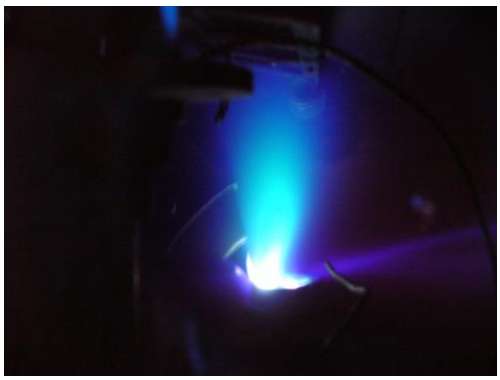
School and research for a “Greener World” at the University Campus of Parma

On May 14th 2014, fifty high school students will visit the University Campus of Parma for a workshop to be held in the frame of the European project “Greener World”- Comenius. The seven European countries involved are Turkey (coordinator), Italy, Poland, Slovakia, Portugal, Spain, France. Italy is represented by I.S.I.S.S. "Pietro Giordani" (Parma), under the supervision of prof. Silvia Urbinelli. “Greener world” is a multilateral school partnership aimed to increase students’ awareness towards sustainable energy usage and development, environmental preservation issues and reduction of wastefulness. Innovative chemico-physical research is of key importance for the development of novel energy-saving devices and to improve the cost-to-performance ratio in already existing tools, such as solar cells. During the workshop, “Greener World” students will come in direct contact with experimental activities of three Physics labs located at the University Campus, actively performing cutting-edge research in the fields of new-generation solar cells and in the development of low-cost, green energy (*vide infra* for details). The three participating laboratories are located at the Department of Physics and Earth Sciences of the University of Parma (DiFeST) and at the Institute of Materials for Electronic and Magnetism of the National Research Council (IMEM-CNR). Doctoral students (Pietro Delcanale, Francesco Cugini Matteo Bronzoni and Filippo Annoni) and pots-doc fellows (Daniele Menossi) will actively participate to the workshop, that will start at 14:30 at the DiFeST: after a welcome they will accompanied to the laboratories where the activities will be carried out as detailed below.

To learn more about “Greener world” see: www.eugreenerworld.com
Department of Physics and Earth Sciences of the University of Parma (DiFeST)
Institute of Materials for Electronic and Magnetism of the National Research Council (IMEM-CNR)

Activity 1. ***Thin Film* Solar Cells**

@: IMEM-CNR (Institute of Materials for Electronic and Magnetism – National Research Council)
Organized by: Dr. Edmondo Gilioli, Dr. Stefano Rampino, Dr. Matteo Bronzoni and Dr. Filippo Annoni



Photovoltaic devices, that convert light into electricity, are important for the implementation of renewable energy supply systems. Today, silicon-based modules are dominating the photovoltaic market, but various emerging technologies, such as thin-films solar cells are rapidly progressing.

Besides cost-reduction, thin-film photovoltaic devices can be manufactured on flexible substrates, enabling the employment of industrial roll-to-roll deposition techniques, suitable for new applications like building integration or portable electronics.

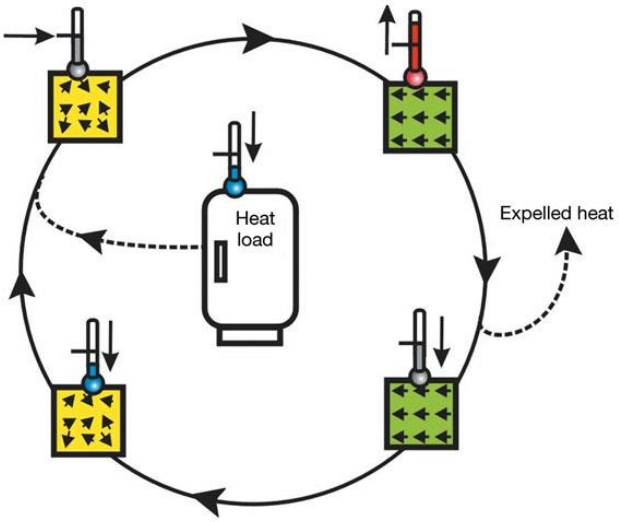
At IMEM-CNR in Parma, we have developed an innovative method to fabricate thin film solar cells based on CIGS [Cu(In,Ge)Se2], by using the Pulsed Electron Deposition (PED) technique. Among the various advantages of PED: the low installation and running costs, the easy deposition process (a single step allows the deposition of a complex material) and the possibility to reduce the deposition temperature (thermolabile

unconventional substrate can be used). During the visit @ IMEM , the students will learn how PED works, how a solar cell is grown layer by layer (a thin film solar cell is a multi-layer device), its characterization and the activities to scale up the process to obtain larger solar cells. *In the picture: Pulsed Electron Deposition of CIGS-based solar cells @ IMEM-CNR, Parma*

Activity 2. The Magnetic Refrigeration

@ Magnetometry Laboratory, Department of Physics and Earth Sciences, Physics building
Organized by: Prof. Massimo Solzi, Dr. Francesco Cugini

A great amount of the worldwide electric energy is consumed today for refrigeration, particularly for food conservation and air conditioning. The actual conventional cooling technology, based on the compression-expansion of gases, has reached its maximum efficiency and, what is even worse, it is based on toxic and environmentally harmful gases. The Magnetic Refrigeration could be an efficient and environmentally friendly alternative. Some solid materials, indeed, can change their temperature, due to an effect named Magneto-Caloric effect, if they are moved inside or outside a region in which there is a magnetic field. By repeating magnetization and demagnetization processes of the material, thermodynamic cycles can be realized for the development of innovative refrigeration machines. In this laboratory activity the students will experimentally observe the Magneto-Caloric effect and how it can be exploited for creating opportune thermomagnetic cycles that will be applied in future cooling devices. The basic thermodynamics of main refrigeration cycles and the Magneto-Caloric effect will be explained with the help of some slides and videos. Then the students will be able to directly see that a small piece of a rare-earth metal (gadolinium) changes its temperature if put inside a magnetic field generated by an electromagnet. Moreover thermomagnetic cycles will be reproduced, by utilizing an appropriate experimental setup, and the students will appreciate the effect of changing amplitude and/or frequency. *In the picture: schematic of a green magnetic refrigerator*



Activity 3. Photovoltaic devices: the last generation

@: Thin Film Laboratory, Department of Physics and Earth Sciences, Physics building
Organized by: Dr.Alessio Bosio, Dr. Daniele Menossi

Photovoltaics stumbling block has always been its cost but it has held the promise of providing clean electricity and competitive rates. More than 90% of the current production uses 1st generation PV wafer based cSi (I G PV), a technology with the ability to continue to reduce its cost at its historic rate. The deposition of thin films directly on large area substrates, such as glass panels (square meter-sized and larger) or foils (several hundred meters long) in roll-to-roll application, recognized as 2nd generation approach (II G PV), is always looked at as the “younger cousin” of the silicon technology. We propose a guided tour of the Thin Film Laboratory (ThiFiLab) where you can "touch with your hands" the new generation of photovoltaic devices. The laboratory is equipped with all the necessary machinery for the construction of a complete PV device; guests can follow the production of a solar cell in all its stages, breathing the air of a modern experimental physics laboratory in which new materials and devices are studied and characterized for developing environmentally friendly technologies dedicated to the low-carbon energy supply. *In the picture: a view of the Thin Film Laboratory at the DiFeST.*