

VOYAGE TO SCIENCE – A PROJECT FOR HIGH SCHOOL STUDENTS WITH INTEREST IN PHYSICS

Vladimír Pospíšil, gdermog@seznam.cz, Gymnázium Jaroslava Seiferta, Praha, Czech Rep.



Evropský sociální fond
Praha & EU: Investujeme
do vaší budoucnosti

INTRODUCTION

The project Voyage to Science was initially created at J. Seifert High School (GJS) in Prague in 2006, with financial support of European Social Fund, Czech Republic state and the city of Prague. The realization of the project was also made possible by the nice attitude of FNSPE and FEE (Czech Technical University), FMP (Charles University) and other institutions. Its main goal was to motivate high school students to follow their future university studies in technical and/or science program, because their interest in these is presently very low. Fulfilling of this goal was done as follows: students from GJS and other high schools, who are interested in science, were introduced to working groups at involved institutions and joined their activities. After going through advanced courses of mathematics, physics, computers and research on a specific topic of their interest, they were given a problem, which they had to solve on their own. Students spent a non-negligible part of their free time on this problem. Results of their work was presented in the form of a poster and proceeding on an adequate science conference. Project was realized in two periods from September 2006 to June 2008 and from September 2009 to August 2011.

INVOLVED HIGH SCHOOLS

Gymnázium Jaroslava Seiferta, named after the renowned Czech writer and Nobel prize winner for literature, professes the ideals embodied by this poet and humanist. GJS was established in 1991 as the second private grammar school in Prague. School's syllabus reflects the importance of education and dedication to providing students with the best possible tools to continue on to university and later a career. The eight-year program is divided into two parts: during the first six years, students complete a comprehensive curriculum (equivalent to secondary school). In the seventh year, there is a considerable increase in optional courses, while the eighth year is structured as a special preparatory course required for university entrance examinations [2].

Gymnázium Christiana Dopplera, founded in 1950, offers four year and eight year form of study. In four year classes are focused on mathematics, physics and informatics, while eight year classes are focused on languages [3].

Gymnázium Karla Sladkovského was established in 1897 by city of Žižkov (contemporary city district of Prague). School offers four year and eight year form of study. Approximately 450 students attends classes at GKS, led by 40 skilled teachers [4].

Gymnázium Jana Nerudy is one of the Prague's oldest high schools, founded in 1865. In 1876 the school was moved into brand new building and was named after czech writer and journalist Jan Neruda on the occasion of 100 years since his birthday anniversary. There are three study branches : common (six years, natural science or languages), bilingual Czech/French (six years) and musical arts (eight years) [5].

INTRODUCTORY COURSES

During the first year of both project participants attended introductory courses. These courses took six hours per week and was aimed at basic terminology needed in physical and technical work. Lectures covers wide area in appropriate fields of knowledge, but without the accent on deep understanding - its main purpose was to give high school student basics in language spoken between scientist and general overview of the subject. Lectures was based on extensive MS PowerPoint presentations, which are distributable under GFDL licence and free to download from [1]. All readers are encouraged to download those presentations and to use them freely in mathematics or physics classes! Namely there was five courses:

Mathematical apparatus of physics summarized important parts of high school mathematics (logic, theory of numbers, sets and representations, progressions and series, functions, equations, complex numbers), gave basic of linear algebra (vector space, base and dimension, representations and operators on vector spaces, norm, scalar and vector product, matrices, sets of linear equations, eigennumbers and eigenvectors of matrices and operators) and showed some areas of mathematical analysis (limits, differential and integral calculus in one and more dimensions, Taylor series, differential equations). There were also basics of probability and statistics given.

Informatics and computers in science includes history of computers and computing science, binary system and digitization, electronics and architecture of contemporary computers, operating systems, basics of Linux and bash and object oriented programming in C++.

Introduction in modern physics summarizes classical mechanic (including Newton's physics and Lagrange and Hamilton formalism), special theory of relativity (including Minkowski timespace), electrics and

magnetism. Lecture also includes basics of nuclear, subnuclear and particle physics and quantum mechanics.

Experimental techniques was lecture oriented in basic measuring techniques and data analysis. It includes basic mathematical procedures for data analysis, working with classical pointer instruments, examples of conversion of physical quantities to electrical impulses, AD/DA converters, function of oscilloscope and basic exercises with digital multimeter, signal generator and counter and oscilloscope.

Trends in contemporary physics was series of popular lectures given by Czech top scientist, including V. Petráček, V. Wágner, T. Čechák or D. Drábová.

WORKING GROUPS

In second schoolyear of the project student chooses one of research miniprojects, offered by one of partner science institution and started to work in pairs on the miniproject under competent supervisor (usually PhD. student). There was ten miniprojects in the first Voyage to Science and sixteen in second. In **first VtS project** there were following workgroups:

- RTG fluorescent analysis of historical relics
- Analysis of structures and fractures of materials
- Experimental setup of normal and anomalous Zeeman effect
- Experimental setup of nuclear magnetic resonance
- Alpha and gamma spectroscopy
- Properties of silicon drift detectors
- Properties of scintillating detectors
- Setup of fusion neutron source
- Catalyzers in radiation chemistry
- Algorithms of artificial intelligence

In **second VtS project** there were following groups:

- Study of magnetocaloric effect of Gd₆₀Mn₄₀
- Development of crystallic structure of R₂TX₈
- Measuring and analysis of the heat capacity of YPd₅Al₁₂ and NdPd₅Al₁₂
- Silicon detectors in particle physics
- Radiation preparation of y₂o₃ nanopowder
- Laser-driven particle acceleration

- Interferometric plasma density measurement in GOLEM tokamak
- The impact of headphones and earphones on hearing of users
- Audio component of virtual reality
- GPU-based acceleration of genetic algorithms
- Study of dynamic phenomena in thermal plasma
- Communication gloves - communicating with a handicap
- Design of the polymer planar waveguides for fthh system
- Electron source for double-slit experiment
- Detector for double-slit experiment
- RTG fluorescent analysis of historical relics

PARTICIPANT'S RESULTS

All participant's duty was to present on regular basis. Each month there was project miniconference, where half of working groups gave presentation about their work and progress. Final output of each workgroup was more detailed presentation given on final project miniconference (which was open to public) and contribution of poster and proceeding to the Conference of Czech and Slovak physicist (16th in Hradec Králové during the first VtS project, 17th in Žilina during the second). All presentations, posters and proceedings are also presented on web page [1].

SUPPORTING ACTIONS

During the Voyage to Science project participants visited several workplaces of research institutes and universities - for example linear accelerator at FMP, CUNI or tokamak GOLEM at FNSPE, CTU. Highlight of supporting actions was three-day visit of European centre of nuclear research (CERN) in Geneva.

OUTLOOK

Presently, continuation of the project is uncertain due to lack of funding. Project is quite expensive and operational programs of ESF in CZ for educational purposes are depleted. Administrators of the project will try to find other source of funding.

REFERENCES

1. <http://veda.gymjs.net/?p=uvod>, Web of Voyage to Science project, (23. 8. 2001).
2. <http://www.gymjs.net/english.html>, Web of GJS, (23. 8. 2001).

3. <http://www.gchd.cz/matematika-a-zive-jazyky>,
Web of GCHD, (23. 8. 2001).
4. <http://www.gykas.cz/index.php>, Web of GKS, (23.
8. 2001).
5. <http://www.gjn.cz/index.php>, Web of GJN, (23. 8.
2001).