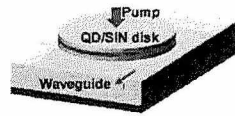
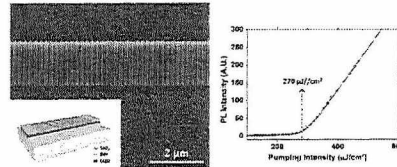


CQD LASERS

- Solution-processable
- Thermally stable
- Tunable bandgap
- ➔ Versatile
- ➔ Studie of randomness in lasers



Xie, W., Stöferle, T., Rainò, G., Aubert, T., Bisschop, S., Zhu, Y., Mahrt, R. F., Geiregat, P., Brainis, E., Hens, Z., Van Thourhout, D., *Adv. Mater.* 2017, 29, 1604866.



Yunpeng Zhu, Weiqiang Xie, Suzanne Bisschop, Tangi Aubert, Edouard Brainis, Pieter Geiregat, Zeger Hens, and Dries Van Thourhout
ACS Photonics 2017 4 (10), 2446-2452

OVERVIEW

- Processing and measurements
- Equal resonators ➔ Extended states
- Random effects ➔ Localized states

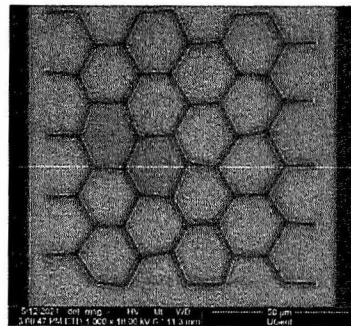
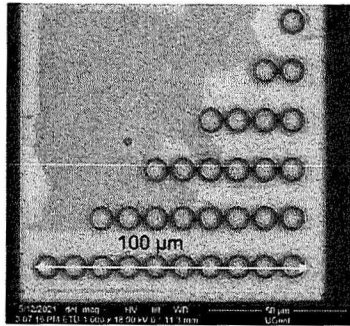
EXTENDED AND LOCALIZED STATES IN COLLOIDAL QUANTUM DOTS BASED MICRORING LASERS

Korneel Molkens, Ivo Tanghe, Dhruv Saxena, Wai Kit Ng, Riccardo Sapienza, Pieter Geiregat, Dries Van Thourhout

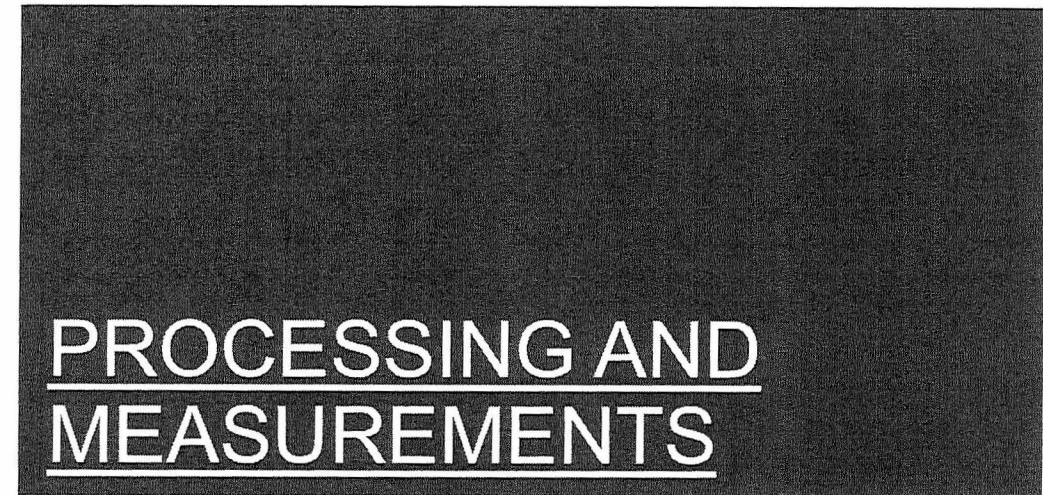
2. PATTERNING

E-beam lithography

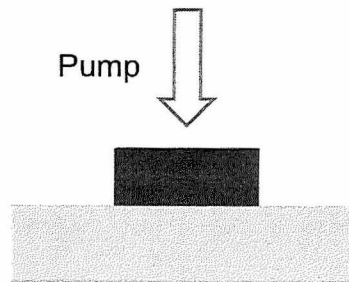
Gaio, M., Saxena, D., Bertolotti, J. *et al.* A nanophotonic laser on a graph. *Nat Commun* 10, 226 (2019).



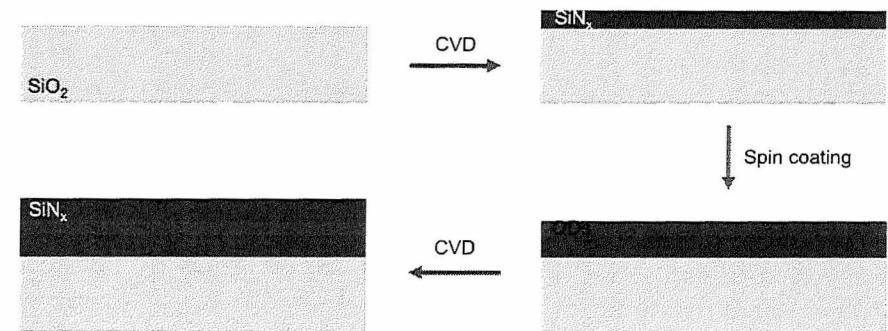
Many geometries are possible!



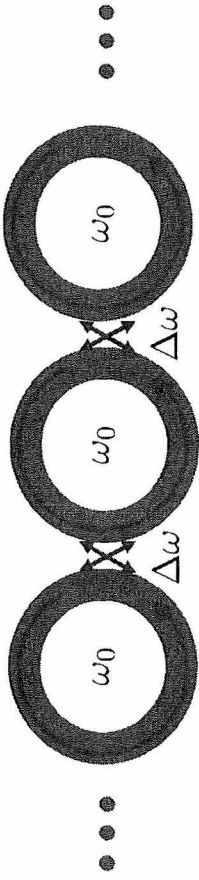
MEASUREMENTS



1. EMBEDDING THE QDS



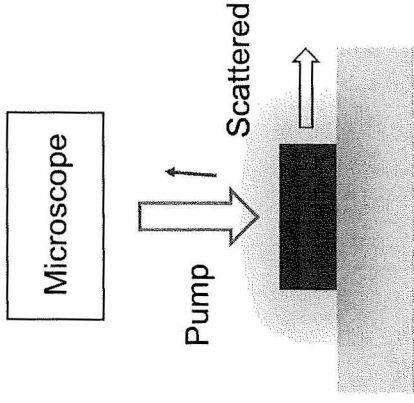
MODELLING



$$H = \begin{pmatrix} \ddots & & & & \\ \ddots & \omega_0 & \Delta\omega & & \\ & \Delta\omega & \omega_0 & \ddots & \\ & & & \ddots & \omega_0 \\ & & & & \ddots \end{pmatrix}$$

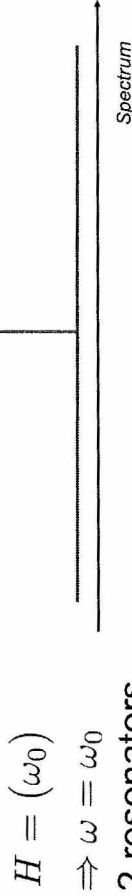
- Eigenfrequencies
- Mode profile

MEASUREMENTS

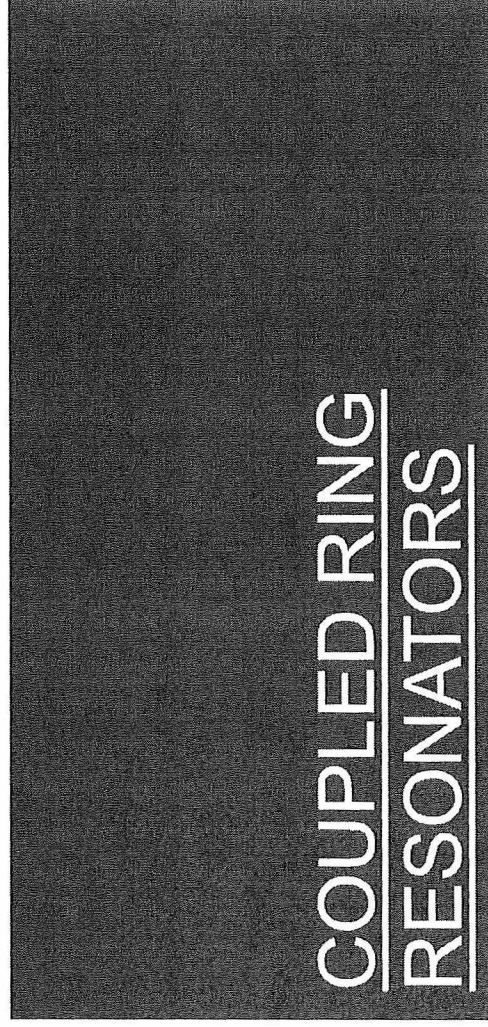
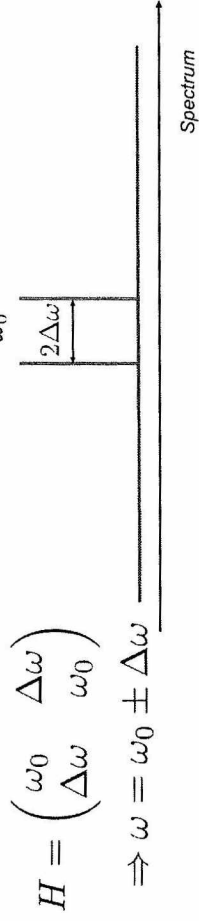


EXAMPLE: EIGENFREQUENCIES

- Single resonator

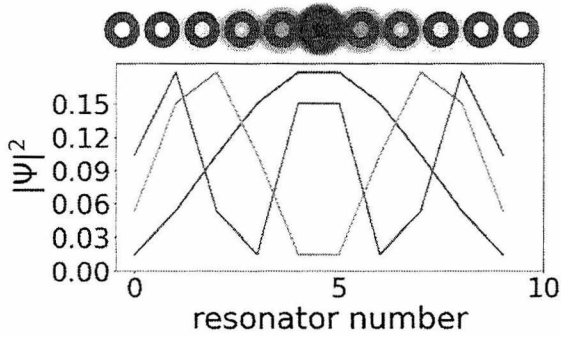


- 2 resonators



EXAMPLE: MODE PROFILE

- 10 resonators
- Plot of eigenvector

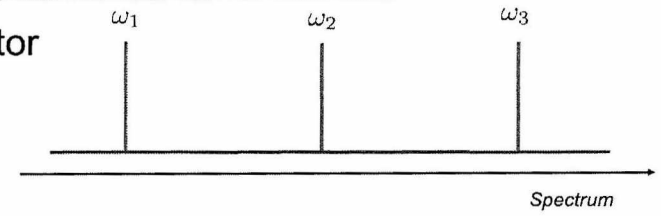


EXAMPLE: EIGENFREQUENCIES

- Single resonator

$$H = (\omega_0)$$

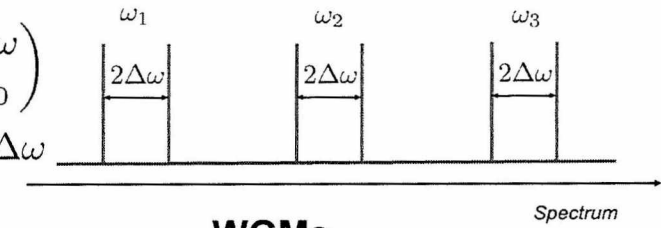
$$\Rightarrow \omega = \omega_0$$



- 2 resonators

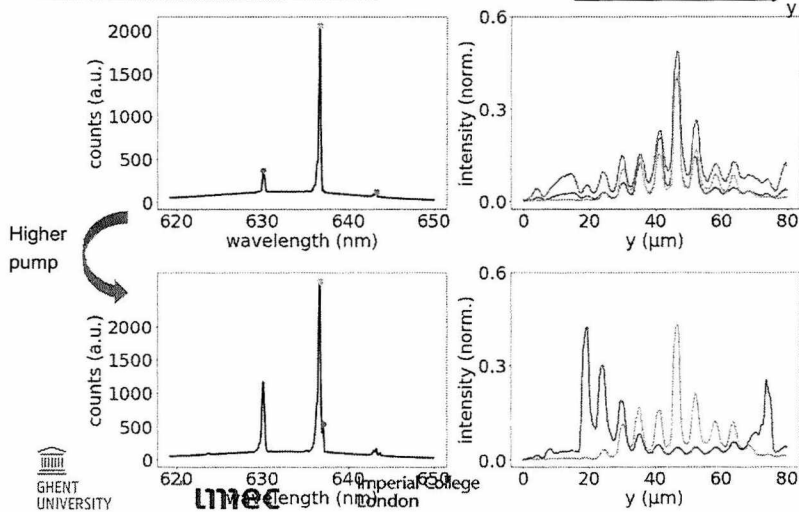
$$H = \begin{pmatrix} \omega_0 & \Delta\omega \\ \Delta\omega & \omega_0 \end{pmatrix}$$

$$\Rightarrow \omega = \omega_0 \pm \Delta\omega$$



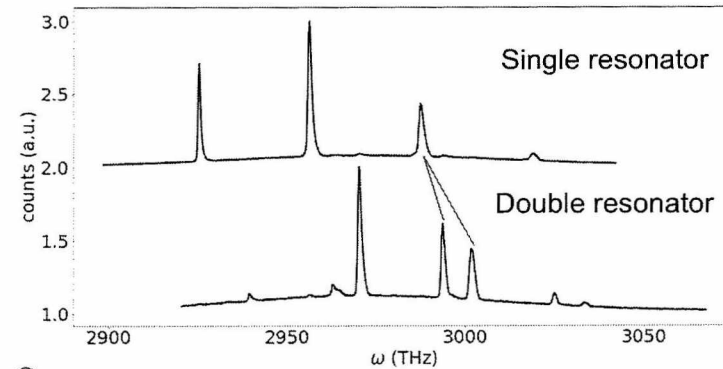
WGMs

EXPERIMENTAL:



EXAMPLE: EIGENFREQUENCIES

- Experimental:



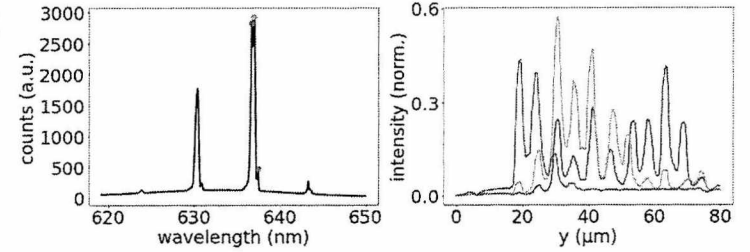
$$\Delta\omega \approx 10\text{THz}$$

MORE DISORDER

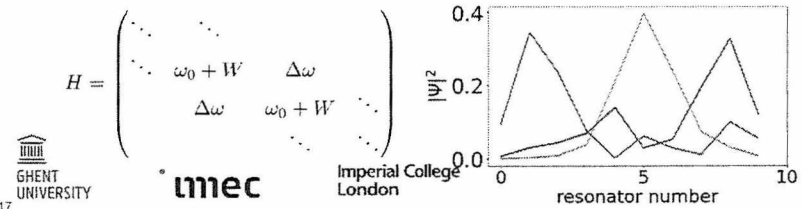
EXPERIMENTAL: OTHER SAMPLES



– Experiment:

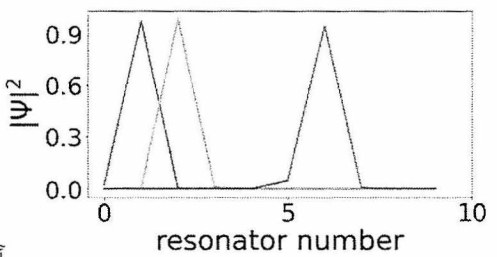


– Simulations: small disorder in ω_0



MODELLING

- Deliberatly added
- Change of ring diameter

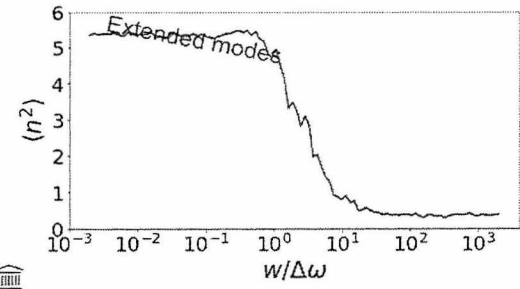


$$H = \begin{pmatrix} \dots & \dots & \dots & \dots \\ \dots & \omega_0 + W & \Delta\omega & \dots \\ \dots & \Delta\omega & \omega_0 + W & \dots \\ \dots & \dots & \dots & \dots \end{pmatrix}$$

CHARACTERIZATION OF FABRICATION ERROR

W uniform
 $\langle n^2 \rangle \sim$ width of mode

$$H = \begin{pmatrix} \dots & \dots & \dots & \dots \\ \dots & \omega_0 + W & \Delta\omega & \dots \\ \dots & \Delta\omega & \omega_0 + W & \dots \\ \dots & \dots & \dots & \dots \end{pmatrix}$$



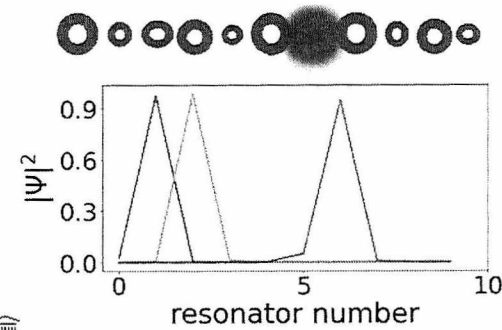
$\rightarrow w \leq \Delta\omega$
 Fabrication error around 10 THz or 5 meV

CONCLUSION

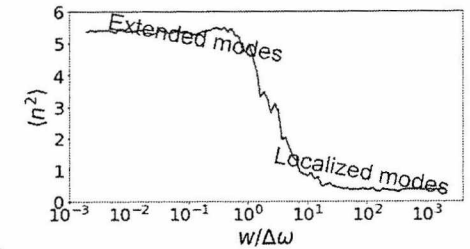
- QCD lasers for complex geometries
- Studie of the effect of randomness
- Extended and localized states
- Many other shapes possible

MODELLING

- Deliberatly added
- Change of ring diameter



$$H = \begin{pmatrix} \dots & \dots & \dots & \dots & \dots \\ \dots & \omega_0 + W & \Delta\omega & \dots & \dots \\ \dots & \Delta\omega & \omega_0 + W & \dots & \dots \\ \dots & \dots & \dots & \dots & \dots \end{pmatrix}$$



THANKS TO EVERYONE



Korneel Molken

Ivo Tanghe



prof. Pieter Geiregat

prof. Dries Van Thourhout

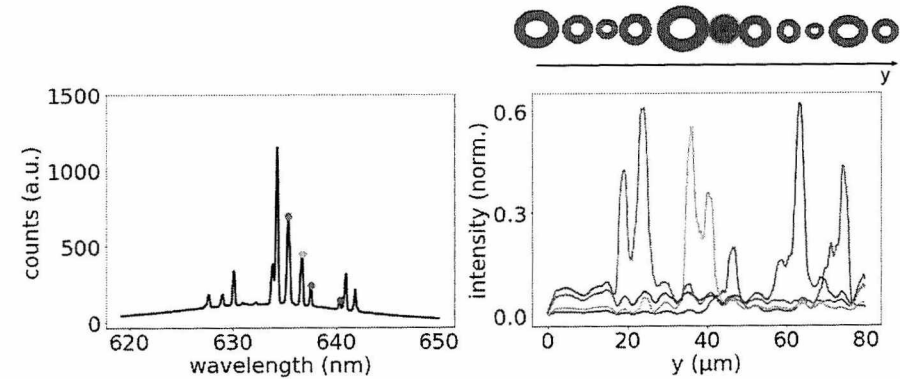


Dr. Dhruv Saxena

Wai Kit Ng

prof. Riccardo Sapienza

EXPERIMENTAL



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Partners



2021 Fall Meeting



LATEST NEWS: All pre-recordings are available on the conference platform until the end of December.

It is with great pleasure that we announce the 2021 Fall Meeting of the European Materials Research Society (E-MRS) to be held as a **VIRTUAL CONFERENCE** from 20th to 23rd September 2021.

Having faced and still struggling with the quite exceptional pandemic years 2020 and 2021, E-MRS has assessed various options how to serve the materials research community as a platform for scientific exchange and dissemination of the newest results in the year 2021. The concept to restart the scientific meeting culture of E-MRS aims to go beyond a simple interim solution of having a virtual conference. The crises related to COVID-19 is aimed to be used as a starting point to further