PROPOSAL DESCRIPTION FOR THE COURSE

RESEARCH ON PHYSICS EDUCATION

1. TITLE AND DATES OF THE COURSES

RESEARCH ON PHYSICS EDUCATION

a) 17-27 June 2003

b) 1-11 July 2003

c) 15-25 July 2003

d) 29 July - 8 August

The order of preference is c) b) d) a)

2. DIRECTORS' NAME, NATIONALITY, AFFILIATION AND KEYNOTES

E.F. Redish - Dept. of Physics and Astronomy, University of Maryland, College Park, MD 20742-4111 – Full Professor. Research in nuclear physics and physics education. Secretary of the International Commission on Physics Education (ICPE)

M. Vicentini - Dept. of Physics, University "La Sapienza" of Roma, P.le A.Moro, 2 - 00185 Roma, Italy – Full Professor. Research on condensed matter, low temperature physics, critical phenomena, physics education. Member of ICPE Commission

3. SCIENTIFIC SECRETARY'S NAME, NATIONALITY, AFFILIATION AND KEYNOTES

C. Tarsitani - Dept. of Physics, University "La Sapienza" of Roma, P.le A.Moro, 2 - 00185 Roma, Italy – Associate Professor. Research on history, philosophy and teaching of physics.

4. PROJECT TOPIC

Physics is a basic science: fundamental for our knowledge of the world, basis for all technical development and part of our cultural history. Therefore physics is a subject at all levels of education: at school, at colleges and at universities, as well. And it is not enough to have well educated physicists only. Understanding of science, especially of physics is necessary to almost all people.

Everybody knows that research in physics is a task which has to be done seriously with proper equipment and men or women power. Teaching of physics in former times has been thought of simply to be the skill of delivering knowledge correctly to students. But teaching is an interactive process between teacher and students and between students among them, as well. The success of this process depends not only on sufficient and correct knowledge of physics by the teacher, but even more on different influencing factors like knowledge and ability of the students, teaching methods, context and structure of the subject, technical devices, etc.

Improving of the teaching-learning process ever since has been a necessary task at all levels of physics education. About 40 years ago scientists around the world saw this necessity and started research on the teaching-learning process. The course is aimed at fostering this research field.

5.1 SCIENTIFIC ORIGINALITY

The actual research on physics education may be framed in the general problem of the basic cultural education at different levels of schooling and for different levels of professionality (from the scientifically informed citizen to science trained professionals to researchers to teachers).

Three main lines of research are particularly meaningful at these times on one side for the changes in the didactical organization which are taking place in various countries and, on the other, for the results of previous research on learning problems. The three lines are:

1) Curriculum development as a research problem:

- definition/restructuring of the knowledge contents for a modern teaching of physics which takes into account the increased knowledge of last century and up-to-date learning models;
- research on the development of cognitive abilities and technical skills relevant for understanding physics;
- definition of teaching strategies for physics aimed at an effective learning in a constructivistic model;
- study of the links of continuity both in a longitudinal connection among the curricula of the different levels and in a transversal connection among different knowledge sectors;
- research on the relation Science/Technology/Society.

2) Research on the processes of learning and teaching:
- studies about conceptual change for what concerns both content knowledge and cognitive abilities;
- epistemological themes for the understanding of the conceptual and methodological structure of physics;
- history of physics as a tool for teaching;
- research on teaching strategies including modern technologies;
- research on the aims and strategies for the teaching of experimental activities;
- research on techniques and tools for the evalutation of learning and teaching;
- studies about appropriate models of structures of students thinking about physics.

3) Research on the image of science and the diffusion of scientific cultural knowledge:
- development of materials for the popularization of physics;
- educational use of science museums;
- inquiries on the public understanding of science.

The proposed course can lead to a significant step forward on the three lines by the comparison among the different approaches to research in the different countries in particular by involving young physicists in the problems of curriculum development at the different levels of schooling and by stimulating reflection on the problems of teaching and learning.

5.2 AIMS OF THE PROJECT

Focus the state of the art of the research. Train young physicists in the research methodology. Stimulate the interest of the importance of research on the teaching and learning of physics in the Physics Community.

6. PROGRAMME CONTENT AND LIST OF TOPICS

The programme content will be developed on the three lines of research above mentioned: curriculum development, processes of learning and teaching, the image of science and diffusion of scientific cultural knowledge.

Therefore the proposed topics for lectures and seminars are:

a) Curriculum development with a focus on the definition of knowledge contents for a modern teaching of physics: the problem of how to update the knowledge base from classical to contemporary physics will be discussed by the presentation of the new approaches recently developed in the research community.
b) Learning models and conceptual change: an overview of the state of the art of the research both on the methodological point of view and on the problems raised by the acknowledged results.

c) Research on cognitive abilities and technical skills: the issue, strictly related to the general learning problems, will be focused on the cognitive aspects of logic, language and other abilities relevant for physics.
d) New technologies for learning and teaching: advantages and limits of different methodologies will be discussed in order to focus also the importance and utility of the new computer based and multimedia technologies.
e) The image of science: epistemological themes for understanding the conceptual and methodological structure of Physics knowledge and the importance, for a researcher in Physics education, to develop and epistemological frame for the conduction of the research.
f) History of physics as a tool for teaching: some case studies will be presented.

7. LECTURERS AND SEMINAR SPEAKERS

The lecturers (see table 1) and seminar speakers (see table 2) have benn chosen with the criterion of having representatives of different countries in order to obtain a reasonable international frame of the research approaches. All are well known exponents of the research community and of the related fields of epistemology (Levy-Leblond), communication (Nersessian). Also, in the seminars, the points of view of the International Commission on Physics Education of IUPAP will be presented (Sahm) and of the Forum on Education of the European Physical Society (Tibell).

The participation will be searched and assured by personal contact of the two directors.

The interaction between the leading scientists and the young researches will start from an interactive organization of the lectures which will try to involve in the planning of new research projects all the participants.

TABLE 1

P. Black, Prof. Emeritus,King's College ,London,HK Gold medal ICPE 2001 (or Robin Millar, Prof. Dept of Educational Studies ,The University of York Heslington,York Y01 5 DD UK - Work on laboratory teaching and epistemology)

J.M. Levy-Leblond, Full Professor, Laboratoire di Physique Theorique Université de Nice CEDEX, France – Author of books on the teaching of Quantum Physics and on the epistemology of Physics

J. Mestre Dept.of Physics University of Mass.Amherst MA 01003-4525 USA – Work on problem solving both as a research and teaching tool)

L. Viennot, Professor, Univ. Paris VII, Laboratoire de Didactique de la Physique Tour 23 2 Place Jussieu 75211 Paris Cedex 05, France – Has worked on problems of understanding physics at the secondary and university levels. Author of books on physics education

A.Di Sessa, Professor, Graduate School of Education University of California Berkeley ,CA 94720 USA (or M.Chi Univ. of Pittsburg LRDC ,3939 O'Hara Str.Pittsburg PA 15260, USA) – Both experts on building models of students' thinking

P. Guidoni, Professor, Did. di Fisica, Università di Napoli, Italy – Has worked in high energy physics and research in physics education at all school levels

M. Euler, Professor, Dept of Physics Education IPN Kiel German, President of International Group of Research in Physics Education (GIREP)

D.Hammer, Professor, Dept of Physics and Curriculum Instruction University of Maryland College Park MD 20742-4111, USA – Research on the epistemological resources needed for teaching and learning

V. Otero - University of Colorado

R. Pintò, Universitat Autonoma de Barcelona Dept.de Didactica de les Ciencies Barcelona Spain

TABLE 2

J. Sahm, Technische Universitat Berlin Fachbereich 4 Hardenberg str.36 D-10623 Berlin, Germany - President ICPE

G. Tibell, Dept. of Radiation Science Uppsala Univ. POBox 535-S-751 Uppsala, Sweden – Chair of the Forum on Education of the European Physical Society

N. Grimellini, Dip.di Fisica Univ.di Bologna via Berti Pichat, Bologna Italy – Research on cognitive problems of physics understanding

N .Nersessian, School of Literature Communication and Culture Georgia Inst. Of Tech. Atlanta Georgia 30307-0165, USA – Cognitive analysis of historical development of physics ideas

R. Millar - Department of Educational Studies, University of York Heslington (UK)

H. Ferdinande - Universiteit Gent (Belgie)

8. TRAINING NEED

The educational changes in the European Community which have taken a starting point with the Bologna Declaration (on the harmonization of curriculum and organizational structure of the studies in higher education among the countries of the Union) and are now taking place focus the need of physicists well trained in the research methodologies for learning and teaching.

9. TRAINING IMPACT

The young researchers will be given the opportunity to acquire the basic knowledge needed for the conduction of educational research in physics by the lectures given by the leading scientists working in the field at the international level.

Personal contact among scientists and researchers, focused on the research problems will add value to the training.

10. EUROPEAN ADDED VALUE OF TOPIC

As already mentioned in point 8 there is a strong need to promote scientific and technological excellence in the field of education with the aim of improving the collaboration among European countries thus strenghthening the European leadership in the field.

11. EUROPEAN ADDED VALUES FOR PARTICIPANTS

The proposed project encourages the interaction among researchers of the different european nationalities by focusing on the educational problems common to the various european cultures and the differences among them. One aim of the course is to promote the development of new european projects. The participation of european researchers will be stimulated by the groups already active in the field and the collaboration of the Physics Departments now involved in the changes in University Education.