

# „Fiat Lux!” – or playing with light

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**Abstract:** We present the philosophical principles, the didactical goals, the organizing strategies for an interdisciplinary exhibition on optics “Fiat Lux! From Witelo to optical tomography. Playing with light”. The exhibition links elements of an interactive physics, the history and philosophy of science, the arts and literature, and is addressed to a broad public, mainly lower secondary school pupils. The exhibition has been organized by the Institute of Physics, University Nicolaus Copernicus in Toruń and the Regional Museum in Toruń. Five editions, in Toruń, Gdańsk, Olsztyn, Legnica and Sosnowiec has gathered more than thirty thousand visitors.

## I. Introduction

It's been over 10 years since the first interactive “Physics of toys” expositions in Warsaw, and Białystok and Słupsk [1] were organized. More recently, first permanent interactive exhibitions have been established, in Szczecin “Eureka”, in Warsaw at the Museum of Science and Technology, in Łódź [2] and recently at “Hewelianum” Center in Gdańsk. Copernicus Center in Warsaw, just opening the first exhibition this year, uses the best practice from abroad. Can one in this “densely populated” area of the scientific expositions and exploratoria astonish a visitor with something new?

## II. Methodology: How to create an exhibition?

How to show in an interesting way, for example, optics, so that not only to entertain but also to teach? You can, of course, put the lenses and mirrors and show how to create an image. You can also put a set of optical illusions and amaze viewers. A lot of surprise, but there is little to learn - either exhibition is playful, or educational. Can these two features be combined, and possibly enriched?

That was the question we have raised when designing in 2007 the exhibition “Fiat Lux! - From Witelo to optical tomography, or playing with light”. The exhibition is the result of collaboration between the Institute of Physics, Nicolaus

Copernicus University and the Regional Museum in Toruń. The starting point for the creation of “Fiat Lux” were collections from the exhibition “Physics and toys” at the University of Trento and the Pomeranian Academy in Słupsk, didactically developed under the project “Physics is Fun” [3]. Unlike in the earlier version [4], broader but didactically weaker, in [3] we have divided optics into sections: 1) the law of reflection, part 1 – plane mirror, a kaleidoscope, a periscope, 2) the law of reflection, part 2 - reflections on the boundary layers, spherical mirrors, 3) the law of refraction - lenses [5], total internal reflection, 4) colors (additive, subtractive, colors offered in Swarovski ball) and ultraviolet light, 5) diffraction (plus infrared). The next stage of expansion were contributions to national and international conferences on, for example, 3D vision, “Three-dimensional goat and the crystal ball” [6] or color “The world through rose colored glasses” [7], and educational articles [5, 8], for example, the lenses in thick centers or centers denser than the air. But again the question arises how to present these quite difficult questions, unknown at the school level, without boring the viewer.

In Toruń, to all these experiences the historical theme was added - the silhouette of the first known Polish scientist Witelo (1237 - ~ 1300). His work “Perspectives” [9], was translated from Latin by prof.



**Photo 1.** Relatively small (100 m<sup>2</sup>) Old Town Hall in Torun basement, created difficulties in managing the flow of spectators. Fortunately, the space below the vault allowed the division of physical problems: each island contains thematic props interactive manually (on tables), interactive with sight (on pillars) and posters on the walls. On the right Vitelo at the desktop, before him volume X of "Perspectives"

Witold Wroblewski in collaboration with prof. Andrzej Bielski and prof. Lech Bieganowski. "Perspectives" is a medieval work, even radically different from the text of Copernicus, and still like the design of Euclid "Elements". How to translate such a hermetic language for fun of the modern schoolboy? How to show that the optics started with Witelo, but has not ended till now?

Thus the statue of Witelo, in the medieval habit opens the exhibition and optical tomography for ophthalmic applications developed by prof. Andrzej Kowalczyk and his team of the NCU, closes the exhibition. An exhibition with historical and natural, artistic, interactive, technical and literary aspects! Functions which had to be met by "Fiat Lux" were just three: 1) to entertain the average viewer, 2) to carry out a school lesson with the group, for example, on the geometrical optics 3) to fascinate the so-called connoisseurs by the personality of Witelo and achievements of physicists-opticians. These three functions, educational, scientific and ludic, as in the synthesis of the three primary colors - are complementary and substituting one another.

### III. Implementation: How to plan an exhibition?

The exhibition functions and availability of exhibits (the exhibition was organized from the resources of NCU and Regional Museum) clearly define the form and scope of the project. In "The Science Museum" in London playing with the lens is held at several meters, color optical bench, permanently placed in the "Energy pad". In Torun, we used the optical bench from the collection of demonstration lab of the NCU. In the "Cit  de Sciences" in La Villette in Paris the synthesis of colors takes place in large prisms and mirrors on a special table and Plucker tubes are hidden in a separate closet. An itinerary nature of the exhibition influenced the size of exhibits - they are larger than in "Physics of toys", but still portable.

Thus, some small exhibits (kaleidoscopes, spinning tops, lenses) created interactive tables (photo 5), a part of the delicate objects was placed on pedestals, under glass and the interactivity stays the movement of the head and not of the exhibit (photo 2), and finally the copies of Witelo experiments occupy a central place in the historical part. Descriptions have been minimized and a large part of additional historical and biographical material was transferred to the posters.



**Photo 2.** Cat grin without a cat - "hologram" burned with powerful laser in the solid glass. The arrow indicates the direction of viewing for the audience, the green dot - the degree of exhibit difficulty

They present the achievements of Sommering, Witelo, scheme of the tomograph, optical phenomena in the atmosphere, Galileo's historical discoveries and contemporary studies of Torun astronomers.

Copernicus could not be missed, next to Kepler and his telescope, hence the title of the poster, "Sage-glass and eye", referring to the Mickiewicz's fascination of Śniadecki astronomy, less than a century after Newton. In one word: an interdisciplinary exhibition. How to talk about the struggle between good and evil in the colors of Goethe and do not show impressionists paintings?

The connecting element between the work of Witelo and the contemporary physics is a solid three-dimensional objects inside a block of glass - increasingly popular objects from the market stalls. The image of the face, burned-in in that cube and placed on concave side seems to

follow the viewer. Similarly, for children, a "hologram" cat points its nose towards the moving viewer. But this is not a cat! This is negative cat! Cat's smile without a cat! Today we would call it an optical illusion. Witelo wrote it differently, "when the eye sees a visible area for your senses, the judging ability of the soul immediately says that we see an object, even if the eye can not see into the extent of the body." (Perspectives IV, th. 63) [9].

The three elements thus form a kind of educational path: 1) three-dimensional goat, as a case illustrating the problem and the law of refraction, 2) the glass block with the face of a woman in reverse, placing the viewer in a surprise (the image seems to lead through the eyes by the viewer), 3) an explanation of Witelo dating back 700 years, and do not using the term "optical illusion" but "the judging ability of the soul."

#### IV. Evaluation: you see you like they judge you

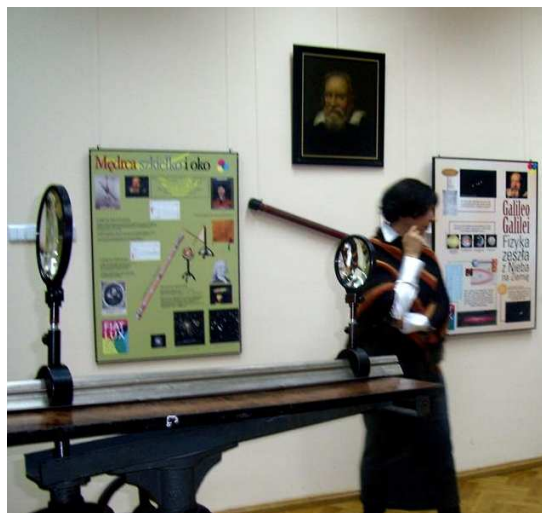
Visitors ratings, spontaneously recorded in the exhibition log, form an independent review. Of the more than 50 pages of entries we selected mainly those which betray the unearned hand of a child or parents comments.

"- I'm a student of 5th grade and I think



**Photo 3.** "Impressions of Light" [11] in Gdansk - Swarovski Owl from Prague, a sphere from Venice, above - a reflection of the selective diffraction filter, in the depths - the organizers





**Photo 4.** The announcement before the exhibition opening in Olsztyn. In the foreground a playful model of the telescope, on the wall faithful reconstruction of the Galileo's "barrel-eye" (*canocchiale*). Poster explaining the telescopes also talks about Copernicus; Galileo poster shows a contemporary photograph of "medici stars" and the trajectories of other satellites of Jupiter

that the exhibition is very cool what I liked most is that you can touch the exhibits"

„- Karolina Matulewicz 01.07.08 – Super!”

„-After visiting the upper floors with art and painting - the son was happy, but a bit tired. When we went downstairs and went straight to the 'kingdom of illusions' he has



**Photo 5.** "Fun with colors" on one side was a part of the educational path of the primary colors in emission and absorption, on the other for children it was a "stop" for fun, where teaching and cognitive functions were replaced by entertainment. Diode lasers and filters from the USA, spinning tops from Italy; descriptions reduced to a minimum

picked up and was fascinated by objects of interest. Thank you for your interesting and informative exhibition of how to revive the interest and education of children - even on holiday."

Mom of 11-year-old Maximilian.

„- I live in Ireland here is Super! Oliwia”.

“-Super! , our Anny entertained for hours getting to know the range of applications of human naivety by receiving with her heart. This gave us a proof that the world should be received by the heart. "

„-Supply show! There are so many interesting things that I did not know yet. COOL! Aska 12 years”.

Entries of adults were generally very positive, too, but clearly referring to the existing experience of customers.

"- Excellent show, reminded me of an extraordinary period of learning and experience from experiments conducted during physics and chemistry lessons.

Thank you! "

"- I believe in" miracles on a stick '! "

Still other entries were foreign, also very flattering and betraying considerable familiarity with the exhibits.

„-This is brilliant. Thank you for your thorough explanations. David, London”.

„- I have seen better but other than that it was really good”

The shortest review, however, expressed a simple man, presumably unemployed, accidentally visiting the exhibition:

- Lord! How interesting! It spins all over in my eyes! "

## V. Acknowledgements

Witelo exhibition is complicated, not only for the viewer, but also for developers. Since the first edition it began to live its own life, stressed by the ideas of its successive hosts. In Torun, the gothic gloom of the medieval town hall basement allowed to play with colored shadows, in the "Hewelium" Center barracks shelter southern lights shone gleams in the Swarovski pyramids [10], in Olsztyn Observatory four floors and winding

staircase between them painstakingly created historic path, in Legnica stained-glass window of Witelo watched the exhibition, in Sosnowiec blue glass vases harmonized with an exhibition of glass art.

Fundamental contributions to the explanation of optics (and physiology of the eye) in Witelo work have prof. A. Bielski and prof. L. Bieganski. The latter is also a prominent expert on the history of glasses. Reconstructions of telescopes were available from the Museum of Kalisz, photo cameras come from private collections, interactive exhibits from the shop windows in various parts of the world. Optical tomograph is a work of a research group led by prof. A. Kowalczyk. The exhibition was proposed and conceptually developed by the author (an the historical part by M. Kłosiński) with the personal involvement of the Institute of Physics, NCU Director W. Jaskólski and director of the Regional Museum in Torun, Dr. M. Rubnikowicz. The curators of the exhibition in Torun were from NCU - author, from the Museum District - M. Kłosiński. Special thanks for their contribution to the preparation of exhibitions and support: M. Karwasz and graduate students of NCU, G. Drązkowska and M. Gęsiński. The curators

of the subsequent editions were: for the "Hewelianum" in Gdansk, P. Misztka and hosted dir. P. Guzow, for the Olsztyn Planetarium: M. Gęsiński, Lidia Kosiorek and hosted by dr J. Szubiakowski, for the Museum of Copper in Legnica dr K. Rochowicz and Mr. T. Stolarczyk (archaeologist) and hosted by the director A. Niedzielenko; in Sosnowiec Joanna Krzysztofik MA (Master of Fine Arts) and hosted by the director. Z. Studencki. The exhibition in two years was visited by tens of thousands of spectators, mostly young people, many of high school students. A more technical description of the exhibition includes work [11] and the online material from the various editions have been prepared by Mr K. Służewski [12]. Successive editions of "Fiat Lux!" are planned in Grudziadz, Bialystok, and Lublin.

P.S. At the opening of the exhibition in Legnica, a three-year-old boy has become co-author who while asked what he sees in a piece of glass with a portrait of "hologram" in the middle, he replied, "her ... the woman." The human mind surpasses what dreamed even by such philosophers as Vitelo!

Translated by dr K. Rochowicz

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