Labs to build modern physics way of thinking

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Abstract

Modern physics in secondary school is a challenge, which involves the possibility to transfer to the future generations a culture in which physics is an integrated part, not a marginal one, involving curricula innovation, in a way that allows the students to manage them in moments of organized analysis, in everyday life, in social decisions. Conceptual knots in classical physics are often quoted to argue the exclusion of modern physics in secondary school, but the physics of the last century is now part of the secondary school curricula in many EU countries and in the last 10 years appear in secondary textbooks, even if in not organic way and sometime with a prevalent narrative approach. A wide discussion on goals, rationale, contents, instruments and methods for its introduction in secondary school curriculum is now increasing. In the theoretical framework of the Model of Educational Reconstruction, the Physics Education Research Unit of the University of Udine developed research based educational proposals based on active role of students. Different king of Lab work are integrated in the proposals, chosen to offer an idea of the differentiated perspective of the work of physicists in modern physics and an epistemological reflection. The main kind of Lab work are:

1) The experimental study of phenomena bridging different theories in physics and relative interpretations, i.e. diffraction and interference;
2) Problem solving Labs by means of a semi-classical interpretation of some condensed matter experimental analysis research techniques, i.e. Resistivity and Hall effect measurements, Rutherford Backscattering Spectrometry, Time Resolved Reflectivity, optical spectroscopy;
3) Phenomenological IBL exploration of new phenomena, i.e. high temperature superconductivity;
4) Conceptual Lab, modelling activities and ideal experiment explorations on some fundamental concepts in different theories (in classical physics, in quantum mechanics and in special relativity), i.e. state, measure, cross section, energy conservation;
5) Hand-on and minds-on exploration of simple experiments of light polarization integrated with ideal experiments to approach the basic concepts in quantum mechanics and to develop formal thinking.

Researches associated are focus on contributing to practice, developing vertical coherent content related learning proposals by means of Design Based Research to produce learning progression and finding ways to offer opportunities for understanding and experience what physics is, what it deals with and how it works in operative way.

The strategies of Lab work assume a formative role in their integration in the context of the different proposals.