QSS34 - Dieter Jaksch - Questions & Answers

Dieter Jaksch

You showed a lot of different non-equilibrium systems in your introduction - including the stock market, traffic, etc. Are there good examples of cross-fertilization between quantum systems out of equilibrium and these classical many-body systems, either in terms of physics, or in terms of mathematical/computational techniques?

DIETER: Yes, quantum systems are used for simulating classical many-body systems like e.g. glassy dynamics or spreading of diseases (see e.g. talk by Igor Lesanovsky in this this seminar series). Also, computational techniques like matrix product states can be utilized for classical as well as quantum many-body systems out of equilibrium.

When you look at a Hubbard model to describe organic salts and cuprates, it is often difficult to know the dissipation microscopically (or we expect is to be somewhat non-Markovian). Are the symmetries you described strong enough that these non-stationary phenomena might occur for different types of (potentially not known!) dissipation?

DIETER: As you say, we do not know the microscopic parameters and thus we cannot know for sure. However, we have tested the effects of unwanted dissipation and find that a few percent of such dissipation still allows observing the discussed physics. Also, there are experiments that demonstrate driving induced superconducting (like) states which is consistent with our theory.

The long-range correlations you saw for "eta" pairs when driving in the spin sector are interesting, also given discussions about the role eta-pairs could play in high-Tc superconductors. Will the long-range correlations you get from noise in the spin sector lead to superconductivity? Are there just long-range correlations, or can we understand this in terms of having a Landau crieterion for the states you generate?

DIETER: As discussed in the later parts of the talk these correlation between eta pairs should lead to transient superconducting states. Please note that the correlations spread at a finite speed and unwanted dissipation (see above) will probably eventually destroy the driving induced states.

This phoenomenon of driving in one sector generating order in another sector is very interesting. Do you expect to mostly see this in idealised systems (e.g., if you use cold atoms), or could this give clues, e.g., to new types of laser-driven superconductivity in solid state materials? In those cases, is there a way to see in experiments whether this mechanism is responsible?

DIETER: There are a number of experiments (I cited one in a later part of the talk) which demonstrate driving induced superconductivity. The phenomenon arises in various different materials which points towards a rather universal mechanism. However, I am not aware of a way how these experiments could directly measure eta pair correlations. They usually measure optical reflectivity and, more recently, transport properties.

Does this physics scale to systems with larger amounts of 'sectors'. Or does the challenge then become to find a system adequate symmetries/geometries.

DIETER: The theory does scale to systems with a larger number of sectors. The challenge is finding the relevant ‘A’ operators and associated frequencies. If there are too many of these operators with incommensurate frequencies it may experimentally become impossible to resolve the non-stationary dynamics of individual observables.

Thinking about existing experiments - both with cold atoms, and driven solid-state systems, is it likely that the phenomenon you describe has already been observed, but not recognised? Or does it need a bespoke experiment?

DIETER: I would be delighted if some recent experiments on light-induced superconductivity could be traced back to this mechanism. Further experiments and investigations are on the way. In cold atoms, I believe that a bespoke experiment may be necessary that tunes the dissipation to be either to the charge (density) or spin sector of the fermions.