

Chiral Quantum Phase Transition in Moiré Dirac Materials at *finite density*

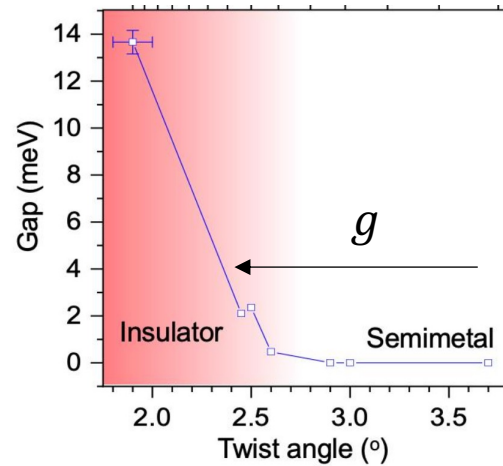
MAX PLANCK INSTITUTE FOR
SOLID STATE RESEARCH



A. García-Page, F. Rennecke, K. Fraboulet, L. Classen



Technische Universität München



Adapted from Ma, L., *et al.*

arXiv:2412.07150 (retrieved 04.03.2026)

Chiral Quantum Phase Transition in Moiré Dirac Materials at *finite density*

MAX PLANCK INSTITUTE FOR
SOLID STATE RESEARCH

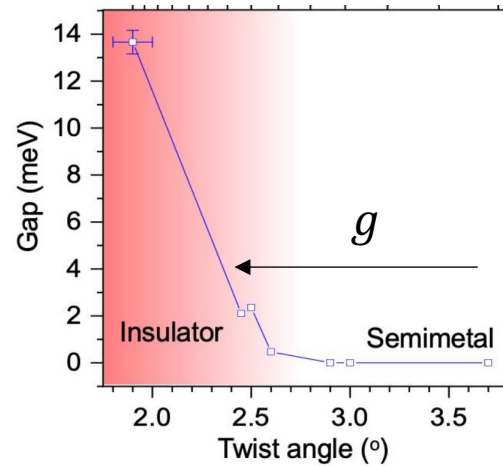


A. García-Page, F. Rennecke, K. Fraboulet, L. Classen

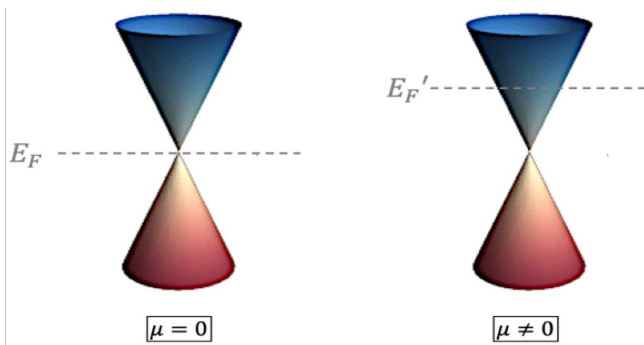


Technische Universität München

$$S[\{\bar{\psi}, \psi\}] = \int d^d r \left\{ [\bar{\psi}(\not{\partial} - \mu \hat{\gamma}_0)]\psi - \frac{g}{2N_f}(\bar{\psi}\psi)^2 \right\}$$



Adapted from Ma, L., *et al.*
arXiv:2412.07150 (retrieved 04.03.2026)



Chiral Quantum Phase Transition in Moiré Dirac Materials at *finite density*

MAX PLANCK INSTITUTE FOR
SOLID STATE RESEARCH



A. García-Page, F. Rennecke, K. Fraboulet, L. Classen



Technische Universität München

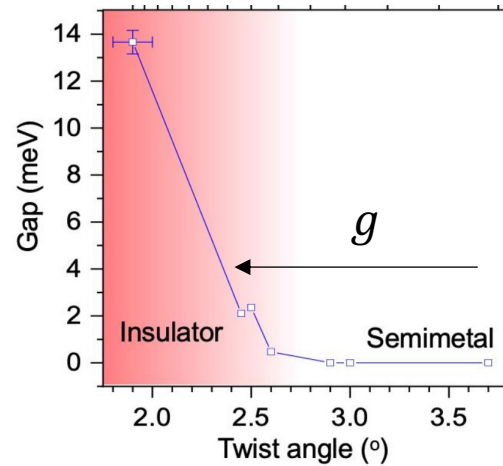
$$S[\{\bar{\psi}, \psi\}] = \int d^d r \left\{ [\bar{\psi}(\not{\partial} - \mu \hat{\gamma}_0)]\psi - \frac{g}{2N_f}(\bar{\psi}\psi)^2 \right\}$$

fRG

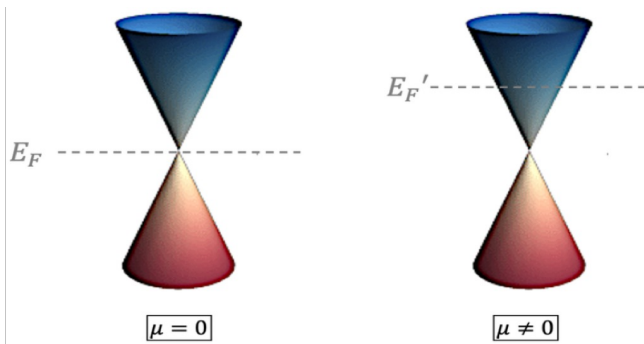
Study of homogeneous phase

Mean-field theory

Homogeneous and
inhomogeneous phases?



Adapted from Ma, L., *et al.*
arXiv:2412.07150 (retrieved 04.03.2026)



Chiral Quantum Phase Transition in Moiré Dirac Materials at *finite density*

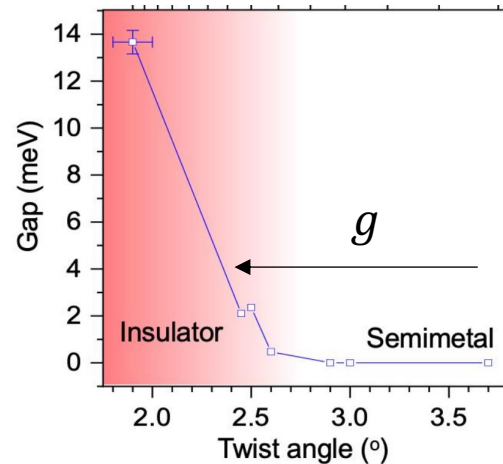
MAX PLANCK INSTITUTE FOR
SOLID STATE RESEARCH



A. García-Page, F. Rennecke, K. Fraboulet, L. Classen



Technische Universität München



Adapted from Ma, L., *et al.*
arXiv:2412.07150 (retrieved 04.03.2026)

$$S[\{\bar{\psi}, \psi\}] = \int d^d r \left\{ [\bar{\psi}(\not{\partial} - \mu \hat{\gamma}_0)]\psi - \frac{g}{2N_f}(\bar{\psi}\psi)^2 \right\}$$

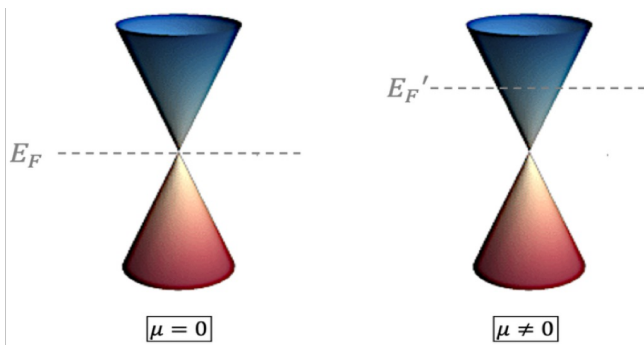
fRG

Study of homogeneous phase

Mean-field theory

Homogeneous and
inhomogeneous phases?

$$S[\phi] = \frac{1}{2g} \int d^d r \phi^2(r) - N_f \text{Tr} \left[\log(i\not{\partial} - \mu \hat{\gamma}_0) + \hat{\phi} \right]$$



Chiral Quantum Phase Transition in Moiré Dirac Materials at *finite density*

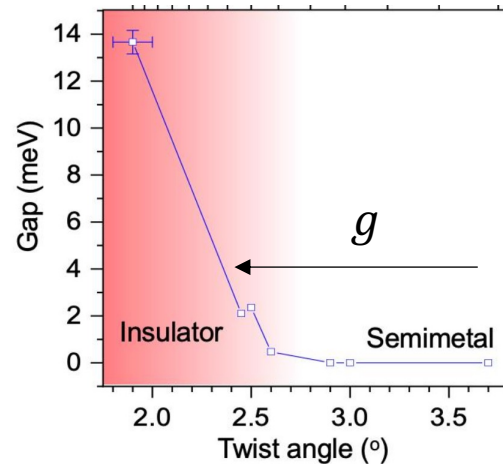
MAX PLANCK INSTITUTE FOR
SOLID STATE RESEARCH



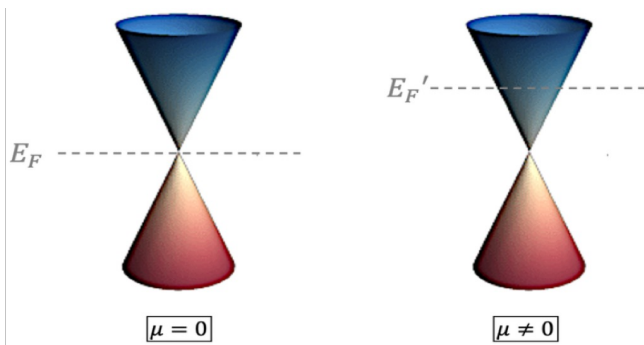
A. García-Page, F. Rennecke, K. Fraboulet, L. Classen



Technische Universität München



Adapted from Ma, L., *et al.*
arXiv:2412.07150 (retrieved 04.03.2026)



$$S[\{\bar{\psi}, \psi\}] = \int d^d r \left\{ [\bar{\psi}(\not{\partial} - \mu \hat{\gamma}_0)]\psi - \frac{g}{2N_f}(\bar{\psi}\psi)^2 \right\}$$

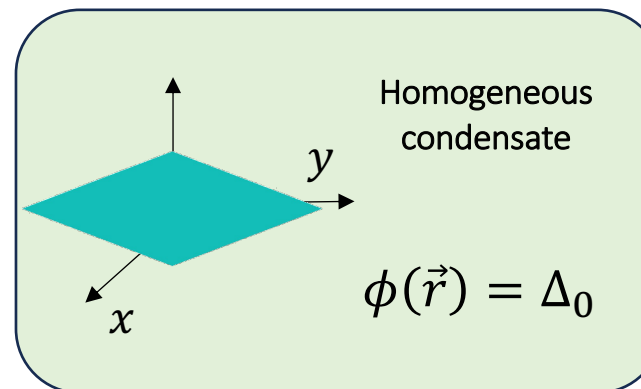
fRG

Study of homogeneous phase

Mean-field theory

Homogeneous and
inhomogeneous phases?

$$S[\phi] = \frac{1}{2g} \int d^d r \phi^2(r) - N_f \text{Tr} \left[\log(i\not{\partial} - \mu \hat{\gamma}_0) + \hat{\phi} \right]$$



Chiral Quantum Phase Transition in Moiré Dirac Materials at *finite density*

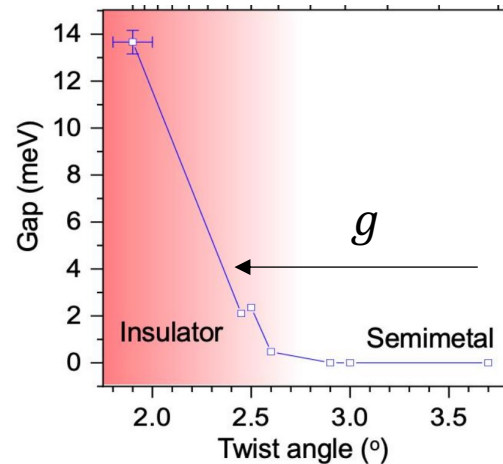
MAX PLANCK INSTITUTE FOR
SOLID STATE RESEARCH



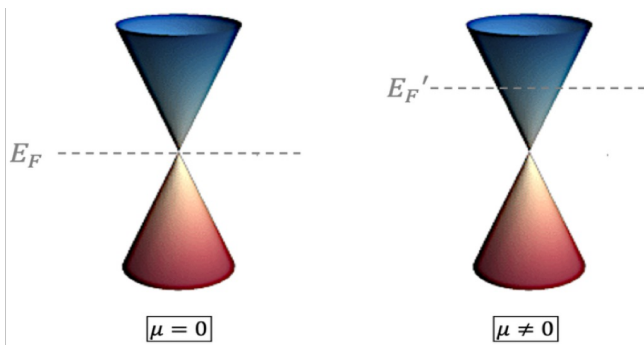
A. García-Page, F. Rennecke, K. Fraboulet, L. Classen



Technische Universität München



Adapted from Ma, L., *et al.*
arXiv:2412.07150 (retrieved 04.03.2026)



$$S[\{\bar{\psi}, \psi\}] = \int d^d r \left\{ [\bar{\psi}(\not{\partial} - \mu \hat{\gamma}_0)]\psi - \frac{g}{2N_f}(\bar{\psi}\psi)^2 \right\}$$

fRG

Study of homogeneous phase

Mean-field theory

Homogeneous and inhomogeneous phases?

$$S[\phi] = \frac{1}{2g} \int d^d r \phi^2(r) - N_f \text{Tr} \left[\log(i\not{\partial} - \mu \hat{\gamma}_0) + \hat{\phi} \right]$$

Homogeneous condensate

$$\phi(\vec{r}) = \Delta_0$$

Gen. Wigner crystal:
Inhomogeneous condensate

$$\phi(\vec{r}) = \frac{\Delta}{2} \sum e^{i\vec{G}_\ell \cdot \vec{r}}$$