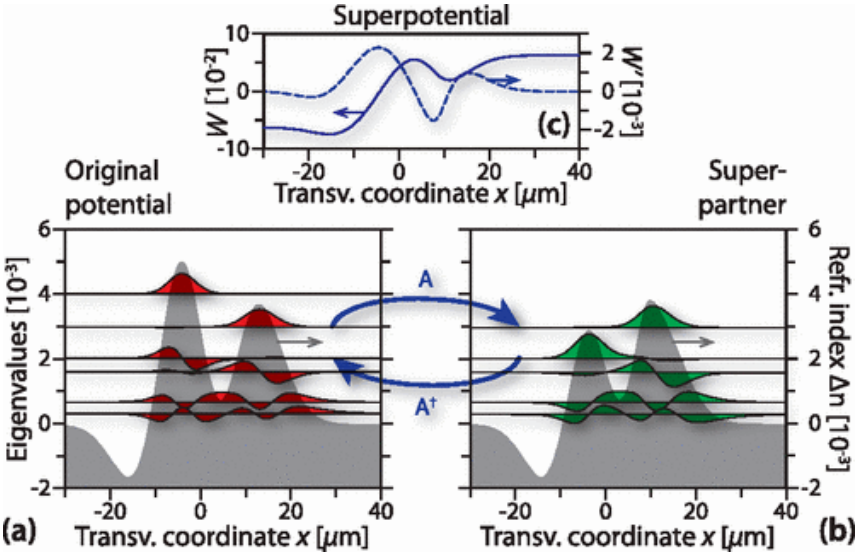
CHALMERS
UNIVERSITY OF TECHNOLOGY

Master Thesis Project

Supersymmetry in Optics

The goal of this thesis project is to investigate whether the methods of supersymmetry can be used in the design of optical devices



Supersymmetry is a theory in elementary particle physics for a yet to be discovered class of particles. Supersymmetry conjectures a relationship between bosons and fermions, creating a partner for every elementary particle known to date. This is achieved by so-called supersymmetry operators, which transform a boson into a fermion, and vice-versa. Using the formulation of supersymmetry, two systems with the same spectrum can be found.

Recently, the methods of supersymmetry were used to design a new type of laser (see Physical Review Letters **110**, 233902), where it was used to create two waveguides with identical spectra. This leads to the question of whether supersymmetry operators can be used in the design of other optical devices. The goal of this master thesis project is to study whether this is the case. In the project, we will first look into how the laws of electrodynamics can be cast in a way revealing supersymmetry. This will then be applied to optical devices with bound states. In unbroken supersymmetry, the ground state from one of the partners is removed from the spectrum of the other partner. This may be used to design optical resonators or waveguides with a single bound state. In broken supersymmetry, both partners have the same spectrum. The work is of theoretical and explorative nature; computer simulations will be used to calculate the spectrum of proposed optical devices.

If you are interested, please contact one of the supervisors for more information: Prof. Ulf Gran (ulf.gran, Origo 6th floor) or Prof. Philippe Tassin, Department of Physics (philippe.tassin, Origo 7th floor).