Contribution ID: **6** Type: **Contributed talk**

# Observation of Nonlinear Response and Onsager Regression in a Photon Bose-Einstein Condensate

*Monday 2 September 2024 14:40 (20 minutes)*

The quantum regression theorem states that the correlations of a system at two different times are governed by the same equations of motion as the temporal response of the average values. Such a relation provides a powerful framework for the investigation of physical systems by establishing a formal connection between intrinsic microscopic behaviour and a macroscopic effect due to an external cause, allowing to determine e.g. structure factors. Here I report experiments demonstrating that the two-time second-order correlations of an photon Bose-Einstein condensate inside a dye-filled microcavity exhibit the same eigenvalues of the dynamics as the response of the condensate to a sudden perturbation of the dye molecule bath. This confirms an unconventional form of the regression theorem for a coupled many-body quantum system, where the perturbation acts on the bath and only the condensate response is monitored. For strong perturbations, we observe nonlinear relaxation dynamics back to the steady state which our microscopic theory relates to the equilibrium fluctuations, thereby extending the regression theorem beyond the regime of linear response. The demonstrated nonlinearity of the condensate-bath system paves the way for studies of novel elementary excitations in lattices of driven-dissipative photon condensates.

## References

## Short bio (50 words) or link to website

https://www.qfl.uni-bonn.de/en

## Relevant publications (optional)

## Career stage

Student

**Primary author:** Mr LONGEN, Nikolas (Institut für Angewandte Physik, Universität Bonn, Wegelerstr. 8, 53115 Bonn, Germany)

**Co-authors:** SAZHIN, Alexander (University of Bonn); ERGLIS, Andris (University of Freiburg); Dr VEWINGER, Frank (University of Bonn); Mr HELLMANN, Göran (Leibniz Institute of Photonic Technology Jena); SCHMITT, Julian (University of Bonn); Prof. WEITZ, Martin (University of Bonn); Prof. WOUTERS, Michiel (University of Antwerps); GLADILIN, Vladimir N. (University of Antwerps)

**Presenter:** Mr LONGEN, Nikolas (Institut für Angewandte Physik, Universität Bonn, Wegelerstr. 8, 53115 Bonn, Germany)

**Track Classification:** FINESS