

Effects of e-ph coupling on stripes in 2D Hubbard model

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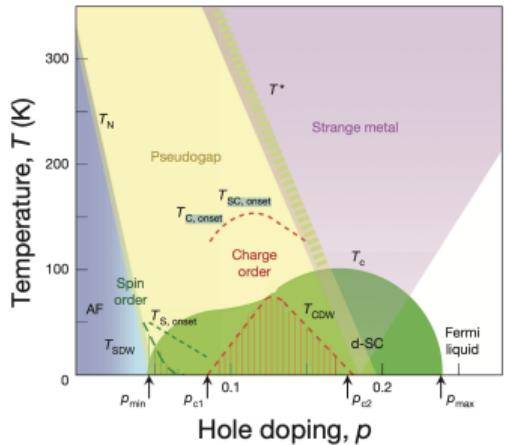
Institute of Advanced Materials and Manufacturing (IAMM), Knoxville

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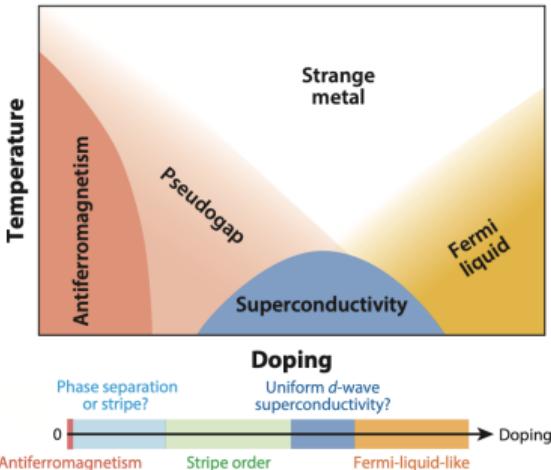


*This work is supported by the U.S. Department of Energy,
under award DE-SC0022311

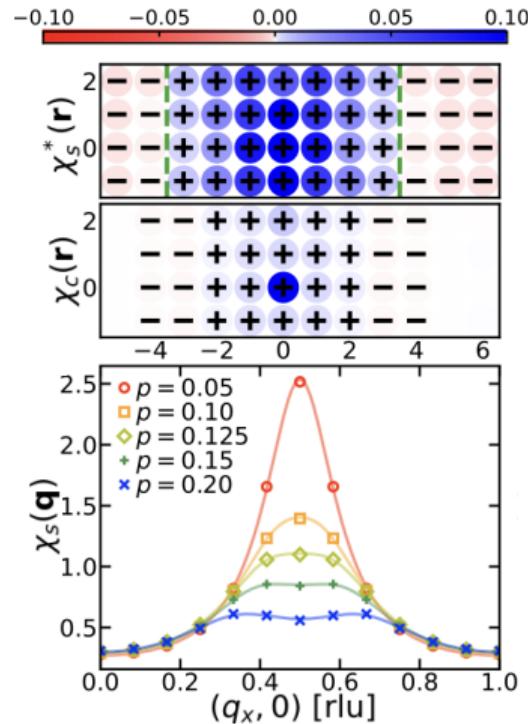
What am I doing



Cuprate phase diagram
Klemm. et al, 2015
<https://doi.org/10.1038/nature14165>

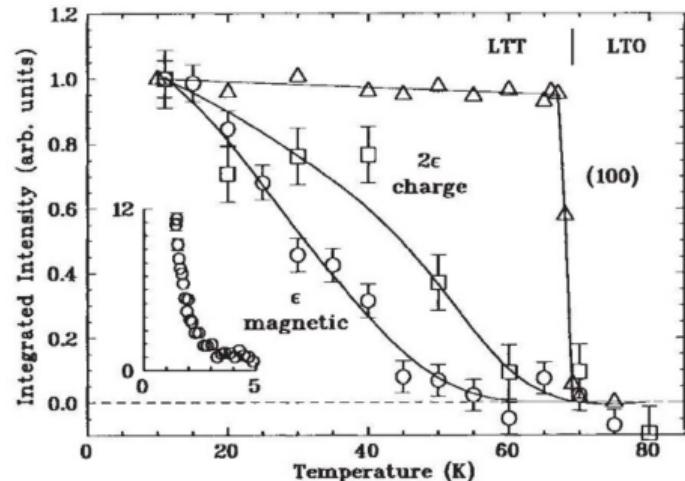


Hubbard Model Phase Diagram
Qin. et al, 2022
<https://doi.org/10.1146/annurev-conmatphys-090921-033948>

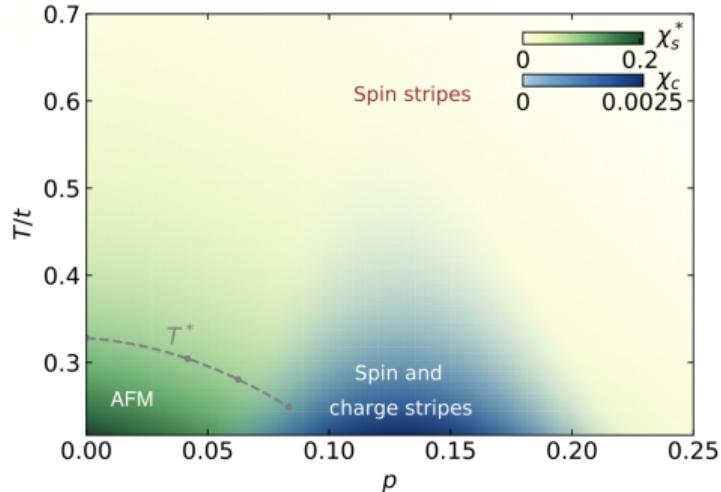


Stripes of CDW and SDW in position and k -space
Edwin W. Han et al, PRB107, 085126

Motivation



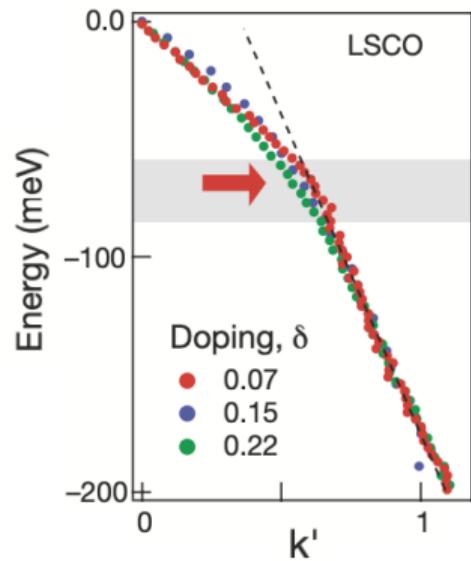
Exp. peaks for SDW and CDW vs T
Tranquada, J. et al, Nature 375, 561–563 (1995)
<https://doi.org/10.1038/375561a0>



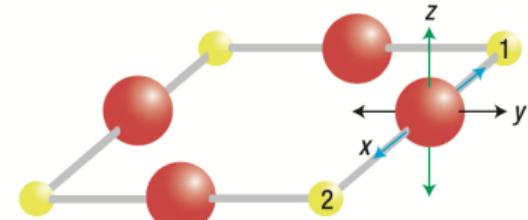
Spin & Charge stripe intensities: Hubbard Model

Edwin W. Huang et al, PRB107, 085126
<https://doi.org/10.1103/PhysRevB.107.085126>

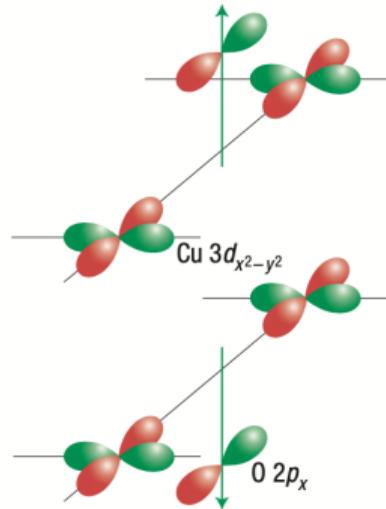
Our proposal



a



b

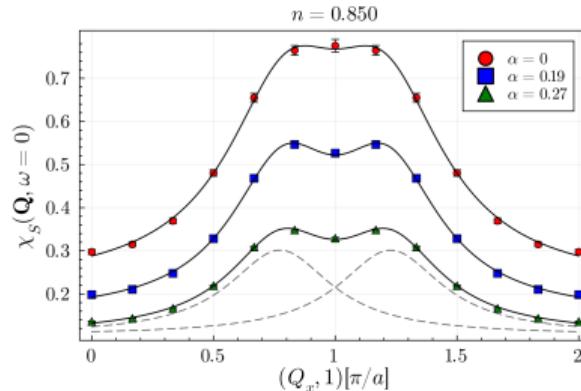
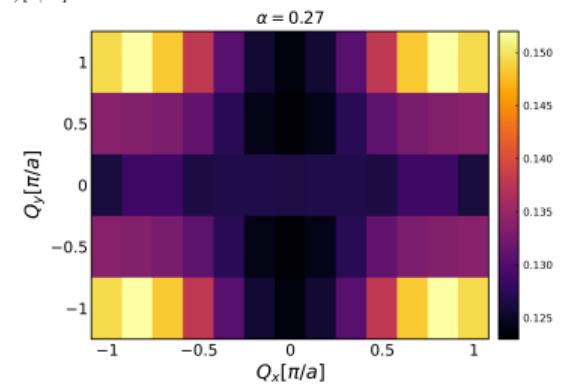
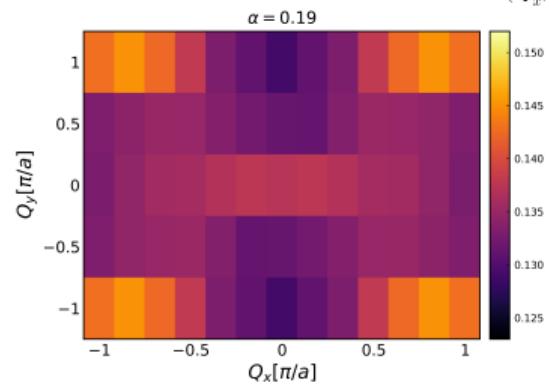
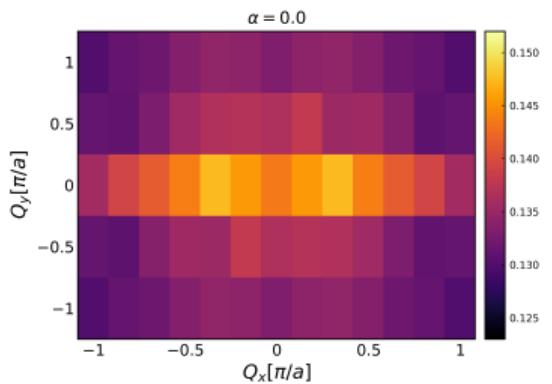


Kink due to e-ph coupling
A. Lanzara, Nature volume 412,
510–514 (2001)

O(red) motion affecting t for Cu-Cu(yellow). Newns, D., Tsuei, C., Nature 3, 184–191 (2007)
In cuprates,
 $t \sim 0.3 \text{ eV} = 300\text{meV}; \Omega \sim 70 - 100 \text{ meV}$
 $\therefore \Omega(\max) \approx t/3 = 0.3t$
 $\Omega = t/2 = 200\text{meV}$: still very high, lower Ω unexplored.

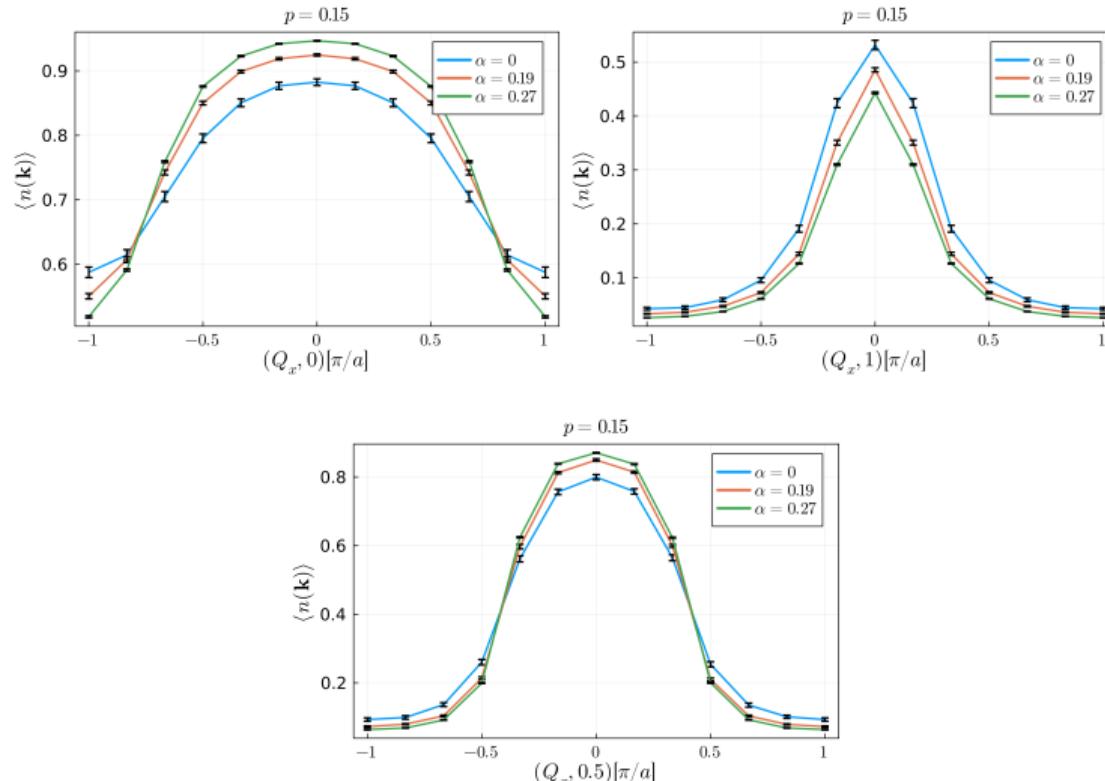
Results

$$\mathcal{H} = \mathcal{H}_e + \mathcal{H}_{ph} + \mathcal{H}_{e-ph}$$
$$\mathcal{H}_{e-ph} = \alpha \sum_{i,j,\nu} X_{i,\nu} c_i^\dagger c_j$$



*errorbars in the plots are 2σ ,
systems simulated using SmoQyDQMC.jl, see talk by Benjamin [ref])

Results



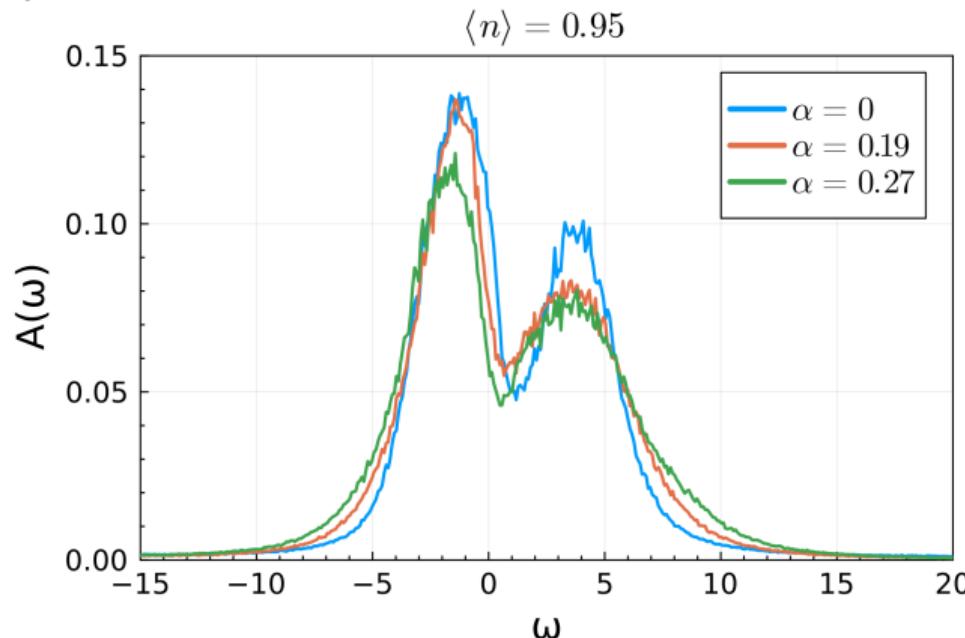
*errorbars in the plots are 2σ ,
systems simulated using SmoQyDQMC.jl, see talk by Benjamin [ref])

Caveat

Phonons on the bonds $\implies \langle \hat{X} \rangle \neq 0$; bonds contract

S. Malkaruge Costa et. al, Phys. Rev. B 108, 165138

<https://doi.org/10.1103/PhysRevB.108.165138>



Nevertheless, suppression(enhancement) of SDW(CDW) warrants further investigation, esp, $T = 0$

*Spectral function computed using SmoQyDEAC.jl (see talk by James[R])

Acknowledgements/Q&A



Dr. Benjamin
Cohen-Stead, UTK



Prof. Steve Johnston,
UTK



THANK YOU! Questions?

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The End

Back-up slides / potential content; formatting

$\langle \text{sign} \rangle$ vs Beta

$\backslash \mu$ vs $\langle n \rangle$

Why SSH not Holstein -(high Tc mech - ref)

Why $p=1/8$

decrease of Mott gap

del_C and del_S analysis

maybe work on correlation length analysis on my data, see what is happening

correlation length plot for SDW and CDW

What can be “intuitively” wrong when looking for very high Ω

