MSc Seminar, Marton Borsi

Names of students *

Szilágyi Zsombor, Szabó Zsolt

Summarize the talk in 5-10 numbered sentences. Some guidance: What is the physical setup presented? What are the control parameters? What are the quantities measured/calculated? Which methods were used? Is this subject particularly interesting or relevant? Why? Do you have any questions? Any comments, suggestions regarding the presentation? *

1. The talk was mostly about decoherence in quantum systems.
2. The decoherence is the destruction of interference due to couplings with the environment.
3. The systems investigated were treated with the Bose-Hubbard model.
4. There were some remarkable theoretical predictions like the emergence of slowly relaxing states and anomalous diffusion of momentium space.
5. The experiemntal setup featured ultra cold atoms on optical lattice.

Note: Borsi Márton was good as usual, but the topic was quite advanced and we lost track fairly quickly.

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Budai Ákos, Tamás Gábor

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1. In 2013, a research group made theoretical predictions for dissipative dynamsics based on the Bose-Hubbard model.
2. The aim of the experiment was to verify these theoretical predictions.
3. Experimental setup: ultracold bosonic Yb-174 atoms on independent 2D optical lattices.
4. Dissipation was induced by lasers (through spontaneous emission) resulting in random walk processes in momentum space.
5. The distribution of atoms in momentum space was measured.
6. Measurements were carried out for different lattice depths.
7. As the lattice depth increased, the decrease of normalized peak amplitude slowed down.
8. Subdiffusion and algebraic decoherence were observed, therefore the predictions were verified.
9. The speaker was well prepared, but he often tried to avoid eye-contact with the audience (looked at the presented slides instead).

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Szász-Schagrin Dávid, Szombathy Dominik, Kovács Panna

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1. The talk was about studying the decoherence phenomena in a strongly correlated system due to continuous dissipation.
2. The system was realised with ultracold bosonic atoms on 2D optical lattices.
3. The theoretical predictions were based on the Bose-Hubbard model.
4. These predictions included an anomalous diffusion in momentum space and an algebraic (power law) nearest neighbour coherence.
5. The experiments showed subdiffusive behaviour and algebraic nearest neighbour decoherence too.

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Sári Péter, Horváth Anna, Balázs Péter

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1. The Bose-Hubbard model was used to describe dissipative dynamics.
2. It consists of three terms: nearest neighbour interaction, repulsive on-site term and periodic lattice potential.
3. The model predicts sub-diffusion in case of strongly interacting particles.
4. In the experiments ultracold atoms were used in an optical lattice, and the dissipation was caused by lasers.
5. A source of error is the disappearance of particles from the system.

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Gyulai László, Györgypál Zsolt

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1. The experiment which was explained in this presentation had been theoretically founded in 2013, however the experiment has only been performed lately.
2. The theory is based on the Bose-Hubbard model, which includes nearest neighbor tunneling and repulsive on-site interaction.
3. The theory of strongly interacting bosonic gases predict that:
-slowly relaxing states emerge
- an anomalous diffusion appears in momentum space.
4. The experiment was performed on ultracold bosonic Yb atoms.
5. The coherence was decreasing in time , and by fitting on the peaks one can deduce the time dependance.
6. The time evolution of the momentum width showed a time dependance of 1/sqrt(t), which is considered slow.

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Varga Zoltán, Földvári Dominic

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1.Talk was about theoretical predictions concerning dissipative dynamics and their verifications by experiment. Decoherence phenomena is under investigation which is destruction of intereference due to couplings with environment.
2. Theoretical setup: Bose-Hubbard model. Which describes interacting bosons and includes nearest neighbour tunneling, repulsive on-site interaction, and harmonic potential of the lattice (optical quasi 2D lattice which has a tunable potential).
3. Prediction: Non-interacting particles would have superdiffusion predicted by the B-H. model. With strongly interacting particles the diffusion is slowed down in momentum space. This is called subdiffusion.
4. Experimental setup: ultracold atoms (Yb-atoms), dissipation induced by laser excitations in independent two dimensional (tunable potential) optical lattice.
5. Verifications: looking at the momentum space distribution in time we see a pattern for subdiffusion. Time evolution of peak amplitudes decreases, and looking at the time evolution of momentum width, subdiffusion has time dependence with lower power than 1/2 (normal diffusion case). Another verification has been made regarding algebraic decoherence.

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Bendeguz Sulyok

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1: The Bose-Hubbard model is interesting even in the absence of dissipation as it describes a phase transition between superfluidic and mott insulator state.
2: In the case of dissipation the BH model gives a theoretical prediction of the decrease of decoherence in time.
3: An experiment was conducted in which ultracold atoms were placed on a 2D optical lattice of some lattice depth V and the dissipation was introduced by laser excitation (causing absorption - spontaneous emission cycles).
4: Measuring dissipation in momentum space we'd see peaks that decrease in time, but the decrease was slower than the theoretical prediction.
5: Using lattice with deeper V meant slower decrease of the peak.
6: A fit on the peaks had one interesting parameter: nearest neighbour coherence.
7: As the loss of coherence is plotted against time we see that the coherence dies out with a power law.
8: As the lattice depth V increases, the power law loss of coherence platoes at 0.5.