MULTISTABILITY IN TWO-COMPONENTS POLARITON CONDENSATES

REPORT

The aim of this visit was to set up a collaboration to implement a proposal for devices based on multistable hysteresis cycles in two-component microcavity-polariton condensates [E. Cancellieri et al, arXiv:1101.1783]. In the theoretical proposal we show that multi-stable hysteresis loops can be realized in two components condensates in which the two components have different energies and momenta instead of different polarizations as in T. K. Paraiso et al., Nature Materials **9**, 655 (2010). The quantity performing the hysteresis cycle in our systems is the ratio between the polariton population with one energy and momenta, divided by the total polariton population in the cavity. In our proposal we show that changing the intensities of the two lasers, continuously pumping at two different frequencies and angles, the population of polaritons can be moved from one component to the other.

The first part of the work in Lecce has been devoted to the the implementation of the experimental set-up. According to the theoretical proposal, two continuous wave lasers have been aligned to pump on the same region of a microcavity with tunable intensities, angles and energies, then the most suitable parameters for the realization of the experiment have been chosen. The second part of the work has been devoted to the collection of sampled experimental data along different hysteresis cycles.

This set of collected data is the first achievement of the visit. Even rough, the data proof the feasibility of the experiment and show that the theoretical predictions can be experimentally verified, i.e. the system can be tuned from one configuration to another simply changing the two pump intensities. This part of the investigation will need further work, both theoretical and experimental. On one side, in fact, new theoretical work will be needed to reproduce the exact experimental parameters, on the other side, new and more accurate sets of data will be need to enhance the precision of the observation and to check limiting cases.

A second important outcome of the visit lies in a proposal for a new experiment that can be performed. Following the intense work of confrontation on the theoretical and experiential issues, a new set-up has been proposed. In this case, a two-component condensate of cavity-polaritons is realized with a continuous laser pumping at two different angles but with degenerate energies, and a second pulsed laser is used to manipulate the system. This configuration might allow the implementation of a very fast and efficient switch. Also for this part of the work, however, further theoretical and experimental work is needed.

To conclude, we plan to develop this fruitful collaboration that leaded, in a very short amount of time, to experimental results ready for publication, and plan to further investigate the newly suggested proposal.