Crescent states in charge-imbalanced polariton condensates

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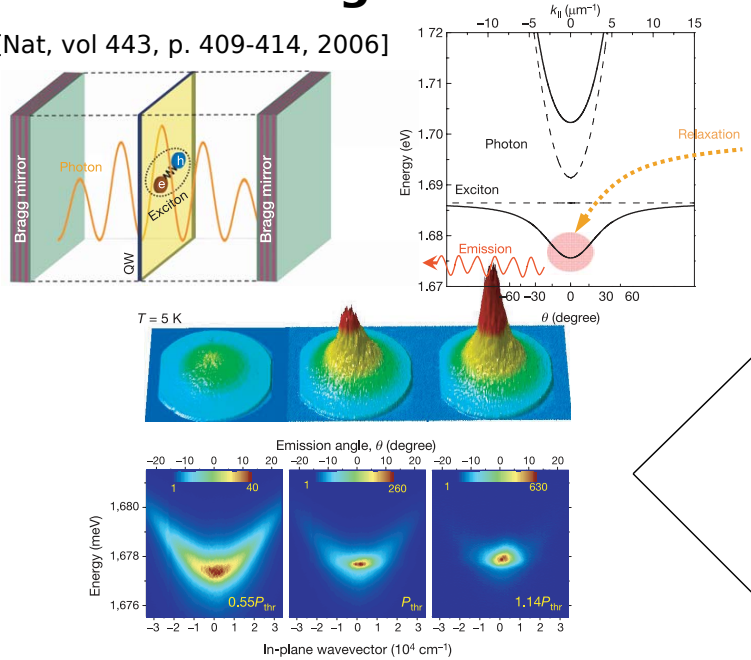
New Physics (arXiv:2001.07726)

Quantum fluids of light

[Nat, vol 443, p. 409-414, 2006]



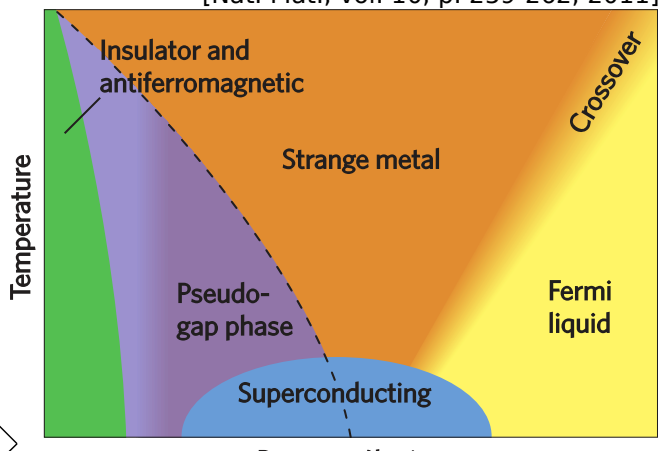
effort & imagination

strong coupling

New Physics

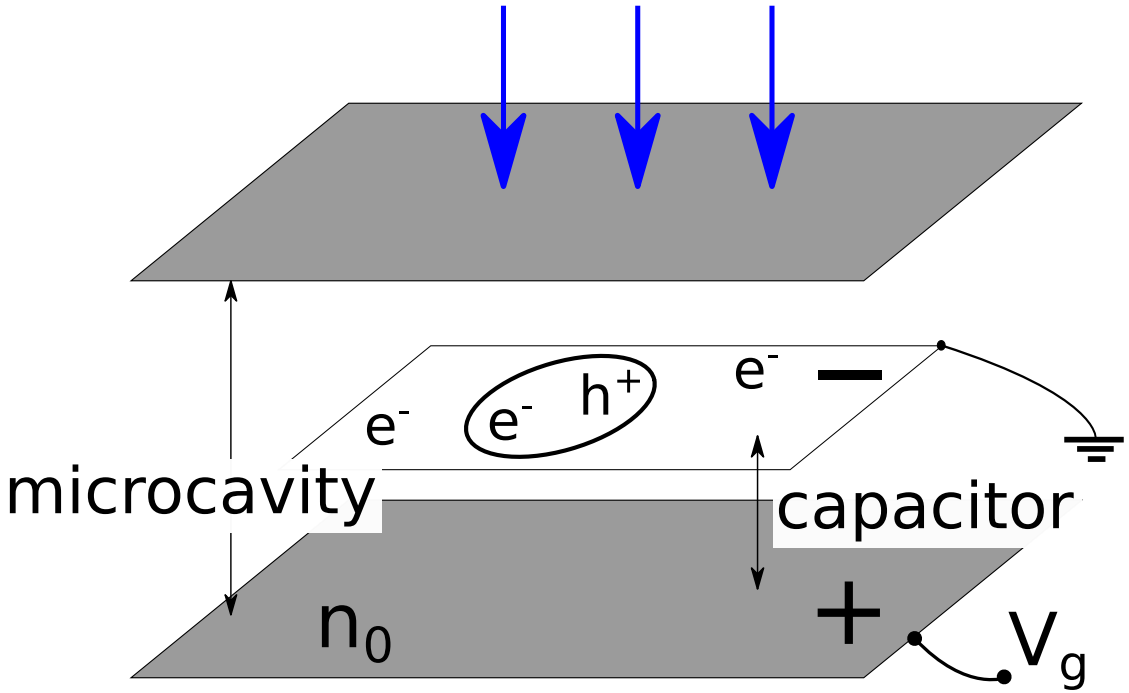
Strongly correlated electrons

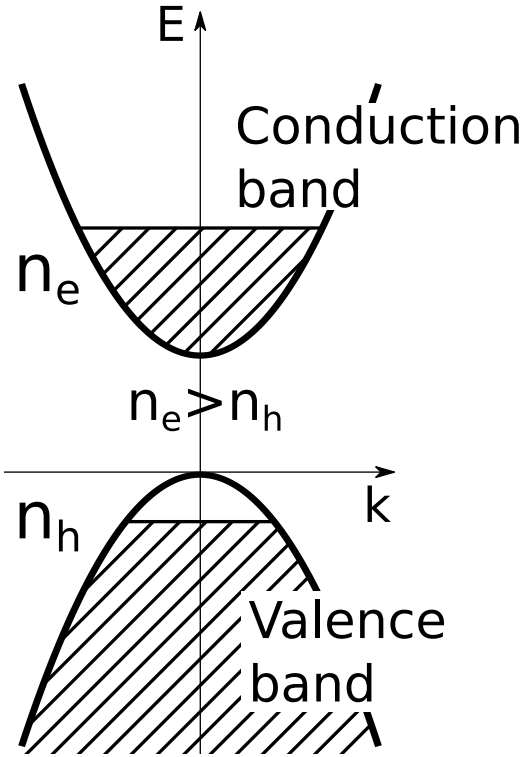
[Nat. Mat., vol. 10, p. 259-262, 2011]



Supersolid
Superconductivity
FQHE
Polarons
Kondo
Topology
Magnetism
Competing & Intertwined orders

System (arXiv:2001.07726)





- No spins, no valleys
- No phonons
- Just two bands and a cavity

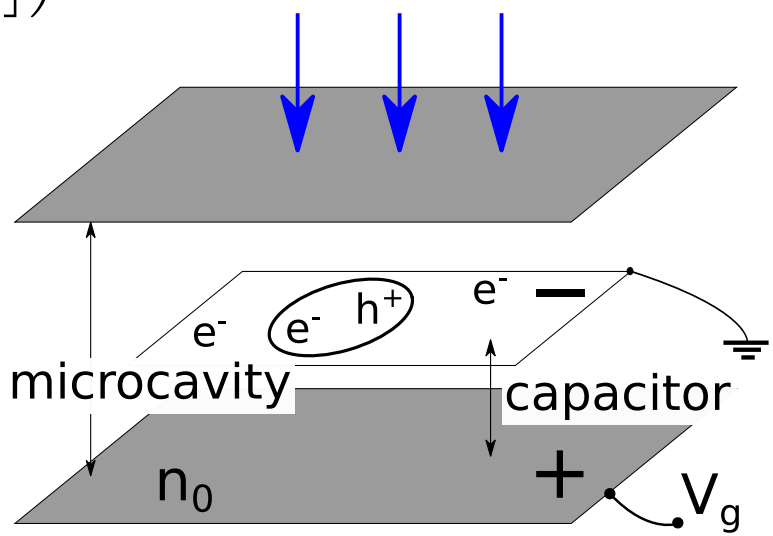
- 6 different phases
- 5 ordered phases
- **1 novel phase**

Model & Solution (arXiv:2001.07726)

$$H = H_0 + H_c + H_{lm} + H_{es},$$

- $H_0 = \sum_{\mathbf{k}} \left[\left(\frac{k^2}{2m_e} + E_G \right) e^\dagger_{\mathbf{k}} e_{\mathbf{k}} + \frac{k^2}{2m_h} h^\dagger_{\mathbf{k}} h_{\mathbf{k}} + \omega_{\mathbf{k}} a^\dagger_{\mathbf{k}} a_{\mathbf{k}} \right],$
- $H_c = \frac{1}{2S} \sum V_{\mathbf{q}} \left\{ e^\dagger_{\mathbf{k}+\mathbf{q}} e^\dagger_{\mathbf{k}'-\mathbf{q}} e_{\mathbf{k}'} e_{\mathbf{k}} + h^\dagger_{\mathbf{k}+\mathbf{q}} h^\dagger_{\mathbf{k}'-\mathbf{q}} h_{\mathbf{k}'} h_{\mathbf{k}} - 2 e^\dagger_{\mathbf{k}+\mathbf{q}} h^\dagger_{\mathbf{k}'-\mathbf{q}} h_{\mathbf{k}'} e_{\mathbf{k}} \right\},$
- $H_{lm} = \sum_{\mathbf{k},\mathbf{q}} \frac{g_{\mathbf{k}}}{\sqrt{S}} \left(e^\dagger_{\mathbf{k}} h^\dagger_{\mathbf{q}-\mathbf{k}} a_{\mathbf{q}} + a^\dagger_{\mathbf{q}} h_{\mathbf{q}-\mathbf{k}} e_{\mathbf{k}} \right)$, item
  $H_{es} = \alpha S \int d^2x (n_c(\mathbf{x}) - n_0)^2$, n_0 — "*target*" charge density,
- $\tilde{H} = H - \mu_{ex} \sum_{\mathbf{k}} \left(a^\dagger_{\mathbf{k}} a_{\mathbf{k}} + \frac{1}{2} \left[e^\dagger_{\mathbf{k}} e_{\mathbf{k}} + h^\dagger_{\mathbf{k}} h_{\mathbf{k}} \right] \right).$

- $F \leq \mathcal{F}_{\text{vMF}} = F_{\text{MF}} + \langle H - H_{\text{MF}} \rangle_{\text{MF}} \to \min$
- $F_{\text{MF}} = e^{-\beta H_{\text{MF}}}$



Increasing Target Charge Density n_0 (arXiv:2001.07726)

$$E_G = 2E_B,\ \mu_{ex} = 3.0E_B,\ T = 0.04E_B,\ \omega_0 = 3.06E_B.$$