2012.

www.dbphysics.com