

Marie Curie ITN cQOM

Summary of the Scientific Achievements

Name of Fellow: Koppany Kormoczi

Principal Investigator: Prof. Florian Marquardt

Academic / Industrial Institution: Friedrich-Alexander Universität Erlangen-Nürnberg (FAU)

Start Date of ITN Fellowship: 01.09.2015

End Date of ITN Fellowship: 31.05.2016

Date of Report: 28.07.2016

1. Description of research work

The goal of the research was to study the interplay of nonlinear dynamics and topological transport in optomechanical systems. Topological properties in various systems, ranging from electrons to cold atoms to phonons and photons, are currently a very active and fruitful area of research. However, almost all of this is confined to the linear regime, where 'single-particle physics' is enough to understand the topological bandstructure of a material and predict the peculiar transport properties, including chiral edge states that are robust to disorder-scattering. It is a wide open question what happens to topological systems in the nonlinear domain. People have started to study this for electrons with interactions. However, precisely in this nonlinear domain, the differences between the various physical platforms start to matter, e.g. the difference between fermions and bosons or between equilibrium and nonequilibrium situations. In this sense, an opportunity arises due to the recent prediction that topological transport of light and sound may be implemented by employing the optomechanical interaction (as shown by our team). The goal of the present research was then to study, at least for the classical regime, the evolution of topological properties upon going into the nonlinear domain. This could be done by studying optomechanical arrays with larger amplitudes of light and sound waves. Interesting parallels with cold atom systems (described by the nonlinear Gross Pitaevskii equation) may be discovered in this direction. The methods to be employed would be numerical solutions of the nonlinear coupled equations of motion, together with suitable analytical methods in limiting regimes.

2. Goals achieved and/or progress towards them

Koppany Kormoczi started to become proficient with the tools of quantum optics and with the concepts and methods applied in cavity quantum optomechanics. In addition, he started learning about topological bandstructures and transport in general, based on a set of training problems developed by the supervisor. This was the status at the end of the (short) period during which Koppany Kormoczi was employed on the ITN.

3. Training received (complementary/soft skills, ITN workshops attended)

- Taking a Research Idea to Product; IBM Research, Zurich, Switzerland (30 Nov – 1 Dec 2015)
- Annual cQOM ITN workshop; Diavolezza, Switzerland (31 Jan – 4 Feb 2016)

4. Participation and role in dissemination and outreach activities

Koppany Kormoczi contributed to the official Wikipedia entry on Cavity Optomechanics, collaborating together with other ITN Fellows from UEN, EPFL, UCAM.

5. Career plans after ITN

At the moment, unclear (Koppany Kormoczi decided not to pursue PhD studies further after the end of the ITN funding period).