Nonlinear models in Quantum Mechanics

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Abstract: The course is an introduction to the study of the nonlinear Schroedinger equation and to the search for solutions of some explicit models.

Content:

Lecture 1. In the first lecture we give a brief introduction to Quantum Mechanics.

Lecture 2. Semiclassical methods in Quantum Mechanics is the main topic of the second lecture.

Lectures 3 and 4. In these two lectures we review some general results concerning the nonlinear Schroedinger equation

Lectures 5 and 6. Finally, we discuss in detail two explicit models: the one-dimensional nonlinear Schroedinger equation with a symmetric double-well potential and the one-dimensional nonlinear Schroedinger equation with periodic potentials.

References:

- Cazenave T., Semilinear Schrodinger Equations, AMS (2003); see also a first version available on-line https://www.ljll.math.upmc.fr/cazenave/36.pdf

- Sulem C., and Sulem P.-L., The nonlinear Schrodinger equations: self-focusing and wave collapse, Springer (1999)

- Sacchetti A., Universal Critical Power for Nonlinear Schroedinger Equations with a Symmetric Double Well Potential, Phys. Rev. Lett. 103, 194101 (2009), a first version is available at arXiv:0908.0246

- Fukuizumi R., and Sacchetti A., Bifurcation and Stability for Nonlinear Schroedinger Equations with Double Well Potential in the Semiclassical Limit, Journal of Statistical Physics 145, 1546-1594 (2011), a first version is available at arXiv:1104.1511

- Fukuizumi R., and Sacchetti A., Stationary States for Nonlinear Schroedinger Equations with Periodic Potentials, Journal of Statistical Physics 156, 707-738 (2014), a first version (with a different title) is available at arXiv:1208.5867

- Sacchetti A., Derivation of the tight-binding approximation for time-dependent nonlinear Schroedinger equations, Annales Henri Poincaré 21, 627-648 (2020); a first version is available at arXiv:1902.09143