Contribution ID: **16** Type: **Poster**

# Microscopic many-body theory of two-dimensional coherent spectroscopy of exciton-polarons in one-dimensional materials

*Monday 2 September 2024 17:00 (2 hours)*

We have developed a microscopic many-body theory for two-dimensional coherent spectroscopy (2DCS) of polarons in one-dimensional (1D) materials [1]. Our theory incorporates contributions from three processes: excited-state emission (ESE), ground-state bleaching (GSB), and excited-state absorption (ESA). While ESE and GSB contributions can be accurately described using Chevy's ansatz with one particle-hole excitation, the ESA process requires information about many-body eigenstates involving two impurities. To address this, we have extended Chevy's ansatz to include double polaron states and verified its validity by comparing our results with exact calculations using Bethe's ansatz.

Our numerical results indicate that in the weak interaction limit, the ESA contribution cancels out the total ESE and GSB contributions, leading to less prominent spectral features. However, under strong interactions, the features of the ESA contribution and the combined ESE and GSB contributions remain observable in the 2DCS spectra, providing valuable insights into polaron interactions. Additionally, we have examined the mixing time dynamics, which characterize the quantum coherences of polaron resonances. Overall, our theory offers a comprehensive framework for understanding and interpreting 2DCS spectra of polarons in 1D materials, shedding light on their interactions and coherent dynamics.

[1] Jia Wang , Hui Hu , and Xia-Ji Liu, PRB 109, 205414 (2024)

## References

[1] Jia Wang , Hui Hu , and Xia-Ji Liu, PRB 109, 205414 (2024)

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

I am an ARC Future Fellow working in the Centre for Quantum Technology Theory (CQTT) at Swinburne University. Prior to my current role, I held postdoctoral positions at both Swinburne and the University of Connecticut Storrs. I earned my Ph.D. from the University of Colorado, Boulder.

## Relevant publications (optional)

[1] PRB 109, 205414 (2024) https://doi.org/10.1103/PhysRevB.109.205414
[2] PRA 107, 013305 (2023) https://doi.org/10.1103/PhysRevA.107.013305
[3] PRL 128, 175301 (2022) https://doi.org/10.1103/PhysRevLett.128.175301

## Career stage

Postdoc

**Author:** WANG, Jia (Swinburne University of Technology)

**Co-authors:** HU, Hui; Prof. LIU, Xia-Ji (Swinburne University of Technology)

**Presenter:** WANG, Jia (Swinburne University of Technology)

**Session Classification:** Posters I

**Track Classification:** FINESS