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Polaritons in solid state physics – from the basic concept to their mathematical properties

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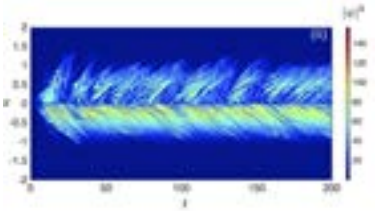
In the study of non-equilibrium polariton condensates, it is usually assumed that the dispersion relation of polaritons is parabolic in nature. We show that considering the true non-parabolic kinetic energy of polaritons leads to significant changes in the behaviour of the condensate due to the curvature of the dispersion relation and the possibility of transfer of energy to high wavenumber components in the condensate spatial profile. We present explicit solutions for plane waves and linear excitations, and identify the differences in the theoretical predictions between the parabolic and non-parabolic mean-field models, showing the possibility of symmetry breaking in the latter. We then consider the evolution of wavepackets and show that self-localization effects may be observed due to the curvature of the dispersion relation. Finally, we revisit the dynamics of dark soliton trains and show that additional localized density excitations may emerge in the dynamics due to the excitation of high frequency components, mimicking the appearance of near-bright solitary waves over short timescales.



Biography

Pinsker F is currently working at the University of Vienna. He has previously worked at Oxford University in the United Kingdom. He started his career as an Engineering and Physical Sciences Research Council (EPSRC) Doctoral Prize fellow in the Department of Applied Mathematics and Theoretical Physics (DAMTP) at the University of Cambridge post completion of PhD degree in Applied Mathematics from the same institution.

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