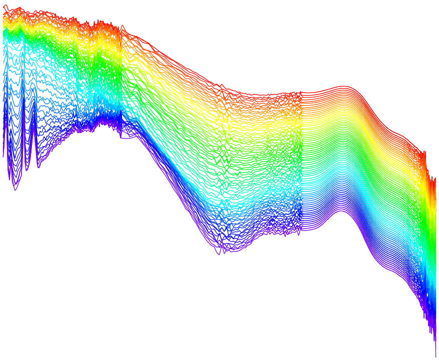
The colour of charge density wave order

Feng, X.

Publication date
2023

THE COLOUR
OF
CHARGE DENSITY WAVE ORDER



XUANBO FENG 馮翾博

The Colour of Charge Density Wave Order

Feng, Xuanbo 馮翾博

ISBN: 978-94-93330-00-9

Cover design by Y. Zheng & X. Feng, inspired by the cloud-and-thunder patterns used on bronze in ancient China during the Shang and Zhou eras (ca. 1600 - 256 BCE). Two adjacent motifs are bonded, which is an interesting analogy to the 1D atomic chain with Peierls instability.

The colour of charge density wave order

ACADEMISCH PROEFSCHRIFT

ter verkrijging van de graad van doctor
aan de Universiteit van Amsterdam
op gezag van de Rector Magnificus
prof. dr. ir. P.P.C.C. Verbeek
ten overstaan van een door het College voor Promoties ingestelde commissie,
in het openbaar te verdedigen in de Agnietenkapel
op woensdag 29 maart 2023, te 13.00 uur

door Xuanbo Feng
geboren te HENAN

Promotiecommissie

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	prof. dr. N.F. Shahidzadeh	Universiteit van Amsterdam
	dr. J. van Wezel	Universiteit van Amsterdam

Faculteit der Natuurwetenschappen, Wiskunde en Informatica

“Yet, in the first place, whenever you cast your eyes, there is no spot in the universe wherein you cannot discern at least some sparks of his glory. You cannot in one glance survey this most vast and beautiful system of the universe, in its wide expanse, without being completely overwhelmed by the boundless force of its brightness. The reason why the author of The Letter to the Hebrews elegantly calls the universe the appearance of things invisible [Heb. 11:3] is that **this skillful ordering of the universe** is for us a sort of mirror in which we can contemplate God, who is otherwise invisible.”[1]

— J. Calvin “Institutes of the Christian religion”

"What could be more delightful than to have in the same few minutes all the fascinating terrors of going abroad combined with all the humane security of coming home again? What could be better than to have all the fun of discovering South Africa without the disgusting necessity of landing there? What could be more glorious than to brace one’s self up to discover New South Wales and then realize, with a gush of happy tears, that it was really old South Wales. This at least seems to me the main problem for philosophers, and is in a manner the main problem of this book. How can we contrive to be at once astonished at the world and yet at home in it? How can this queer cosmic town, with its many-legged citizens, with its monstrous and ancient lamps, how can this world give us at once the fascination of a strange town and the comfort and honour of being our own town?"[2]

— G. K. Chesterton "Orthodoxy"

[1] Calvin, J., McNeill, J. and Battles, F. (2006). Institutes of the Christian religion. Louisville, Kentucky: Westminster John Knox Press. (Emphasis added)
[2] Chesterton, G. K. (1908). Orthodoxy.

List of publications

This thesis includes work described in two publications:

X. Feng, J. Henke, C. Morice, C. J. Sayers, E. Da Como, J. van Wezel, and E. van Heumen, *Signatures of the charge density wave collective mode in the infrared optical response of VSe_2*, Phys. Rev. B **104**, 165134 (2021).

Contributions: X.F. and E.v.H performed the optical measurements and the data analysis. X.F. performed the transport measurements with the help of Dr. Anne de Visser. J.H., C.M. and J.v.W. performed the calculations of the matrix elements. C.J.S. and E.D.C. prepared the samples. The manuscript was written by X.F. and E.v.H..

X. Feng, E. Da Como, and E. van Heumen, Optical response of the bulk stabilized mosaic phase in se doped $\mathrm{TaS}_{2-x}\mathrm{Se}_x$ (2022).

Contributions: The manuscript written by X.F. and E.v.H. is in preparation. X.F. and E.v.H. performed the optical measurements and data analysis. The group of E.D.C. provided the samples and performed the transport measurements.

Other publications by the author are listed below:

J. Groefsema, X. Feng, C. Morice, Y. Huang, and E. van Heumen, *Optical phonons and magnetoelastic coupling in the ionic conductor* agcrse_2, Phys. Rev. Mater. **6**, 115402 (2022).

E. van Heumen, X. Feng, S. Cassanelli, L. Neubrand, L. de Jager, M. Berben, Y. Huang, T. Kondo, T. Takeuchi, and J. Zaanen, *Strange metal electrodynamics across the phase diagram of $Bi_{2-x}Pb_xSr_{2-y}La_yCuO_{6+\delta}$ cuprates*, Phys. Rev. B **106**, 054515 (2022).

Contents