-Purpose of the visit

The visit was aimed to set-up and perform time-resolved experiments on the hydrodinamic formation of vortices as a consequence of the interaction of a propagating polariton superfluid with a spatially extended defect.

-Description of the work carried out during the visit

The first week of the visit has been devoted to build the optical setup used for the experiments. It consists in a modified transmission micro-photoluminescence setup coupled to a time-resolved detection system. In particular a confocal mask has been inserted in the excitation path in order to modify the spatial behavior of the excitation beam, thus allowing the generation of a non-uniform polariton density inside the microcavity.

As already reported by other groups [J. K. Lagoudakis et al., Science 326, 974 (2009)] [D. Sanvitto et al., Nat. Phys. 6, 527 (2010)], a vortex in the polariton flow is identified by a phase singularity in the light emitted by the polaritons. To detect such feature, a Michelson interferometer has been built in the detection path and its output has been focused on a streak camera with a time resolution of ~2ps.

In the second week of the visit the experiments has been carried out, and preliminary results obtained. In particular, as described in next section, the time resolved system has been exploited to obtain time and phase resolved 2D images in order to follow the evolution of polariton vortices as a function of time.

-Description of the main results obtained

A resonant femtosecond-pulsed laser has been used to excite a polarion flow and to shine it on a potential defect. Such defects, spontaneously formed during the growth of the microcavity, can allow the formation of turbulence in the laminar polariton fluid flowing toward them, thus generating vortices, antivortices or solitons [S. Pigeon et al, arXiv:1006.4755 (2010)].

As already mentioned, such features have been studied by exploiting the time resolved interference pattern obtained by a Michelson interferometer coupled with a streak camera. In particular, the light emitted by the microcavity has been mixed with a reference beam with constant phase, allowing the observation of the phase singularities created by vortices.

In the sequence of images reported in fig.1 some “phase forks” moving the direction of the polariton flow are clearly visible. These features show that a turbulent regime can be generated by hitting a potential defect with a laminar polariton fluid.

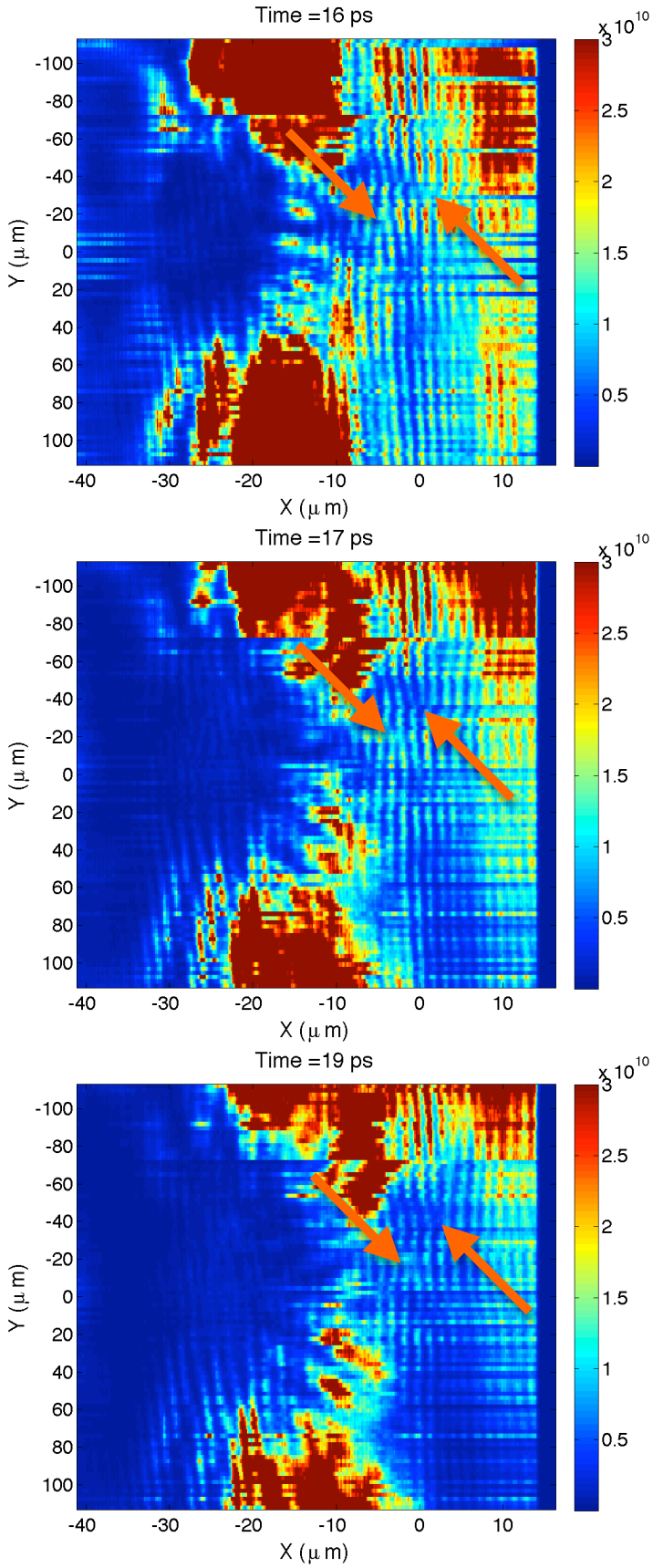

Fig.1 Vortices formed in the the polarion flow (the fluid is moving toward positive x)

-Future collaboration with host institution (if applicable)

The experiment is in progress in lecce and other visits are planned in 2011.

-Projected publications/articles resulting or to result from the grant (ESF must be acknowledged in publications resulting from the grantee's work in relation with the grant).

The preliminary results obtained during this stay are very promising, because vortex nucleation has been clearly observed. More refined measurements are necessary, to explore the whole range of variation of the parameters which play an important role in the experiment (such as excitation density, polariton speed, defect size etc). The team in Lecce is working in this direction to obtain a complete set of experimental data suitable for publication in a peer reviewed journal.

-Other comments (if any)