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Departmental Seminar

STUDY OF SOLITONS IN BOSE-EINSTEIN CONDENSATES

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ABSTRACT

One of the most striking and exciting aspect of nonlinear waves are the large amplitude solitary waves called solitons which are created due to the balance between dispersion and nonlinearity effects exhibiting particle like characteristics. A lot of physical systems produce these coherent, nonlinear structures that can be regarded as systems of interacting solitons and which show up in Bose-Einstein Condensates and nonlinear optics. The important properties of these solitons is that they do not change shape, they are limited to a region and they maintain their shape after dealing with other solitons. Most of the Bose-Einstein condensate applications are at present confined to the laboratory as the method for generating BECs require a reasonable amount of precision and time. BECs can be used to **simulate condensed matter systems** as they are more easily tunable where with the same sample lattice spacing, strength of interaction between atoms and the number density of atoms can be easily varied, which is extremely difficult to do with condensed matter systems where you need to grow all new samples for every new set of values you want to generate. There is also a good deal of interest in BEC for possible applications in **precision measurement**. At the moment, some of the most sensitive detectors ever made for rotation, acceleration, and gravity gradients come from atom interferometry, using the wavelike properties of atoms to do interference experiments that measure small shifts induced by these effects. BEC systems may provide an improvement beyond what you can do with thermal beams of atoms in these sort of systems. The other really hot area of BEC research is in looking for ways to use BEC systems for **quantum information processing**. If you want to build a quantum computer, you need a way to start with a bunch of qubits that are all in the same state, and a BEC could be a good way to get there, because it consists of a macroscopic number of atoms occupying the same quantum state. The presence of solitons in Bose-Einstein condensates can be studied using nonlinear partial differential equation called the Gross-Pitaevskii equation. An analytical technique using darboux transformation alongwith a lax pair was attempted alongwith a numerical analysis to identify the ideal conditions for the formation of various types of solitons in Bose-Einstein condensate systems

REFERENCES

1. **Gayathree Mohan**, "Theoretical Investigation of Solitons in Bose-Einstein Condensates", Scholars' Press, **ISBN** 9783639666557