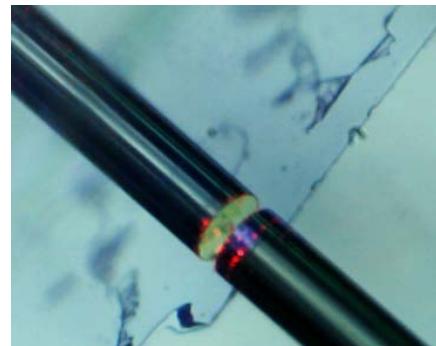


# Coupling a GeV Center to a $\mu$ -Cavity



Alexander Huck

COST-NQO, Brussels

04 April 2019

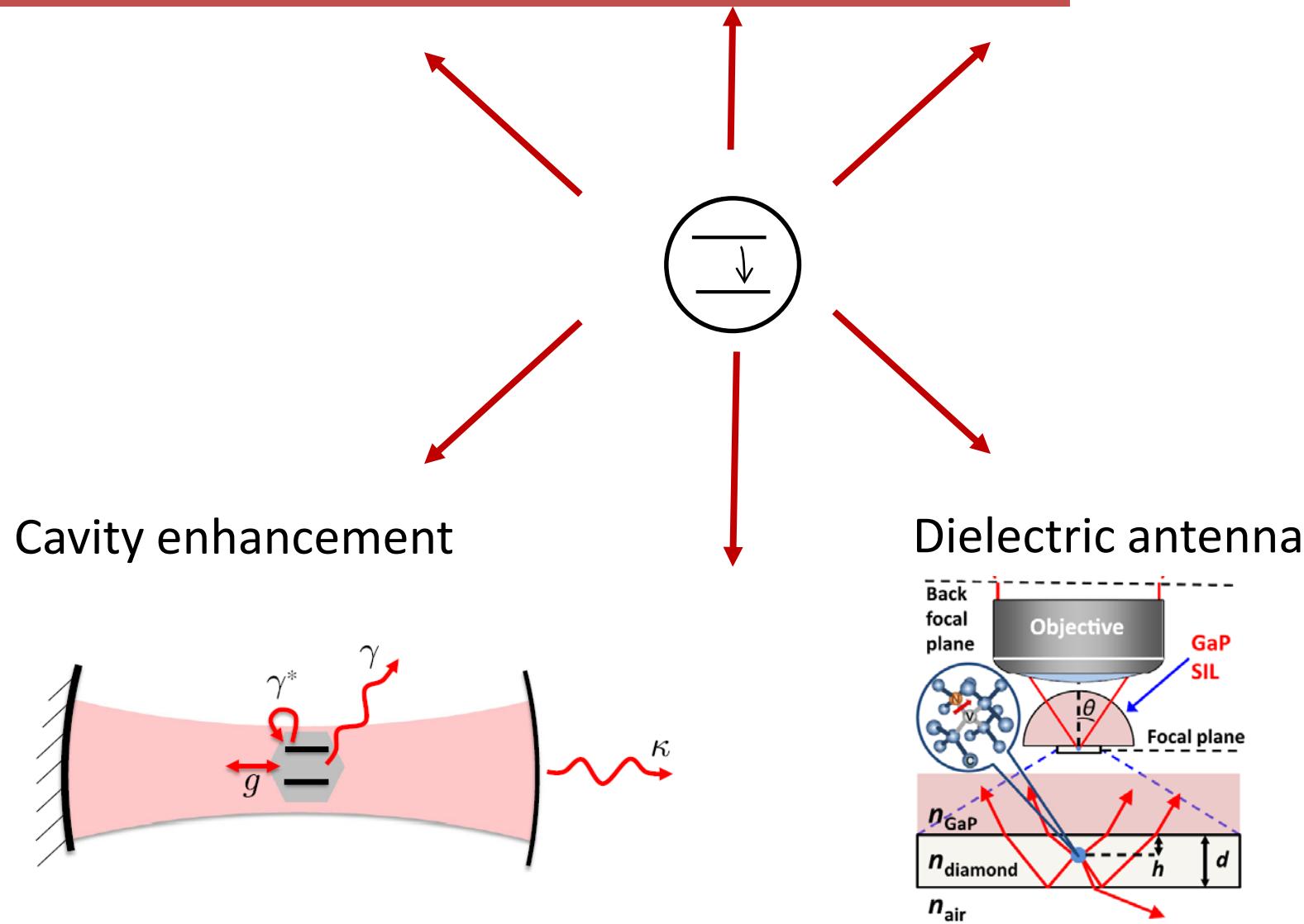


CENTER FOR  
MACROSCOPIC  
QUANTUM STATES

| DTU Physics  
Department of Physics

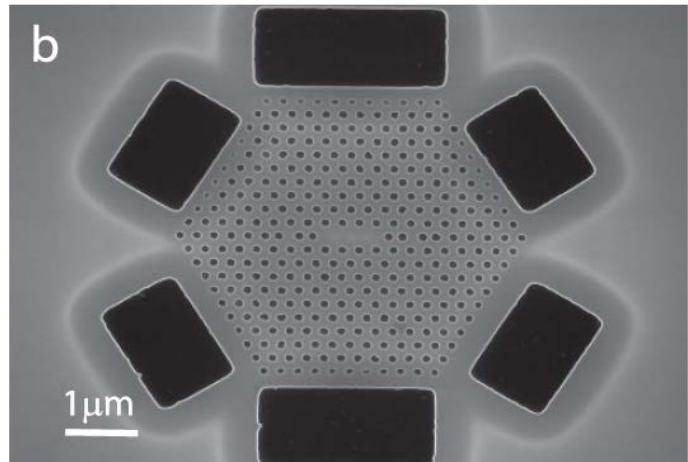
# Motivation

big Q

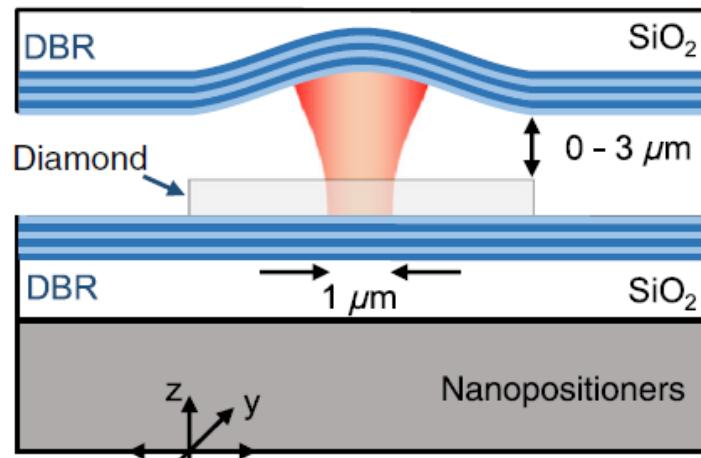


# Earlier Work - Cavities

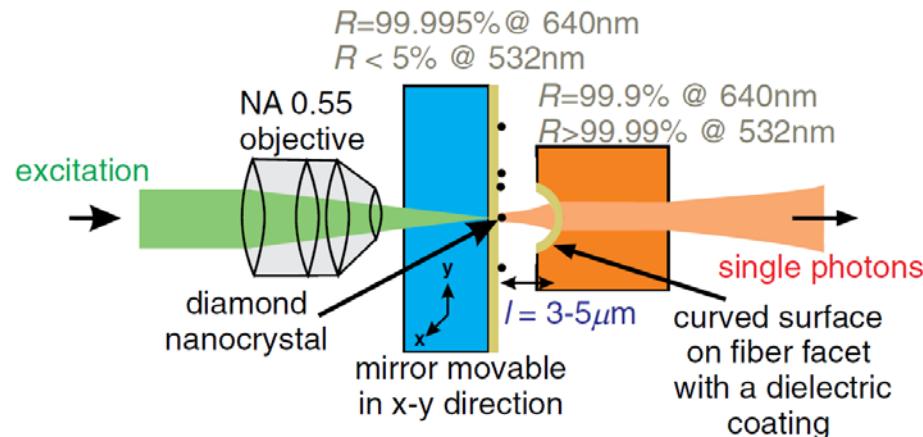
big Q



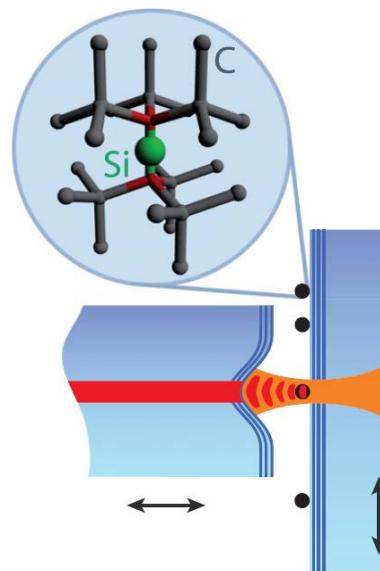
Faraon et al., PRL 109, 033604 (2012)



Riedel et al., PRX 7, 031040 (2017)

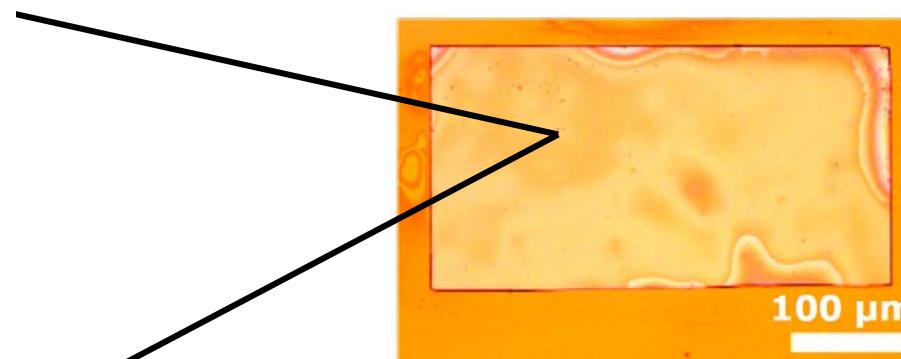
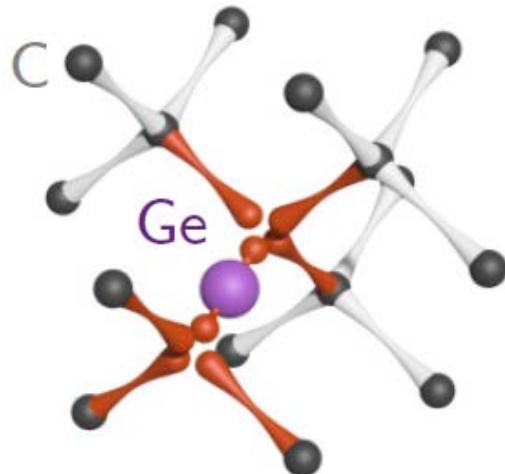


Albrecht et al., PRL 110, 243602 (2013)

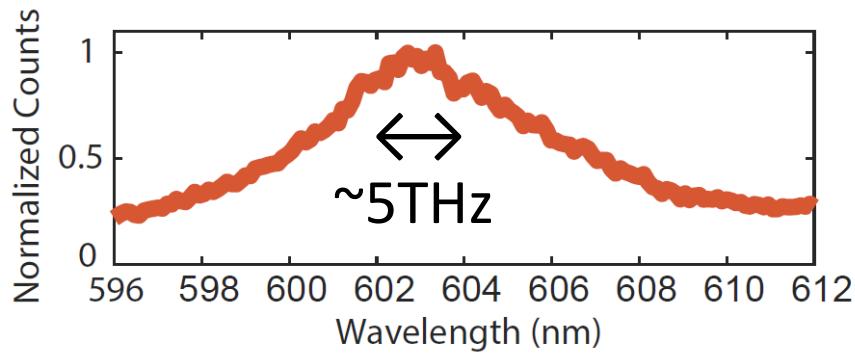


Benedikter et al., PR Appl 7, 024031 (2017)

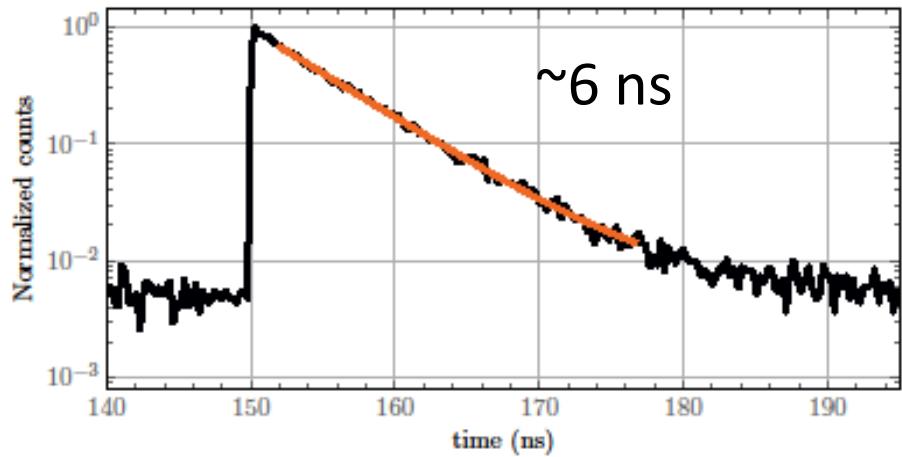
# Germanium Vacancy center



- Thickness  $\sim 1\mu\text{m}$
- Roughness  $\sim 0.3 \text{ nm rms}$

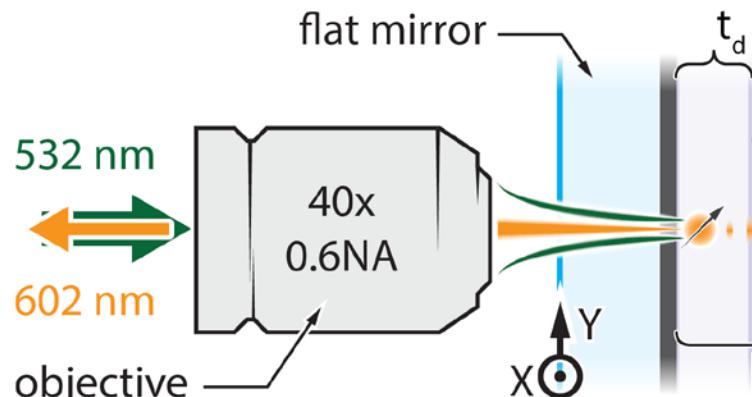


Branching ration  $\sim 60\%$  into ZPL



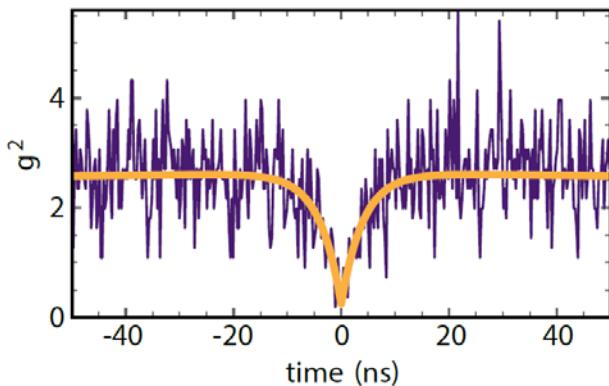
# Experiment

big Q

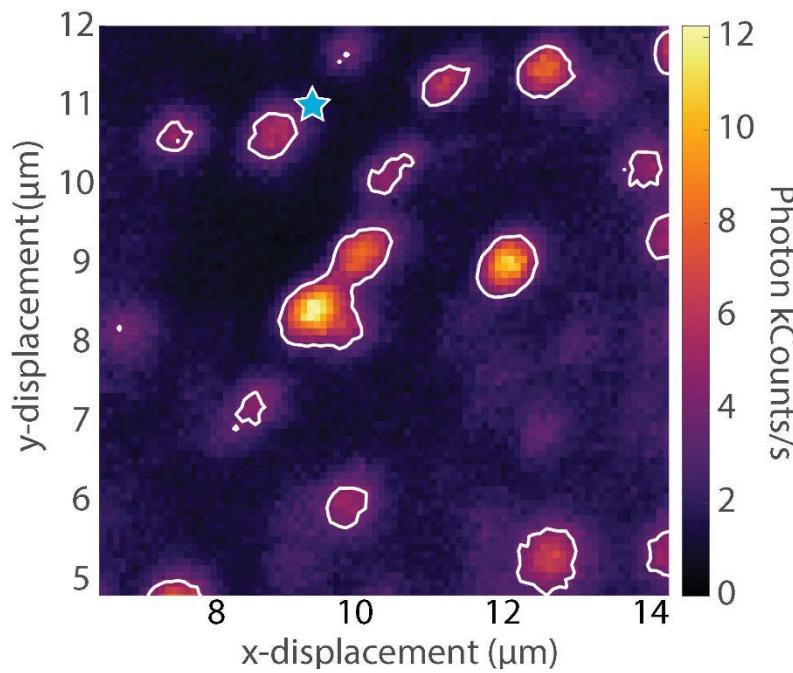


$$T_{532} \approx 1$$
$$T_{602} \approx 70 \text{ ppm}$$

- ~5% collection with NA = 0.7
- quantum efficiency
- > 2 levels



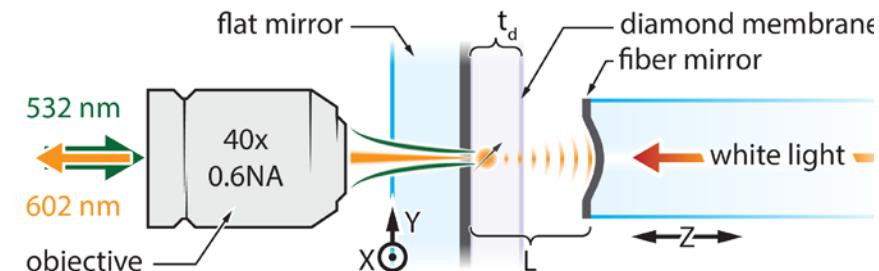
Confocal scan



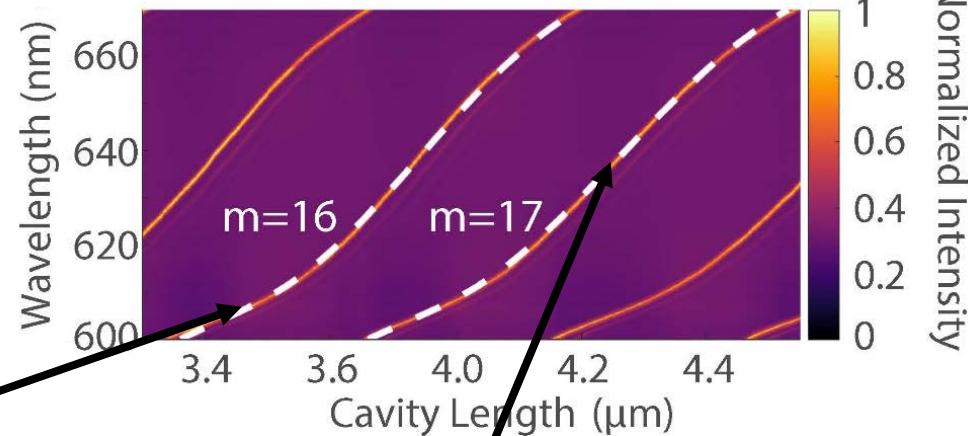
# Cavity Modes

big Q

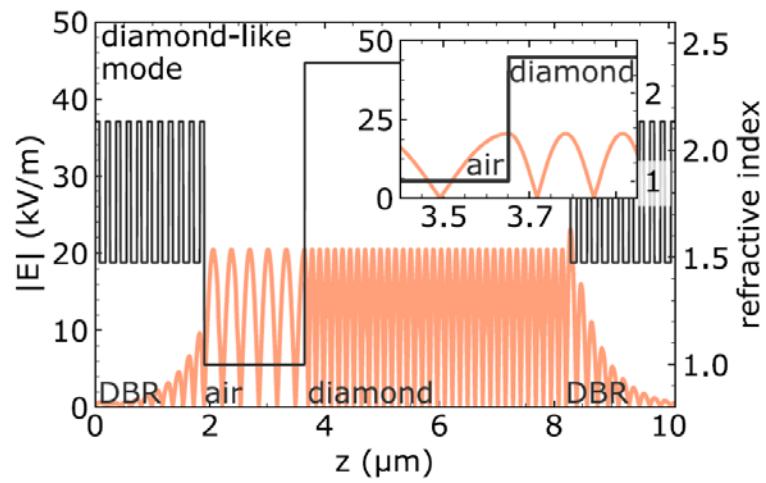
$$t_D \approx 0.86 \mu\text{m}$$



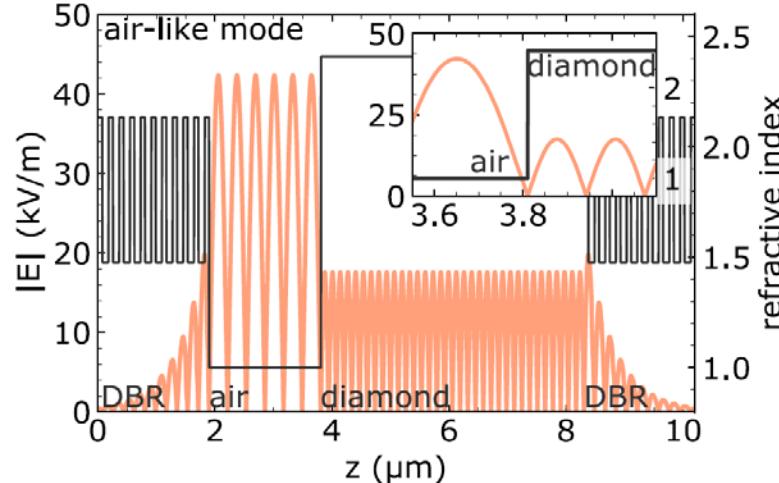
$$\text{Finesse} \approx 10^4$$



Diamond-like

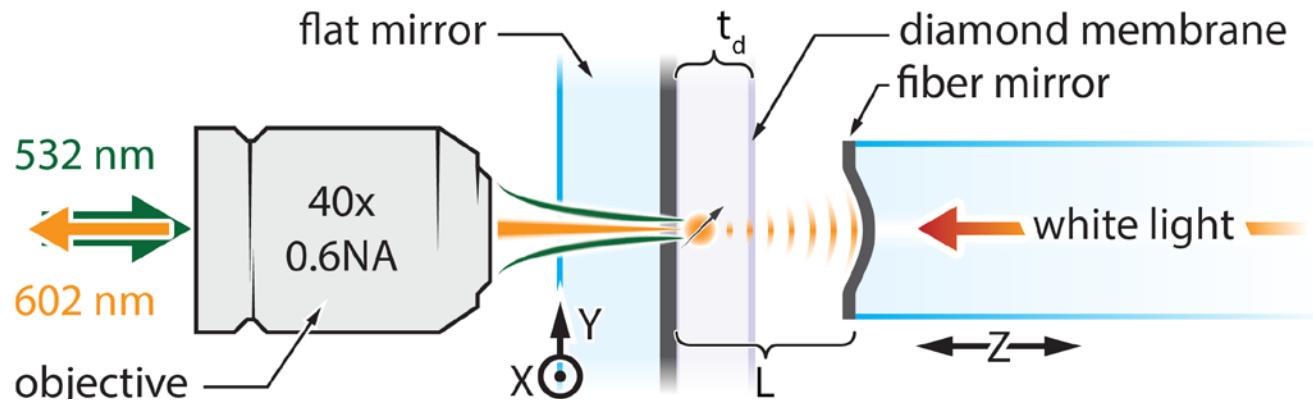


Air-like

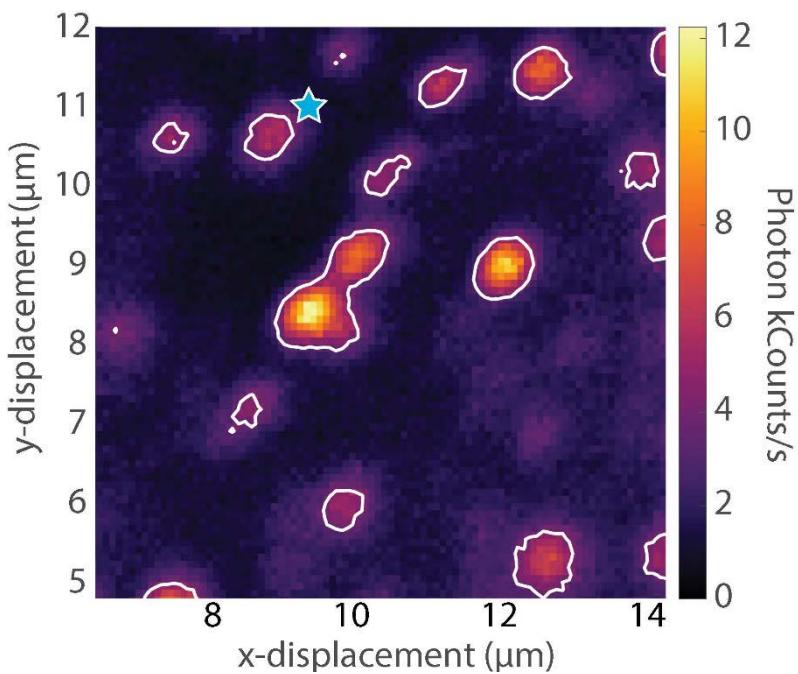


# Fiber scan

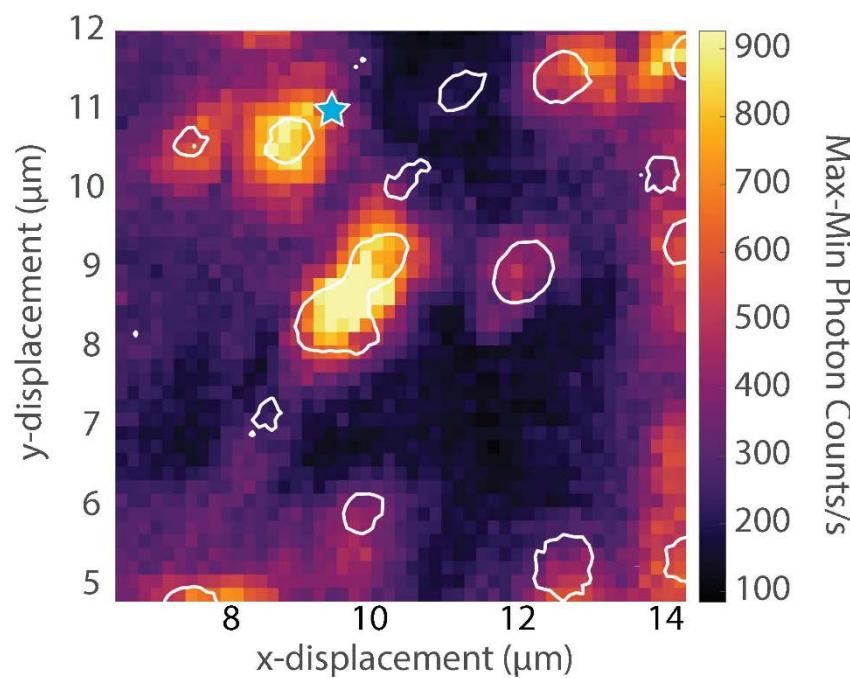
big Q



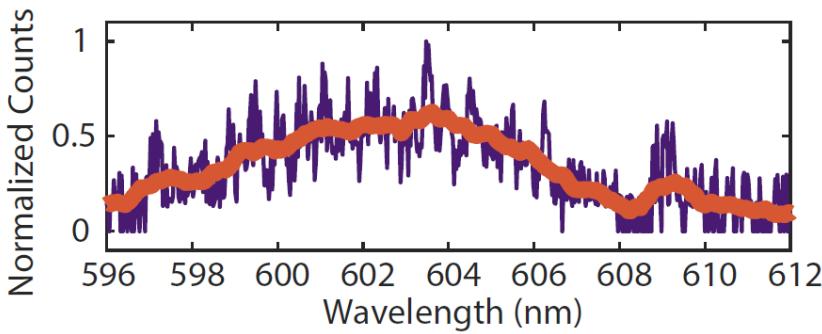
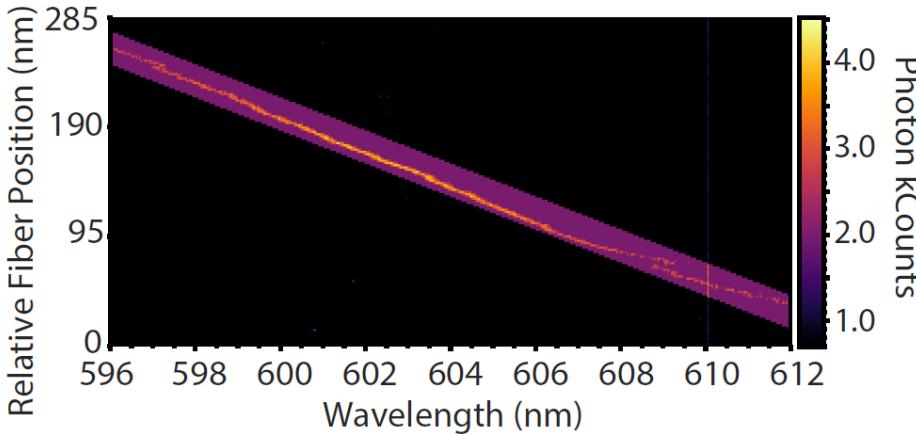
## Confocal scan



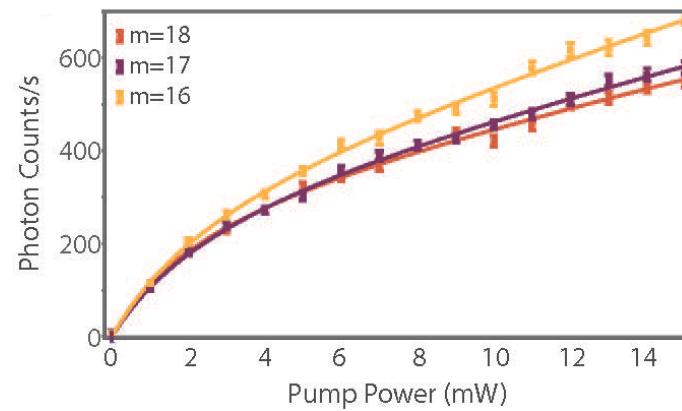
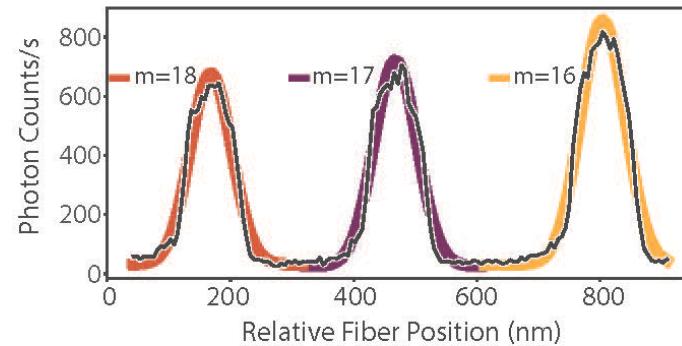
## Fiber scan



# Cavity Coupling



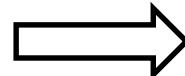
→ GeV spectrum retrieved



→ saturation behaviour

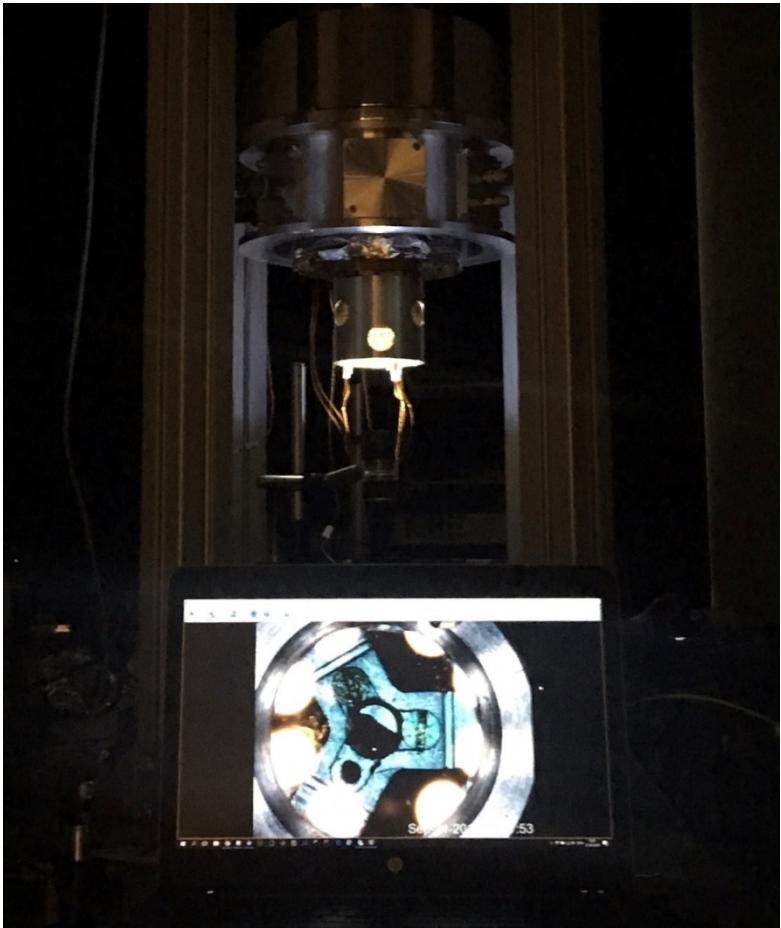
Quantify coupling:

$$\frac{I_{\infty, \text{free}}}{\eta \text{BW}} \approx 86 \pm 27 \frac{\text{counts}}{\text{s GHz}}$$

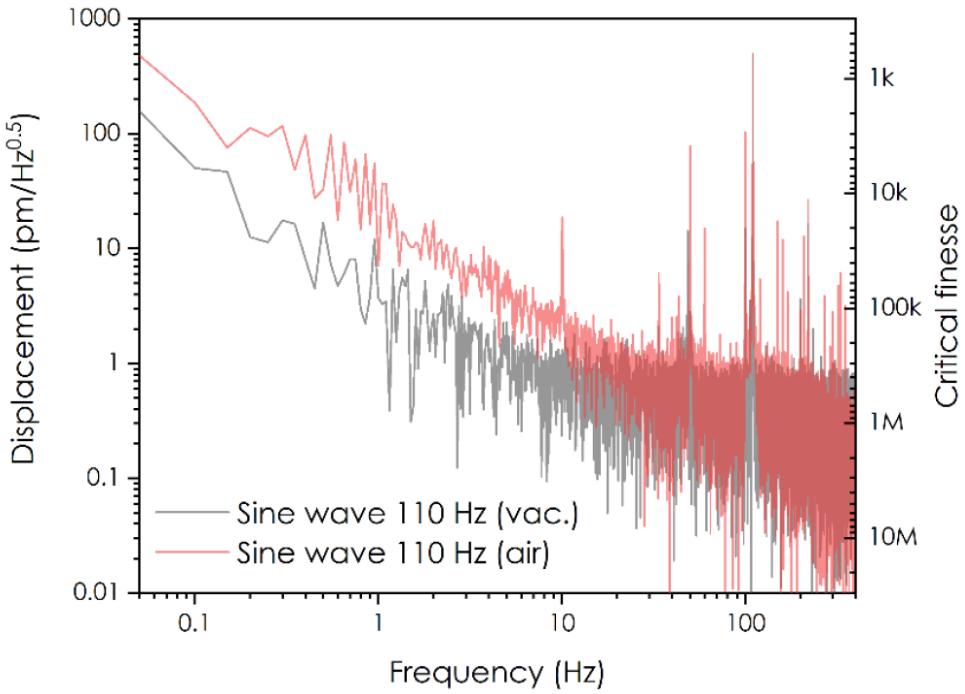


$$\frac{I_{\infty, \text{cavity}}}{\eta \text{BW}} \approx 2200 \pm 500 \frac{\text{counts}}{\text{s GHz}}$$

# Next step



Bath cryostat with vibration  
isolation



Stability within cavity  
resonance

# Contributions



Ulrik Lund Andersen



Alexander Huck

Olivier Gboron

Rasmus Jensen

Maxime Bergamin

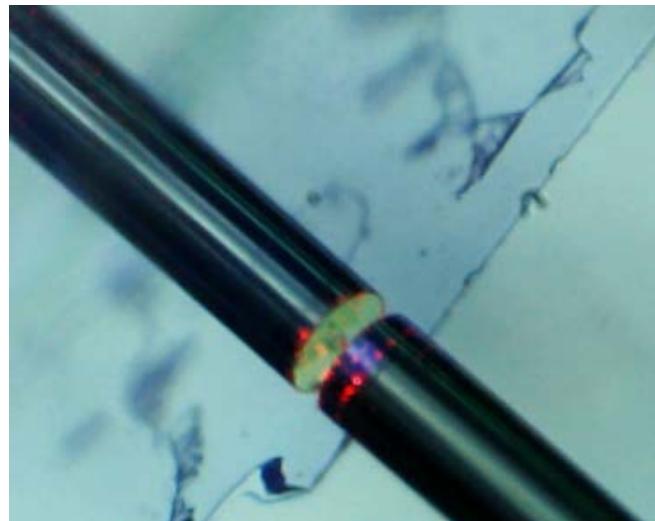


Collaboration with:

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Erika Janitz

Yannik Fontana



Danmarks  
Grundforskningsfond  
Danish National  
Research Foundation



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Thank you!