

DEPARTMENT OF ASTRONOMY OF PETNICA  
SCIENCE CENTER – 25 YEARS

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**Abstract.** The Petnica Science Center (PSC) was founded in 1982. The Department of Astronomy of PSC exists from the beginning and has had several periods of activities in the field of astronomy education. Different types of programs and activities are presented, from informal camps at the beginning to currently implemented specialized two-year programs. The PSC, as very important non governmental organization and informal educational institution for all interested secondary school pupils, has its own "School" of astronomical education and first steps into the scientific research.

## 1. INTRODUCTION

Petnica Science Center (PSC, hereinafter also referred to as Petnica) is the largest and, probably, the oldest independent nonprofit organization for extracurricular science education in SE Europe. Since 1982 Petnica has organized nearly 2,200 programs (seminars, workshops, research camps...) for 45,000 students and science teachers in 15 disciplines of science, technology and the humanities.

The majority of programs are designed for secondary-school students although there are a lot of programs for primary-school pupils, university students and science teachers. The attendants of regular Petnica programs are coming from all countries of former Yugoslavia. All the courses are taught in Serbian language. However, Petnica also occasionally organizes programs (like PI) in English for international participants.

The main goals of PSC programs are:

- to identify gifted students and to give them intensive extracurricular education,
- to enable extraordinary motivated students to learn through research and therefore develop rational, critical and creative thinking,
- to enable best students to work on scientific projects under the supervision of professional scientists and science teachers,
- to instruct young science teachers to apply up-to-date scientific concepts, knowledge, educational methods and technology,
- to initiate co-operation and exchange of ideas and experience among students interested in different science disciplines and

- to establish rich international and intercultural contacts and co-operation among young people, students and teachers.

Today, PSC has large network of associates and associate organizations and successfully co-operates with about 70 scientific institutions in Serbia and over 100 worldwide, with 250 schools (Serbia, Montenegro, Bosnia and Herzegovina, Croatia, Macedonia, etc.), and over 1,500 associates.

Programs of PSC have been supported by the European Commission, Fund for Open Society, HESP Budapest, KulturKontakt Austria, Serbian Ministry of Education, Serbian Ministry of Science, Swiss Development Agency, The British Council, UNESCO, etc.

## 2. PROGRAMS

Activities in Petnica Science Center are organized in the following programs: astronomy, physics, electronics, mathematics, computer science, biology, chemistry, molecular biomedicine, geology, linguistics, archeology, psychology, ethnology and history.

The structure of each program is similar and three groups of people are involved with the realization of activities. The head of the department is responsible for the organization and realization of all program activities, planning, as well as for the engagement and coordination of the lecturers. University students of relevant faculties and former students of PSC are engaged as junior associates. Their task is to deal with the program activities and to help the head of department in everyday work with students (peer education). Senior associates are university professors, researchers from the institutes, and all other professionals who can contribute with giving lectures, supervising projects, and similar. In cooperation with the Ministry of Education PSC also organizes camps for the high-school teachers aimed at improving their educational work.

Each program has its own Program Commission composed of experts in the field. The task of the Commission is to propose the program, to monitor the activities of students, to give suggestions, comments, etc. Commission meets at least once a year.

## 3. STUDENTS

At the end of year, Petnica Science Center initiates the application process for participation in the next year programs. A call is sent to all schools in Serbia, as well as to the schools in Croatia, Bosnia and Herzegovina, Montenegro and Macedonia. Candidates provide their CV, essay on a specified topic, and a motivation letter. A committee consisting of about 50 people, reviews the applications and selects students.

Students are usually divided in two main groups: those who participate in the program for the first time and those who have already passed the introductory course.

The first group of students gets acquainted with the basic concepts of the selected science, its methods and the equipment used. Students who have already completed the introductory program conduct their own research. While working with their supervisor they pass through all phases of the project: the definition of topic, selection of the literature and methodology, the use of equipment, processing of the results, scientific cooperation, and presentation of results at the conference.

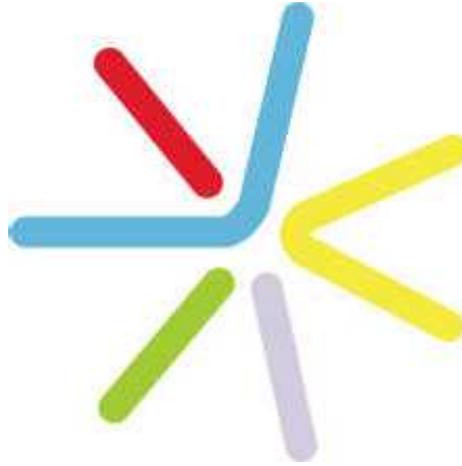


Figure 1: Logo of PSC.

## 4. ASTRONOMY CAMPS

### 4. 1. WINTER CAMPS

For students who participate in the astronomy program (AST1) for the first time, winter astronomy camp is organized as an introduction to astronomy. Since these students have different levels of knowledge, this camp is designed to make them informed on all the important disciplines related to astronomy. Some of the usual topics are: Introduction to Astronomy, Solar System, Variable and Binary Stars, Stellar Spectra, Sun and Solar Activity, Signals and Systems in Astronomy, EM Radiation, Evolution of Stars, Cosmology, Stellar systems, etc. There are also Introduction to Mathematical Analysis, Programming, Introduction to Probability and Statistics... Another part of winter seminars for AST1 is the work of students, the use of literature, written reports. The basic training in star-gazing and using telescopes is also included in the program of the first camp.

Winter astronomy camp for older students (AST2) is designed as a theoretical seminar, during which the students become familiar with scientific research. Our professional astronomers present their research and the methodology they use. Also, students learn basic mathematical and computational tools they will need in realization of their individual projects.

As an example, let us mention the topics of the winter camp for AST2 in 2006: Analysis and Interpretation of the Spectra of AGN, Interstellar Matter in Spiral Disks, Structure of the Galaxies, What We Know About the Chemical Composition of Celestial Bodies?, Asteroids, CCD Astronomy, Nonlinear Dynamics, Differential Equations, Numerical Methods, Programming, N Body Problem, etc.

During this camp students define topics for their individual projects. All lectures are aimed at helping students to choose the topic.

#### 4. 2. SPRING CAMPS

Spring camps are essentially methodological. They are a theoretical and logical continuation of winter camps.

Spring camp for AST1 is designed for students to learn the basics of data analysis and to write scientific reports. The participants start using the equipment under the supervision of PSC associates. Spring camp for students of AST2 is a preparatory seminar for their individual projects. Students elaborate the methods they will use. Mathematical and programming tools are issues, too. Some time is planned to be spent with mentors.

#### 4. 3. SUMMER CAMPS

Summer camp for AST1 is practical. During two weeks students have to do 10 exercises, 5 practical and 5 theoretical (Clea virtual exercises). The output of every exercise is a written report. Some examples of practical exercises are: Determination of the gravity acceleration, Determination of latitude of Petnica using gnomon, Determination of hair thickness using diffraction of the laser beam, Thermal noise of CCD camera, Determination of atmospheric extinction using CCD camera. There are five more Clea virtual exercises: Determination of the period of rotation of Jupiter satellites, The Energy of the Sun, The emergence of elements, Rotation of the Sun and Astrometry of Asteroids.

The summer camp for older group of the participants (AST2) is the crown of a two-year cycle of astronomical education in the Petnica Science Center. During this 2-weeks camp, participants work with their mentors on the realization of their projects.

#### 4. 4. AUTUMN CAMPS

Autumn camps are theoretical with selected most popular issues in astronomy. The idea is to present the latest discoveries in astronomy and related sciences to the students. These two camps are pretty much the same both for AST1 and AST2, but they are still organized separately, because the students don't have the same level of knowledge.

### 5. PRESENTATION OF RESULTS

At the end of every year, the most successful projects are presented at the conference "Step into the Science" that is held in Petnica. After the summer camp, students send their papers to the Organizing Committee, which then makes the selection for oral and poster presentations. Every year, about 60 to 70 projects are presented (about 4-5 for each PSC program). Papers are printed in the Proceedings of the Conference "Notebooks of Petnica".

As an example of astronomical topics for students' papers in Petnica here we give a list of those completed in the last 5-years period (2003-2007):

- Dynamical Stability of Habitable Zone in Alpha Centauri AB System
- Effects of a Close Stellar Encounter on the Dynamical Characteristics of the Kuiper Belt

- Numerical Modeling of Gravitational Lensing Effect
- Universality and Scaling of Chaotic Transport in Perturbed Hamiltonian Systems: Kinetic Model and Numerical Simulation
- Numerical Simulation of the Geminid Meteor Stream
- Determination of the Earth Collision Frequency of the Minor Solar System Bodies
- Determining Basic Parameters of the Open Stellar Cluster M41
- Evolution of the Haley Comet Meteor Shower
- Transit Detection of the Extra-Solar Planet
- Change of Orbital period of the Ecliptic Binary XY UMa
- A Simple Model of Interaction Between Galaxies
- Analysis of the structural characteristics in the distribution of Earth impact craters
- Mass Segregation in Globular Clusters
- Apical Motion of Eclipsing Binary PV Cass
- Determining basic stellar parameters of open cluster M41 II
- Phase Transition Pressure in the Jupiter Type Planets

## 6. CONCLUSION

During 26 years of work, Petnica Science Center has grown up from an informal idea to the place for gathering young enthusiasts and the institution that deals with scientific education of students.

There are some specific things in Petnica Science Center, such as peer education (youth associates are only slightly older than students), informal methods of the work (everyone works as much as he thinks it is necessary), free communication (no fear of authority and participation in the discussion), independence during the work (students choose what they want to work on and the way they want to do it), accessibility of literature, the opportunity for verification of the results... Thus we can say that the Petnica Science Center has formed its own "school" for scientific education of young people, which is already recognized in Europe and the world.