

Optical probing of the Coulomb interactions of an electrically pumped polariton condensate

S.Mandal,TCH Liew

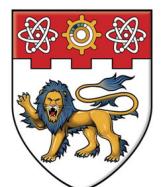
Nanyang Technological University, SPMS, PAP

With M.Klaas,M.Amthor,S.Klembt,L.Worschech, C.Schneider and S. Höfling

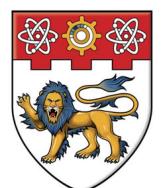
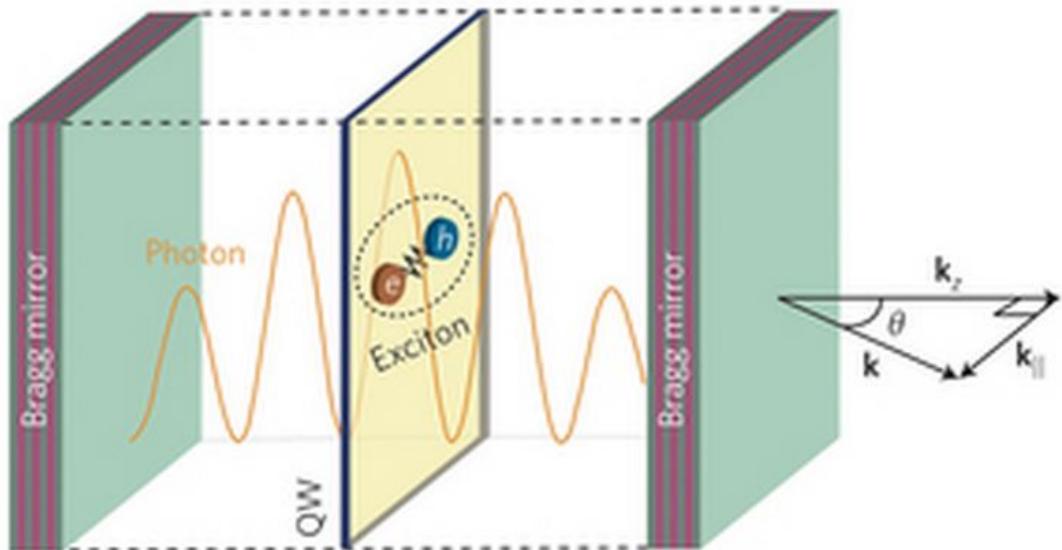
Universität Würzburg,Germany

Outline

- Exciton Polaritons
- Polariton Condensatation
 - Optically Induced
 - Electrically Induced
- Summary

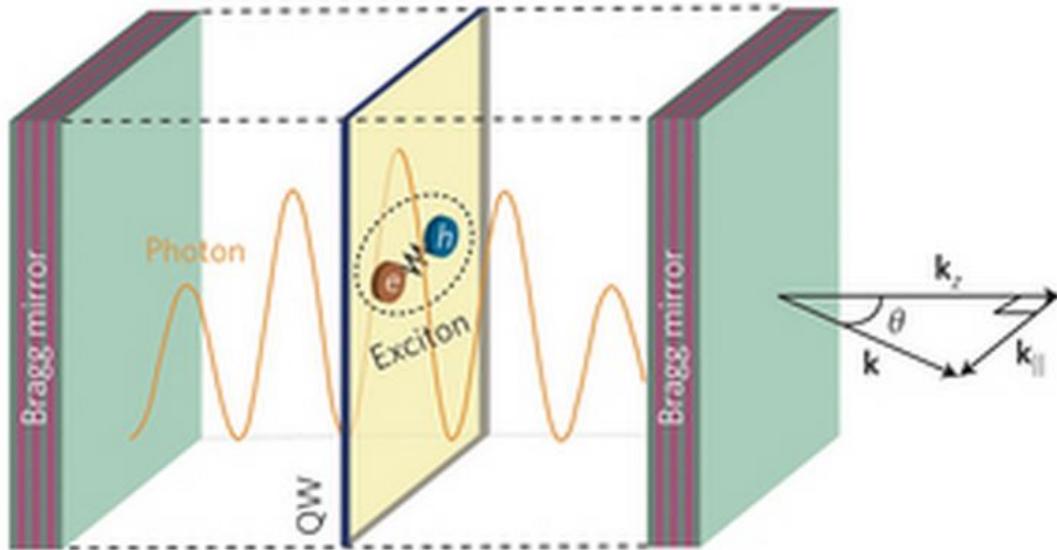


Exciton-Polariton



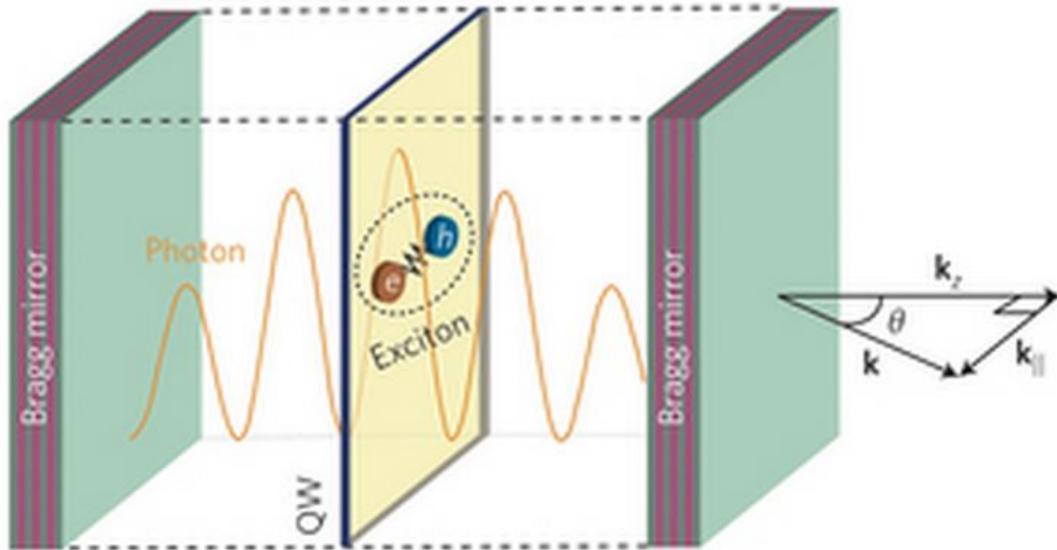
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Exciton-Polariton



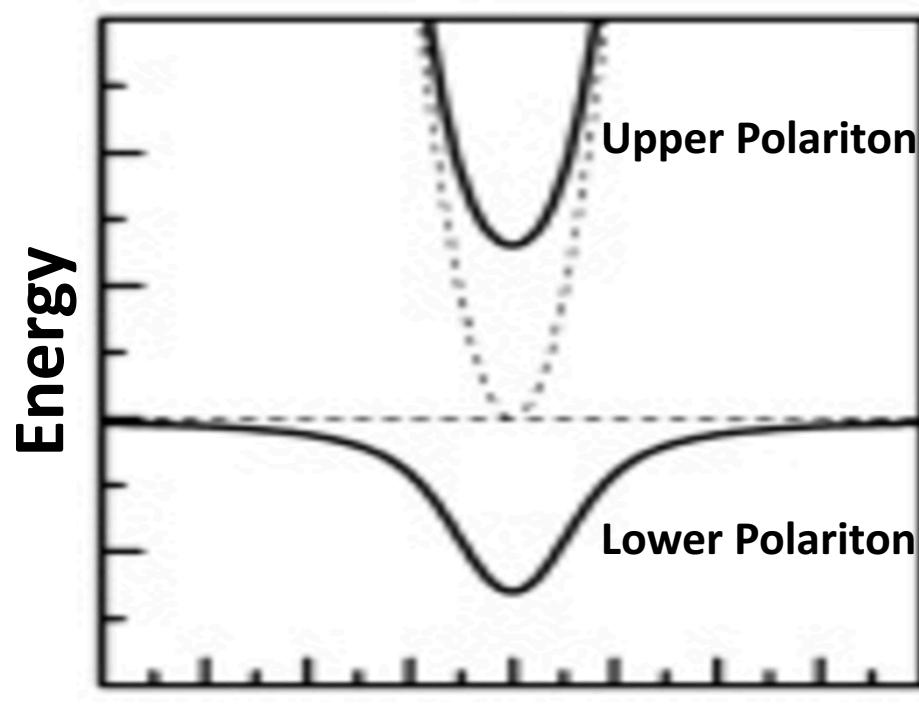
- **Bosons**
- **Low mass**
- **Short life time**
- **Excitonic component**

Exciton-Polariton

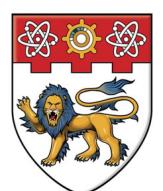


- **Bosons**
- **Low mass** \rightarrow **BEC**
- **Short life time**
- **Excitonic component**

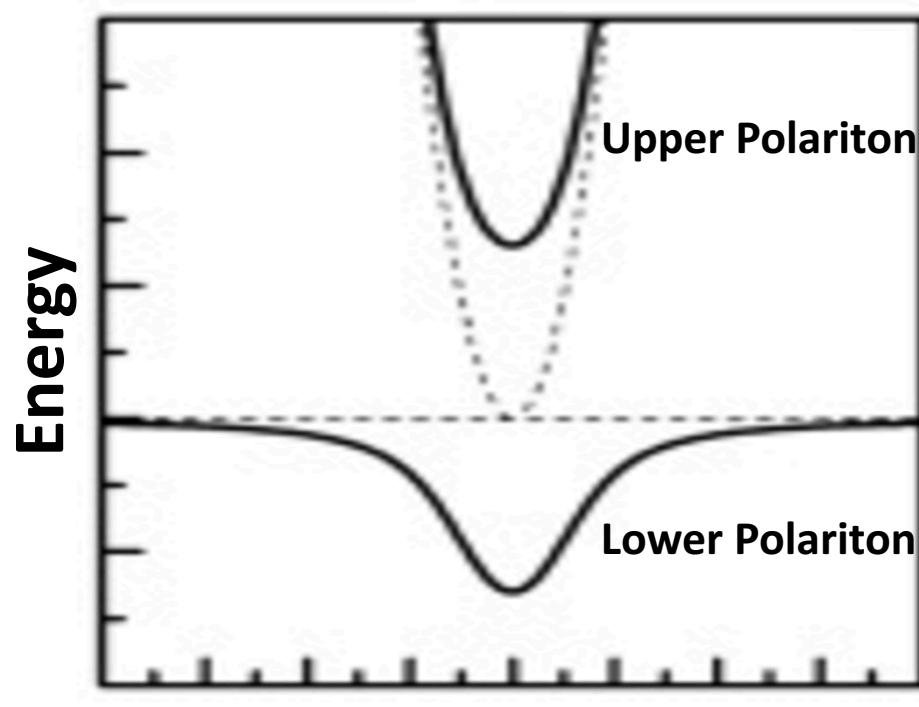
Exciton-Polariton Condensation



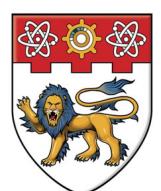
- Bosons
- Low mass \rightarrow BEC



Exciton-Polariton Condensation

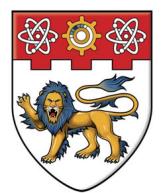
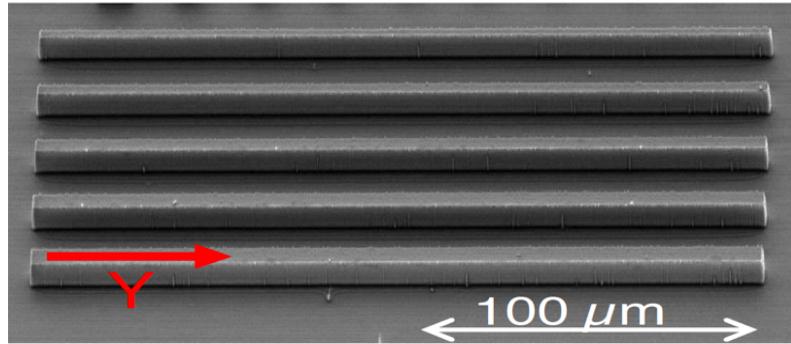


- Out of equilibrium system
- High exciton density in the reservoir



Polariton Condensation in 1D

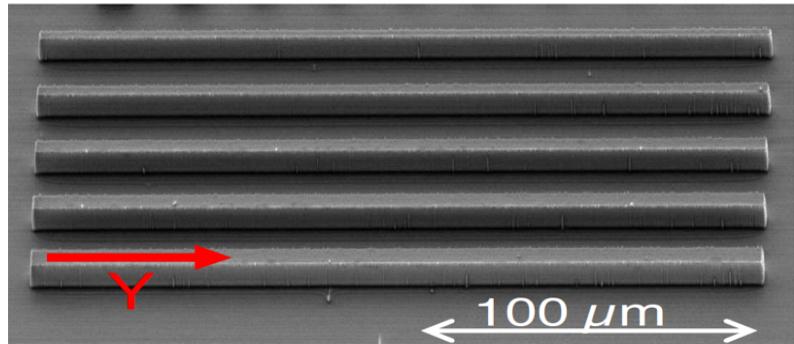
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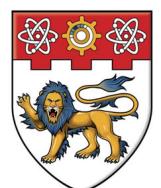
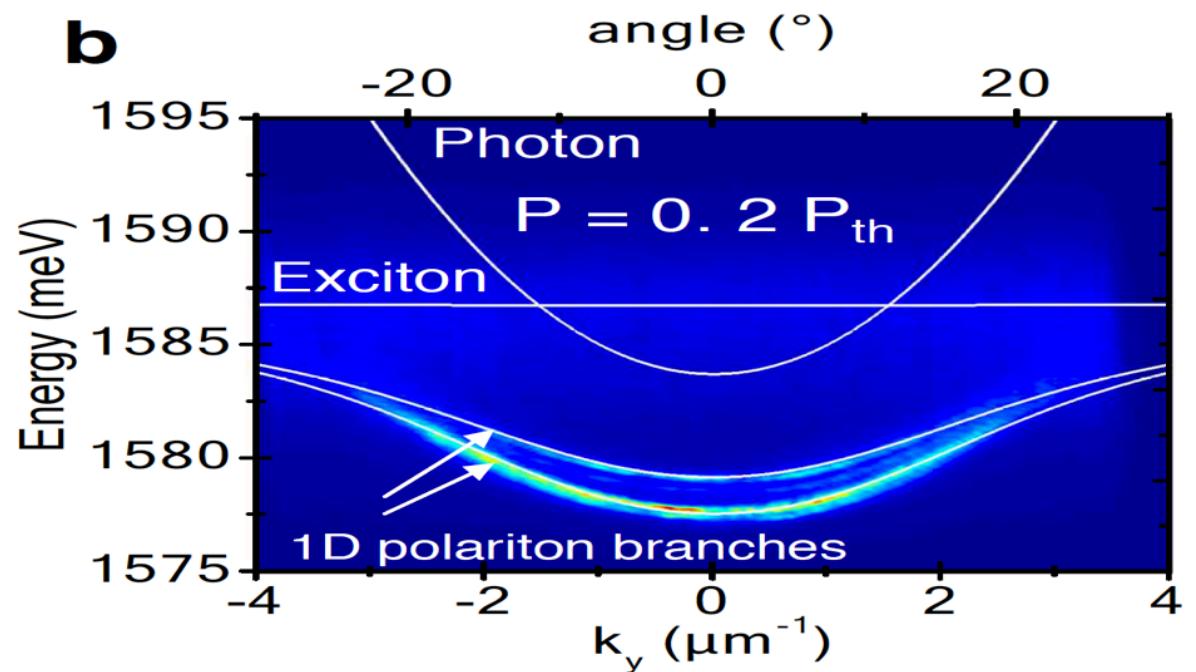
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Polariton Condensation in 1D

a



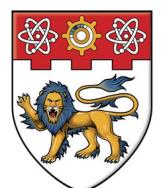
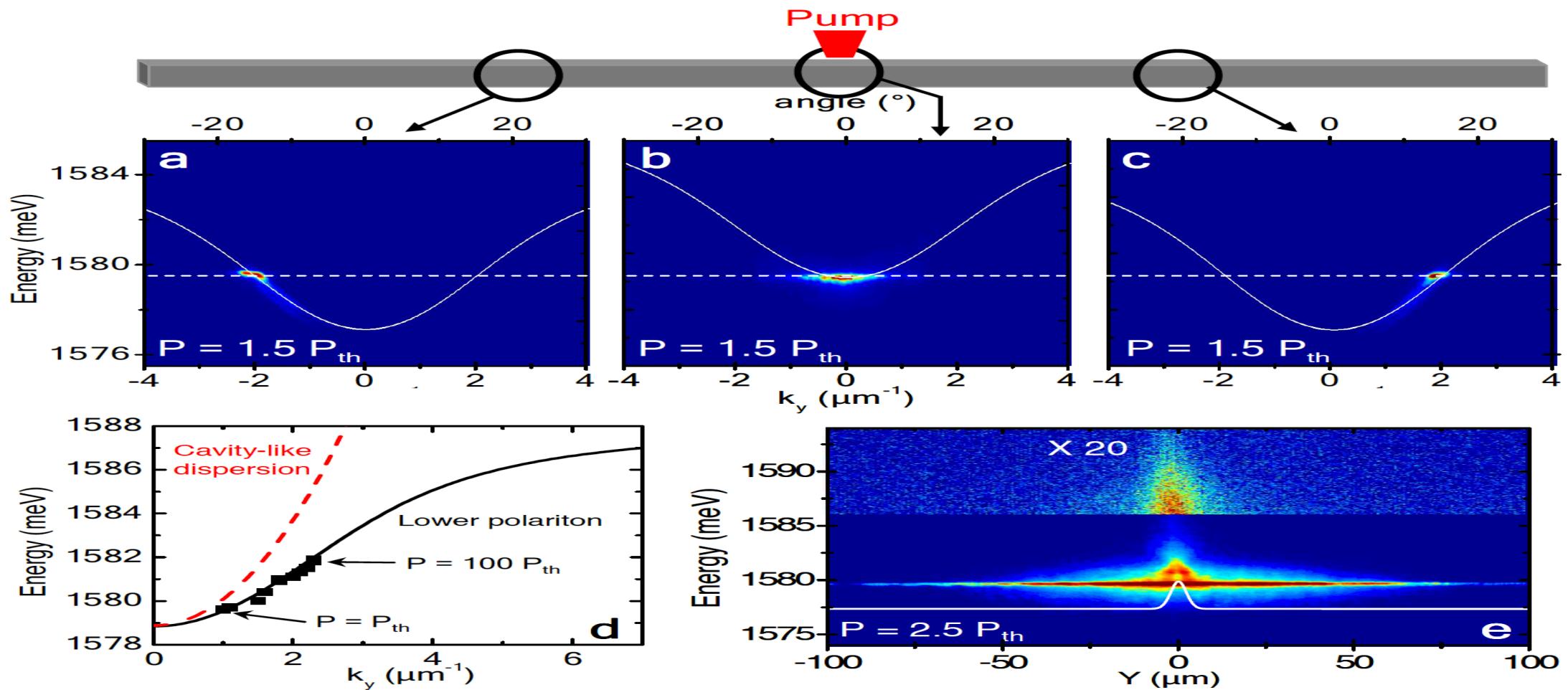
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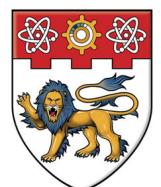
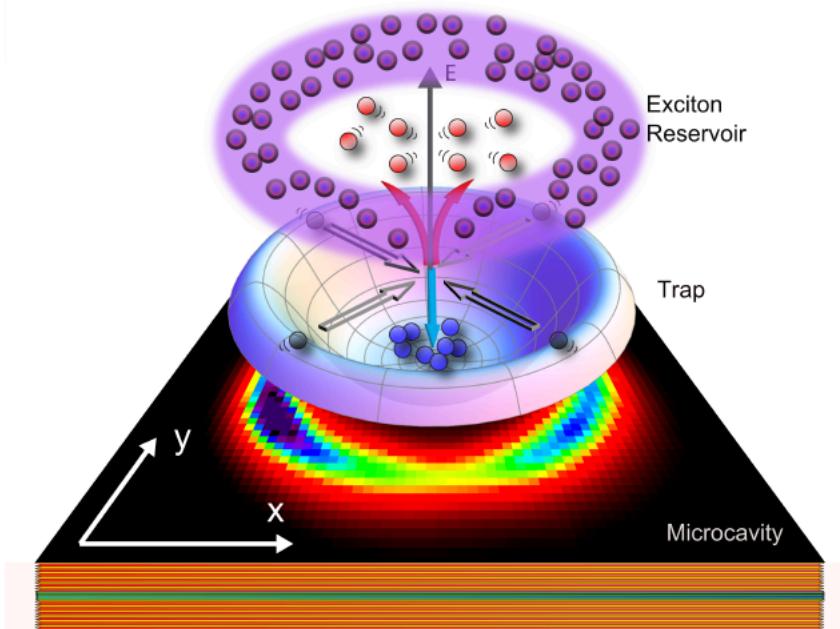
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E Wertz, et al., Nature Phys., 6, 860 (2010).

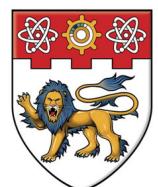
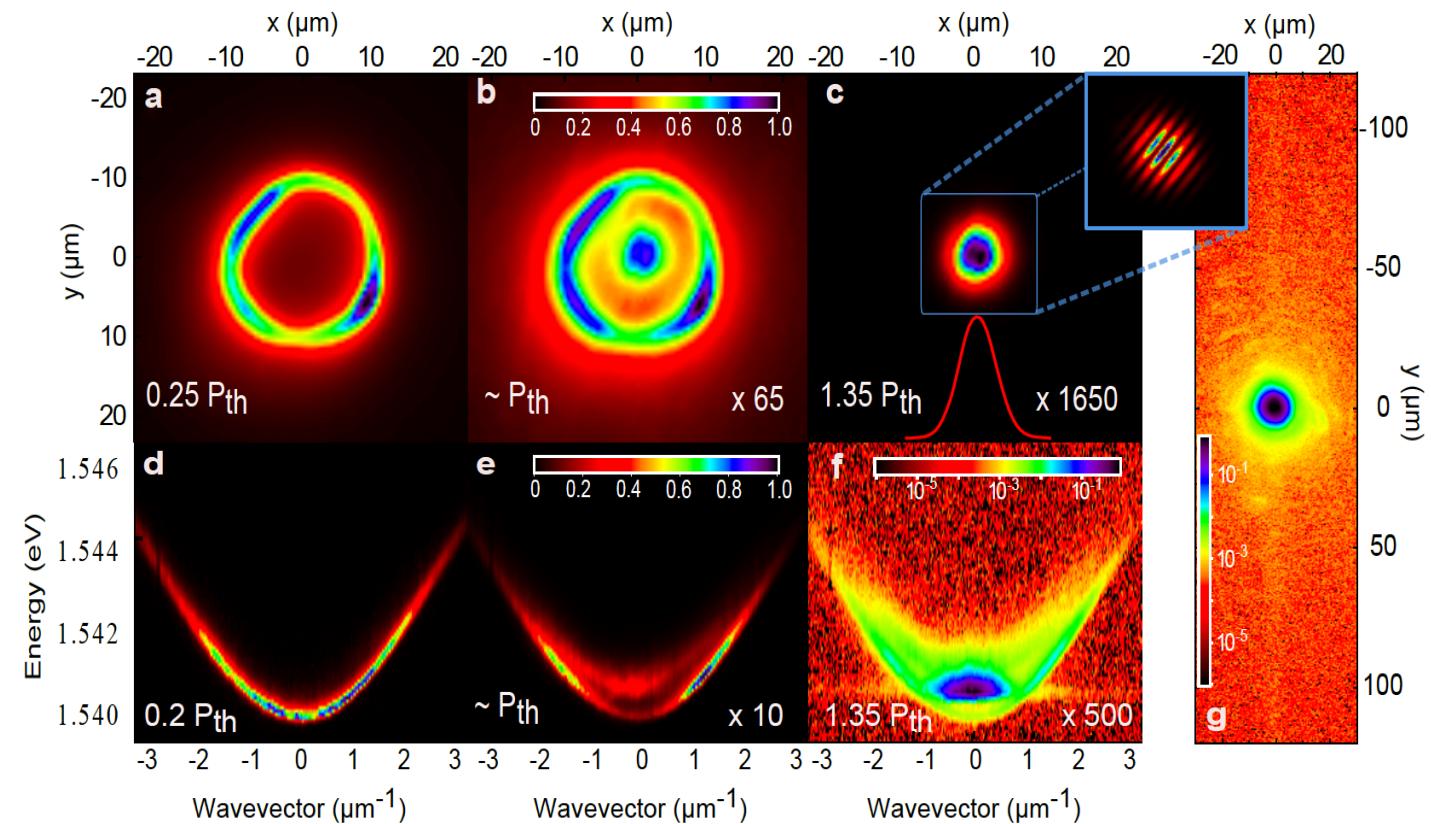
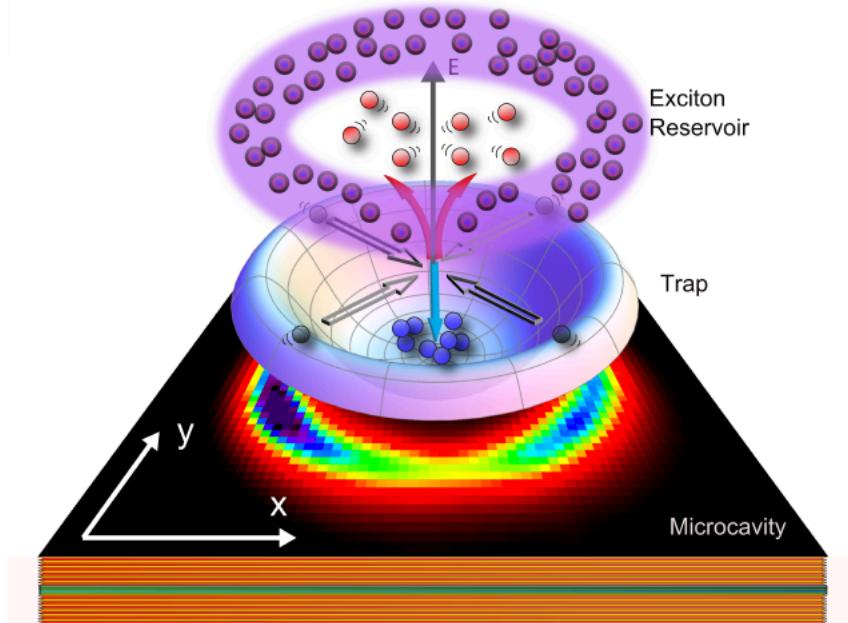
Polariton Condensation in 1D



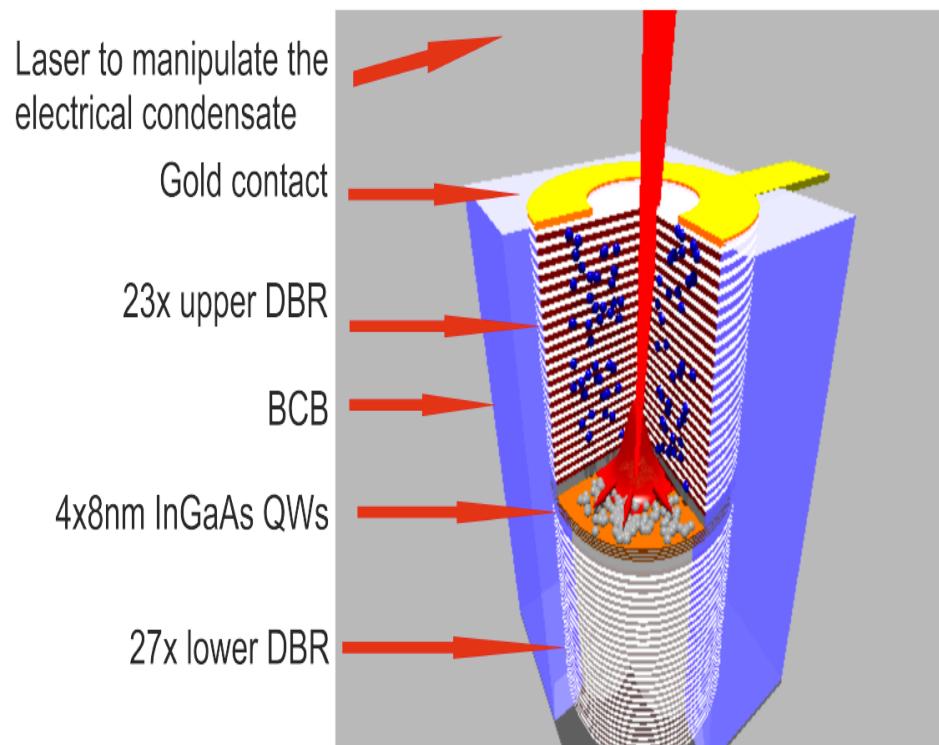
Polariton Condensation in an optically induced 2D potential



Polariton Condensation in an optically induced 2D potential



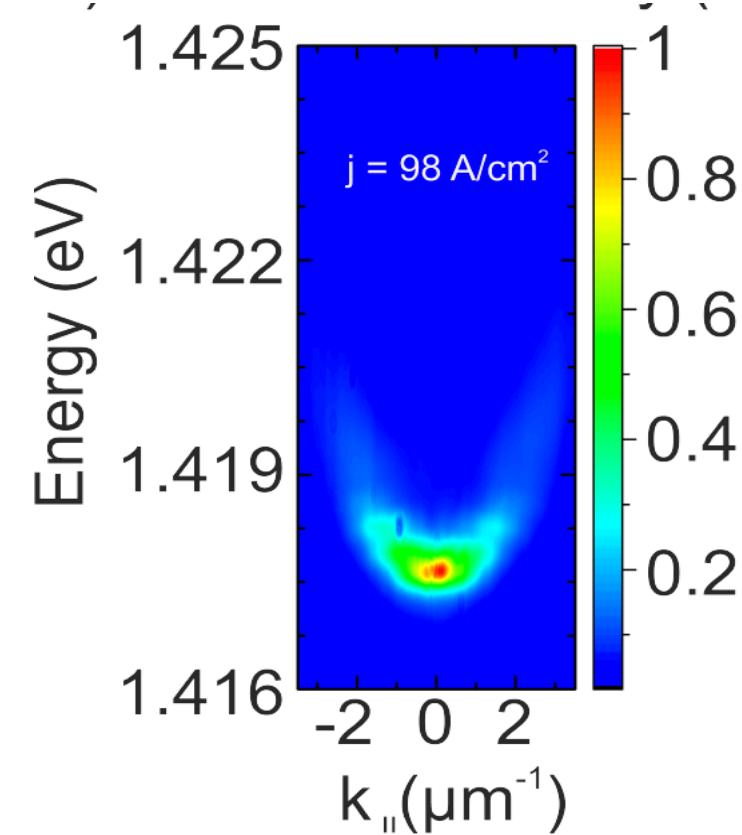
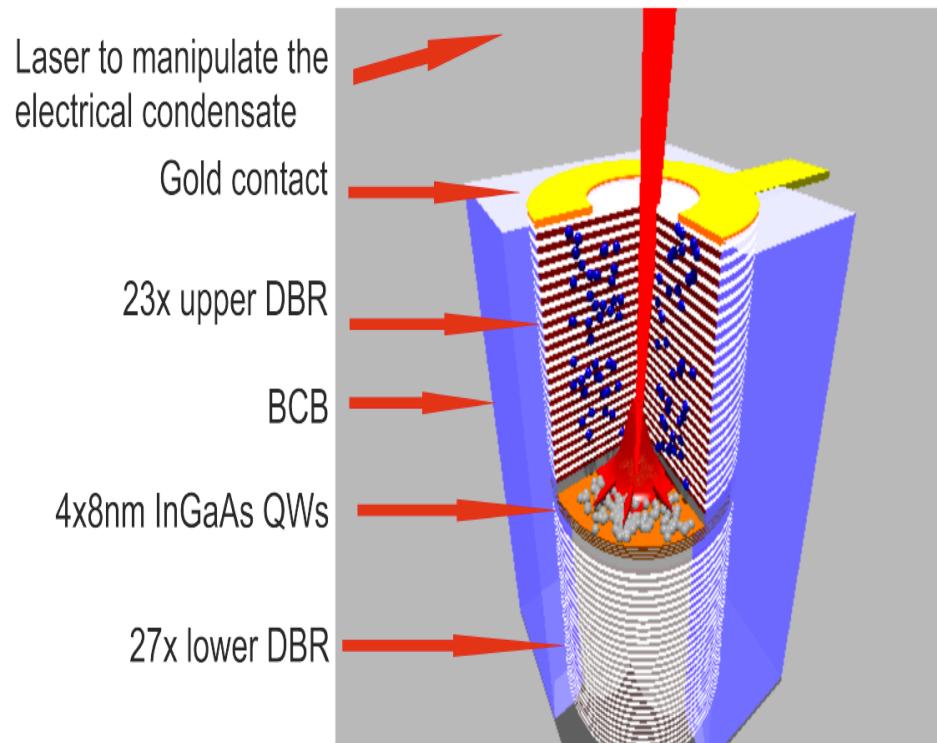
Experiment



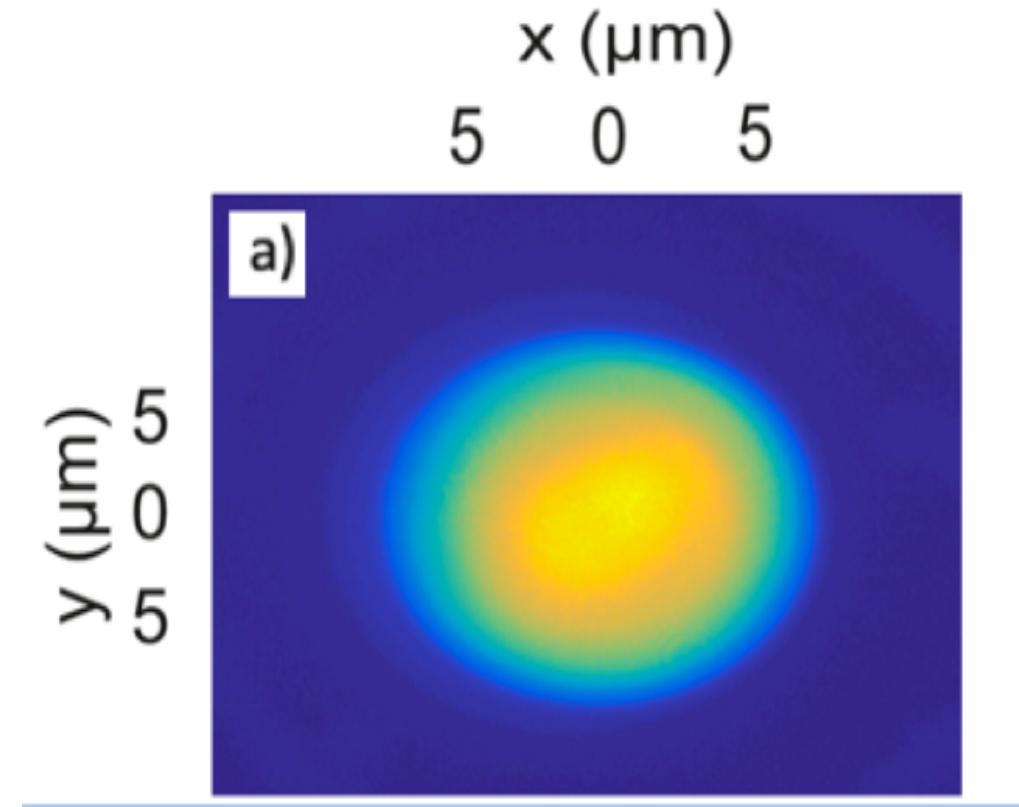
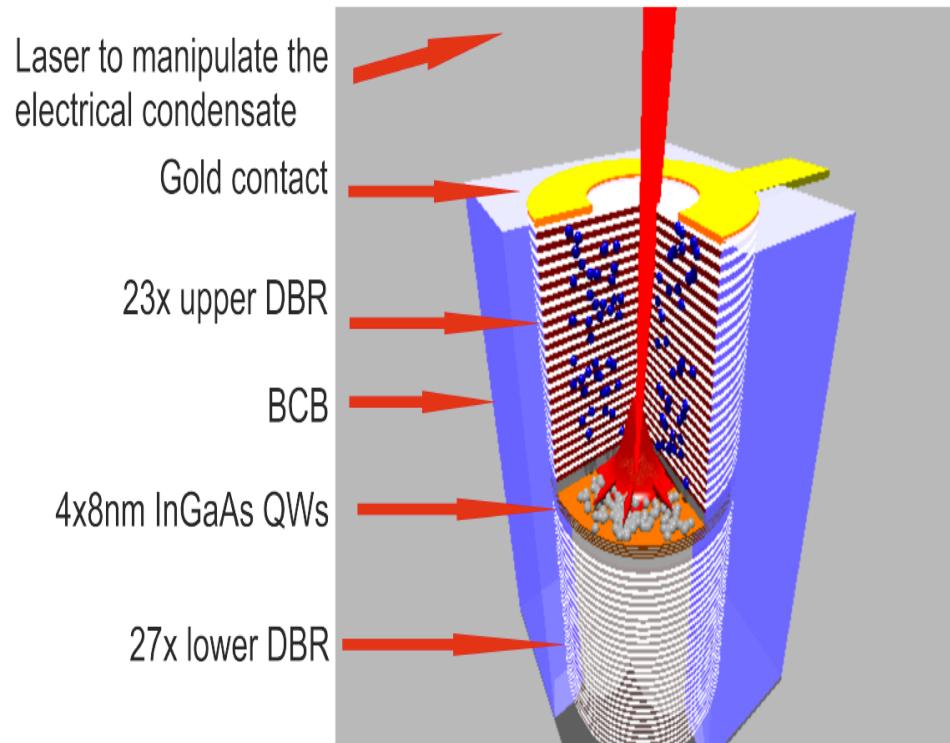
Schneider, Christian, et al. *Nature* 497.7449 (2013): 348-352.

M.Klaas, et al., *Appl. Phys. Lett.* 110, 151103 (2017)

Experiment & Results



Experiment & Results



Experiment & Results

Laser to manipulate the electrical condensate

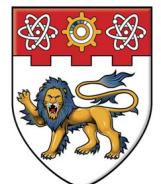
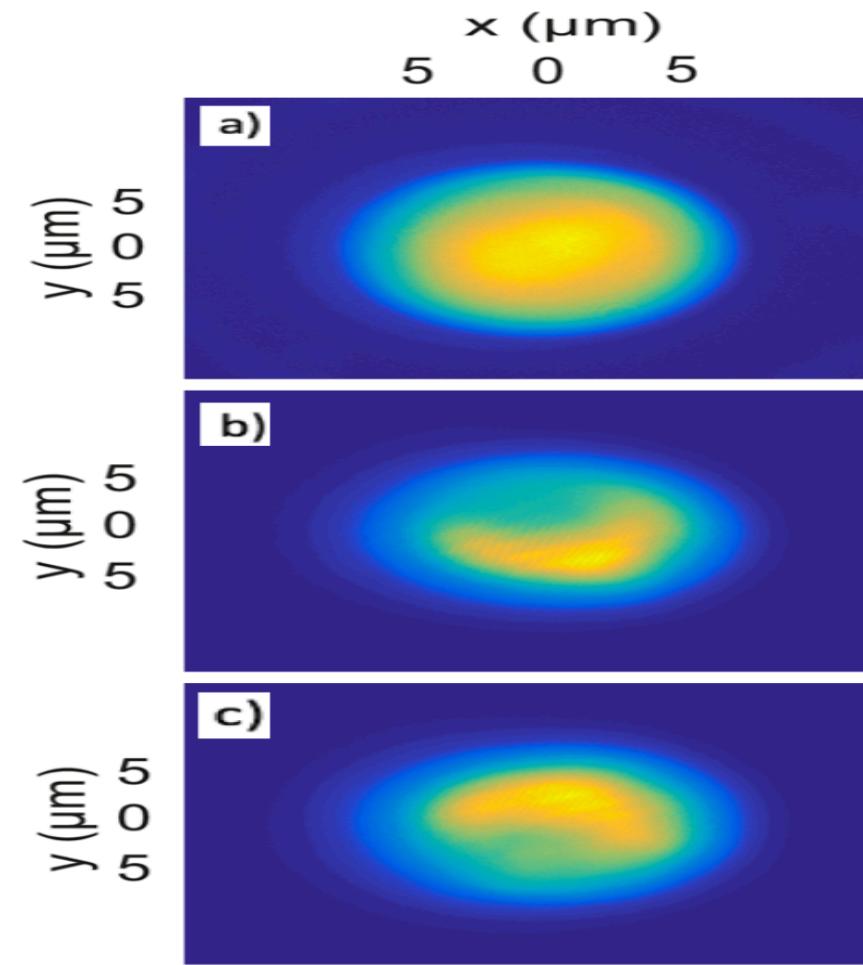
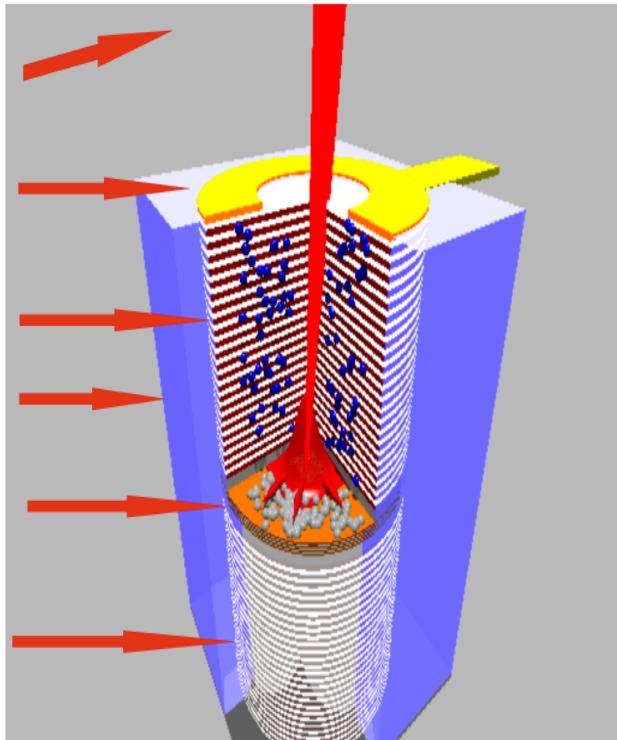
Gold contact

23x upper DBR

BCB

4x8nm InGaAs QWs

27x lower DBR



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M.Klaas, et al., Appl. Phys. Lett. **110**, 151103 (2017)

Polariton Wave Function

GPE:

$$E_n \psi_n(x) = \left[-\frac{\hbar^2 \nabla^2}{2m} + \left(g_R + \frac{i}{2} \right) P(x) + g_c |\Psi(x)|^2 - \frac{iR}{2} \right] \psi_n(x)$$

Kinetic Energy

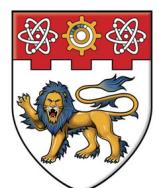
Interactions with the excitonic reservoir

Decay

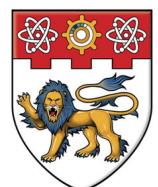
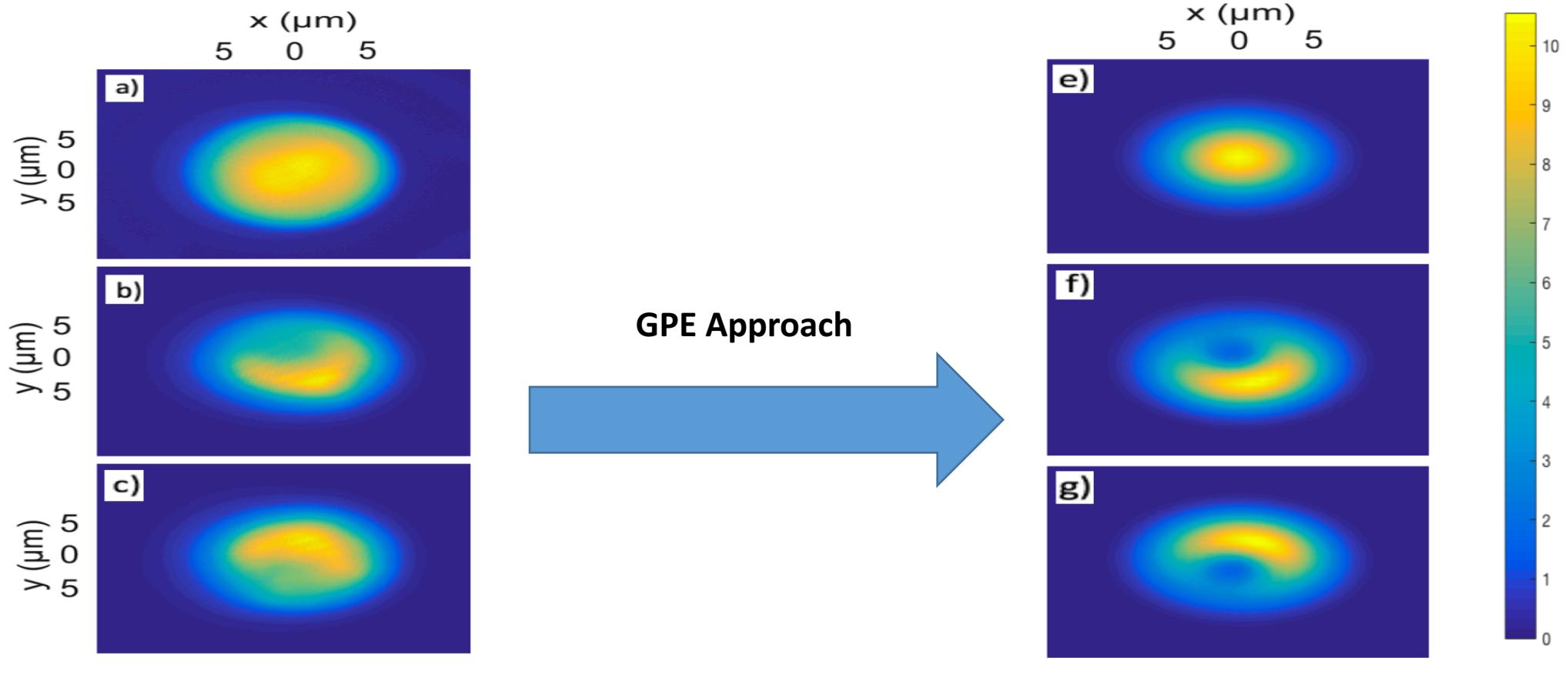
Pumping term

Interaction within the condensate

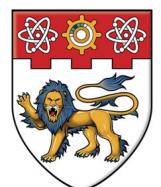
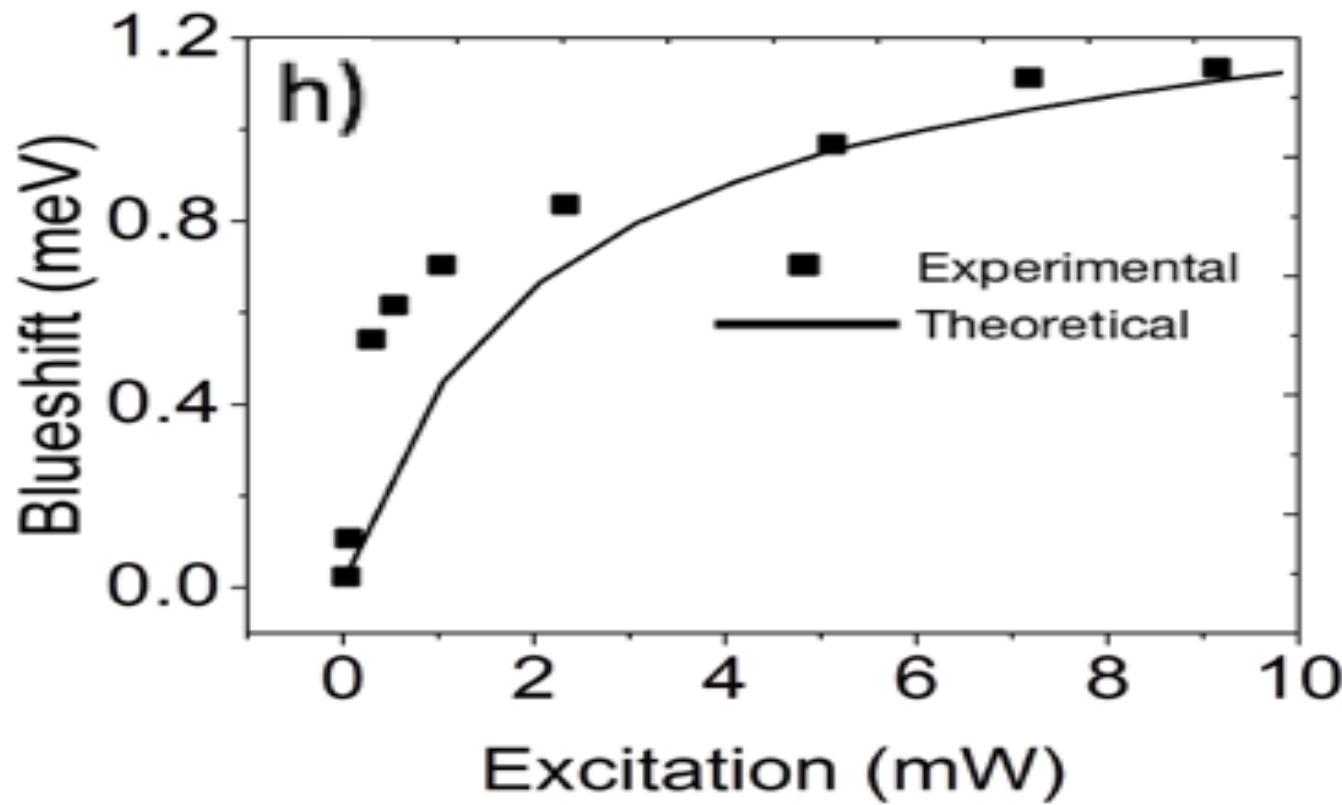
The diagram illustrates the components of the Gross-Pitaevskii Equation (GPE). The equation itself is centered, showing the energy E_n times the wave function $\psi_n(x)$ as equal to a sum of four terms: Kinetic Energy, Interactions with the excitonic reservoir, Decay, and Interaction within the condensate. Blue arrows point from each component label to its corresponding term in the equation. The Kinetic Energy arrow points to the first term, the Decay arrow points to the last term, the Interactions with the excitonic reservoir arrow points to the second term, and the Interaction within the condensate arrow points to the third term. The Pumping term label is positioned below the second term.



Results:



Blue Shift:



Thank You for your attention

