

# Oberseminar Nichtlineare Differentialgleichungen

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### On the validity of the Nonlinear Schrödinger approximation with applications to relativistic Bose-Einstein Condensation

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Abstract: The Nonlinear Schrödinger Equation can be found in numerous fields of Physics, and it is a well-known model for nonlinearities arising from the self-interacting nature of many of the considered systems, such as the bosons making up a Bose-Einstein Condensate. This equation also arises as an approximate description of the envelope characterising the localised solutions of many more complex nonlinear wave equations. In the following work, we will describe and study the Nonlinear Schrödinger Equation as a tool to approximate the cubic Nonlinear Klein-Gordon Equation. The work is intended to be understandable to physicist even while presenting topics mainly researched by mathematicians. This is done by showcasing the possible applications and uses of this topic. The work will also focus on a mathematical analysis of the efficiency of the approximation, which will also be discussed numerically on Python for further proof and to display the advantages of its application in computing. The approximation will also be applied to a renowned situation in relativistic physics, involving a bosonic cloud interacting with a weak gravitational field, so to further explore the possible physical applications.

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