

SCIENTIFIC REPORT on the School
"Cold atoms, excitons, exciton-polaritons and surface plasmon-polaritons" of the
POLATOM ESF research networking programme, hold in Maratea, Spain from August
30th to September 6th, 2013.

Summary

The main goal of the school was to give a background of the basic aspects of cold atoms, excitons, exciton-polaritons and surface plasmon-polaritons physics so that students from related fields are able to follow the most recent and exciting developments of these communities. Some lectures were also given with a more applied perspective dealing with Nanophotonics and Photovoltaics, since the ESF school was organized in collaboration with the International School of Nanophotonics and Photovoltaics. Additional aims were to promote cooperation between the students and to produce synergy among these fields.

The school was organized following the scope of the POLATOM Network, offering the students the opportunity to cross the borders between cold-atom physics and the physics of excitations in semiconductors strong coupled to light. Slightly differently from the previous meetings, the lectures of the school have not only covered the most recent advances but went also more deeply on the basic physics and historical developments in these fields, with two lectures by each speaker, lasting 45 minutes each. Also was new in this School the applied aspects of Nanophotonics covering fields as solar cells, organic photovoltaics and organic optoelectronic devices.

Scientific content

Students arrived at the school site on August 30th and departed on September 6th.

The lectures started on Saturday, August 31st at 8:50 with a short welcome by the organizer of the events, Profs. Alexey Kavokin, Aldo Di Carlo and Luis Viña.

The two first lectures on “*Dye Sensitized Solar Cells*” by Prof. Aldo Di Carlo and on “*Bimolecular process in catalysis and photophysics*” by Prof. Carlo Levi were imparted in the first session of the school. The second morning session was devoted to “*The physics of the ultrastrong coupling regime*”, the lectures were taught by Prof. Simone De Liberato. In the first afternoon session, “*Many body physics with ultra cold atomic gases*” was covered by Dr. Chiara Fort. The scientific activity of the day finished with the lectures of Prof. Stephanie Reimann on “*Vortices in rotating BECs*”.

On September 1st, Profs Luis Viña presented his lectures on “*Manipulation of polariton condensates in semiconductor microcavity ridges*”. After the coffee break, Prof. Paolo Lugli gave his lecture on “*Organic optoelectronic devices*”. In the afternoon, Prof. Alexey Kavokin taught on “*Spin dynamics of excitons*”. The scientific activity of the day finished with a poster session where the students presented and discussed about the research performed in their PhD thesis. Four “best poster” awards, sponsored by the Journal EPL were given to Nathan Shammah (Southampton University, UK), Mikhail Petrov (Saint-Petersburg State University, Russia), Carlos Anton (Universidad Autonoma de Madrid, Spain) and Martin Thunert (Universität Leipzig).

On the next day of the school, the first session was devoted to “*Electrical and optical manipulation of polariton condensates on a chip*”, subject presented by Prof. Pavlos Savvidis . The second part, after the break, dealt with “*Spin-orbit coupling and topological effects in polariton condensates*” being the lectures imparted by Prof. Dmitriy Solnyshkov. In the afternoon Prof. Alberto Bramati taught on “*Quantum optics in solid state system*”. After the coffee break a lecture on “*Organic nanostructures for large area Organic Photovoltaics*” was given by Prof. Andrea Reale and the session finished with the two lectures of Prof. Pavlos Lagoudakis on “*Hybrid nanophotonics for energy efficiency*” and “*Huygen’s clocks and Berry’s interferences in semiconductor microcavities*”.

The following day of the school was devoted to a cultural visit to the site of Matera, an area that has been settled since the Palaeolithic. Its ancient town, "Sassi di Matera", originate from a prehistoric (troglodyte) settlement, with many of its houses being only caverns.

On the 4th of October the first two lectures were given by Prof. Yuriy Rubo on "*Vortices in multicomponent exciton-polariton superfluids*". These were followed by seminars on "*Excitonic effects in carbon-based nanostructures*" imparted by Prof. Mikhail Portnoi. In the afternoon Dr. Wolf Von Klitzing presented "*Experimental aspects of Bose-Einstein Condensation*". After the coffee break a lecture on "*Usage of low-power off-grid solar photovoltaic systems in high mountainous regions*" was given by Prof. Konstantin Kobakhidze.

The last day of the school started with the presentations of Prof. Iacopo Carusotto about "*The quest for strongly correlated gases of photons and polariton*", these were followed by the lectures on "*Surface Plasmon Polaritons*" given by Prof. Carlos Tejedor. The last seminar of the school was given by Dr. Vladimir Kochereshko on "*Exciton g-factor in quantum wells*".

The program is presented in the following Table:

VI International School of Nanophotonics and Photovoltaics (ISNP-13)

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POLATOM ESF School on

"Cold atoms, excitons, exciton-polaritons and surface plasmon-polaritons"

August 30 – September 06, 2013 - MARATEA, Italy

Program

30.08.2013 Fri	Arrival and Registration of the participants at the Hotel Villa del Mare	
13:00	14:30	<i>Lunch</i>
20:00	<i>Welcoming cocktail</i>	

31.08.2013 Sat.		<i>Speaker</i>	<i>Title of lecture</i>
09:00	10:00	Aldo Di Carlo	Dye Sensitized Solar Cells
10:15	10:45	Carlo Levi	Bimolecular process in catalysis and photophysics

10:45	11:00	Coffee break	
11:00	11:45	Simone De Liberato	The physics of the ultrastrong coupling regime
12:00	12:45	Simone De Liberato	The physics of the ultrastrong coupling regime
13:00	14:30	Lunch	
15:00	15:45	Chiara Fort	Many body physics with ultra cold atomic gases
16:00	16:45	Chiara Fort	Many body physics with ultra cold atomic gases
16:45	17:00	Coffee break	
17:00	17:45	Stephanie Reimann	Vortices in rotating BECs
18:00	18:45	Stephanie Reimann	Vortices in rotating BECs

01.09.2013 Sun.		Speaker	Title of lecture
09:00	09:45	Luis Vina	Manipulation of polariton condensates in semiconductor microcavity ridges
10:00	10:45	Luis Vina	Manipulation of polariton condensates in semiconductor microcavity ridges
10:45	11:00	Coffee break	
11:00	11:45	Paolo Lugli	Organic optoelectronic devices
12:00	12:45	Paolo Lugli	Organic optoelectronic devices
13:00	14:30	Lunch	
15:00	15:45	Alexey Kavokin	Spin dynamics of excitons
16:00	16:45	Poster session	
17:00	17:45	Poster session	

18:00	18:15	Coffee break
		<i>Football game</i>

02.09.2013 Mon.		Speaker	Title of lecture
09:00	09:45	Pavlos Savvidis	Electrical and optical manipulation of polariton condensates on a chip
10:00	10:45	Pavlos Savvidis	Electrical and optical manipulation of polariton condensates on a chip
10:45	11:00	Coffee break	
11:00	11:45	Dmitriy Solnyshkov	Spin-orbit coupling and topological effects in polariton condensates
12:00	12:45	Dmitriy Solnyshkov	Spin-orbit coupling and topological effects in polariton condensates
13:00	14:30	<i>Lunch</i>	
15:00	15:45	Alberto Bramati	Quantum optics in solid state system
16:00	16:45	Alberto Bramati	Quantum optics in solid state system
16:45	17:00	Coffee break	
17:00	17:45	Andrea Reale	Organic nanostructures for large area Organic Photovoltaics
17:45	18:30	Pavlos Lagoudakis	Hybrid nanophotonics for energy efficiency
18:30	19:00	Pavlos Lagoudakis	Huygen's clocks and Berry's interferences in semiconductor microcavities

20:00	<i>Social dinner. Dancing Hall</i>
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03.09.2013 Tuesday

Sightseeing Day — Matera

04.09.2013 Wed.		Speaker	Title of lecture
09:00	09:45	Yuriy Rubo	Vortices in multicomponent exciton-polariton superfluids
10:00	10:45	Yuriy Rubo	Vortices in multicomponent exciton-polariton superfluids
10:45	11:00	Coffee break	
11:00	11:45	Mikhail Portnoi	Excitonic effects in carbon-based nanostructures
12:00	12:45	Mikhail Portnoi	Excitonic effects in carbon-based nanostructures
13:00	14:30	Lunch	
15:00	15:45	Wolf Von Klitzing	Experimental aspects of Bose-Einstein Condensation
16:00	16:45	Wolf Von Klitzing	Experimental aspects of Bose-Einstein Condensation
16:45	17:00	Coffee break	
17:00	17:45	Konstantin Kobakhidze	Usage of Low-power Off-grid Solar Photovoltaic Systems in High Mountainous Regions
20:00		Dinner. Dancing Hall	

05.09.2013 Thu.		Speaker	Title of lecture
09:00	09:45	Iacopo Carusotto	The quest for strongly correlated gases of photons and polariton
10:00	10:45	Iacopo Carusotto	The quest for strongly correlated gases of photons and polariton
10:45	11:00	Coffee break	
11:00	11:45	Carlos Tejedor	Surface Plasmon Polaritons
12:00	12:45	Carlos Tejedor	Surface Plasmon Polaritons
13:00	14:30	Lunch	
15:00	15:45	Vladimir Kochereshko	Advanced seminar: "Exciton g-factor in quantum wells"
16:45	17:00	Coffee break	

20:00	<i>Dinner, Dancing Hall</i>
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06.09.2013 Friday
Departure day

Results and impact

The lectures have been opened to students working on other field of physics, not only to those being trained on cold-atoms and polariton physics, who sought extending their knowledge in physics, and to more senior scientists who were interested in educating themselves. Consequently, the school has given the chance to the cold-atom and polariton communities to educate each other, and to other communities to learn about the exciting physics carried out in cold atoms and semiconductor polaritons. In this occasion a broader perspective was also given presenting applied aspects on Nanophotonics and Photovoltaics.

The school, as it was the case during the previous ones, was structured to give the maximum opportunity for informal discussion between the lecturers and the students. All the event, lectures and accommodation happened in the same place, Hotel Villa del Mare in Acquafredda di Maratea (Italy), what greatly facilitated these discussions also during the coffee breaks and the lunch and dinner time. The students were encouraged repeatedly to ask question and an animated interchange of ideas did happen.

This school has provided a basic knowledge about cold-atom and polariton science to a large number of students and mainly about the common physics underlying the main trends in both fields, and have helped to cross-fertilize these field. The students got also the required background to attend more specialized workshops.

The complete viewgraphs of the lectures will be made available to the participants in the school through links in the internet, where the students can study in great detail all the presentation of the school.

List of participants

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