

“Physics is Fun”

Publishable executive summary

Can one keep in hand a single lepton? How precise do we know the masses of quarks, constituting all material objects? Why Sun’s gravitation field is life-friendly?

Programme “Physics is Fun” proposes a new approach to teaching Physics, and Science divulgation, in general. Common divulgation sources state that electrons are too small to be seen, quarks exist in atomic nuclei but can not be separated, and Newton’s gravitational law is just a mathematical expression. This is all true but makes Physics a kind of hermetic, ideal science. Like it was in pre-Kopernik, pre-Galileo and pre-Newton times.

They three (and many more) showed that the same laws govern the motion of Earth, Jupiter’s satellites and falling of apples. We come back to such a teaching by *surprising analogies*. A hyperbolic funnel models a “normal” gravitational field but any *kitchen* funnel can model much more complicated gravitational fields, in which planet’s orbits would be open, and therefore four weather seasons would continuously vary [1].

Objectives of the project are to increase the common interest in Physics, in all age groups and to deliver instruments for successful teaching of complex problems of Modern Science, with special attention on their interdisciplinary aspects and practical applications.

Objectives of the programme were obtained by:

- 1) producing objects illustrating laws of Physics and examples of applications
- 2) their presenting to broad public on a series of exhibitions in 5 EU countries (Slovenia, Italy, Germany, France, Poland)
- 3) production of virtual versions of these exhibitions, in the form of CD-Roms and web-sites.

The project produced objects and descriptions at two levels:

- Physics of everyday objects, of table-top gadgets and toys – we use these objects to show laws of Mechanics, Thermodynamics, Electricity and Optics.
- Walking though Modern Physics – here we comment some achievements, but even more, open problems in contemporary Physics.

The target for the first level stories spans from pre-school visitors to secondary school pupils, and serves to explain and make interesting the Classical Physics. The target for the second part of the project are students and broad public – we try to de-mythologize the research in general. Say, graduated students usually do not know that masses of quarks are known with 50% error bars. A two-fold conclusion can be drawn: more research is needed, and/or the knowledge of “normal” quark masses is not so indispensable for everyday life, if it would cost too much.

Events which summed up for the 16-months programme included four international and four regional events, each time targeting the specific audience:

- 1) 3rd GIREP Seminar (Groupe International sur l'Enseignement de la Physique) Ljubljana, 05-09 September 2005
- 2) XXXVIII Congress of The Polish Physical Society, Warszawa 11-16.09.2005
- 3) Open Days in École Centrale Paris, Chatenay- Malabry, 05.12- 09.12.2005
- 4) 10th Workshop on Multimedia in Physics Teaching and Learning, Freie Universität Berlin, 5-7 October 2005
- 5) Porte Aperte, Università di Trento, , 18-26.02.2006
- 6) Giornate scientifiche, Università di Udine, 29-31.03.2006
- 7) IV Baltic Science Festival, University of Gdansk, 25-28.05.2006
- 8) IV Baltic Science Festival, Pomeranian Pedagogical Academy Słupsk, 25-28.05 May 2006

All events were visited by about 12,000 spectators, starting from pre-school children to university professors.

A. Exhibitions on “Physics and Toys” showed about 100 objects, accompanied with simple, 2-3 phrases descriptions. It targeted low-age spectators, primary school pupils and their teachers. Shown in Warsaw, Gdańsk, Słupsk, Kościerzyna and Ostrów Wilkp in Poland it gathered about 9,000 visitors.

B. Almost the same objects, but in thematic sets and with rigorous description of physical laws, were shown during GIREP and MPTL seminars and in Ecole Centrale in Paris. For example, different oscillators (weights, springs, balancing objects) and sound sources (flutes, glasses, sand-tubes) serve to explain the concept of Fourier transform [2]; a set of experiments with electricity is used to illustrate Maxwell's laws [3]. For Baltic Science Festival in Słupsk and Ostrów a thematic exhibition on energy and environment problems entitled “A water-driven car” was prepared. It targeted organized scholastic groups, mainly.

C. “Modern Physics” exhibitions consists of 27 A1-size posters on rigid support and describes, among others:

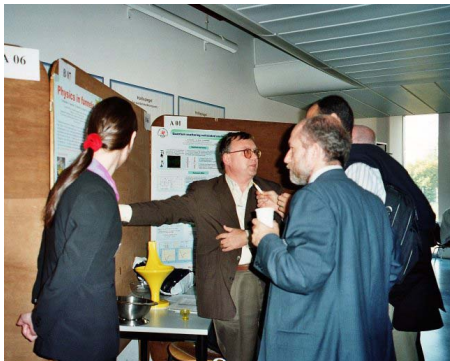
- Spectroscopy
- Atomic Physics
- Quarks and Elementary Particles
- Material Science
- Astrophysics.

This latter exhibition is accompanied with experiments, like electron mass measurement, electron charge experiment, gas laser tube, optical emission spectroscopy, experiments on Plank's law etc. Complete laboratory sets like lasers but also simple objects illustrating their operation (selective mirrors, light guides etc.) are shown.

This exhibitions targeted students of Science Faculties, university professors, organized groups from secondary schools. Its main aim was to awake imagination of spectators, and surprise them with new aspects, even if specialist in a given field. For example, specialists in semiconductors know usually everything what is described, apart from the ticket price for the superconductive train in Shanghai and that “squid” is a kind of fish.

Exhibitions triggered interest of

1. University professors (see photos from Berlin and Paris)



2. University students (photos from Trento and Udine universities)



3. Secondary schools pupils and teachers (Słupsk, Ostrów Wlkp.)

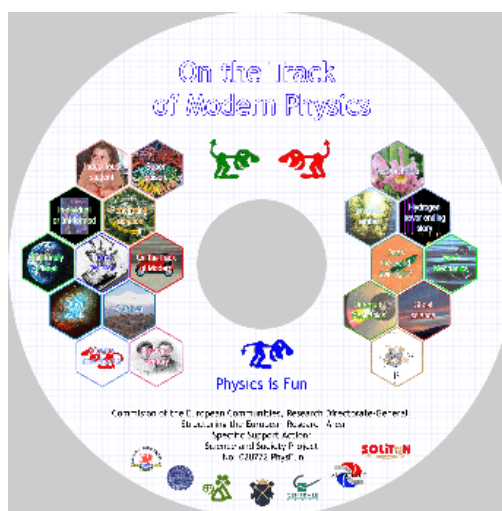
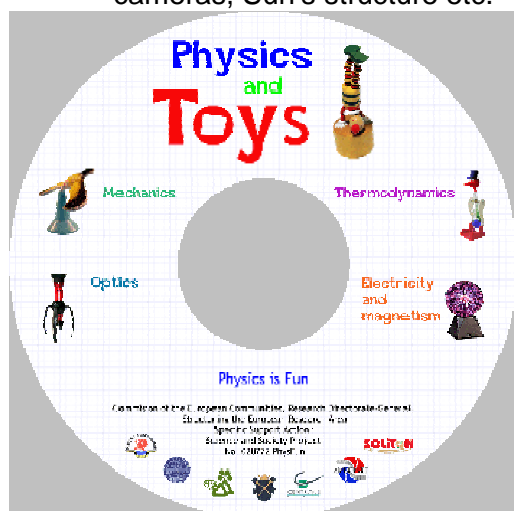


4. Children at all ages (Gdańsk, Warsaw etc.)



Post-exhibition production consists of two CD-Roms and a special issue of “Foton” (in English and Polish) and mirror internet sites <http://modern.pap.edu.pl> and <http://modern.umk.pl>).

- I. “Physics and Toys” (in English, German, French, Italian and Polish) describes 96 “toys” divided into Mechanics, Electricity, Optics and Thermodynamics. Two-level explanations are used: the first one, not requiring notions in Physics are simple, 6-8 phrases, catching attention; the second level gives detailed explanations, with mathematical laws, if needed, schemes and practical applications. It contains more than 450 photos, 30 drawings, 80 films.
- II. “Modern Physics” resumes this exhibition, and is enriched by thematic stories, like “How are you, Miss Orchidea?” on photo-acoustic spectroscopy, or “Albert and Mileva” on Einstein’s discoveries. It includes a history-line on XXth Century Physics and some guest presentation, allowed by top-level scientists (like prof. M. Charlton from Swansea University). It includes also 12 video clips on subjects, like neutron cameras, Sun’s structure etc.



“Physics-is-Fun” consortium consists of six partners:

1. Pomeranian Pedagogical Academy, Słupsk, Poland
2. Ecole Central Paris, Chatenay-Malabry, France
3. Trento University, Italy
4. “Ambernet”, Warsaw, Poland
5. “Soliton”, Sopot, Poland
6. “Foton”, Jagellonian University, Kraków, Poland

CD-Roms are available free-of charge from:

- 1) Soliton, 81862 Sopot, Mazowiecka 6/1, Poland
- 2) Ambernet, 01541 Warszawa, Czarnieckiego 59, Poland

Coordinator’s contact details:

Prof. Grzegorz Karwasz
 Institute of Physics, University of Nicolaus Copernicus, 87600 Toruń, Poland
 Tel. 0048-56-611-2704
 e-mail: karwasz@if.pap.edu.pl
 Dr Tomasz Wróblewski
 Institute of Physics, Pomeranian Pedagogical Academy, 76200 Słupsk, Poland
 Tel. 0048-59-8405-331
 e-mail: tomek@if.pap.edu.pl

PS. And leptons (an electron is the lightest of leptons) in our exhibition are Greek 1 cent (lepto) coins. One can touch even an electron!