

Supercontinuum generation in silica nanowires



Photonics West
San Jose, CA, 26 January 2006

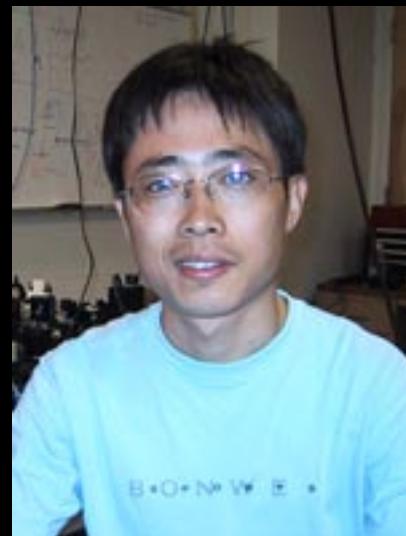




Rafael Gattass



Geoff Svacha



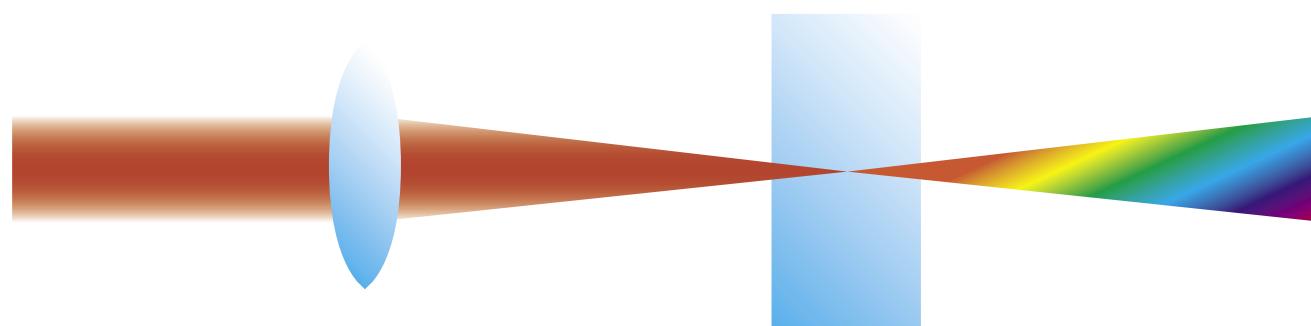
Limin Tong



Eric Mazur

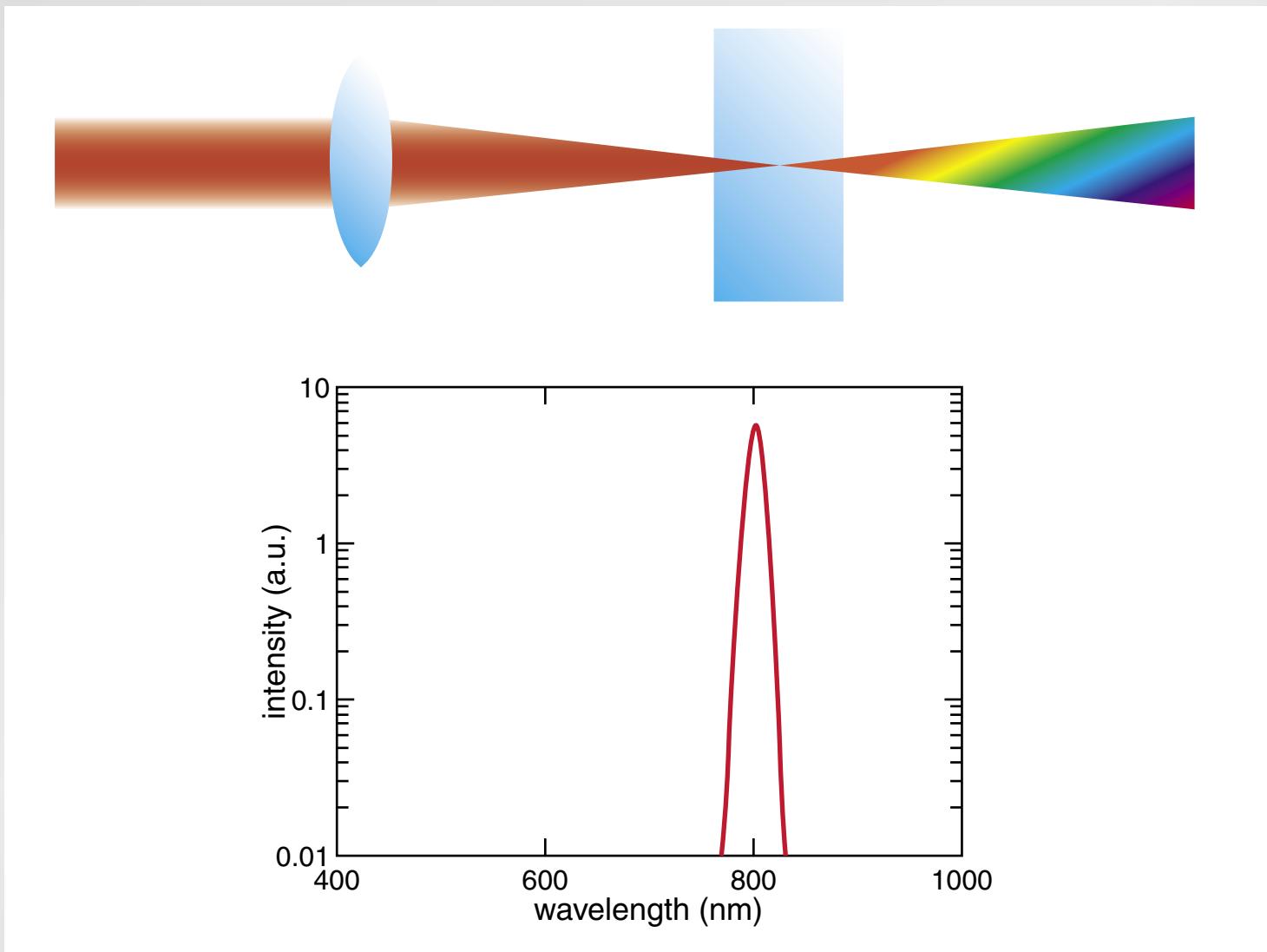
Motivation

conventional supercontinuum generation



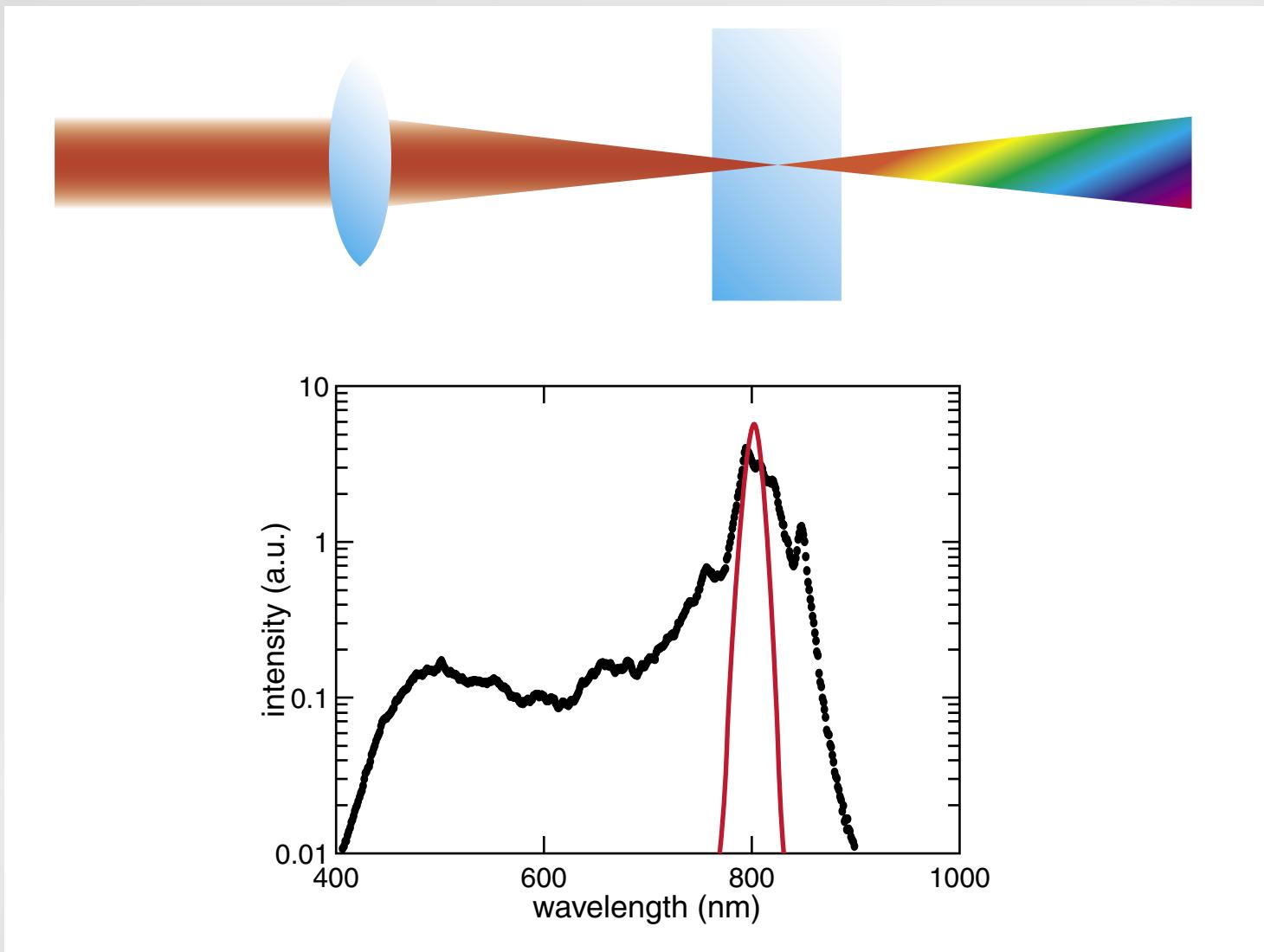
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conventional supercontinuum generation



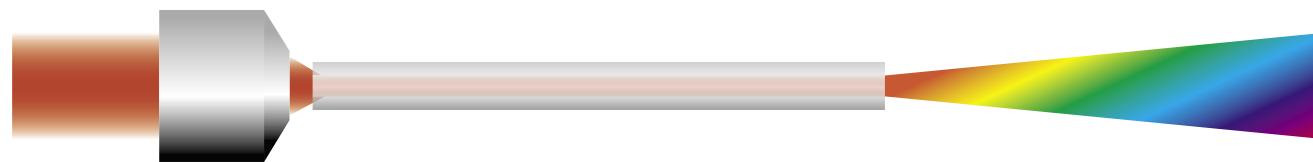
Motivation

conventional supercontinuum generation



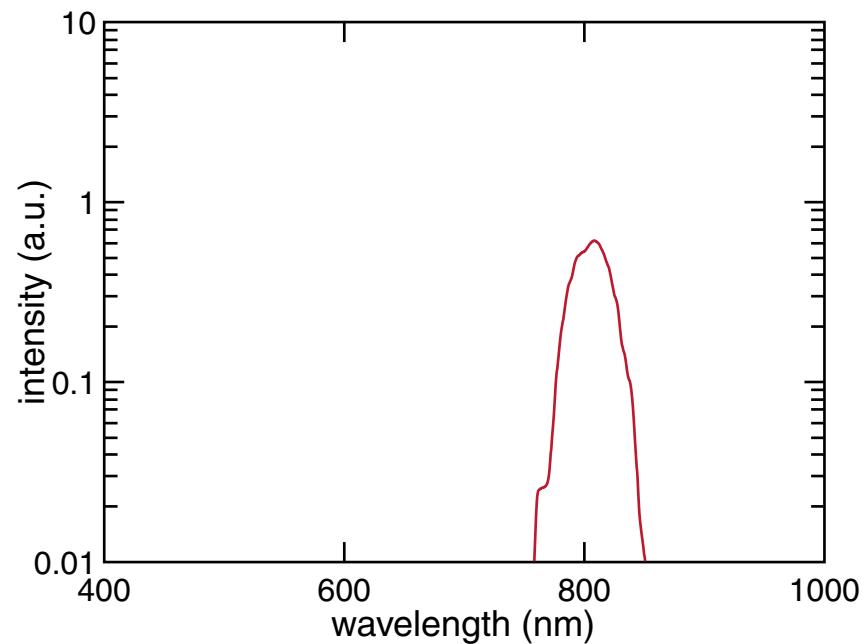
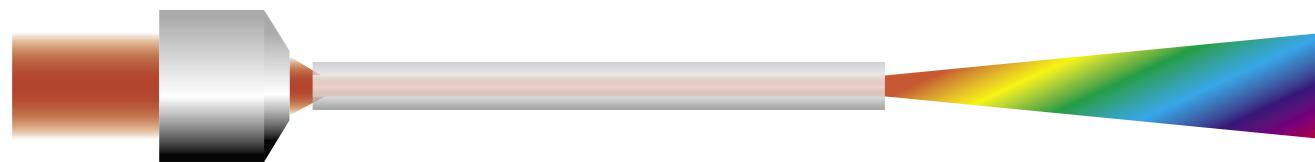
Motivation

fiber supercontinuum generation



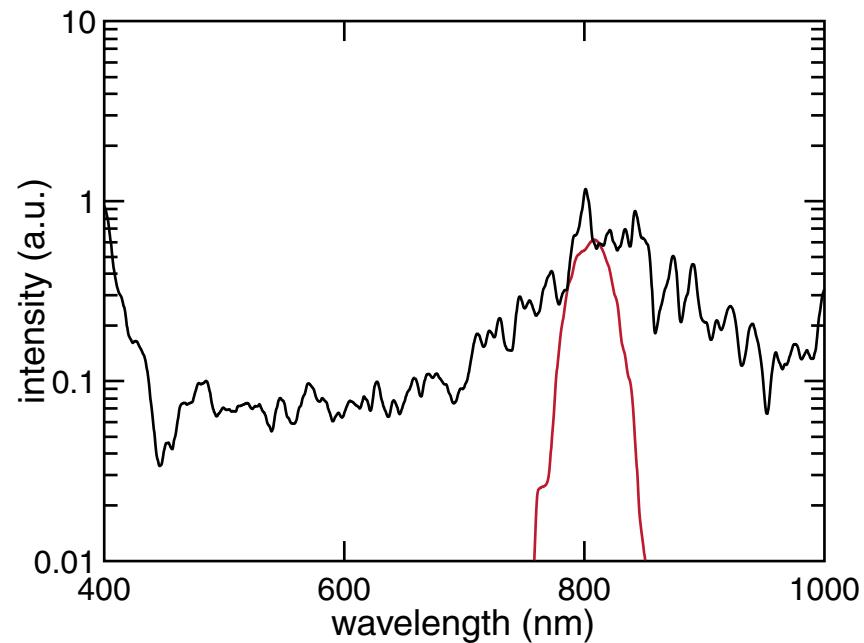
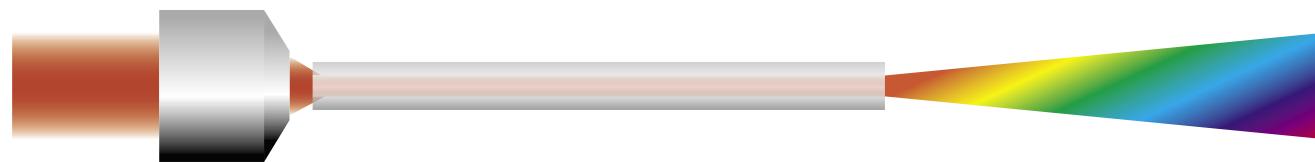
Motivation

fiber supercontinuum generation



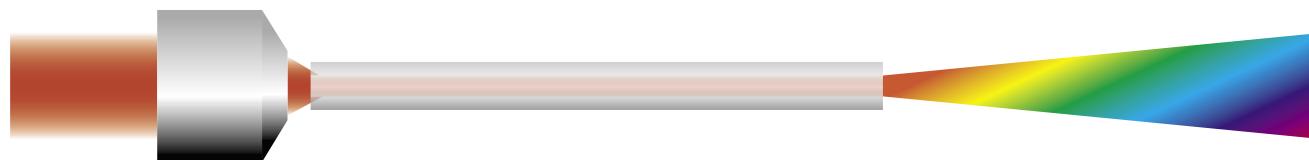
Motivation

fiber supercontinuum generation



Motivation

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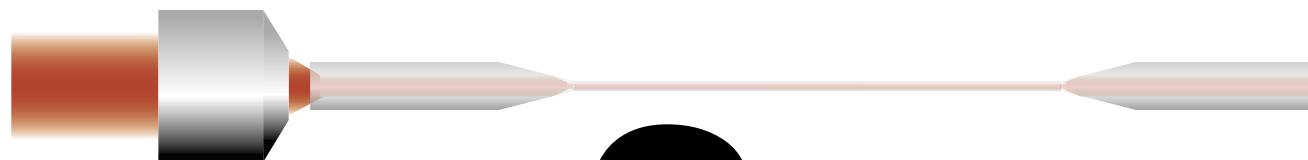
mode field confinement

large interaction length

dispersion control

Motivation

nanowire supercontinuum generation



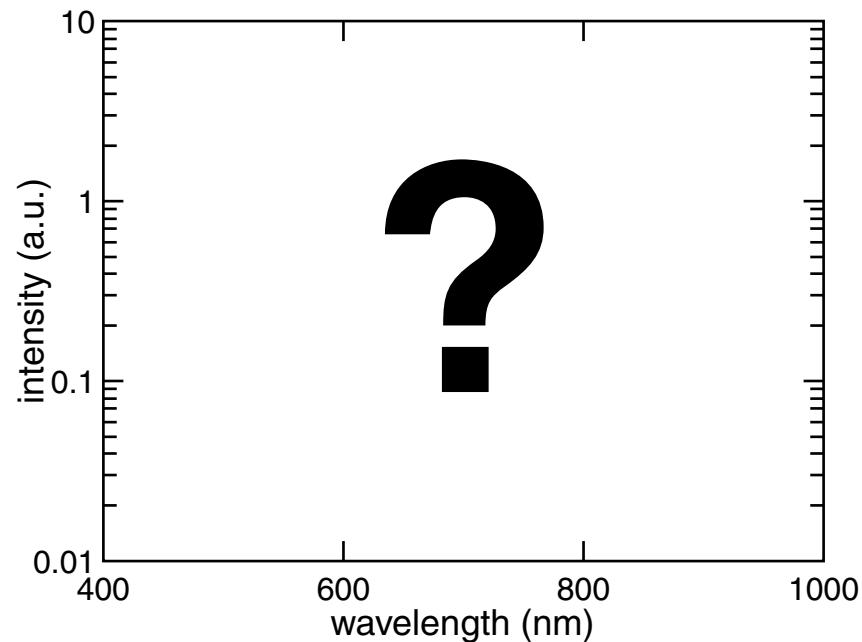
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Outline

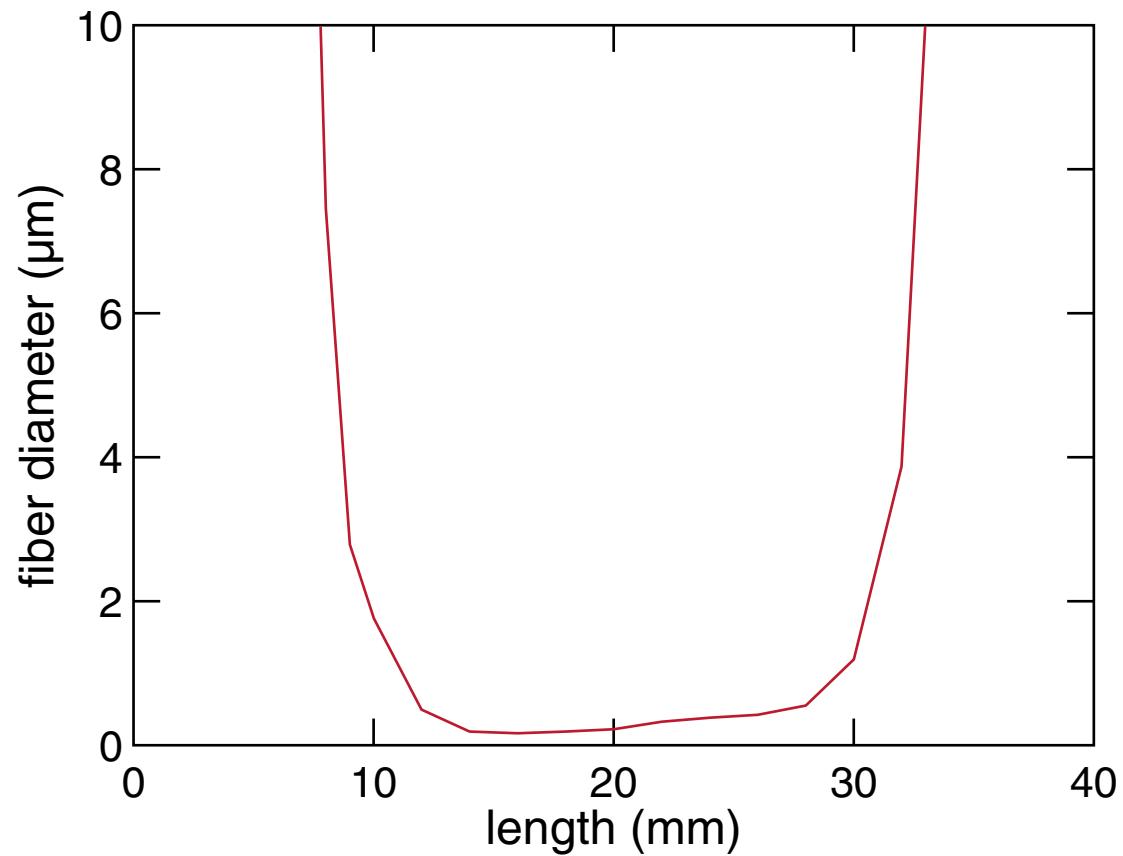
- nanowire
- optical properties
- supercontinuum spectra

Outline

- nanowire
- optical properties
- supercontinuum spectra

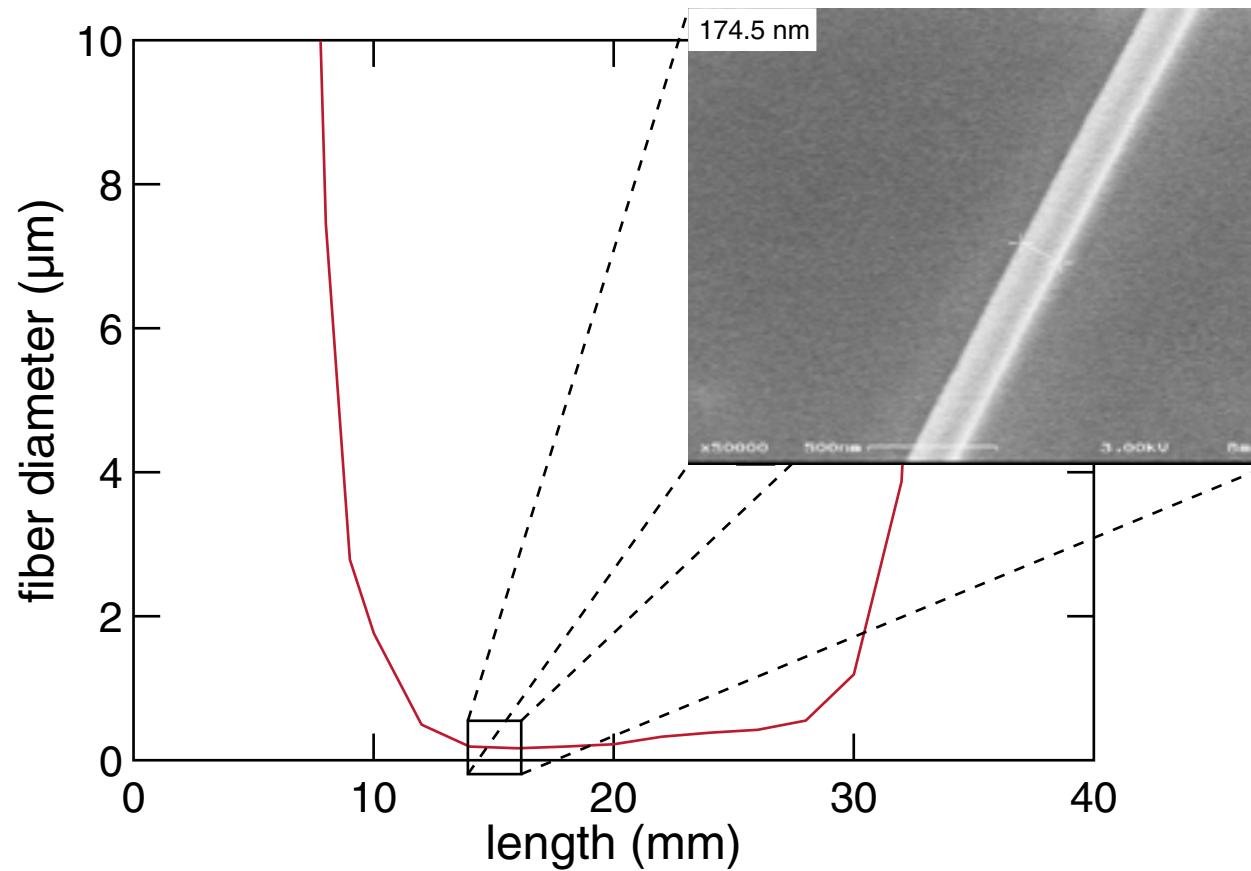
Optical properties

how small?



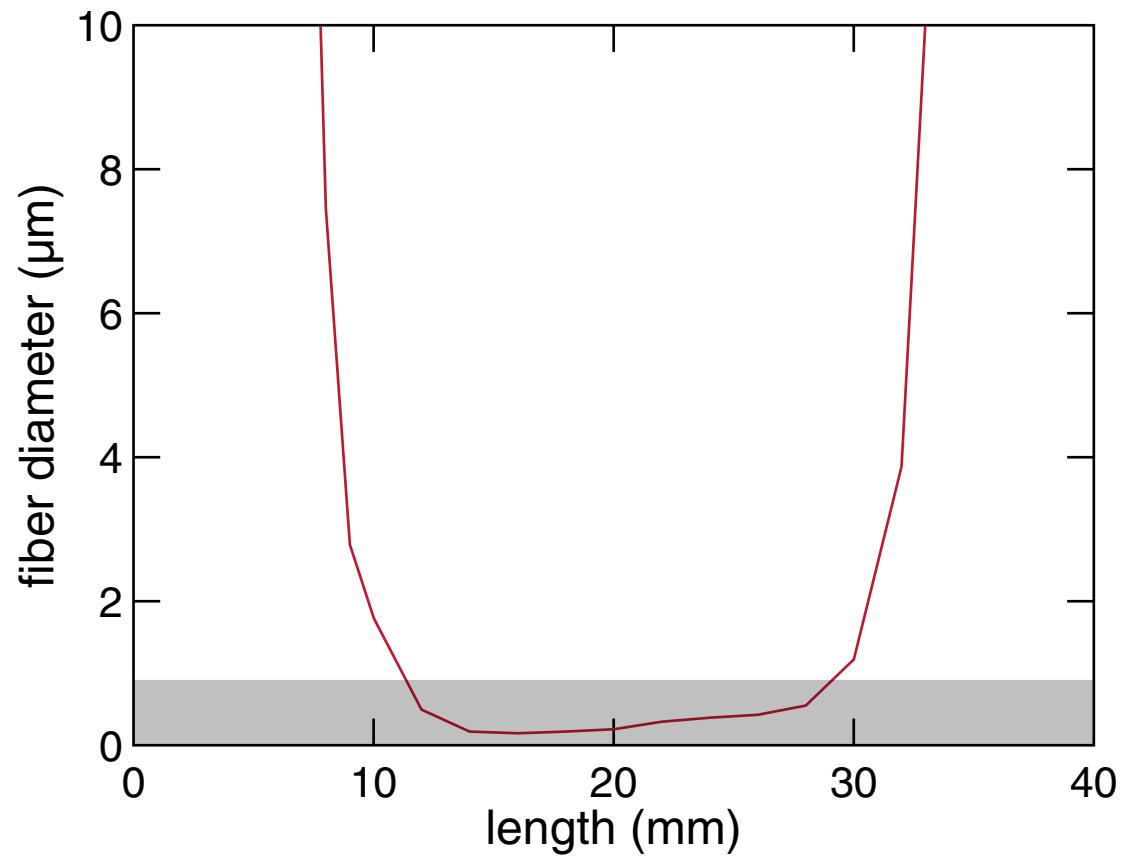
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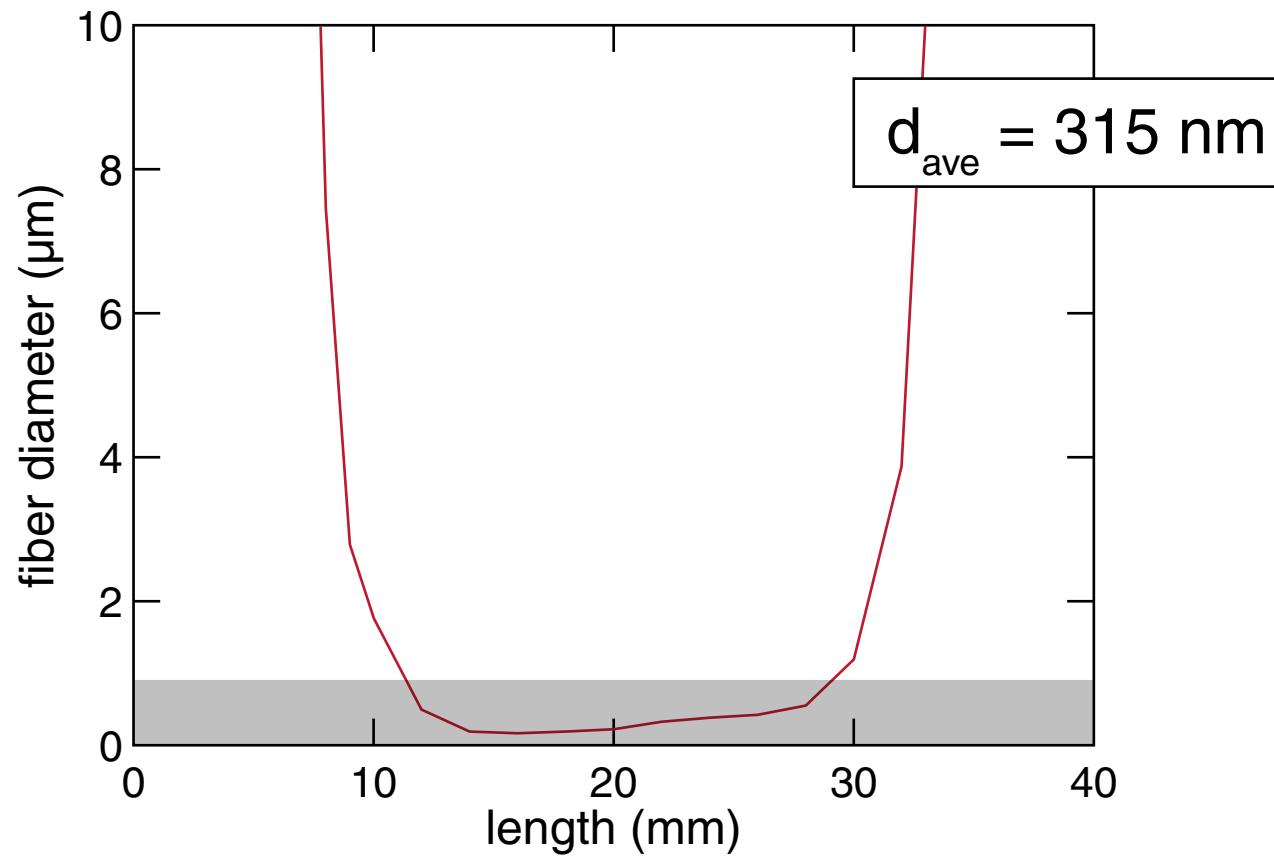
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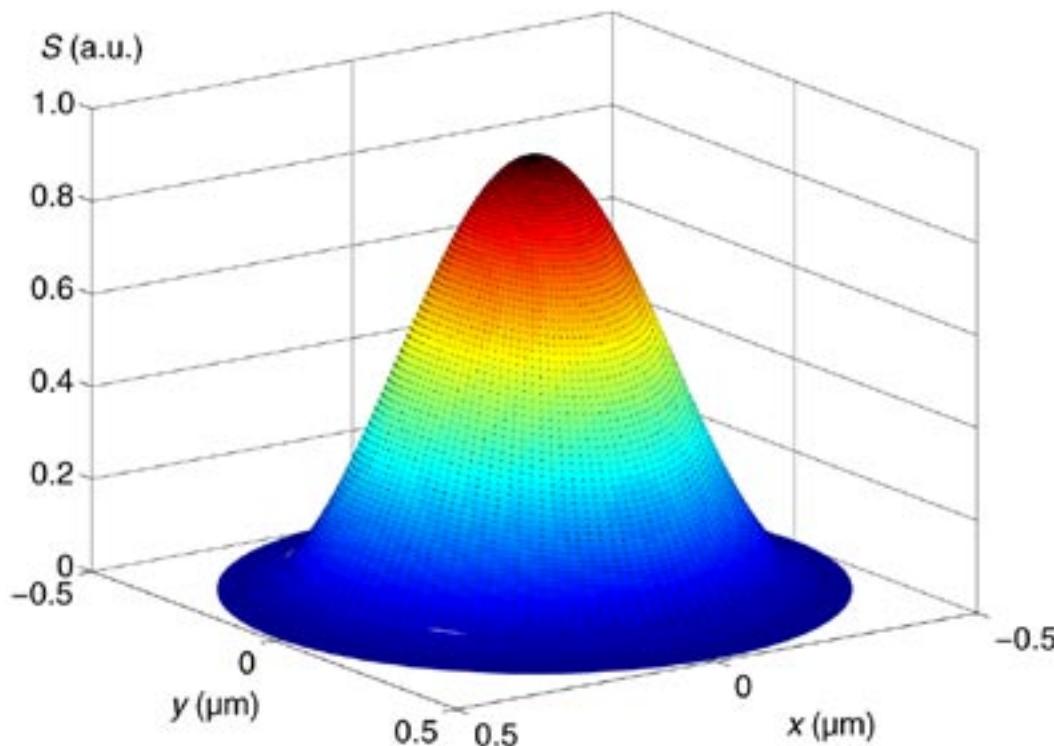


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- nanowire
- optical properties
- supercontinuum spectra

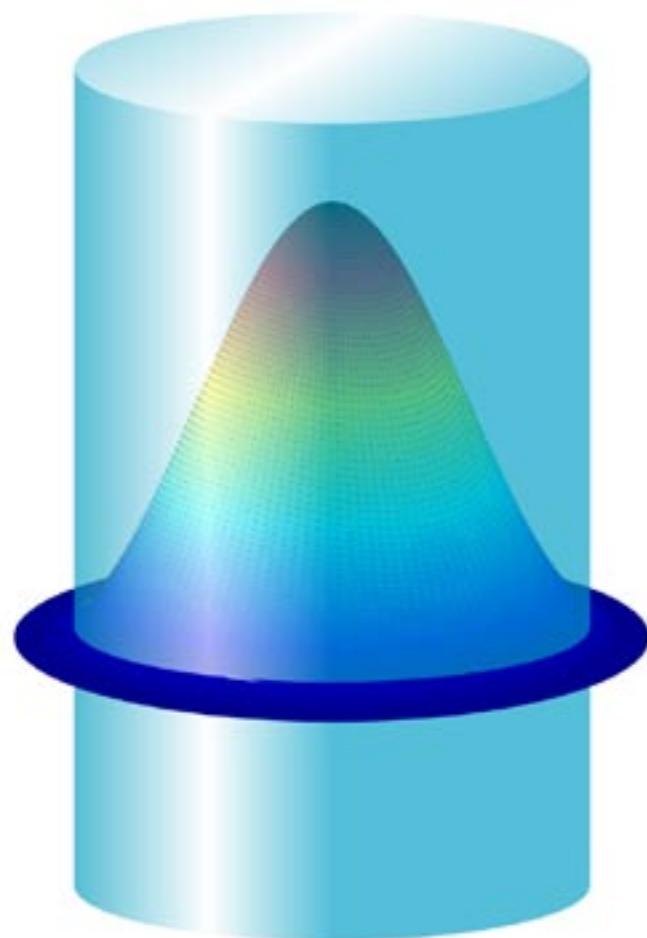
Optical properties

Poynting vector profile for 800-nm nanowire



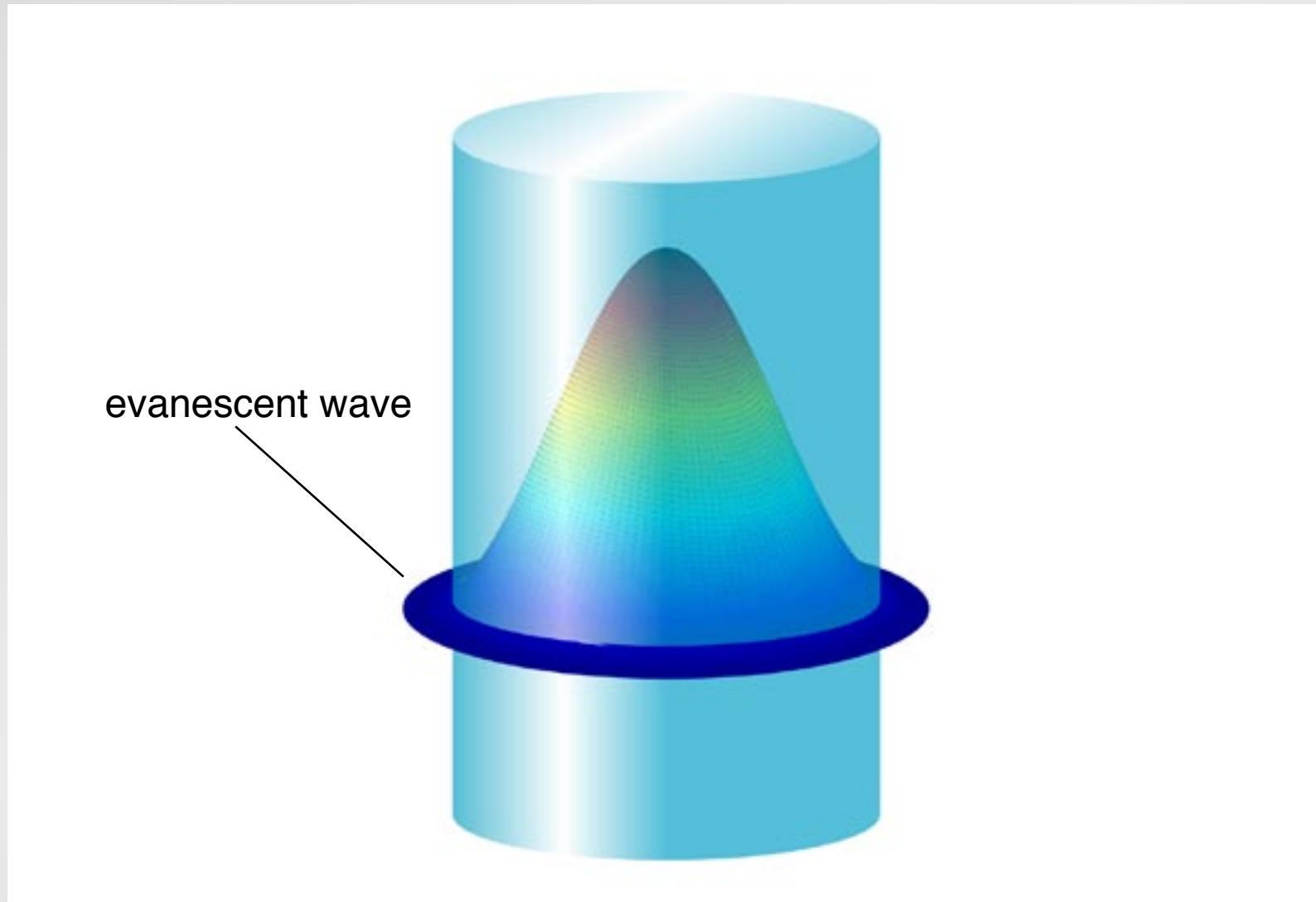
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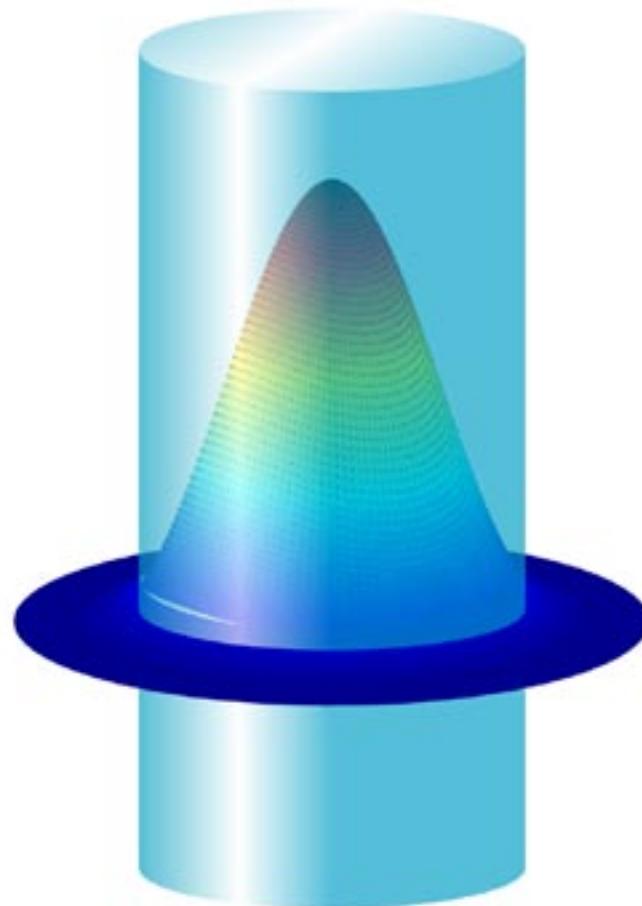
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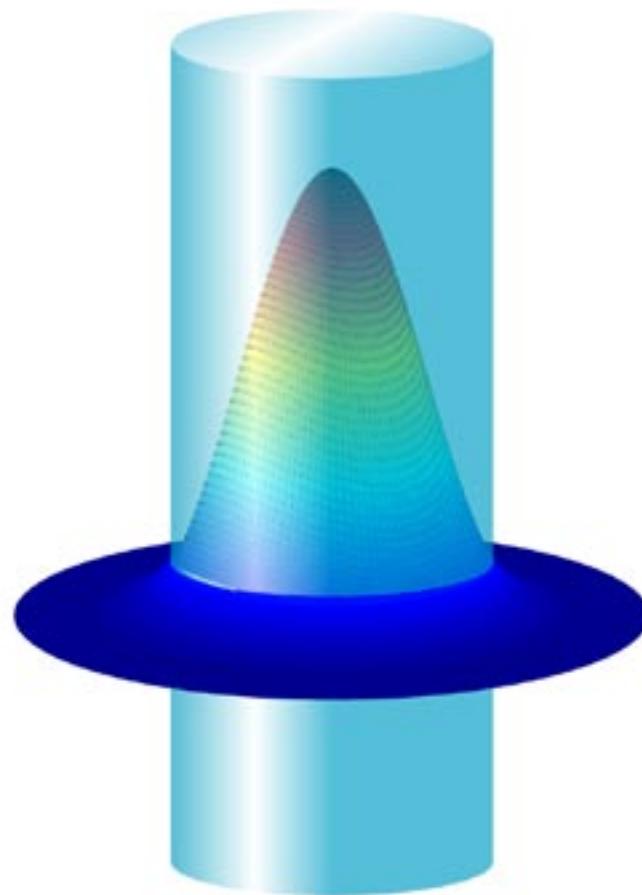
Optical properties

Poynting vector profile for 600-nm nanowire



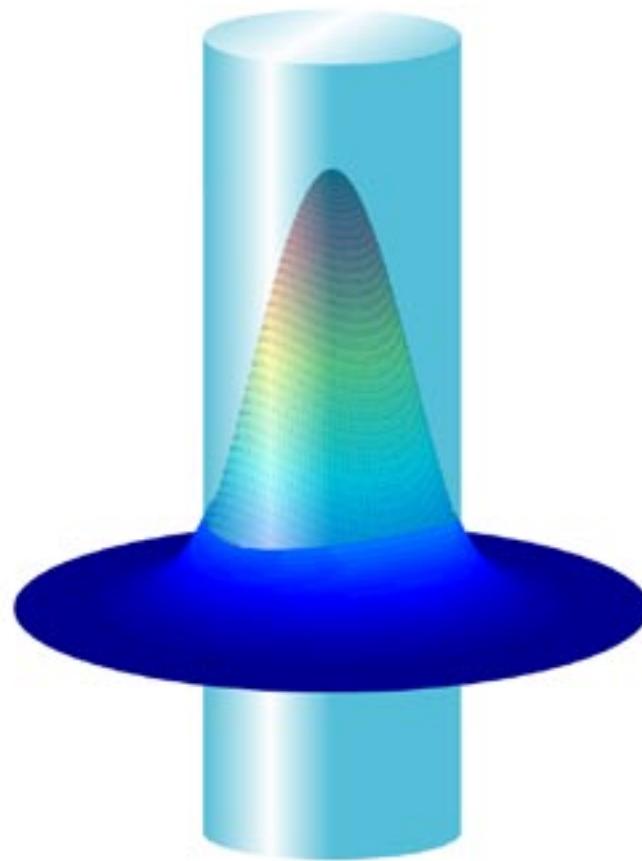
Optical properties

Poynting vector profile for 500-nm nanowire



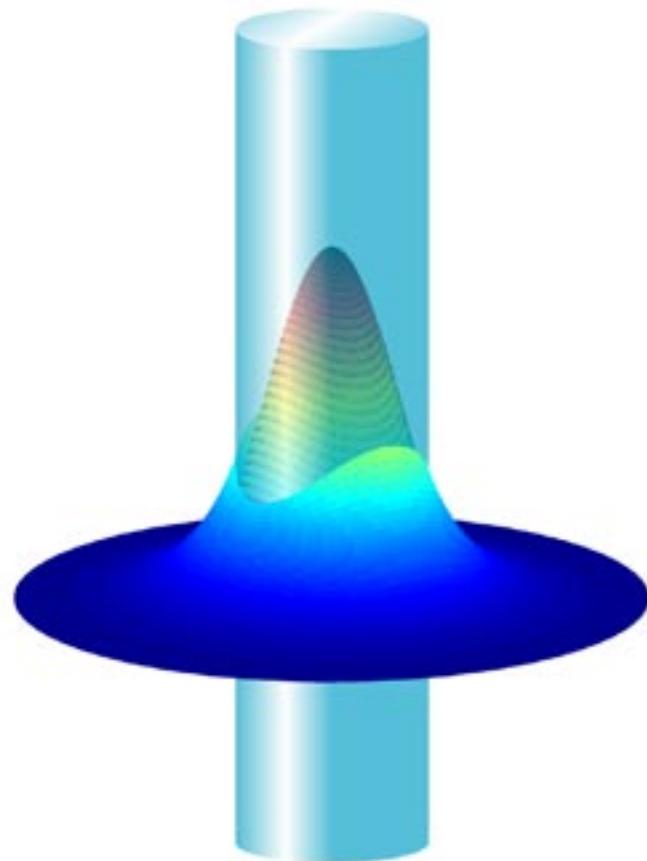
Optical properties

Poynting vector profile for 400-nm nanowire



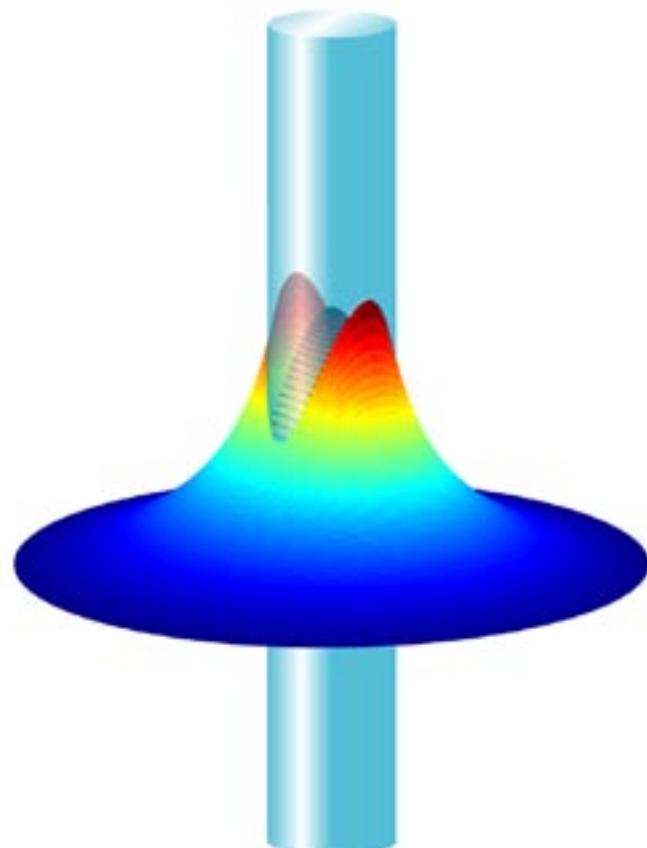
Optical properties

Poynting vector profile for 300-nm nanowire



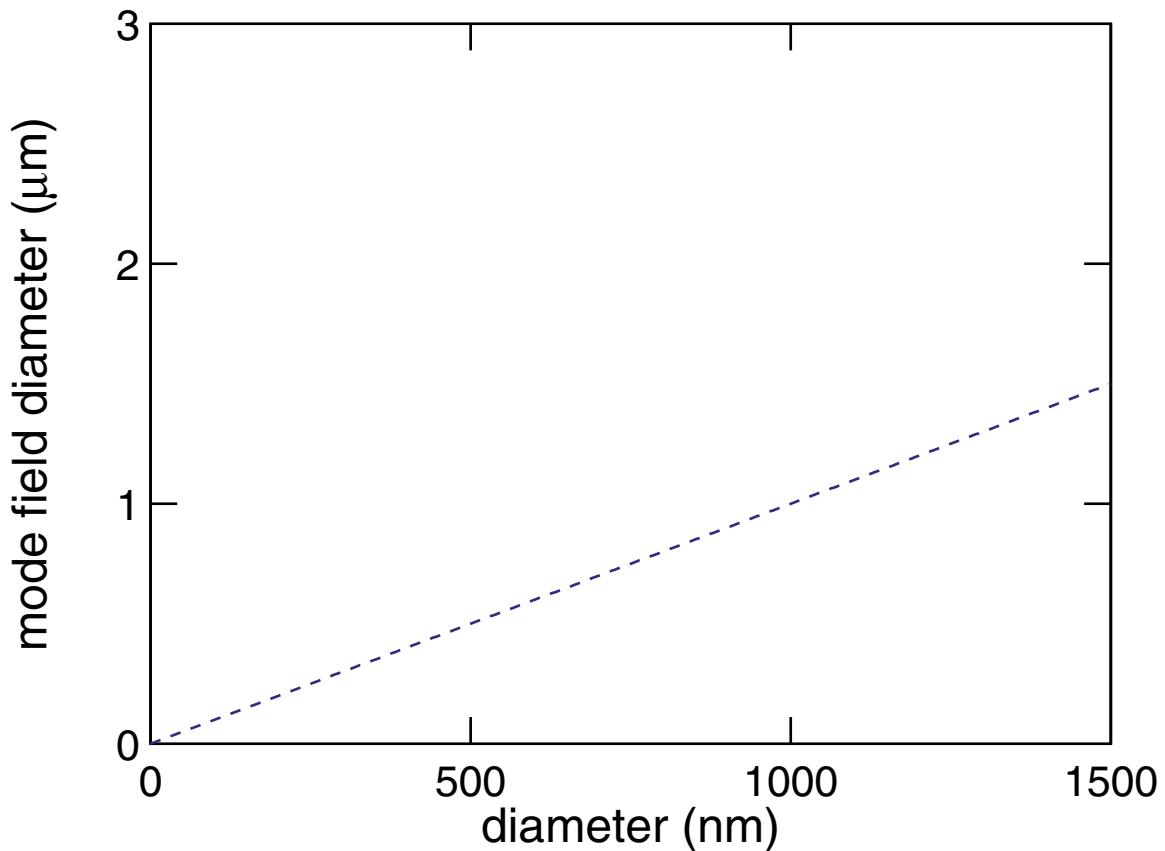
Optical properties

Poynting vector profile for 200-nm nanowire



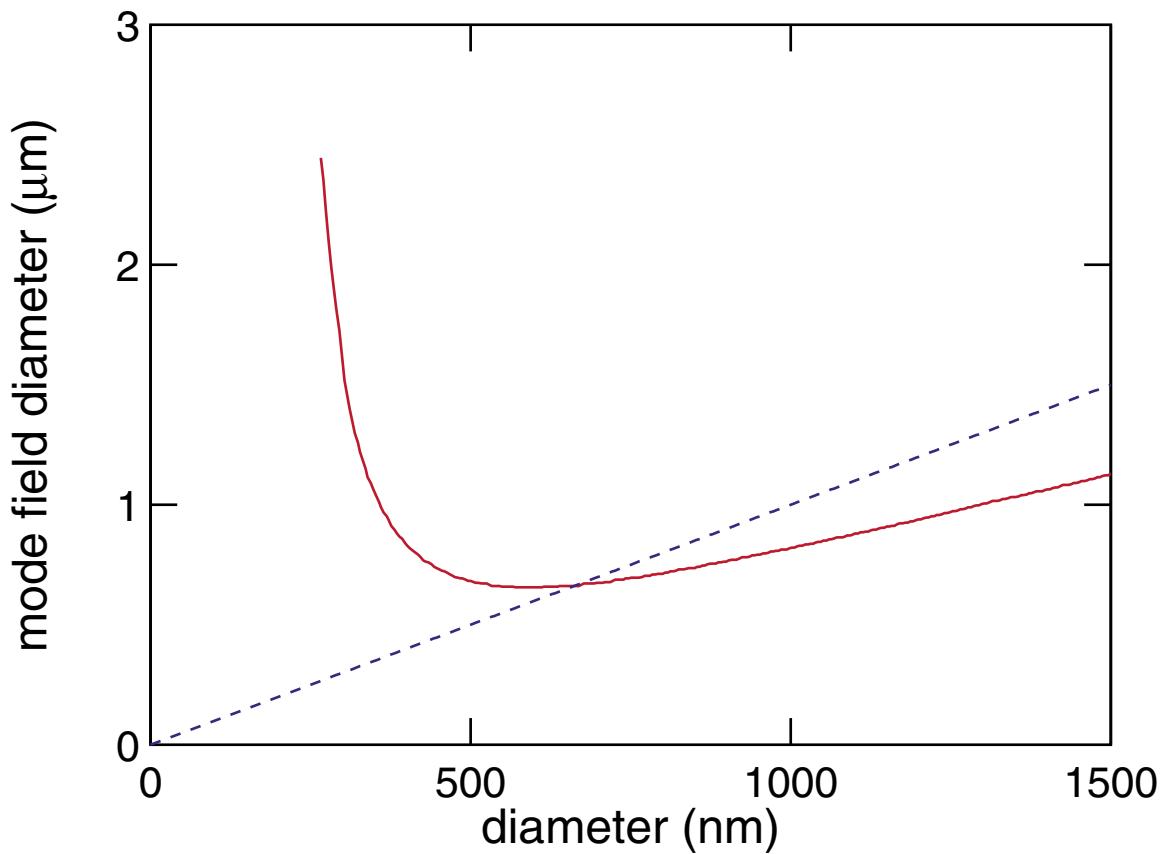
Optical properties

mode field diameter ($\lambda = 800 \text{ nm}$)



Optical properties

mode field diameter ($\lambda = 800 \text{ nm}$)



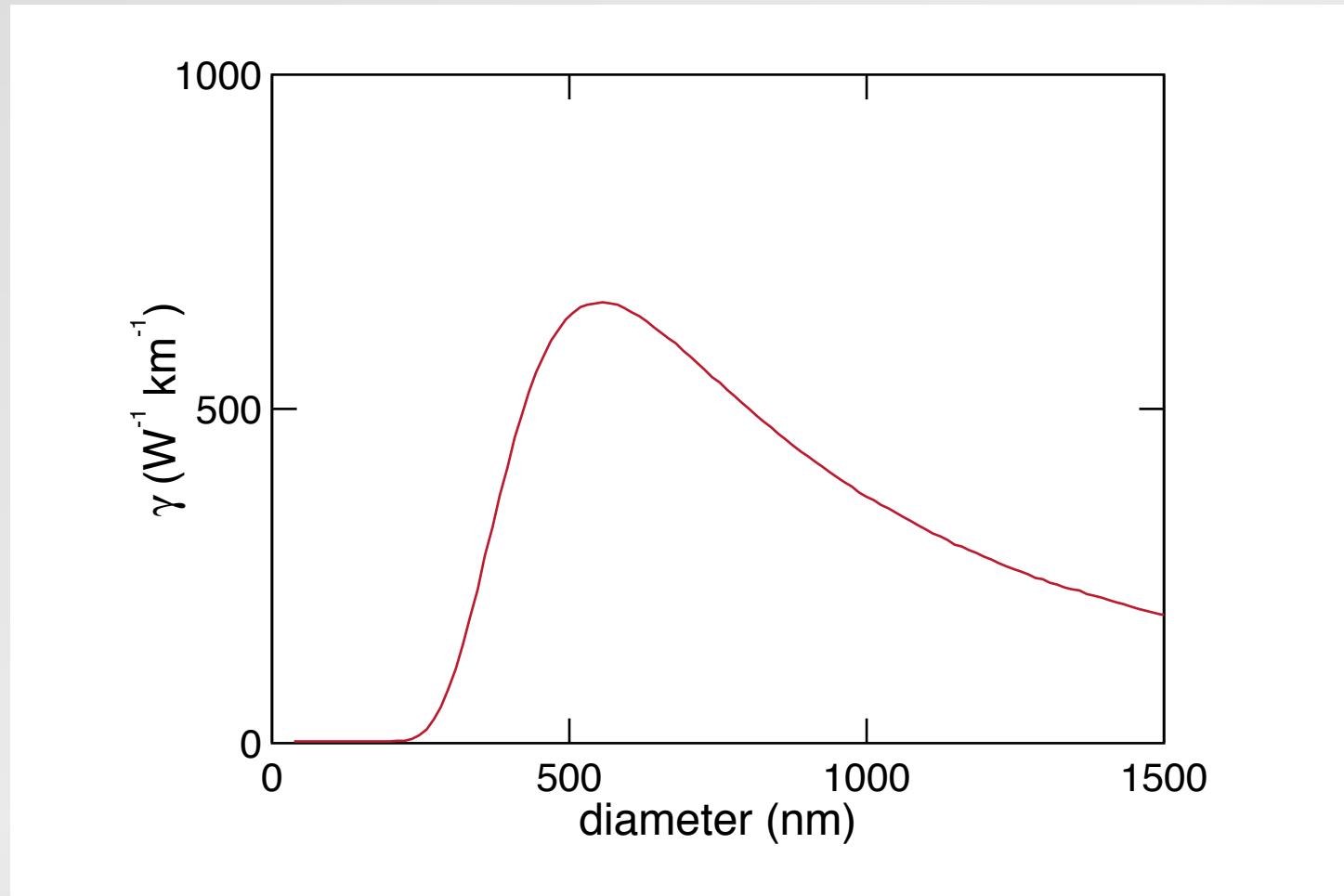
Optical properties

quantifying nonlinearity

$$\gamma = \frac{2\pi}{\lambda} \frac{\int n_2(r) S_z^2(r) d^2(r)}{\left(\int S_z(r) d^2(r) \right)^2}$$

Optical properties

nonlinear parameter



Optical properties

dispersion:

- modal dispersion
- material dispersion
- waveguide dispersion
- nonlinear dispersion

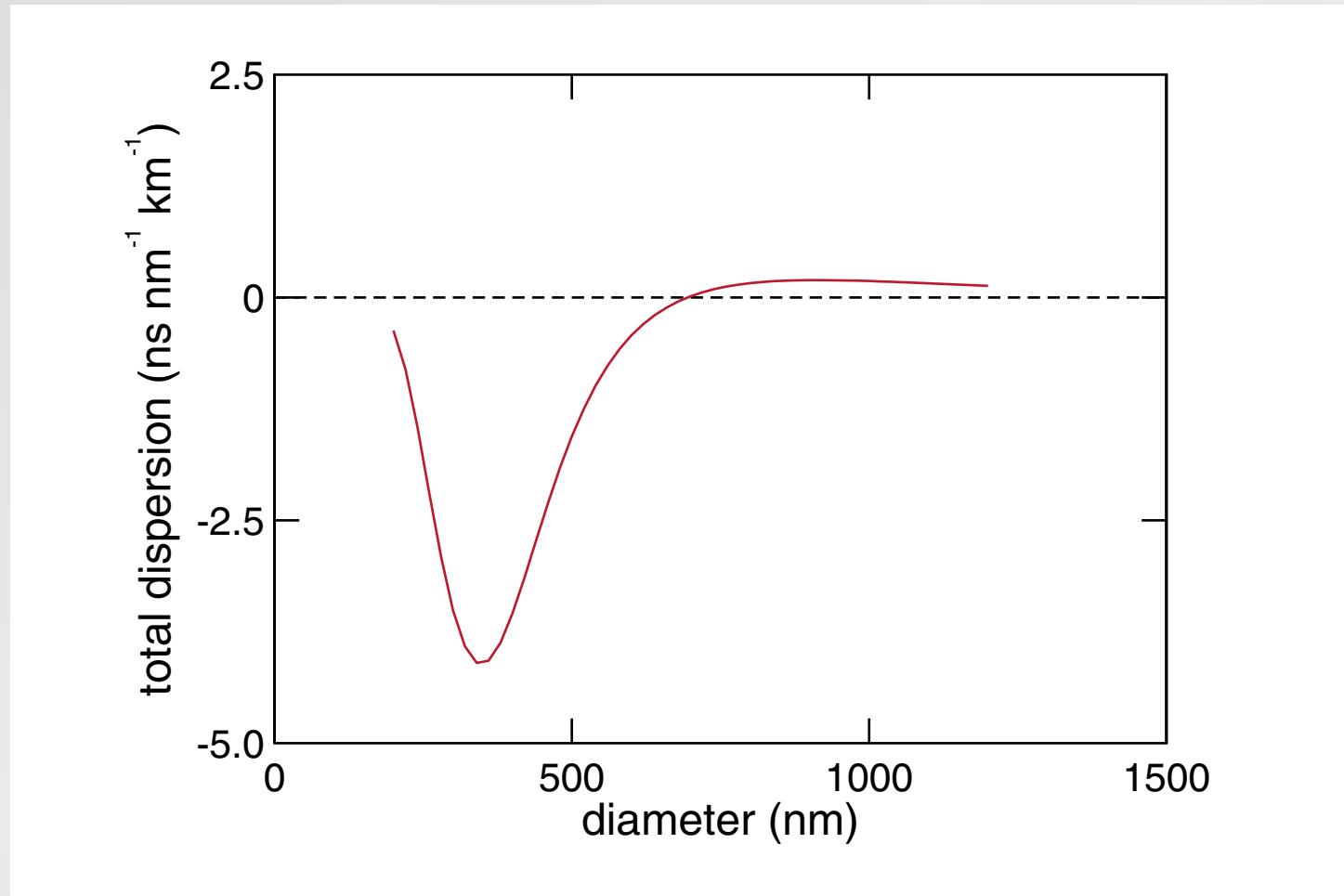
Optical properties

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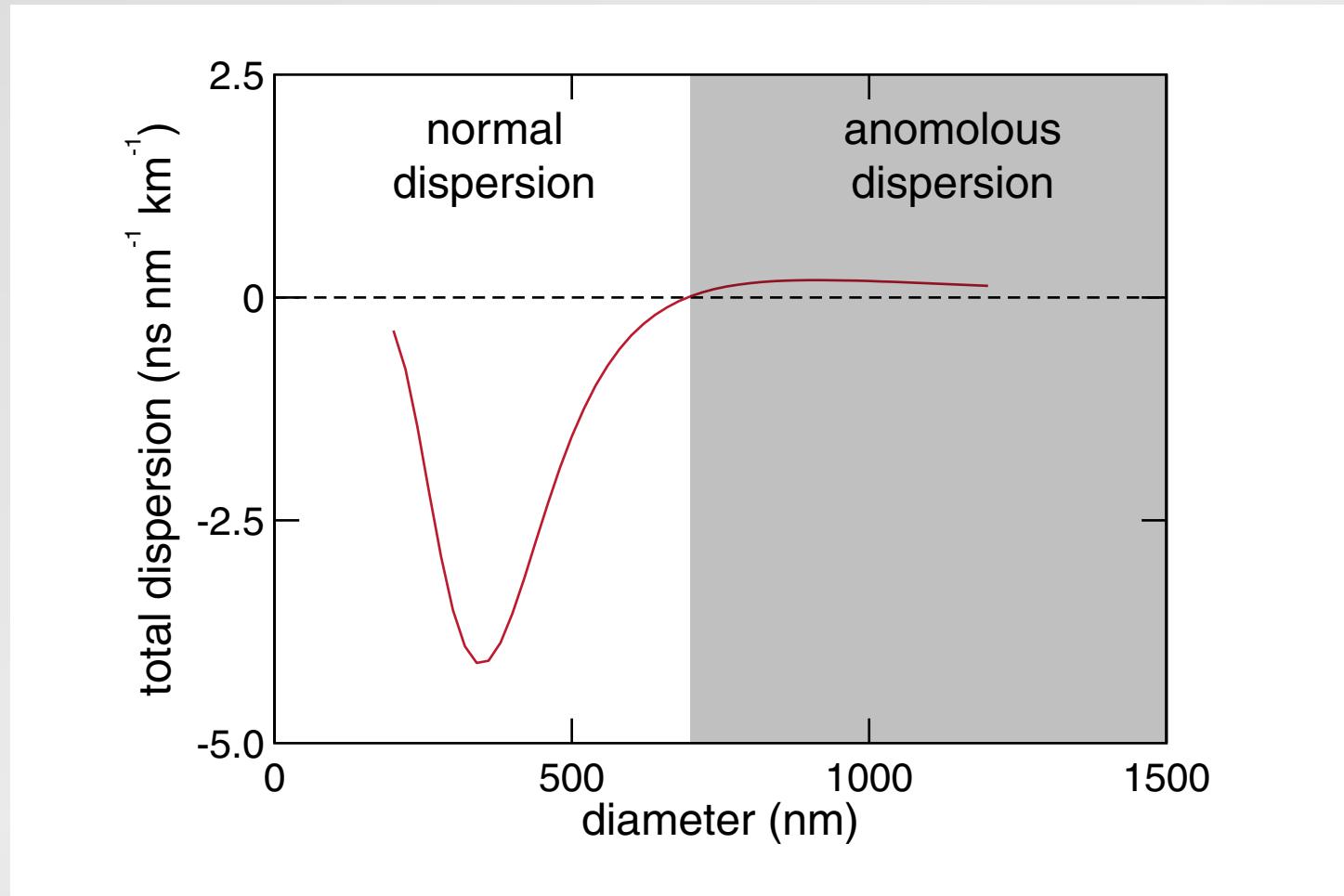
Optical properties

material + waveguide dispersion ($\lambda = 800 \text{ nm}$)



Optical properties

material + waveguide dispersion ($\lambda = 800 \text{ nm}$)



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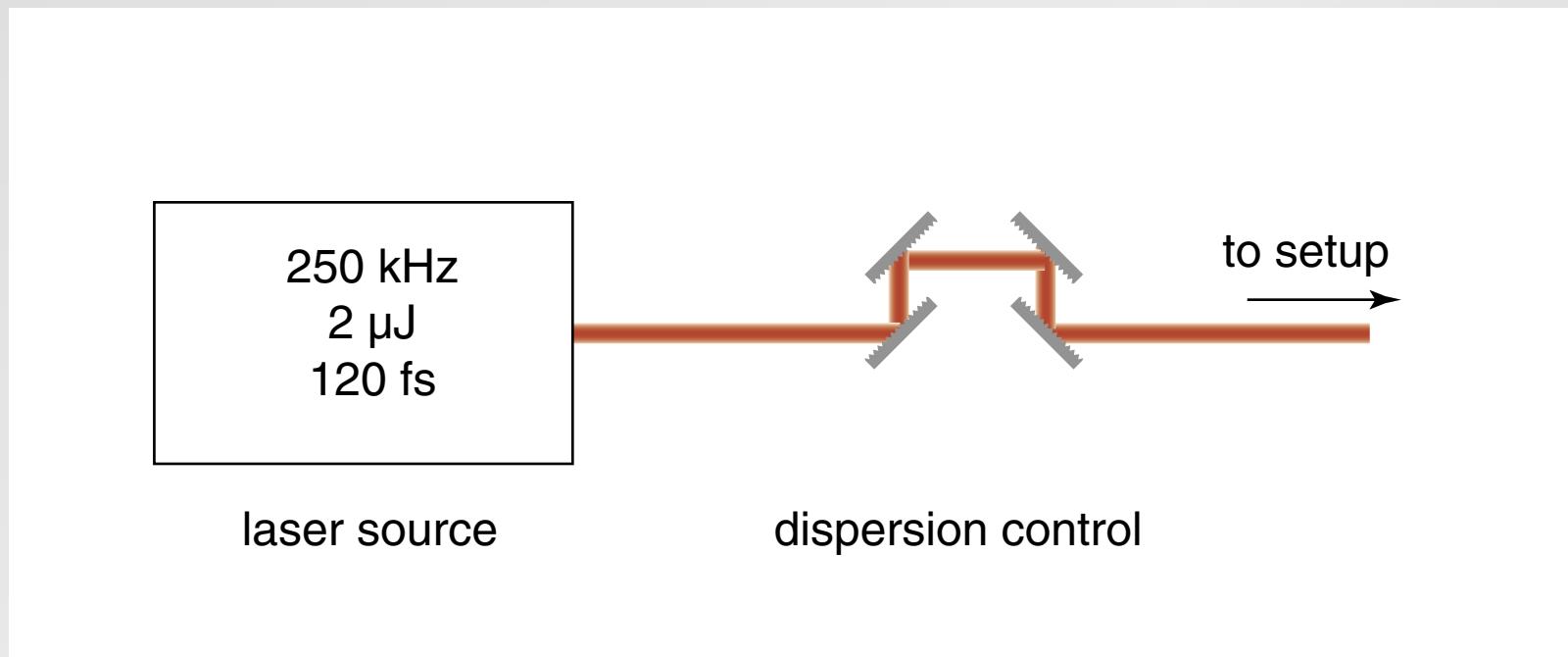
- nanowire
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- supercontinuum spectra

Supercontinuum

- mode field confinement
- large nonlinearity
- dispersion compensation

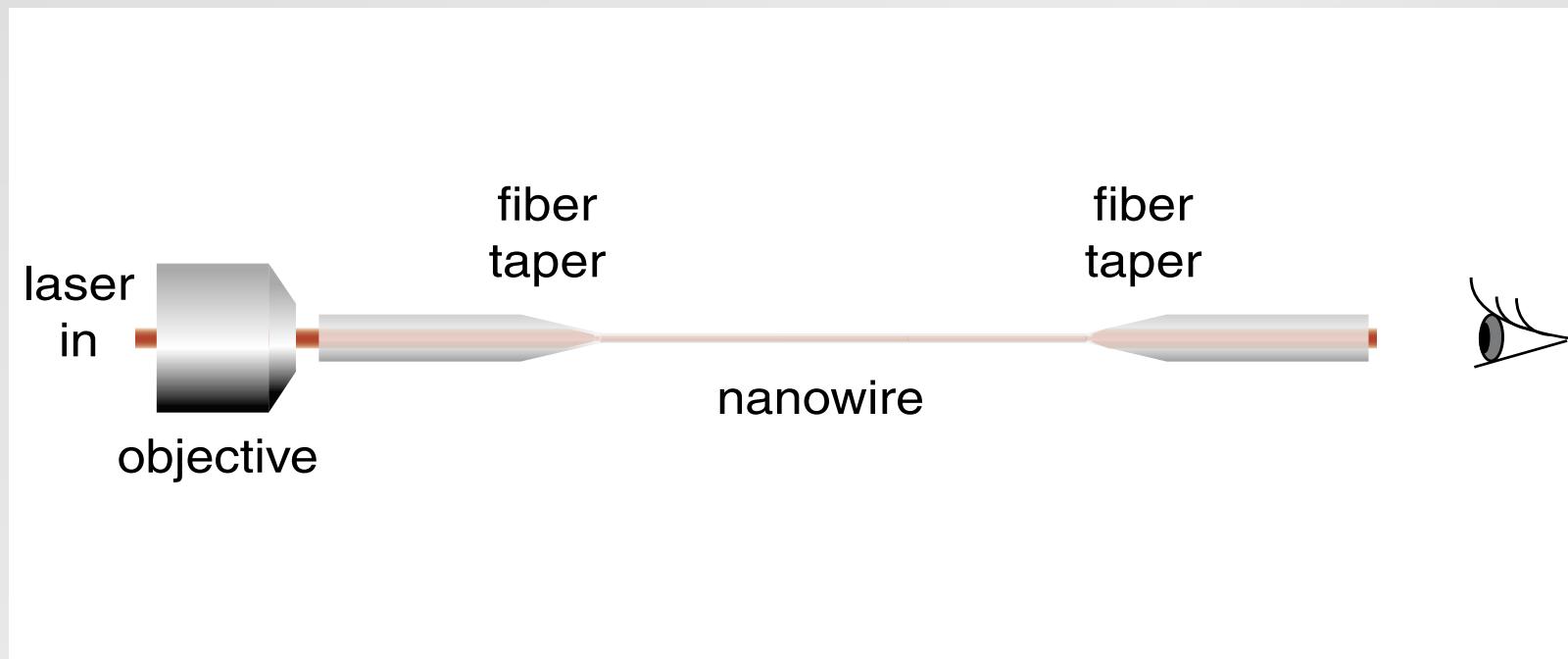
Supercontinuum

coupling light into nanowires



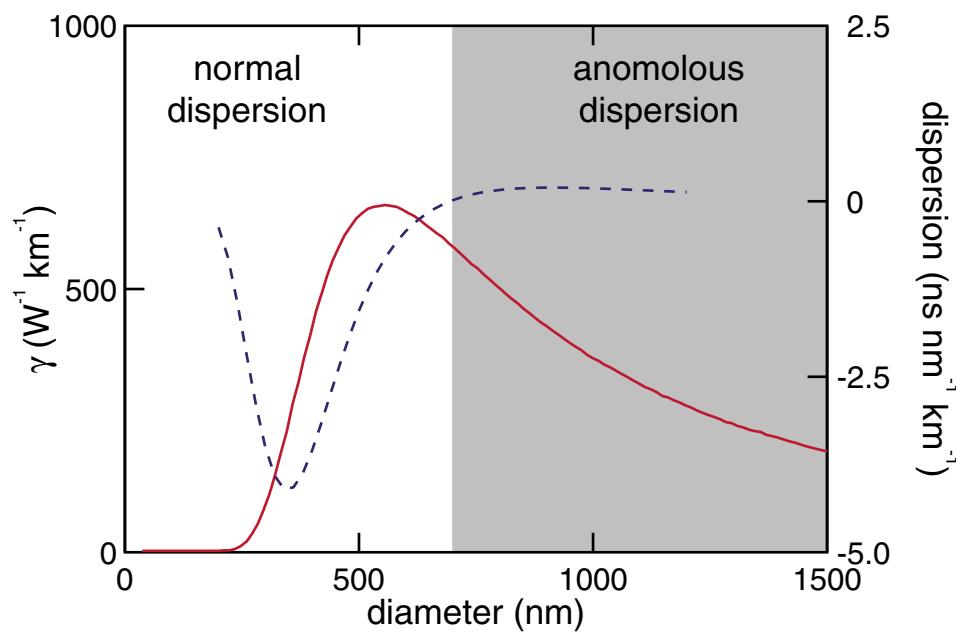
Supercontinuum

coupling light into nanowires



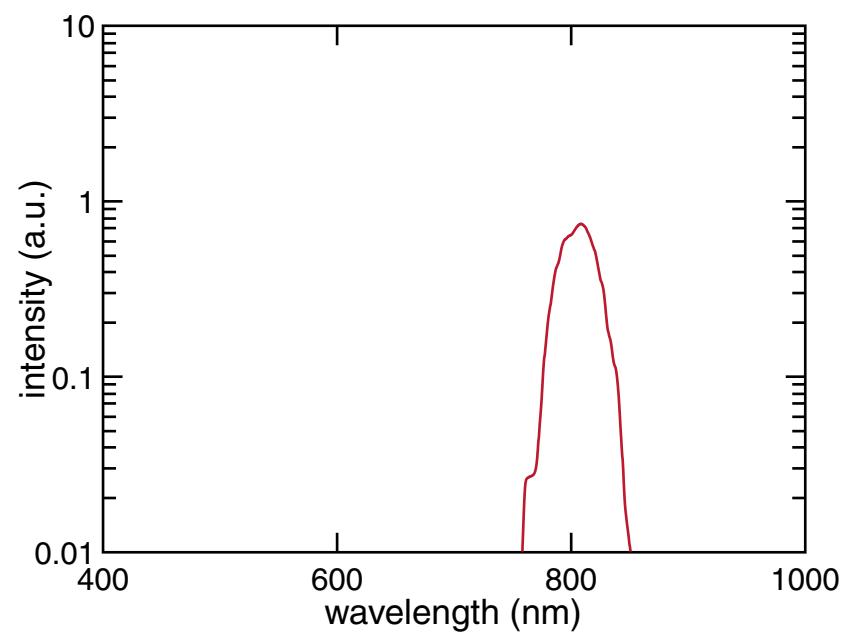
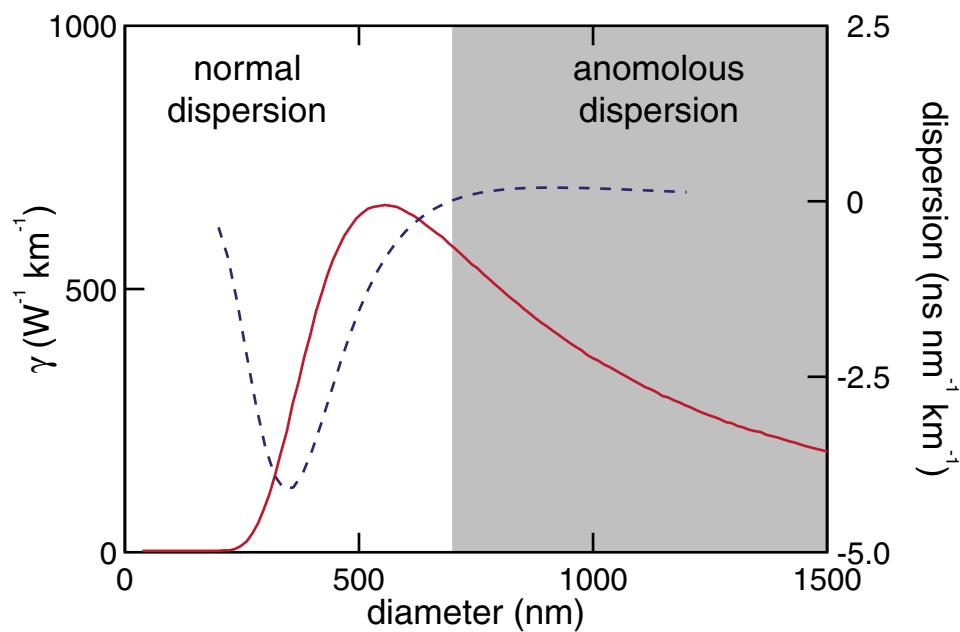
Supercontinuum

nanowire supercontinuum generation



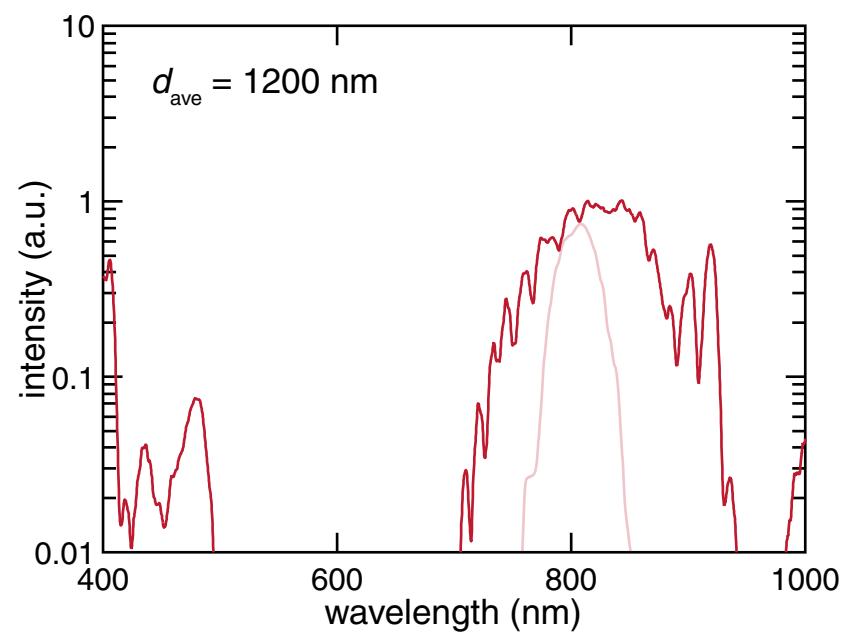
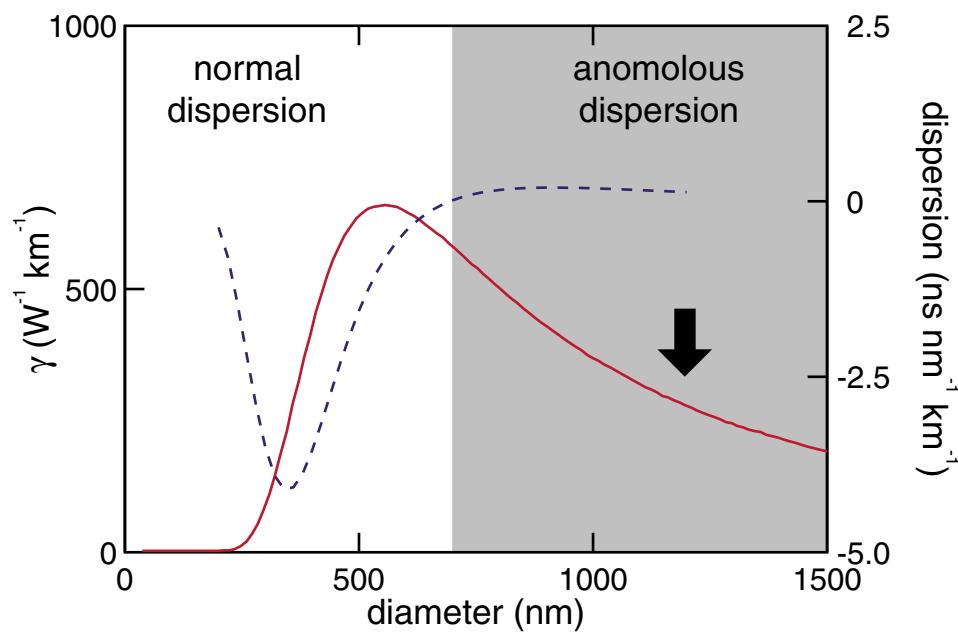
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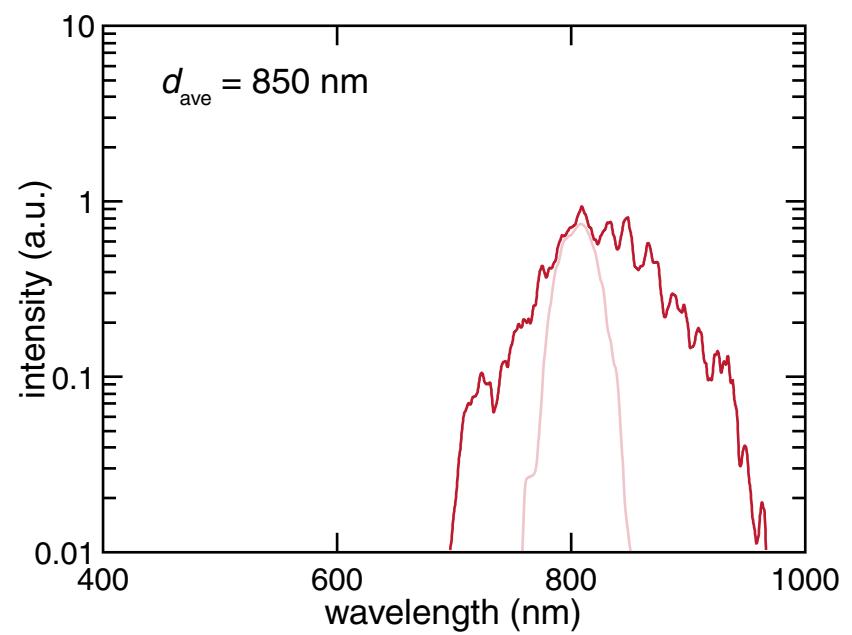
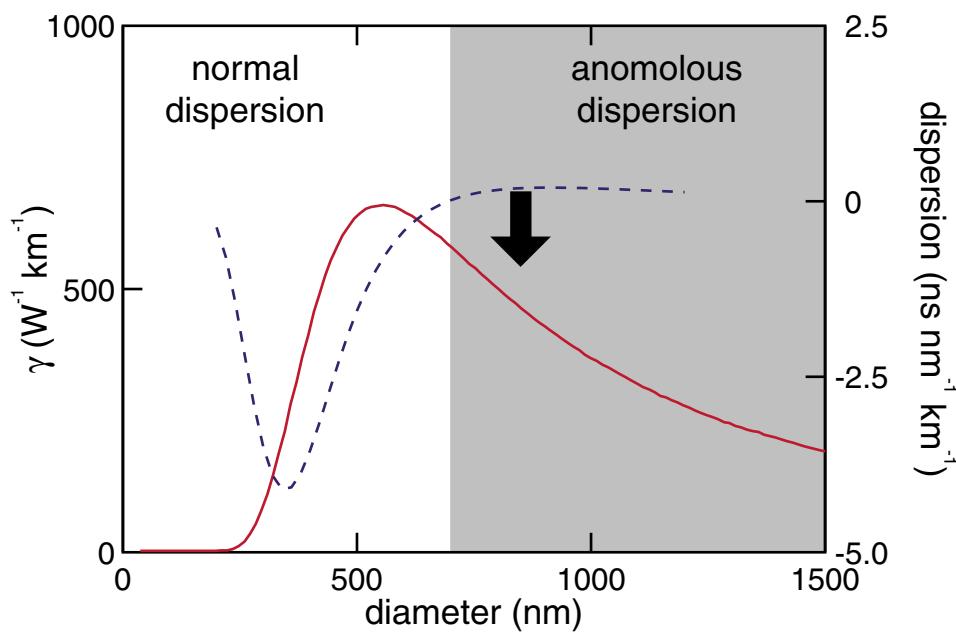
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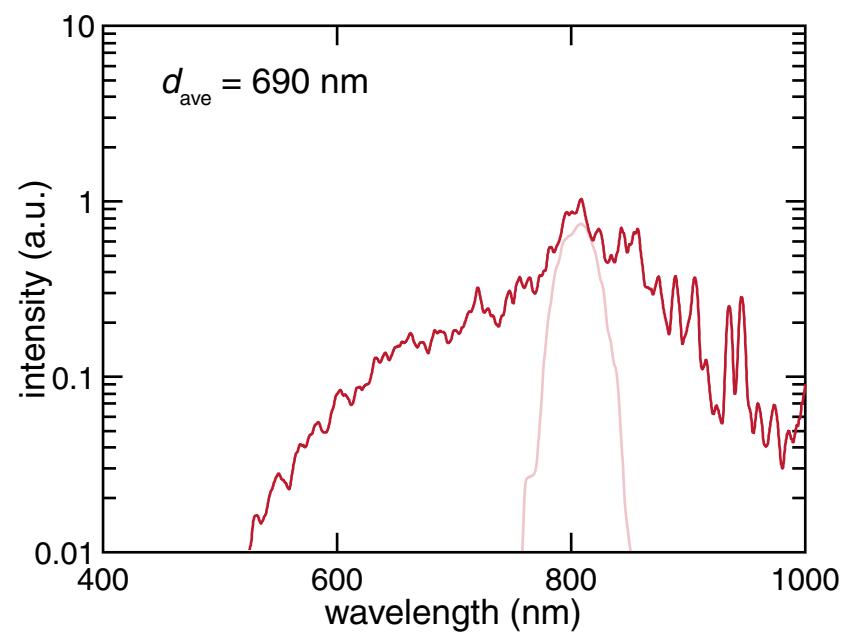
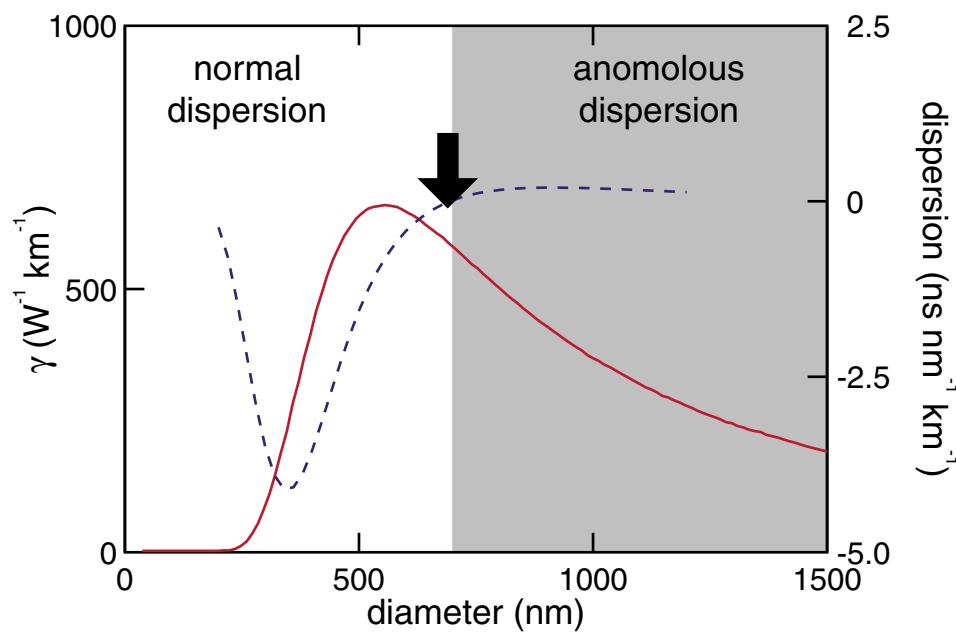
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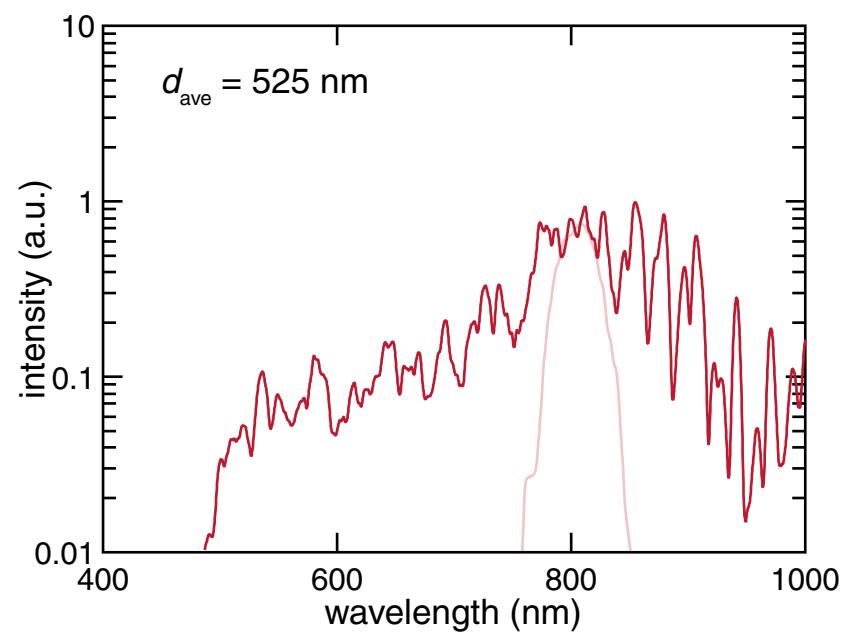
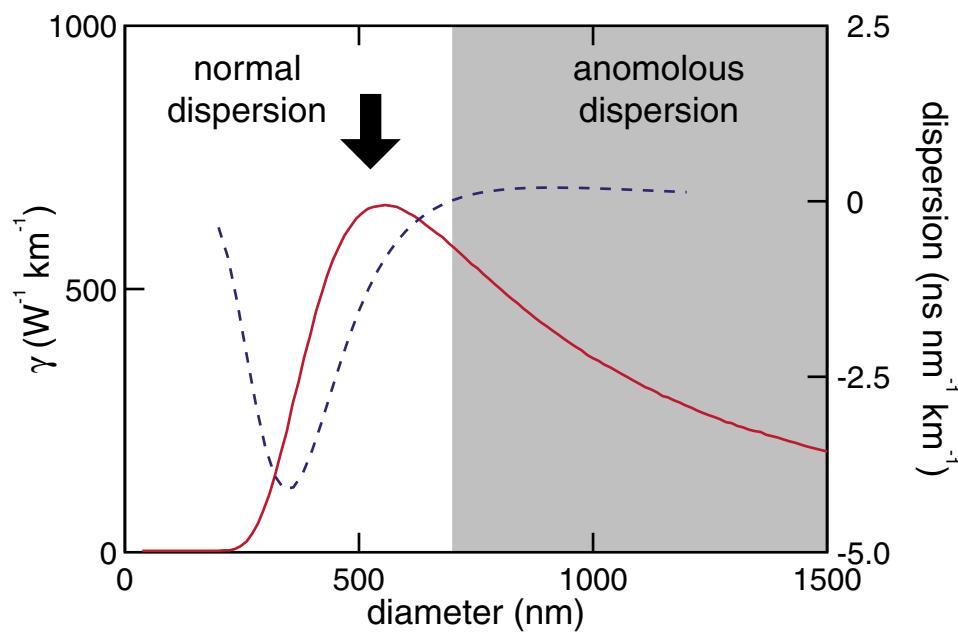
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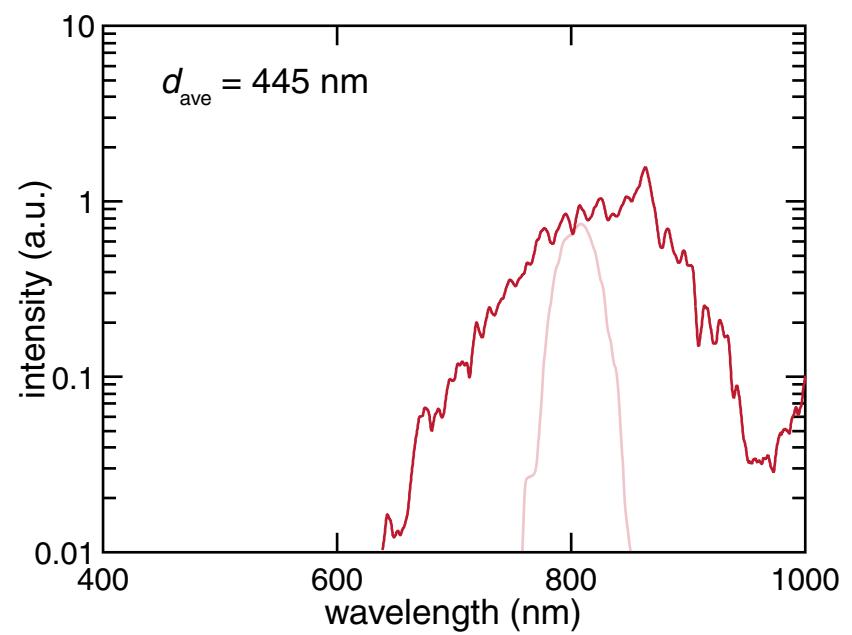
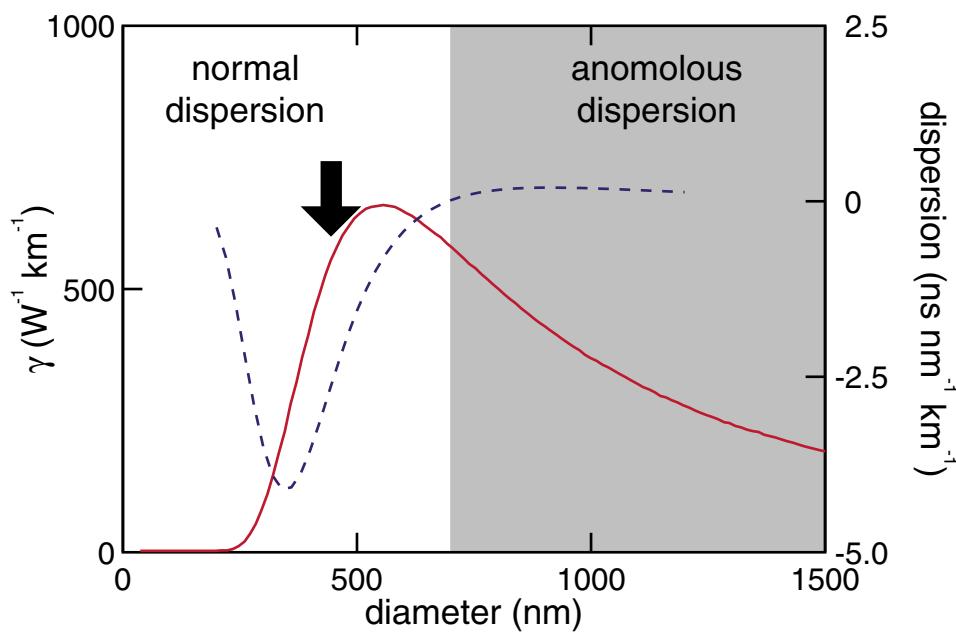
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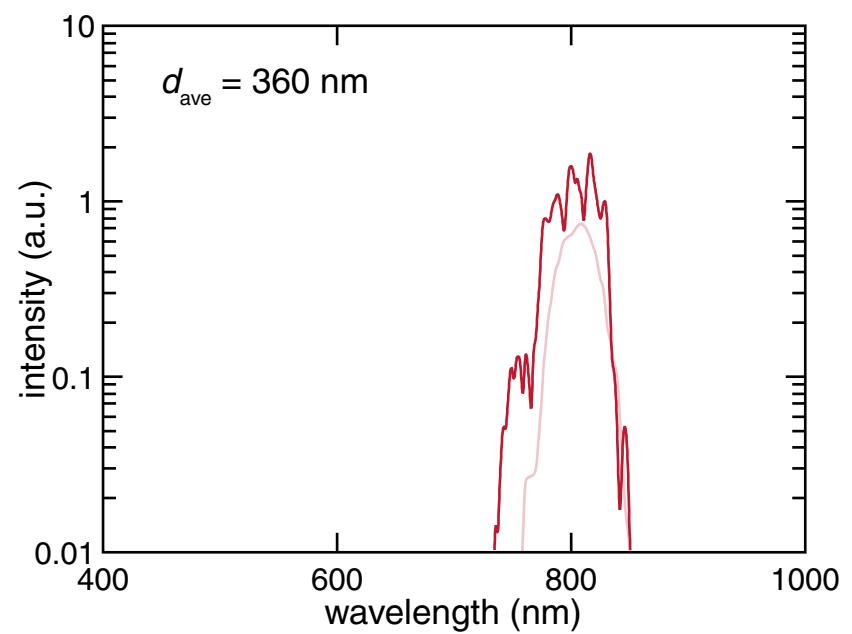
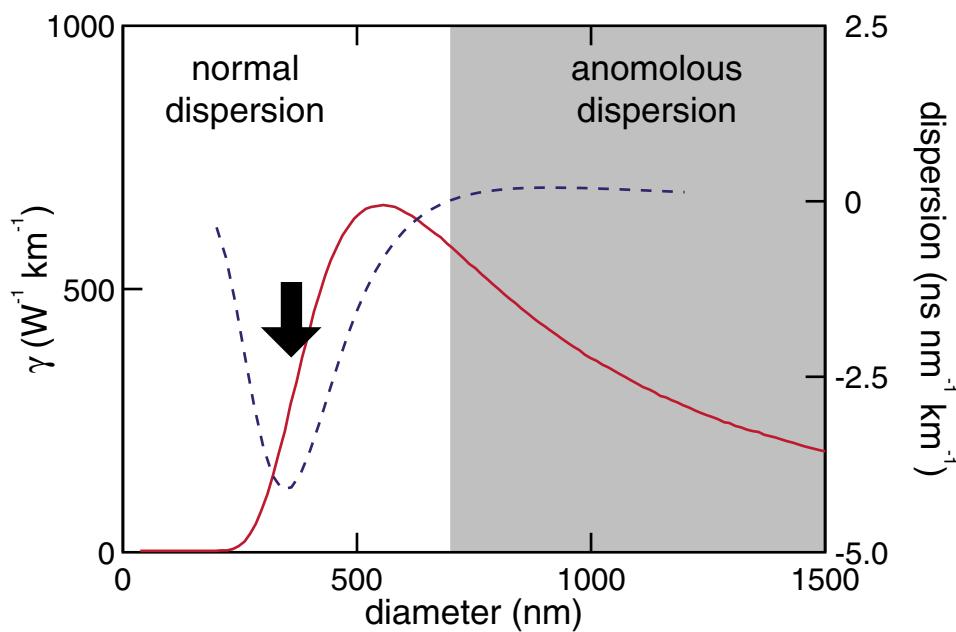
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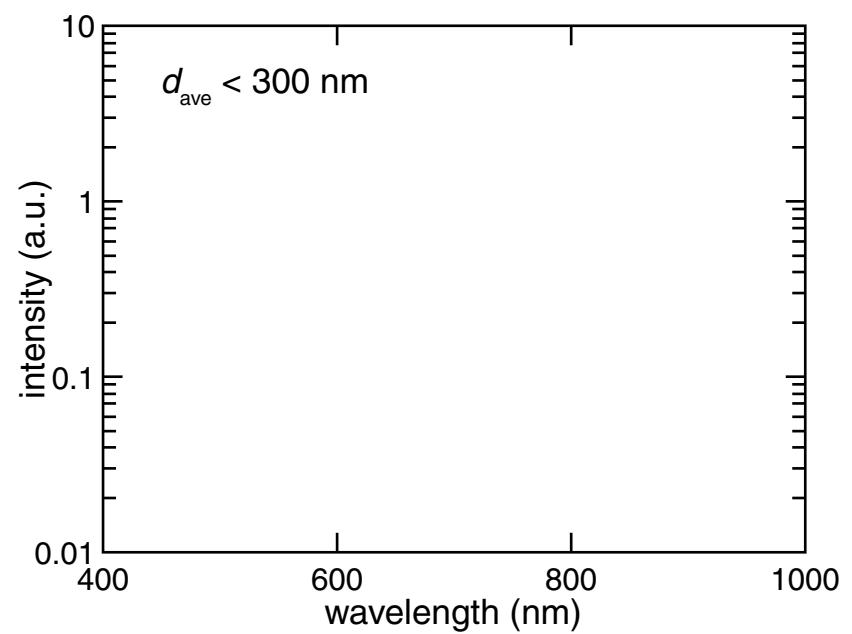
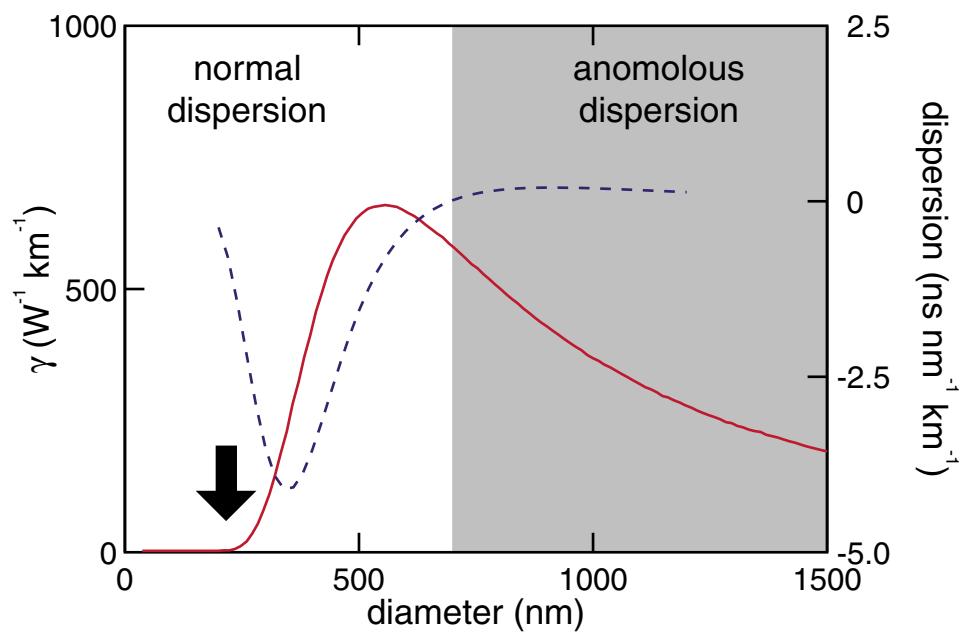
Supercontinuum

nanowire supercontinuum generation



Supercontinuum

nanowire supercontinuum generation



Summary

- diameter controlled nonlinearity
- wavelength source for sub-micrometer photonics
- linear silica nanophotonic circuits





Funding:

Harvard Center for Imaging and Mesoscopic Structures

National Science Foundation

National Natural Science Foundation of China

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