WE ARE ON

OSA Photonic Metamaterials Technical Group

Metaphotonics and Metasurfaces Empowered by Mie Resonances

Yuri Kivshar, Australian National University

Technical Group Leadership 2020

Chair

Wei Ting Chen
Harvard Univ.

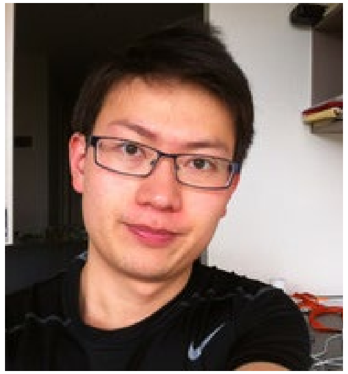
Webinar Officer

Aaron Joseph Pung
Sandia National Laboratories

Webinar Officer

Maxim Shcherbakov
Cornell Univ.

Event Officer



Haoran Ren
LMU Munich

Event Officer

Md Saad-Bin-Alam
University of Ottawa

Photonic
Metamaterials
Technical Group

Technical Group at a Glance

- Total Members: 1,516 members
  - A part of benefits of OSA membership

- Mission and Focus
  - Serve the community by sharing latest information and providing a pathway for young professionals to greater involvement with mentors and peers

- OSA Incubator meeting "Flat Optics: Recent Advances and Future Opportunities"

Follow-up meeting in 2021 Optical Design and Fabrication Congress (open for submission)

#OSAMetamaterialsTG

Join Our Online Community

Tweet #OSAMetamaterialsTG

#OSAMetamaterialsTG

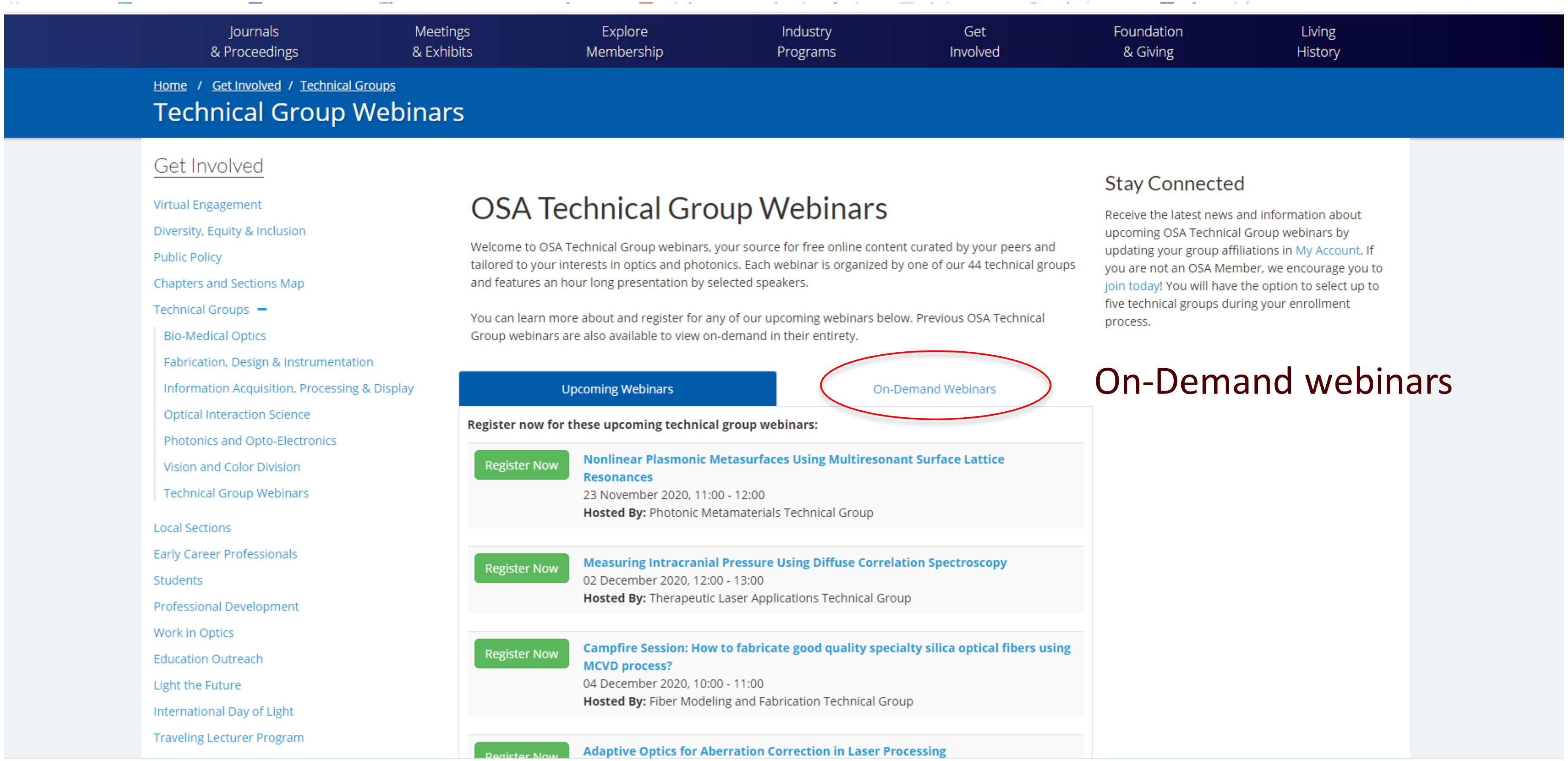
Curated Tweets by @hvwalter

Featured tweets from the OSA Photonic Metamaterials Technical Group

Next chair: Dr. Dimitrios C. Tzarouchis

Past webinar recordings

- https://www.osa.org/TGwebinars



On-Demand webinars

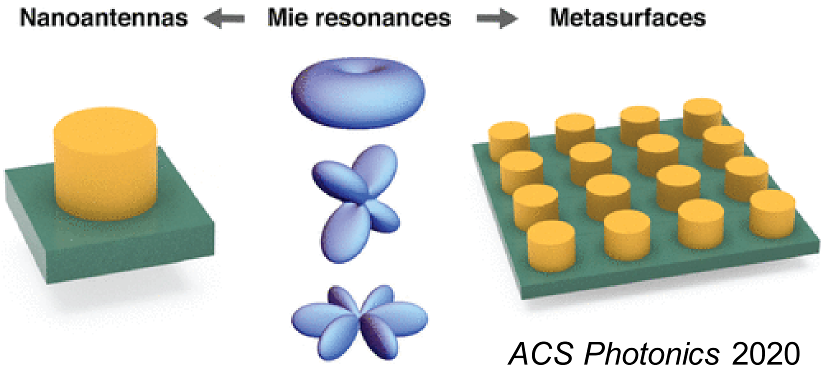
Photonic
Metamaterials
Technical Group

Photonic Metamaterials Technical Group

Webinar Series

Metaphotonics and Metasurfaces Empowered by Mie Resonances

Tuesday, December 15th, 6:00 pm EST



ACS Photonics 2020

Speaker: Prof. Yuri Kivshar

Head, Nonlinear Physics Center, Research School of Physics and Engineering, Australian National University

Metamaterials and metasurfaces empowered by Mie resonances

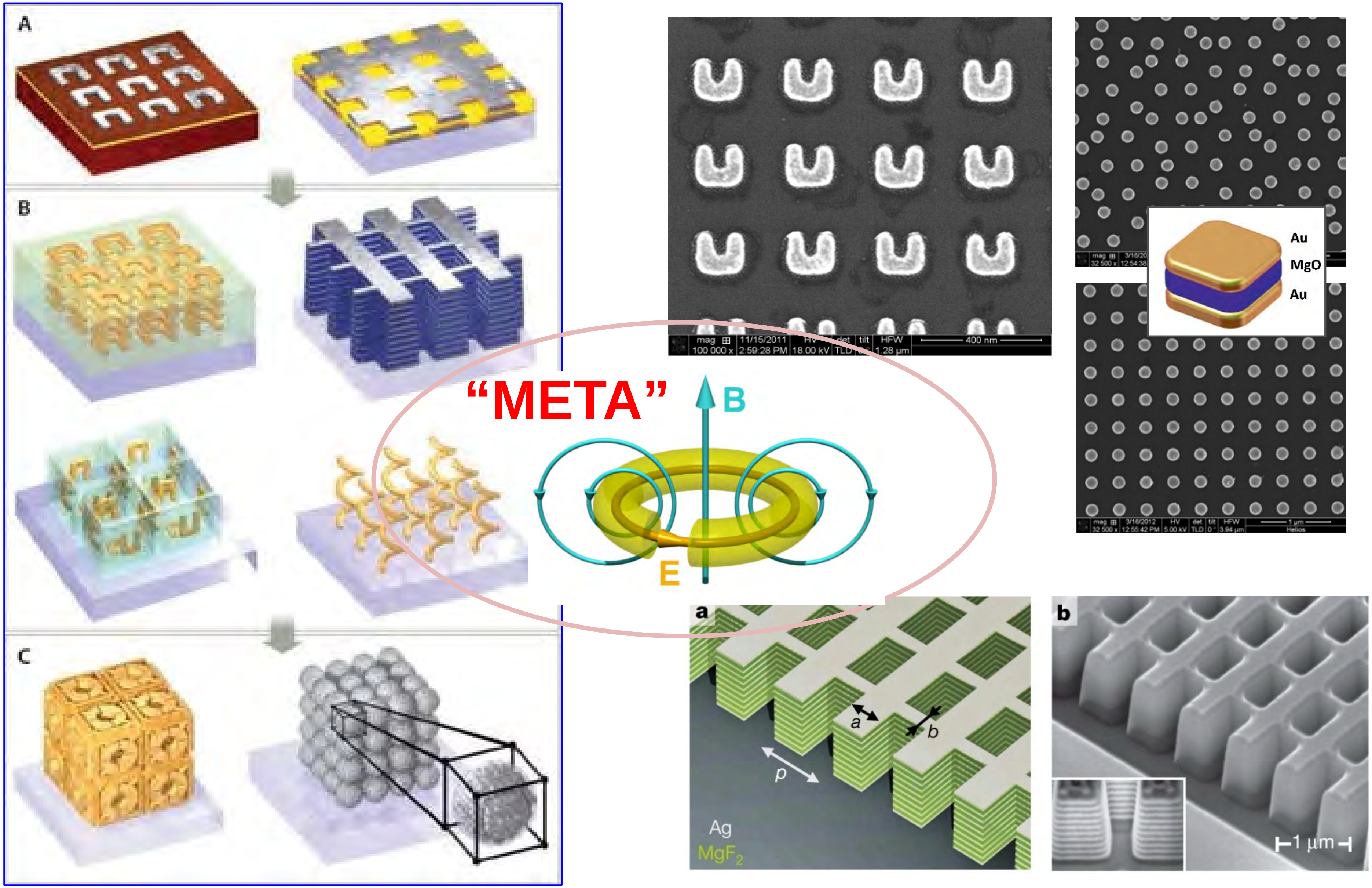
Yuri Kivshar

Australian National University

NATURAM PRIMUM COGNOSCERE RERUM

ITMO UNIVERSITY

“Meta” : Electric and magnetic resonances



Mie-resonant metaphotonics

meeting report

NATURE PHOTONICS | VOL 13 | SEPTEMBER 2019 | 585-587 |

Into the 'Mie-tronic' era

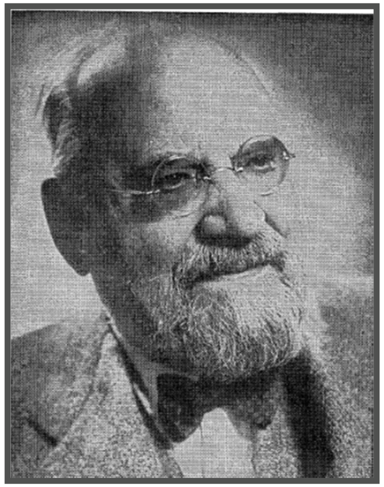
Dielectric antennas and metasurfaces open up new opportunities for future applications in advanced optoelectronics, light detection and ranging for autonomous vehicles, fluorescence-enhancing substrates for bioimaging and many more.

See K. Koshelev and Y. Kivshar, Dielectric resonant metaphotonics ACS Photonics 2020, https://doi.org/10.1021/acsphotonics.0c01315

Australian National University

ITMO UNIVERSITY

1908: Mie theory



$$x = \frac{2\pi r}{\lambda}$$

Gustav Mie (1868-1957)

- x << 1 : Rayleigh scattering
- x ~ 1 : Mie scattering
- x >>1 : Geometric scattering

1908. №

ANNALEN DER PHYSIK.

VIERTE FOLGE. BAND 25.

1. *Beiträge zur Optik trüber Medien, speziell kolloidaler Metallösungen; von Gustav Mie.*

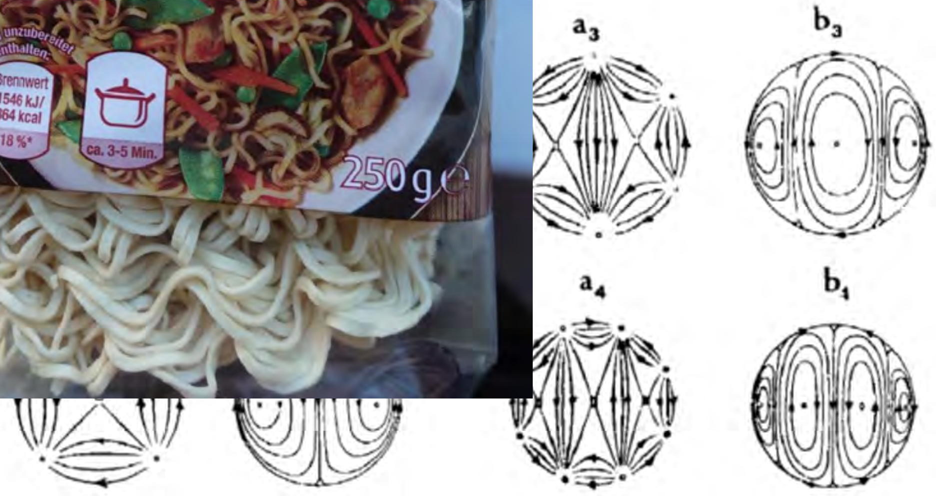
∞

$$\ldots_{1n} - i b_n^r \mathbf{n}_{e1n}^{(3)}),$$

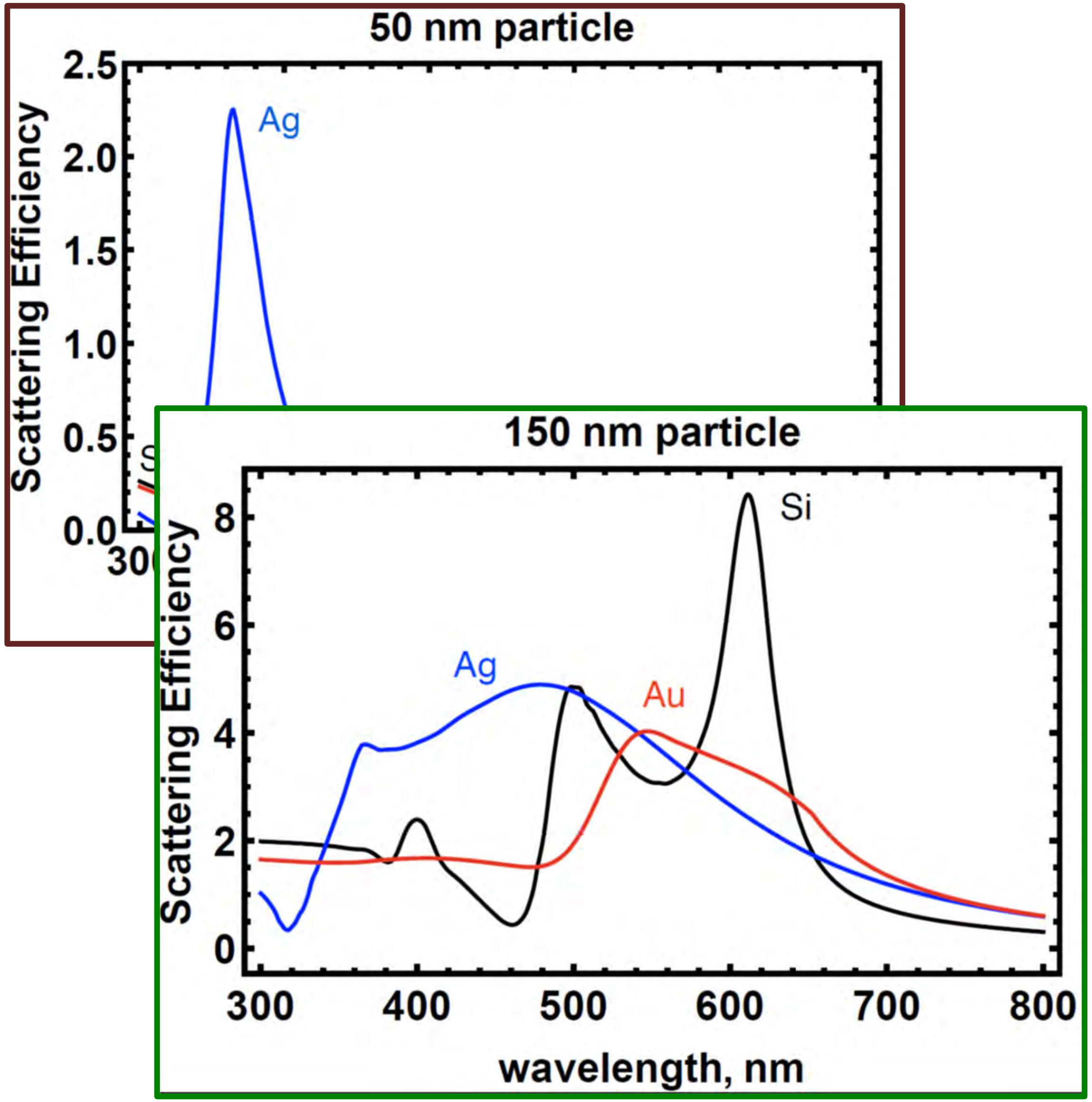
$$\ldots (b_n^r \mathbf{m}_{e1n}^{(3)} + i a_n^r \mathbf{n}_{o1n}^{(3)}),$$

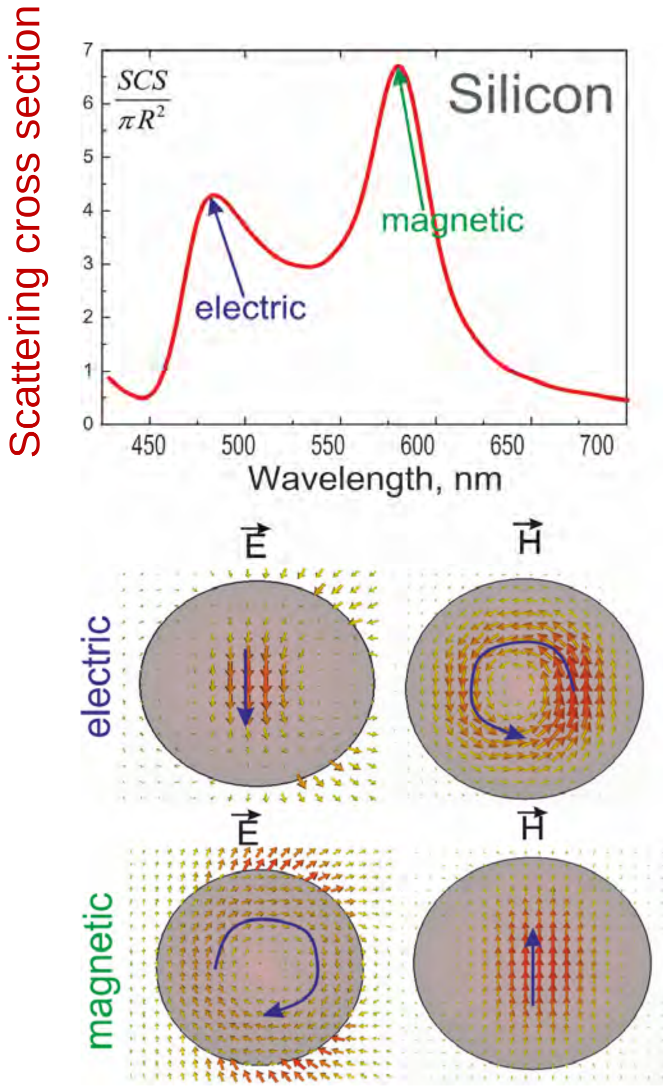
$$\frac{\ldots \mu_2 j_n(\rho)\,[N\rho j_n(N\rho)]'}{\ldots h_n^{(1)}(\rho)\,[N\rho j_n(N\rho)]'}$$

$$\frac{\ldots \mu_2 N^2 j_n(N\rho)\,[\rho j_n(\rho)]'}{\ldots \mu_2 N^2 j_n(N\rho)\,[\rho h_n^{(1)}(\rho)]'}$$

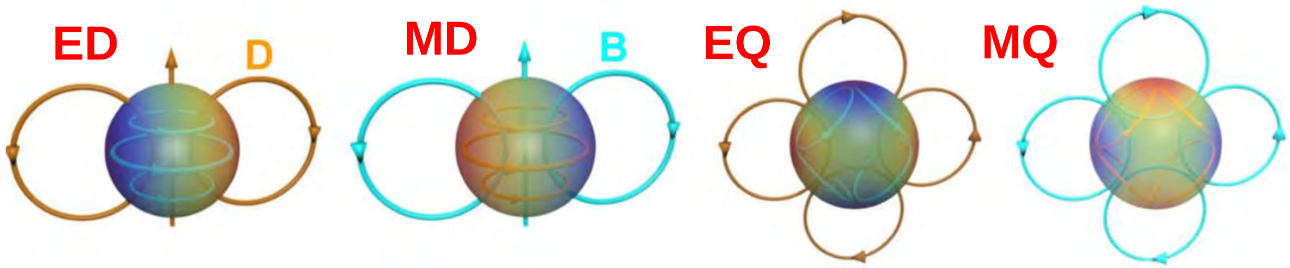


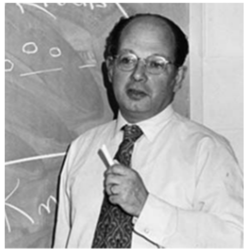
Electromagnetic response of a Mie sphere





Interferences and Kerker effects

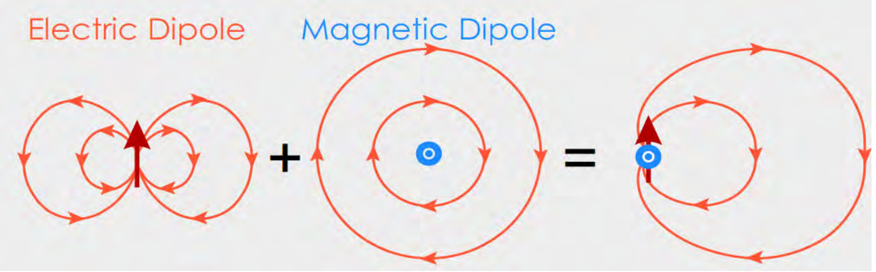




M. Kerker

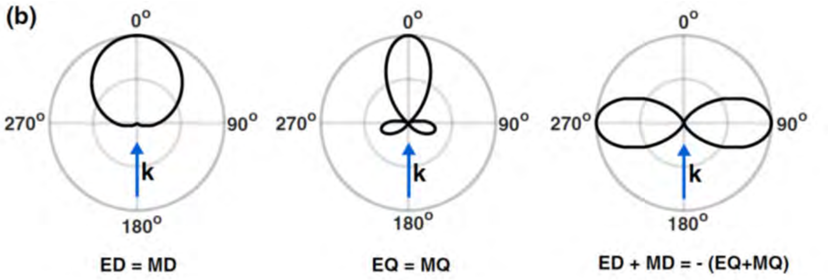
- **Multipolar interferences and control of emitted radiation**
- **Enhancement of many effects near MD resonances**
- **High-Q resonances: bound states in the continuum**

Kerker effect



A recent review: Opt. Exp. **26**, 13085 (2018)

Transverse Kerker effect



Phys. Rev. Lett. **122**, 193905 (2019)

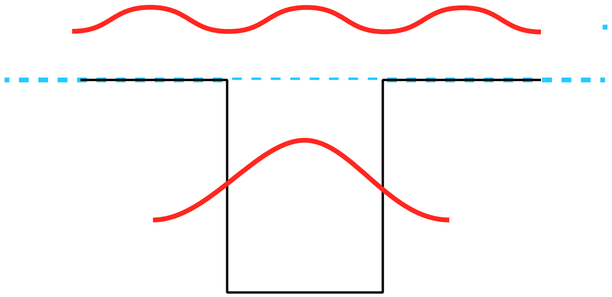
Bound state in the continuum (BIC)

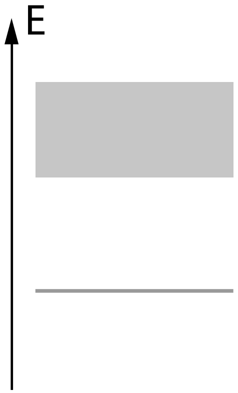
J. von Neumann E. Wigner

Über merkwürdige diskrete Eigenwerte

J. von Neumann and E. P. Wigner

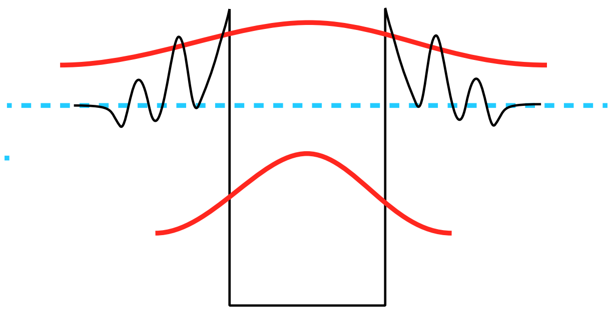
Physikalische Zeitschrift *30*, 465–467 (1929)

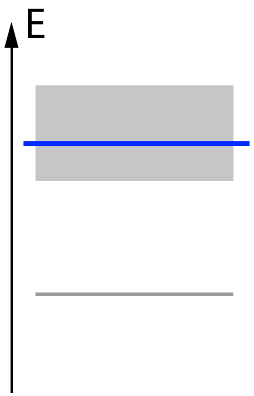




Continuum

Discrete level





Bound state in the continuum

Discrete level

First experimental efforts

1992

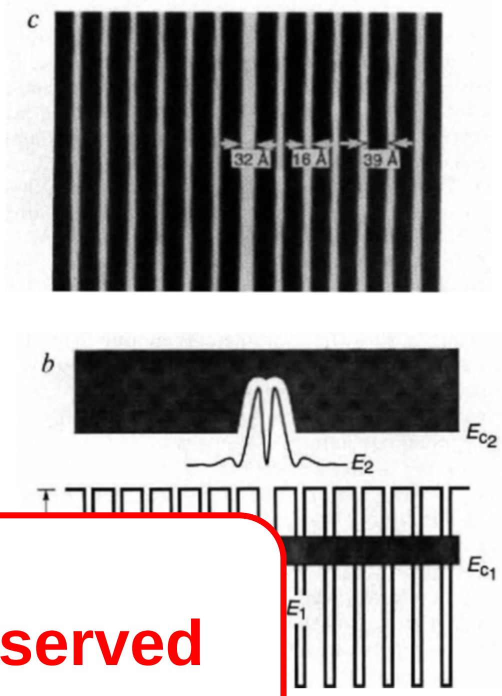
LETTERS TO NATURE

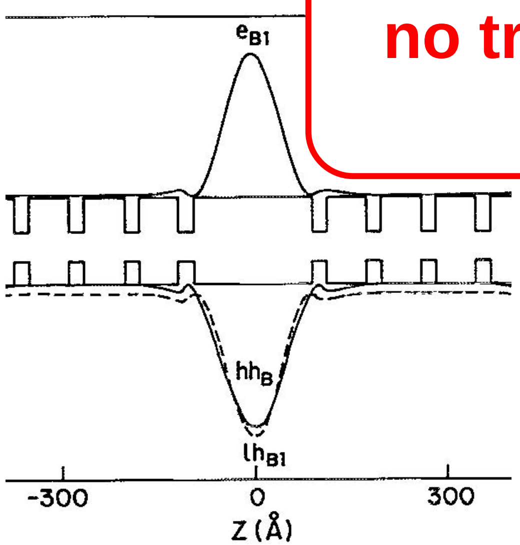
Observation of an electronic bound state above a potential well

Federico Capasso, Carlo Sirtori, Jerome Faist, Deborah L. Sivco, Sung-Nee G. Chu & Alfred Y. Cho

AT&T Bell Laboratories, Murray Hill, New Jersey 07974, USA

NATURE · VOL 35





no true BIC was observed

Experimental evidence of Bragg confinement of carriers in a quantum barrier

M. Zahler, I. Brener,[a] G. Lenz,[b] J. Salzman, E. Cohen, and L. Pfeiffer[c]

Solid State Institute, Physics Department and Electrical Engineering Department, Technion-Israel Institute of Technology, Haifa 32000, Israel

(Received 9 January 1992; accepted for publication 11 June 1992)

Appl. Phys. Lett. **61** (8), 24 August 1992

Many mathematical papers …

PHYSICAL REVIEW A VOLUME 11, NUMBER 2 FEBRUARY 1975

Bound states in the continuum

Frank H. Stillinger and David R. Herrick
Bell Laboratories, Murray Hill, New Jersey 07974
(Received 5 November 1974)

ANNALS OF PHYSICS: **22,** 123–132 (1963)

Bound States Embedded in the Continuum and the Formal Theory of Scattering

LUCIANO FONDA

J. Phys. A: Math. Gen. **29** (1996) L581–L584. Printed in the UK

LETTER TO THE EDITOR

A remark on von Neumann–Wigner type potentials

A A Stahlhofen
Max-Planck-Institut Metallforschung, Institut für Physik, Heisenbergstrasse 1, D-70569 Stuttgart, Germany
and
Max-Planck-Arbeitsgruppe 'Nichtklassische Strahlung', Rudower Chaussee 5, Gebäude 10.16, D-12484 Berlin, Germany

2008: the idea came to optics ….

PRL **100,** 183902 (2008) PHYSICAL REVIEW LETTERS week ending 9 MAY 2008

Bound States in the Continuum in Photonics

D. C. Marinica and A. G. Borisov*
Laboratoire des Collisions Atomiques et Moléculaires, UMR CNRS-Université Paris-Sud 8625, Bâtiment 351, Université Paris-Sud, 91405 Orsay Cedex, France

S. V. Shabanov
Department of Mathematics, University of Florida, Gainesville Florida 32611, USA
(Received 14 December 2007; revised manuscript received 5 March 2008; published 8 May 2008)

IOP PUBLISHING JOURNAL OF PHYSICS A: MATHEMATICAL AND THEORETICAL
J. Phys. A: Math. Theor. **46** (2013) 175302 (17pp) doi:10.1088/1751-8113/46/17/175302

Exceptional points of a Hamiltonian of von Neumann–Wigner type

N Fernández-García[1], E Hernández[2], A Jáuregui[3] and A Mondragón[2]

[1] Sección de Estudios de Posgrado e Investigación, UPIITA, IPN, Av IPN 2508, 07340 México DF, Mexico
[2] Instituto de Física, Universidad Nacional Autónoma de México, Apdo Postal 20-364, 01000 México DF, Mexico
[3] Departamento de Física, Universidad de Sonora, Apdo Postal 1626, Hermosillo, Sonora, Mexico

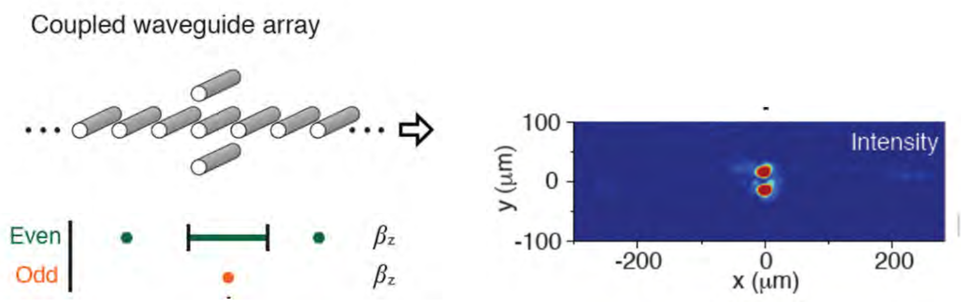
Bound states in the continuum in optics

2011 Arrays of coupled waveguides

PRL **107,** 183901 (2011) PHYSICAL REVIEW LETTERS week ending 28 OCTOBER 2011

Experimental Observation of Optical Bound States in the Continuum

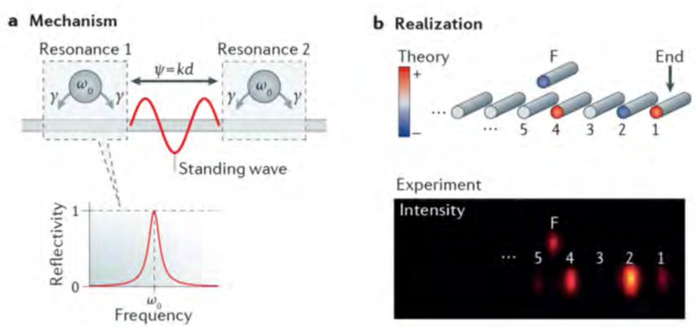
Yonatan Plotnik,[1] Or Peleg,[1] Felix Dreisow,[2] Matthias Heinrich,[2] Stefan Nolte,[2] Alexander Szameit,[1] and Mordechai Segev[1]



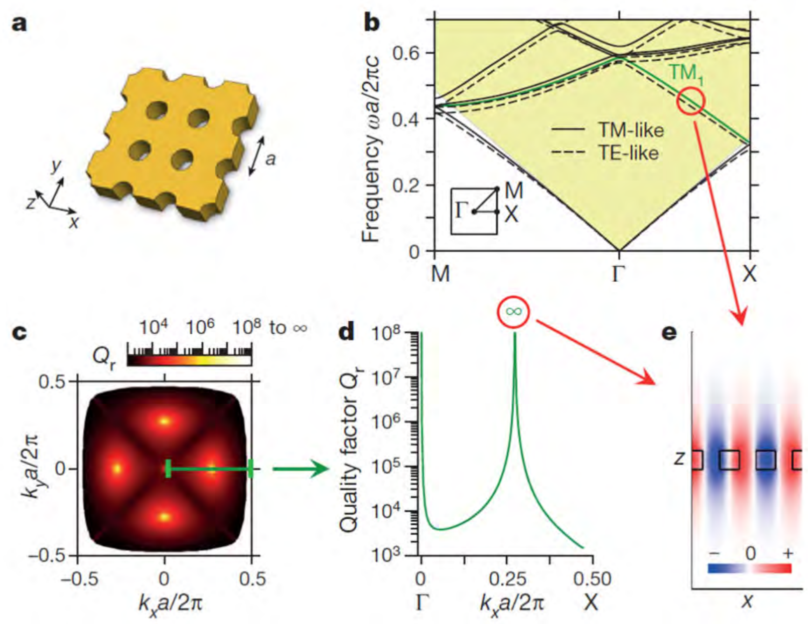
PRL **111,** 240403 (2013) PHYSICAL REVIEW LETTERS week ending 13 DECEMBER 2013

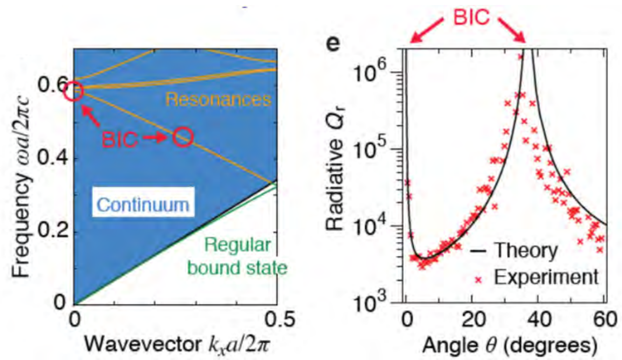
Compact Surface Fano States Embedded in the Continuum of Waveguide Arrays

Steffen Weimann,[1] Yi Xu,[2] Robert Keil,[1] Andrey E. Miroshnichenko,[2] Andreas Tünnermann,[1] Stefan Nolte,[1] Andrey A. Sukhorukov,[2] Alexander Szameit,[1] and Yuri S. Kivshar[2]



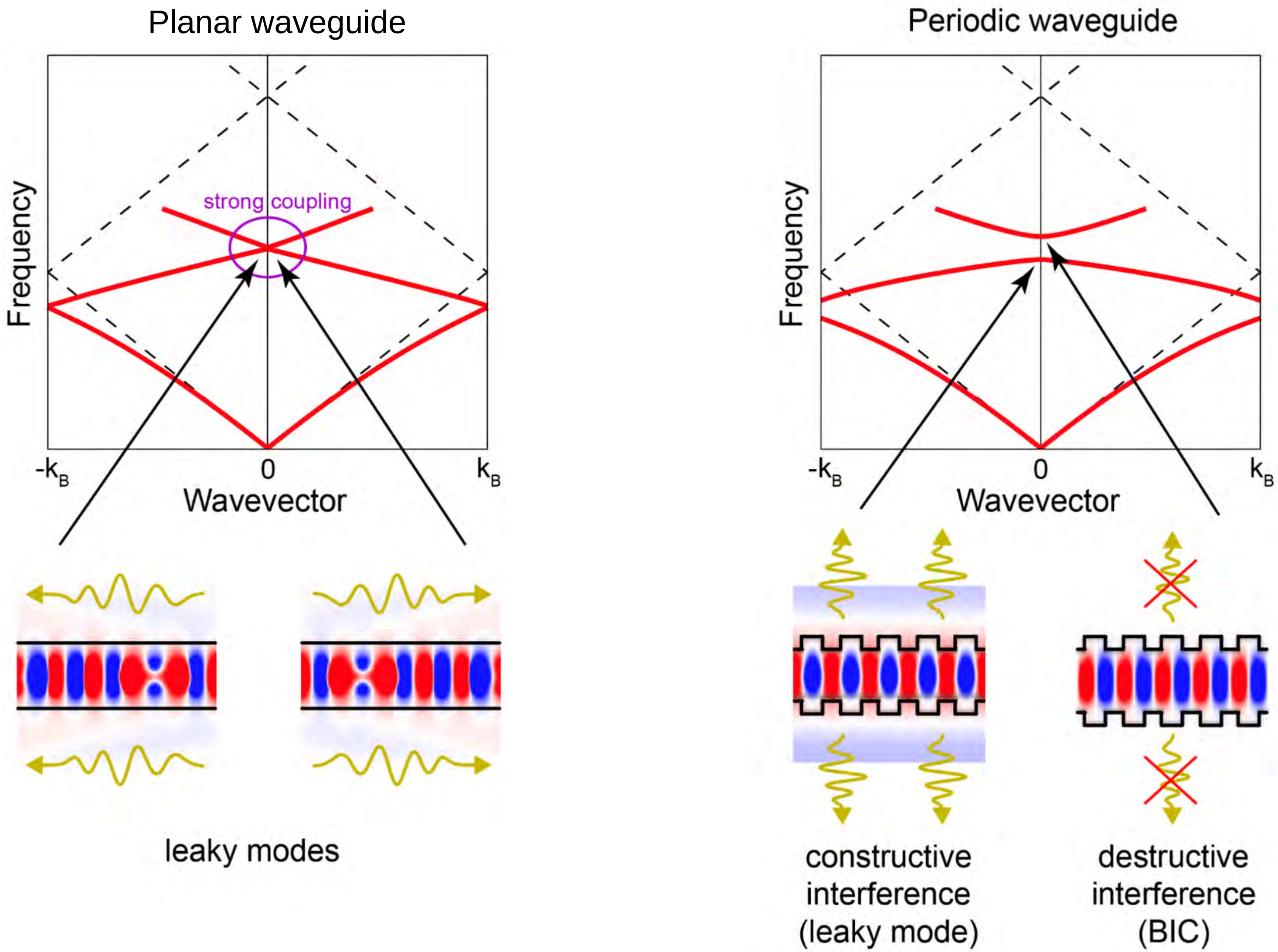
2013 Photonic crystal slabs





Hsu et al, Nature 2013

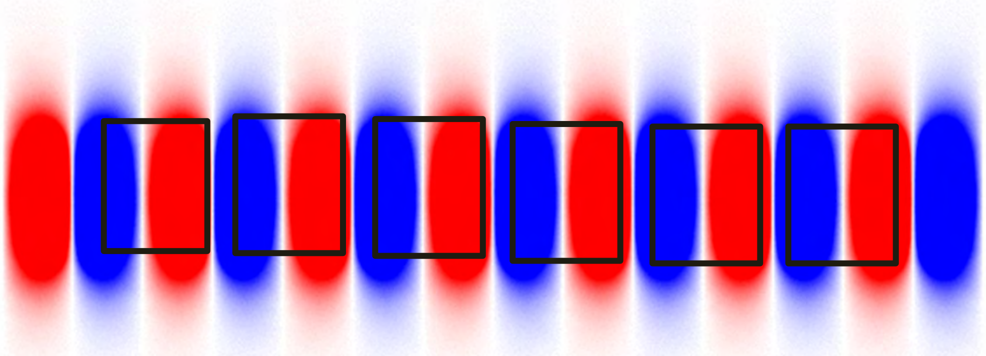
BIC in photonics: origin and physics



Complete destructive interference in far field

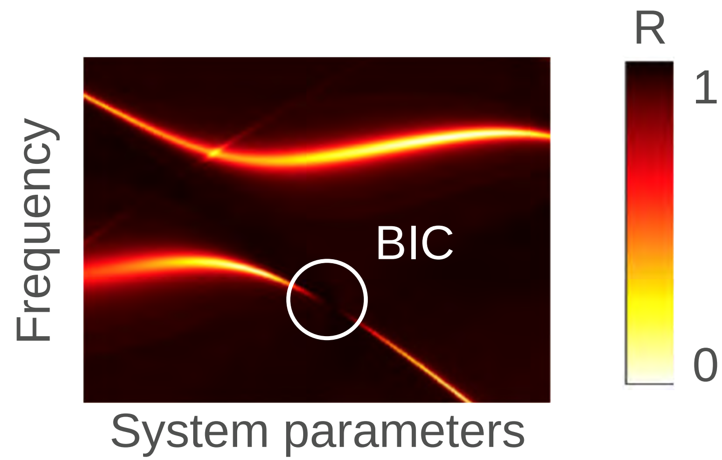
Different types of BICs

Symmetry-protected (conventional)



in-plane inversion symmetry
time reversal symmetry

Accidental (Friedrich-Wintgen)



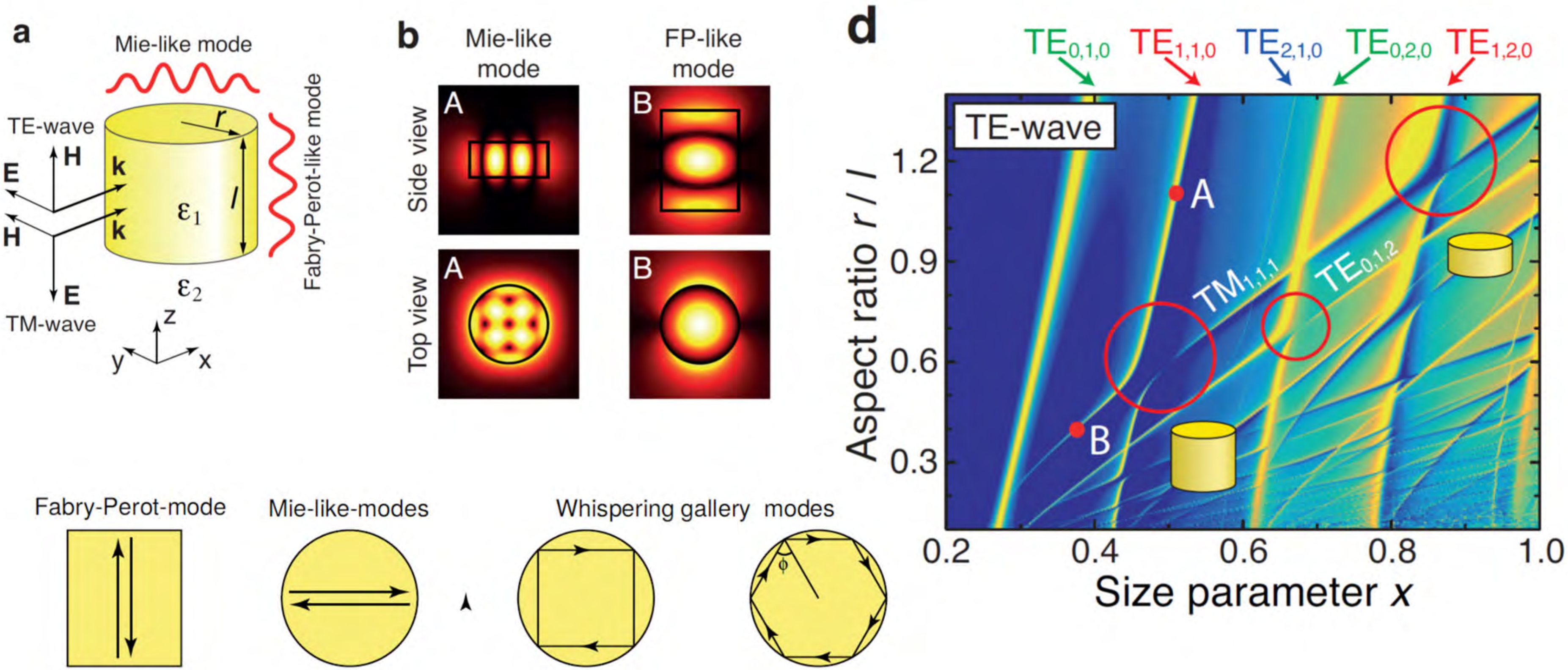
in-plane inversion symmetry
time reversal symmetry
up-down symmetry

PHYSICAL REVIEW A VOLUME 32, NUMBER 6 DECEMBER 1985

Interfering resonances and bound states in the continuum

H. Friedrich and D. Wintgen
Physik Department, Technische Universität München, D-8046 Garching, West Germany
(Received 24 June 1985)

BIC in a subwavelength resonator



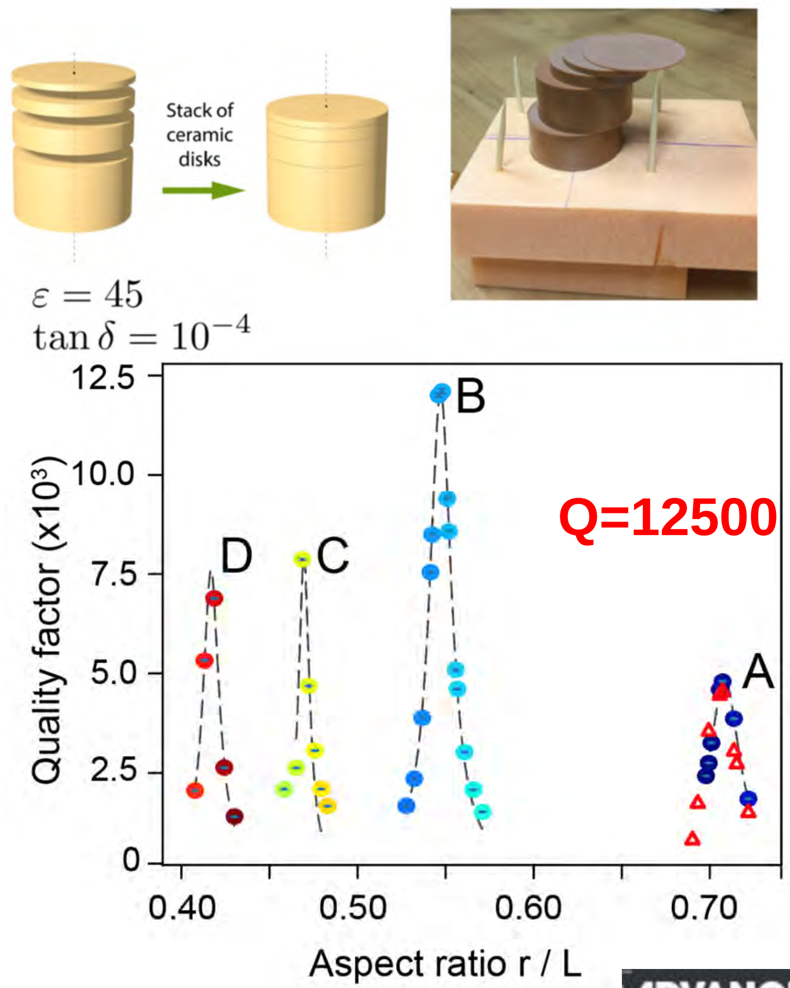
PRL **119,** 243901 (2017) PHYSICAL REVIEW LETTERS week ending 15 DECEMBER 2017

High-*Q* Supercavity Modes in Subwavelength Dielectric Resonators

Mikhail V. Rybin,[1,2,*] Kirill L. Koshelev,[1,2] Zarina F. Sadrieva,[2] Kirill B. Samusev,[1,2] Andrey A. Bogdanov,[1,2]
Mikhail F. Limonov,[1,2] and Yuri S. Kivshar[2,3]

Recent experimental demonstrations

RF experiment



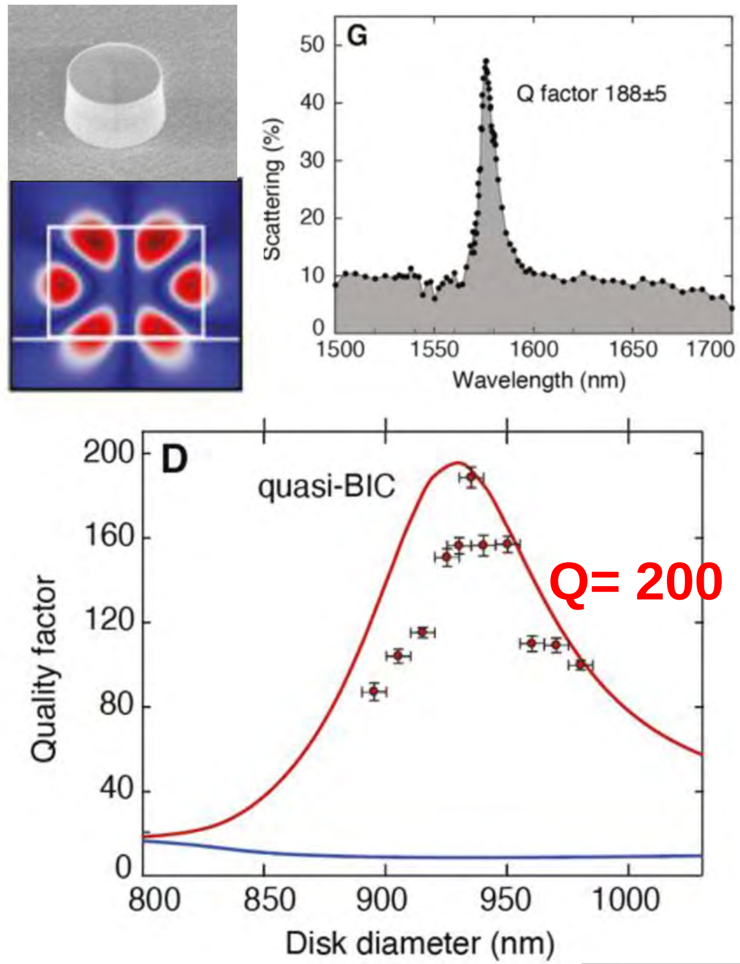
ADVANCED MATERIALS

COMMUNICATION

Observation of Supercavity Modes in Subwavelength Dielectric Resonators

Mikhail Odit, Kirill Koshelev, Sergey Gladyshev, Konstantin Ladutenko, Yuri Kivshar,*

Near-IR experiment



Science AAAS

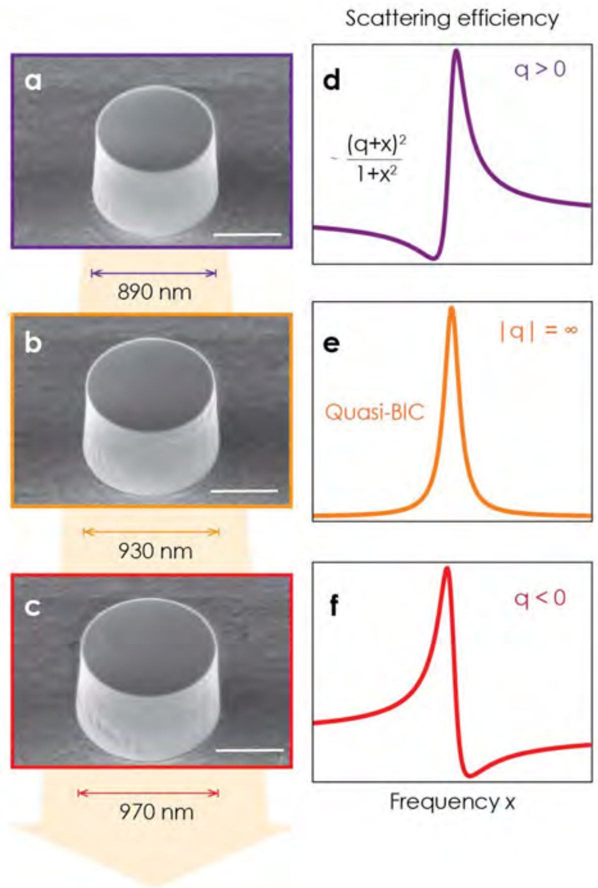
RESEARCH

OPTICS

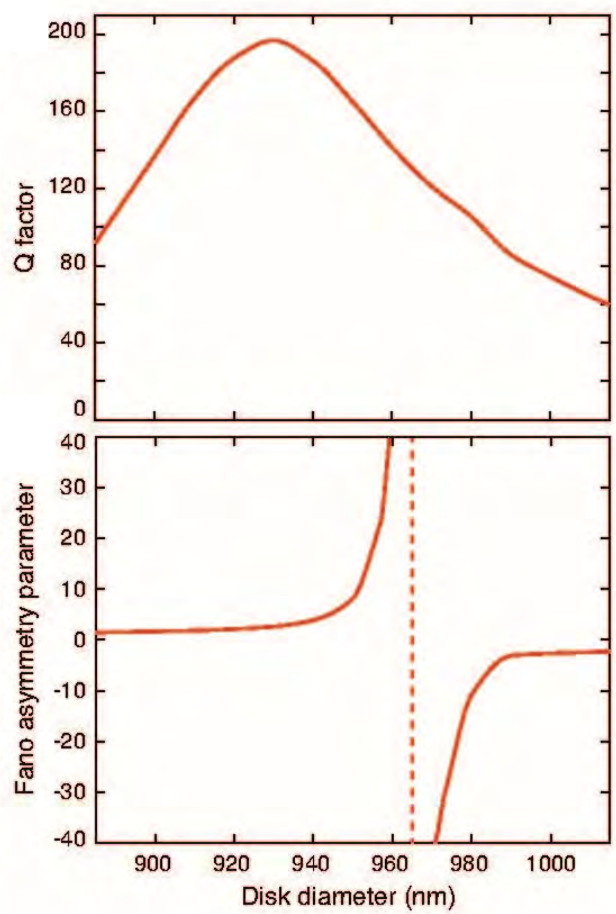
Subwavelength dielectric resonators for nonlinear nanophotonics

Kirill Koshelev[1,2], Sergey Kruk[1], Elizaveta Melik-Gaykazyan[1,3], Jae-Hyuck Choi[4], Andrey Bogdanov[2], Hong-Gyu Park[4]*, Yuri Kivshar[1,2]*

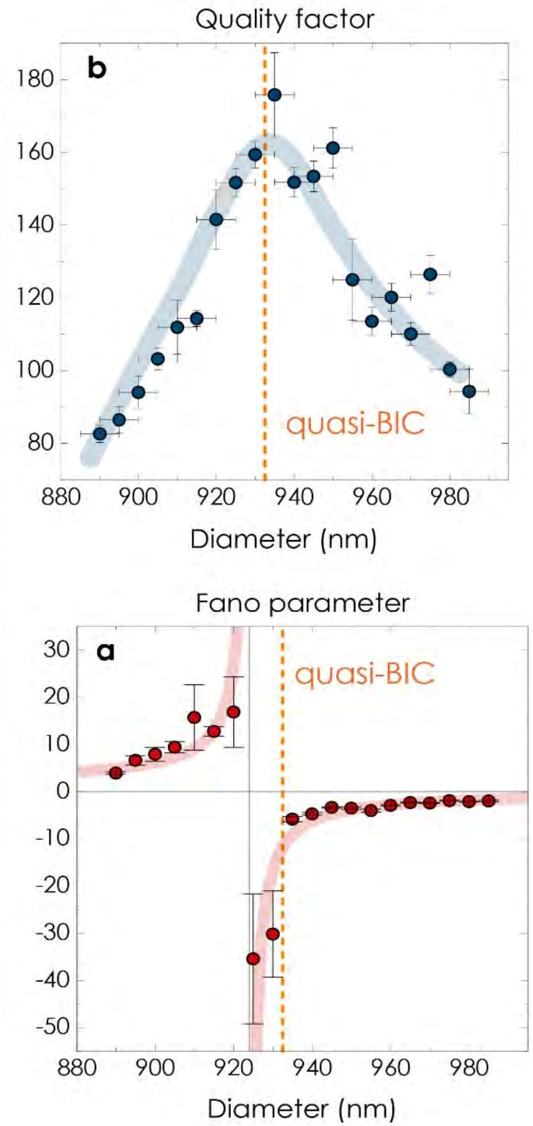
Fano vs. quasi-BIC resonances



Theory

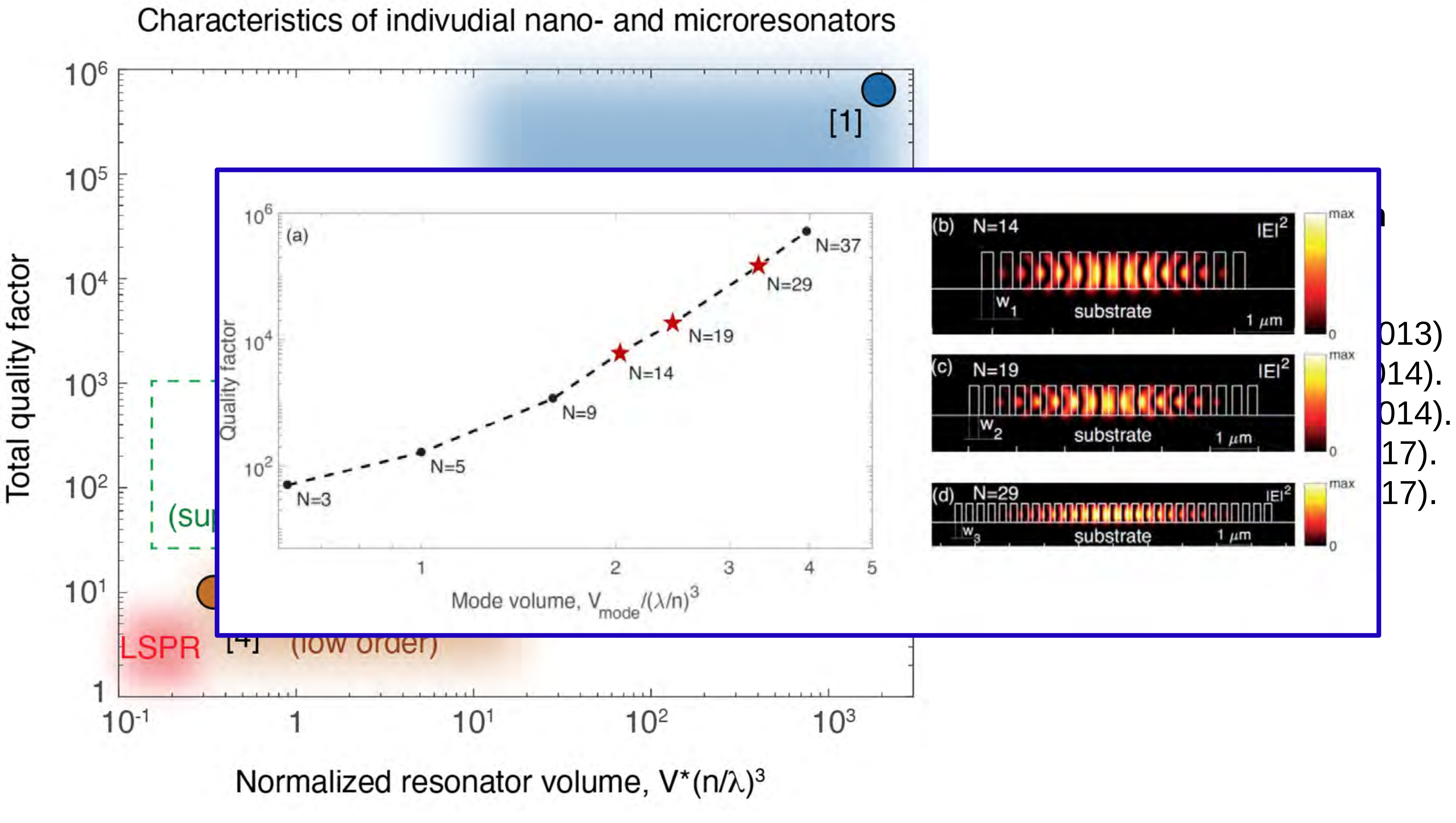


Experiment



In preparation

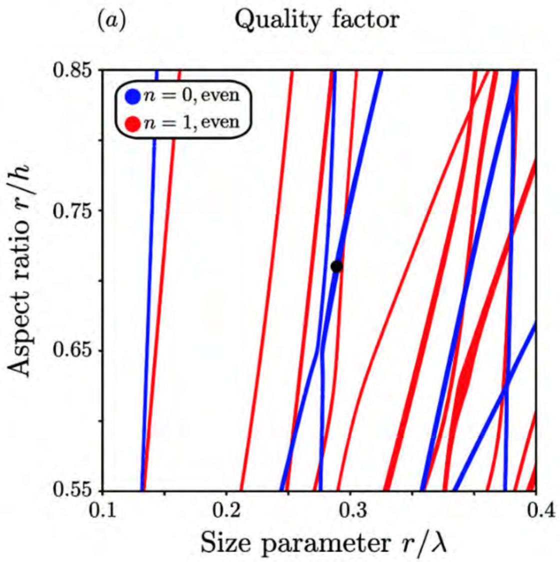
Quality factor vs. mode volume

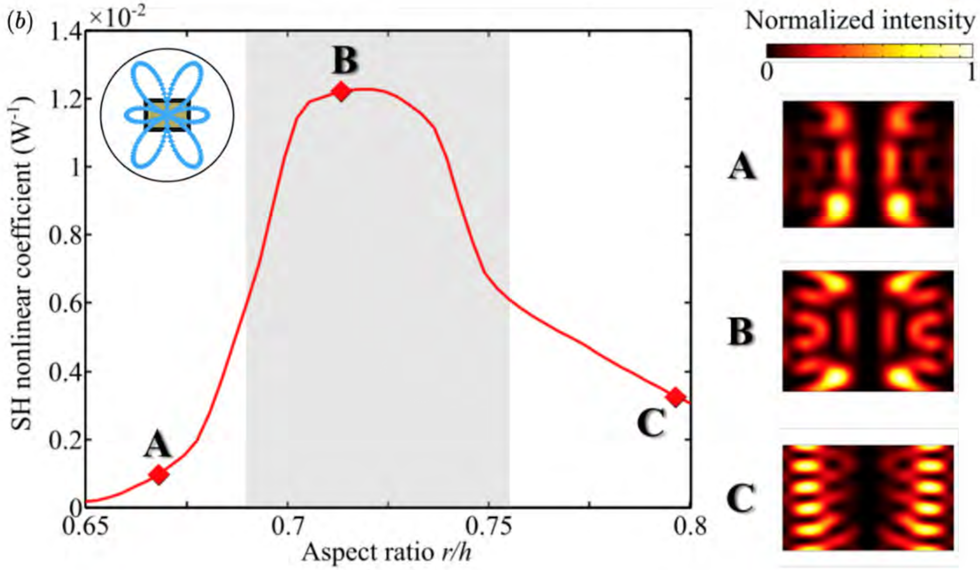


Quasi-BIC = high Q factor and small sample footprint & mode volume

Nonlinear response of quasi-BIC states

Mode	Polarization	$\rho_{SH} \times 10^4$ (W^{-1})	η	λ_{FF} (μm)	Q
BIC	Azimuthal	210	0.77	1.55	114
BIC	Linear	270	0.06	1.55	114
MD	Linear	1.8	0.84	2.98	10



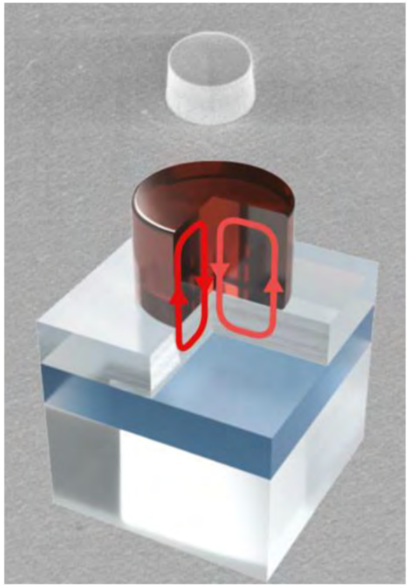


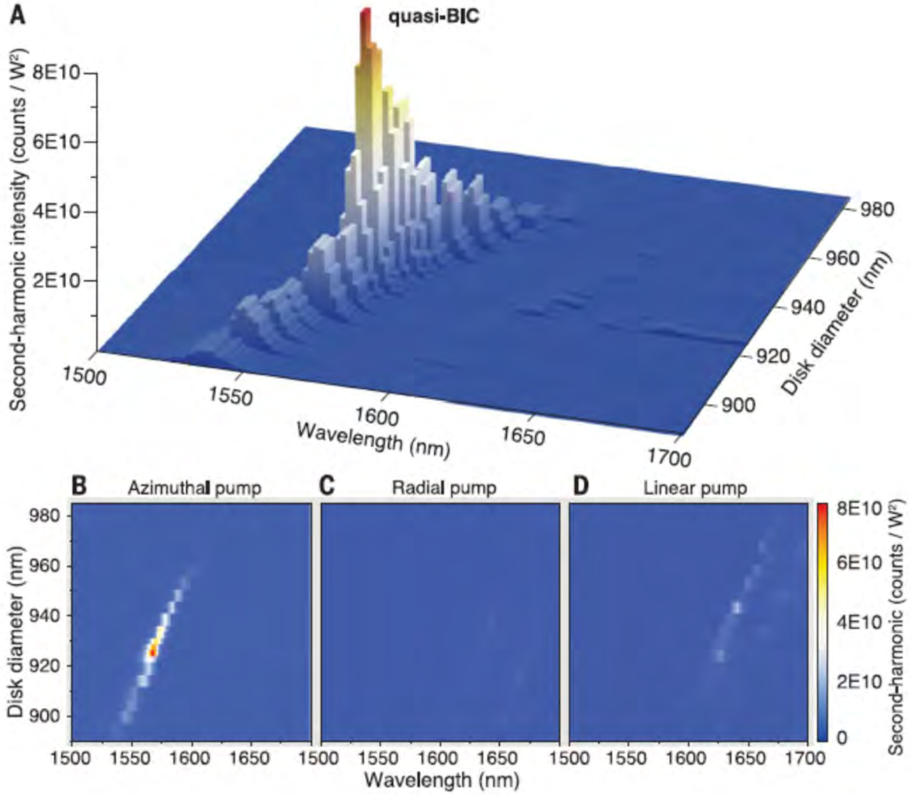
PHYSICAL REVIEW LETTERS **121,** 033903 (2018)

Giant Nonlinear Response at the Nanoscale Driven by Bound States in the Continuum

Luca Carletti,[1] Kirill Koshelev,[2,3] Costantino De Angelis,[1] and Yuri Kivshar[2,3]

SHG from quasi-BIC states: Recent experiment





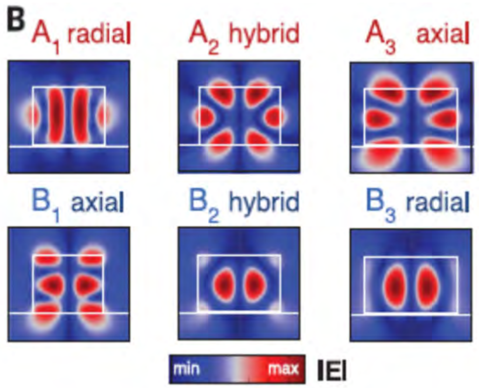
Science 367, 288 (2020)

RESEARCH

OPTICS

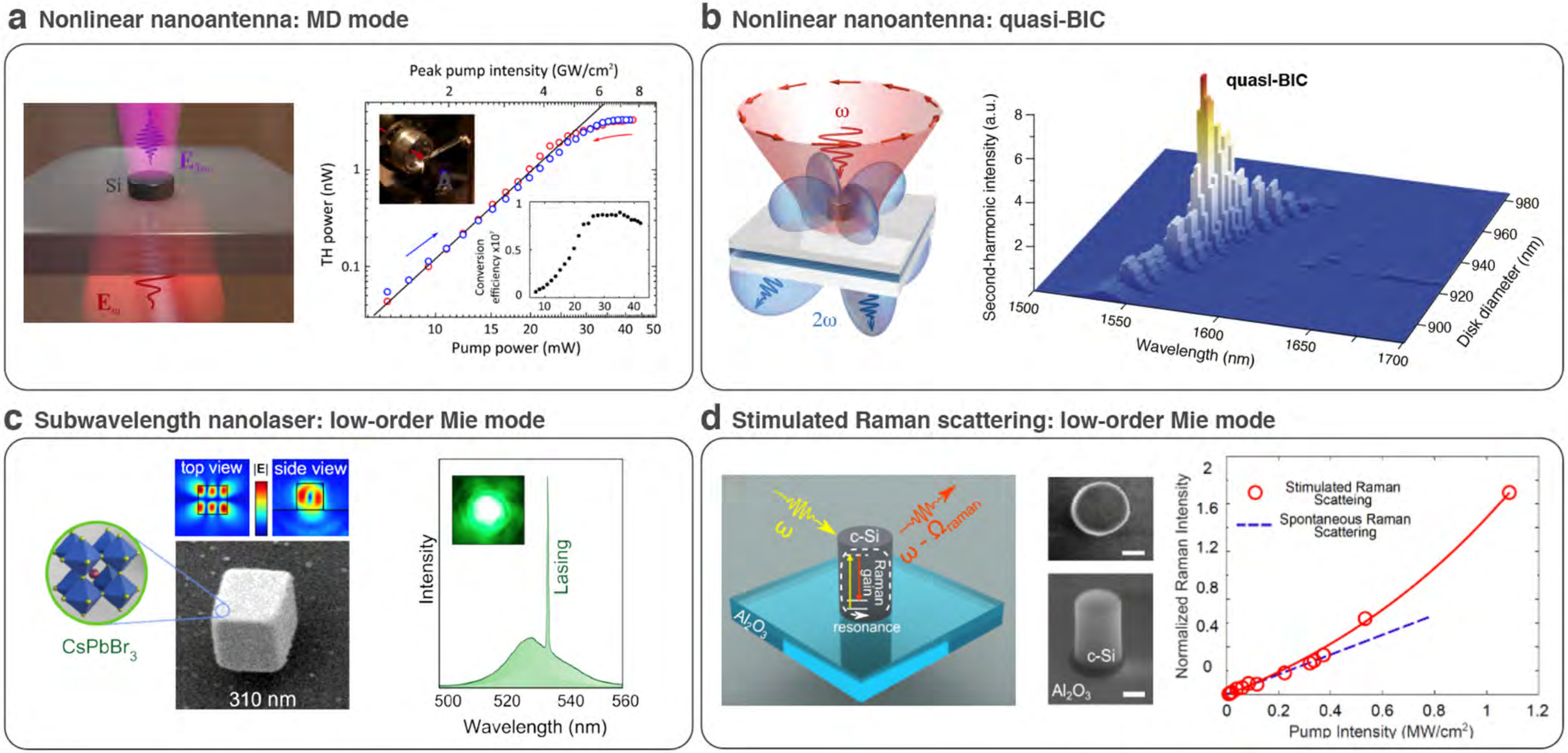
Subwavelength dielectric resonators for nonlinear nanophotonics

Kirill Koshelev[1,2], Sergey Kruk[1], Elizaveta Melik-Gaykazyan[1,3], Jae-Hyuck Choi[4], Andrey Bogdanov[2], Hong-Gyu Park[4]*, Yuri Kivshar[1,2]*



Examples of nonlinear "Mie-tronics" effects

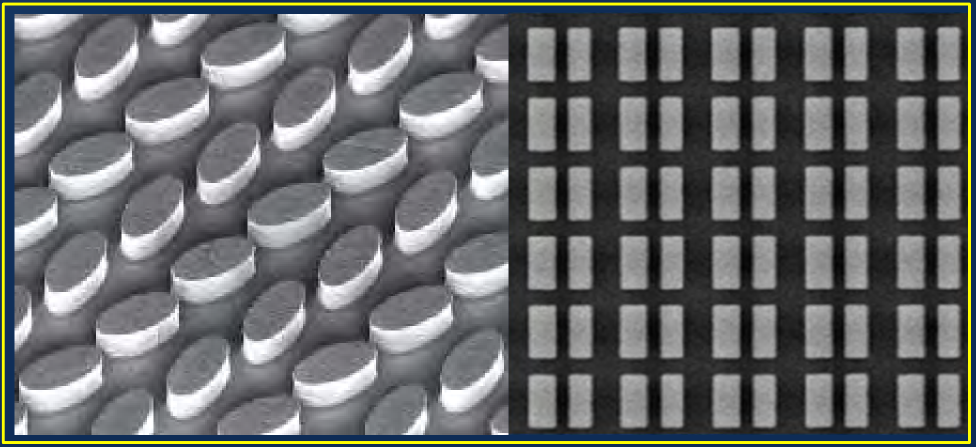
Nano Letters (2014) Science (2020)



ACS Nano (2020) Nano Letters (2020)

K. Koshelev and Y. Kivshar, Dielectric resonant metaphotonics, ACS Photonics, https://dx.doi.org/10.1021/acsphotonics.0c01315

All-dielectric metasurfaces

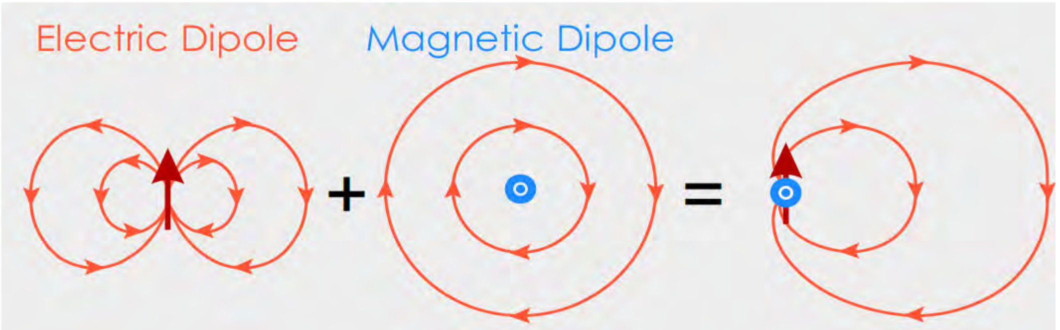


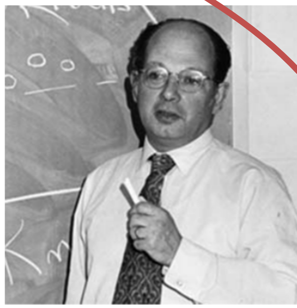
Australian National University

ITMO UNIVERSITY

Two strategies for optical metasurface engineering

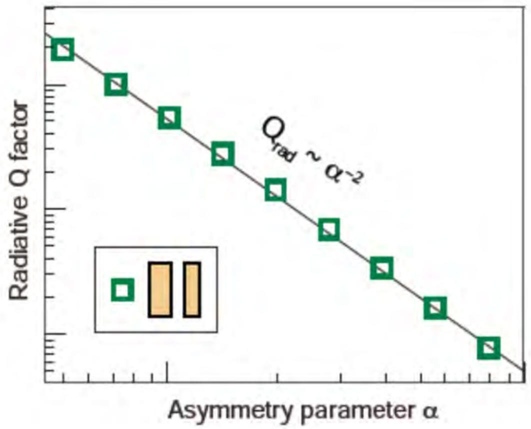
Multipoles for highly efficient transmission

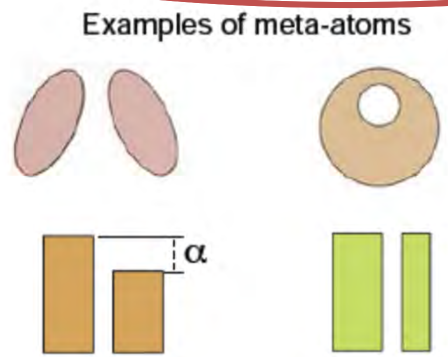




Milton Kerker

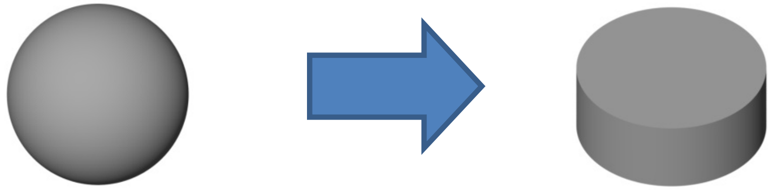
Resonances with bound states in the continuum





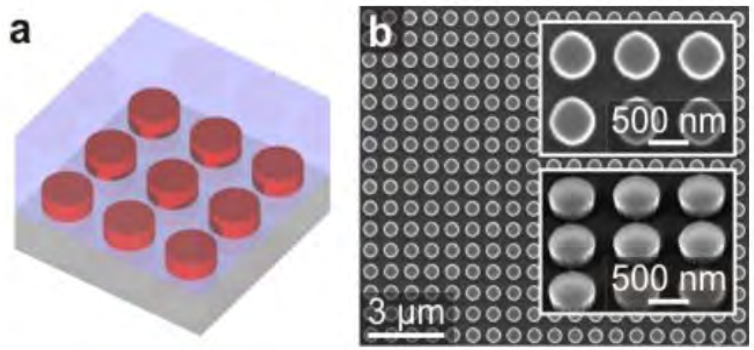
J. von Neumann E. Wigner

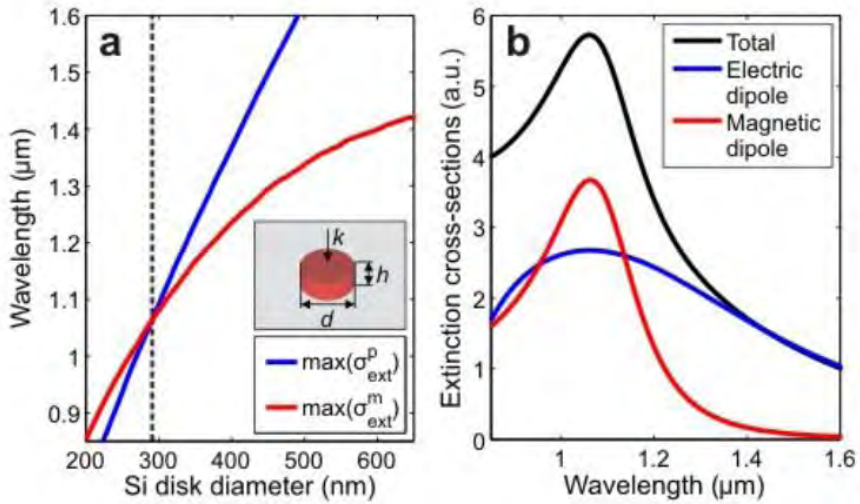
Tailoring magnetic response

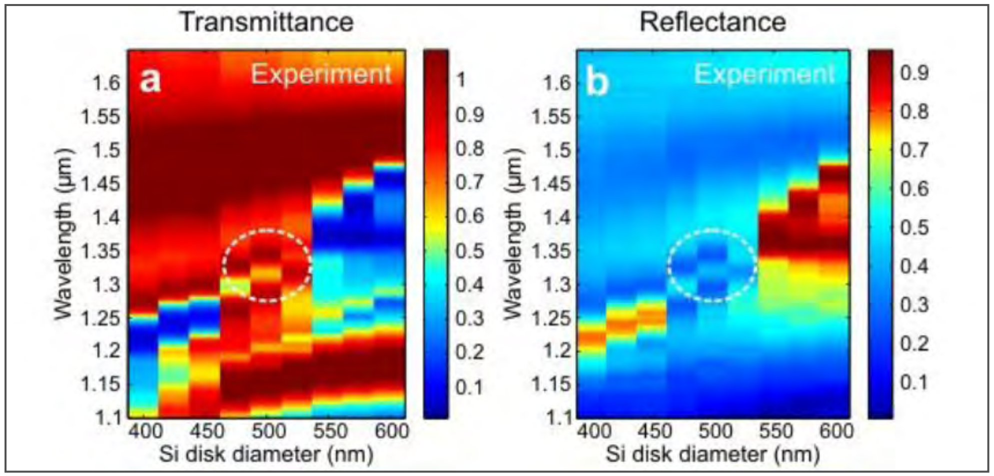


diameter

diameter, height



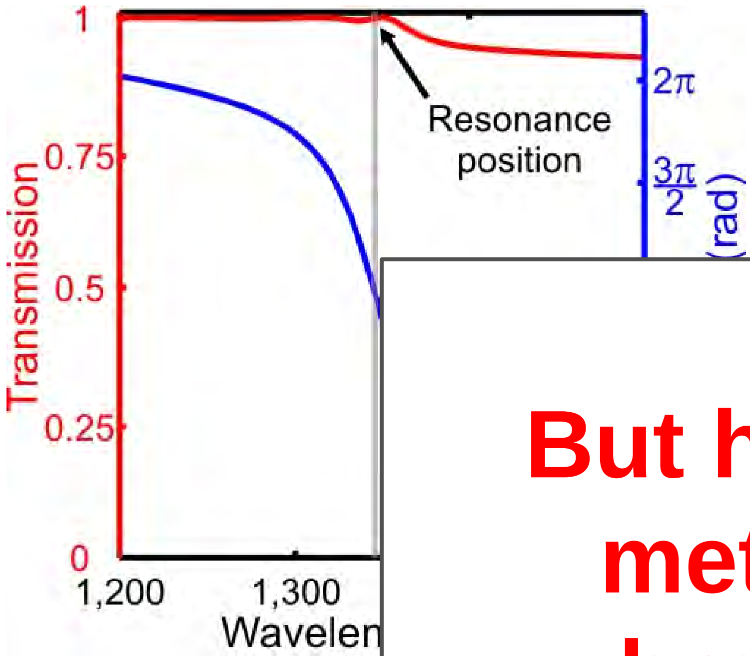




I. Staude et al, ACS Nano 7, 7824 (2013)

Huygens' metasurfaces

Silicon nanodisks embedded in n = 1.66 medium



- Complete 2π phase coverage
- → Near-unity transmittance:
  T > 91% for embedded disks

s (NIR)

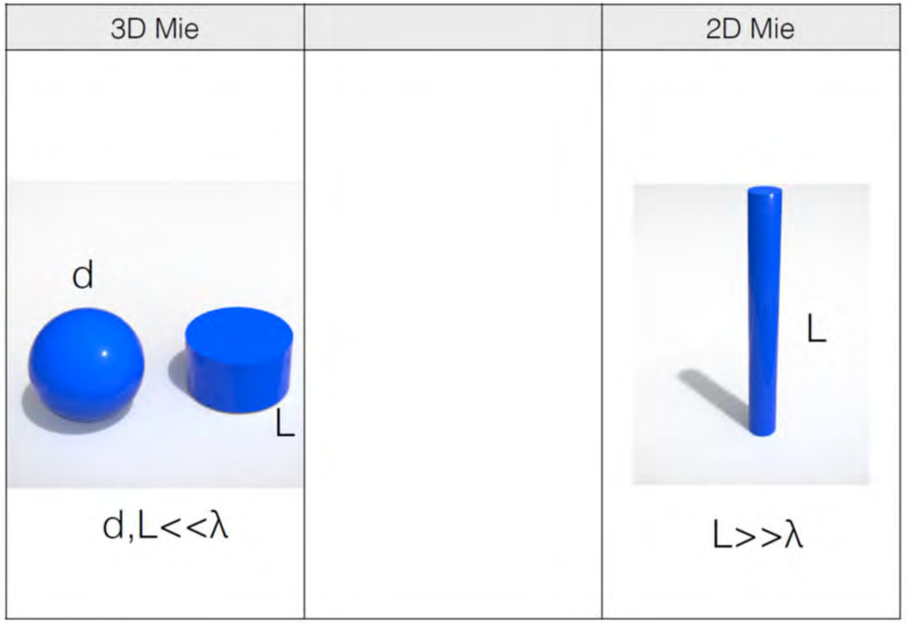
ersion losses

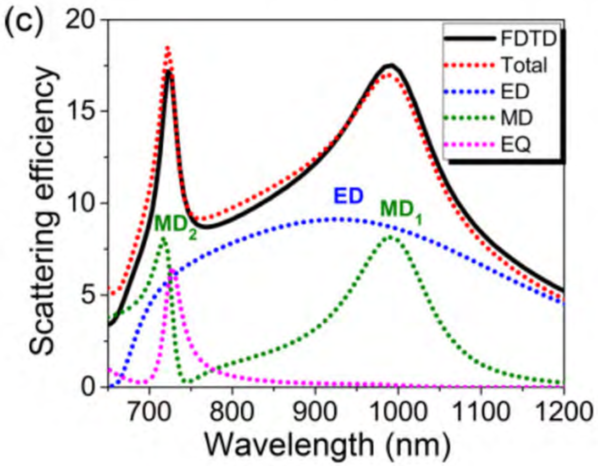
But how to make metasurfaces broadband ?

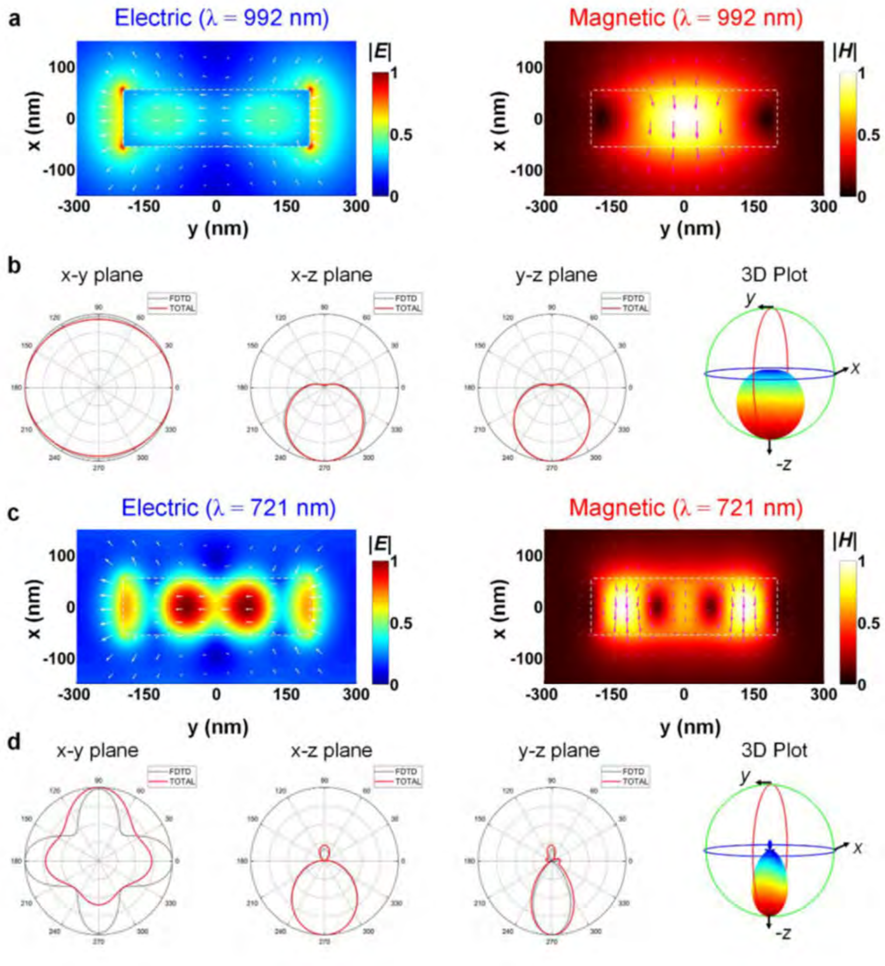
High-Efficie

Manuel Decker, Isabelle Staude, Matthias Falkner, Jason Dominguez, Dragomir N. Neshev, Igal Brener, Thomas Pertsch, and Yuri S. Kivshar*

Mie + Fabry-Perot resonances

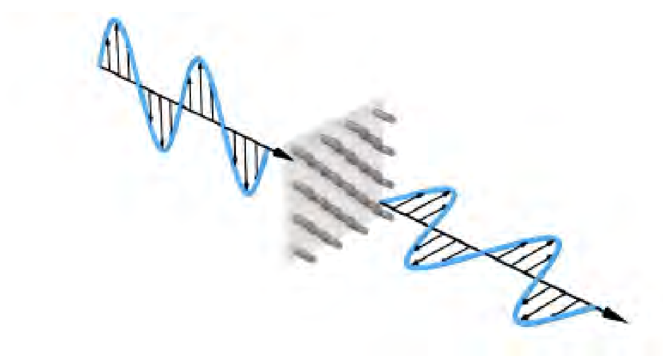


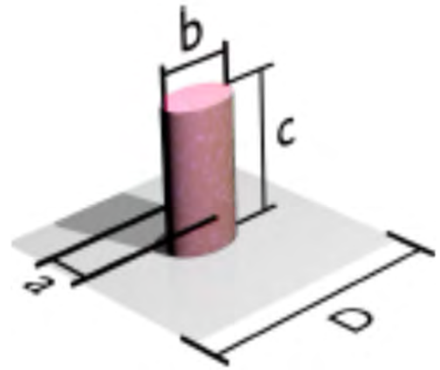


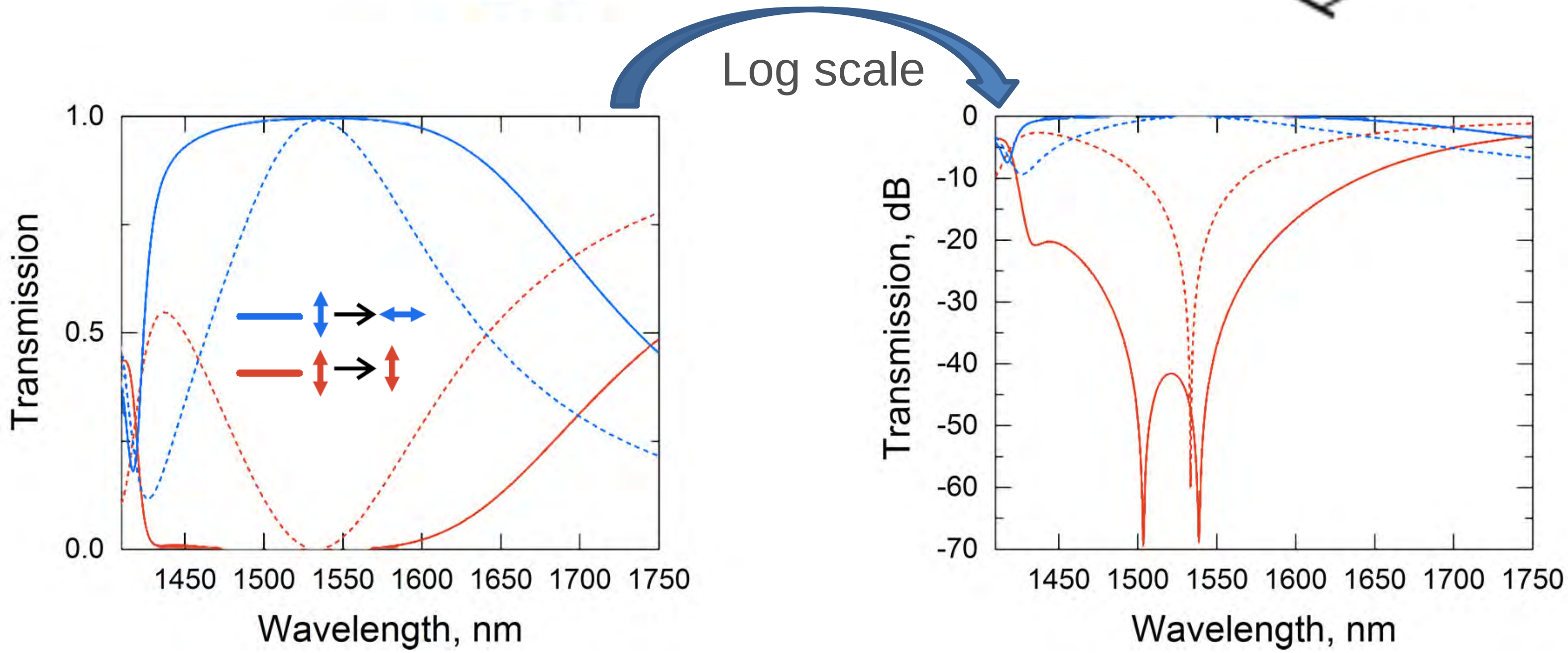


Y. Yang et al, Phys Rev B **95**,165426 (2017)

How to make a metasurface broadband ?

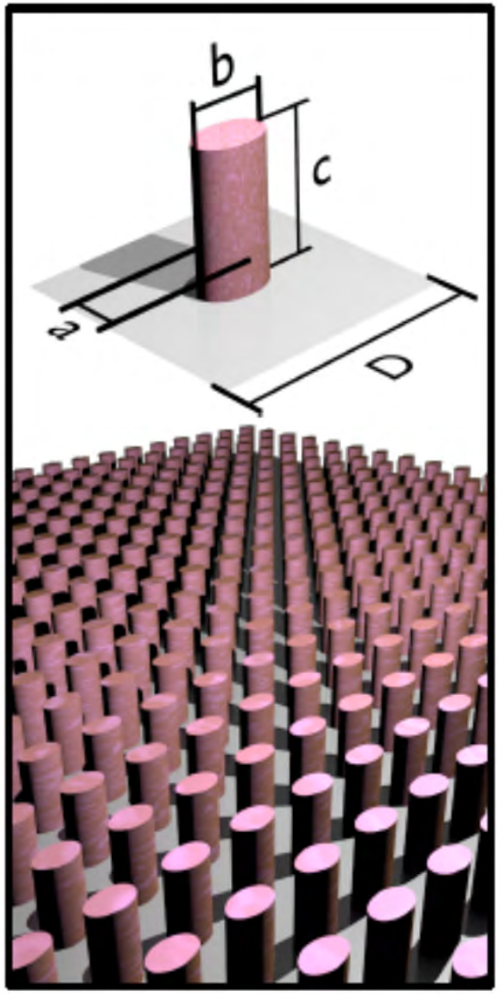


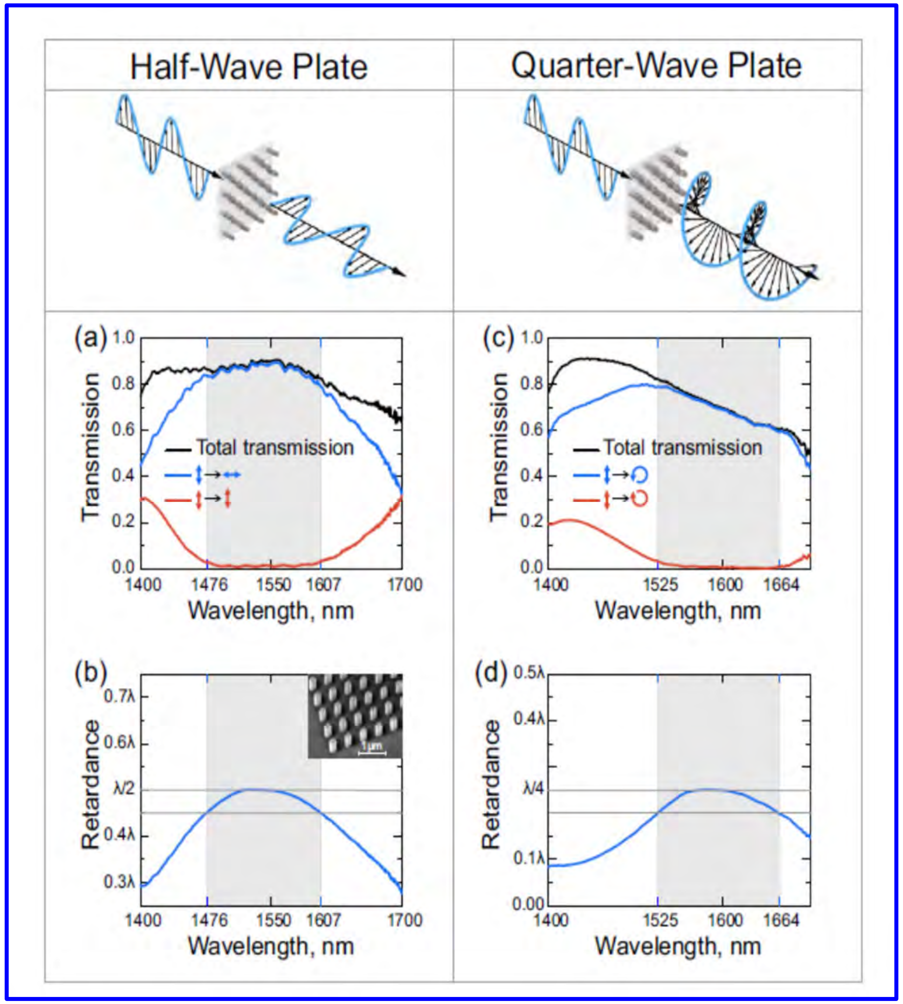


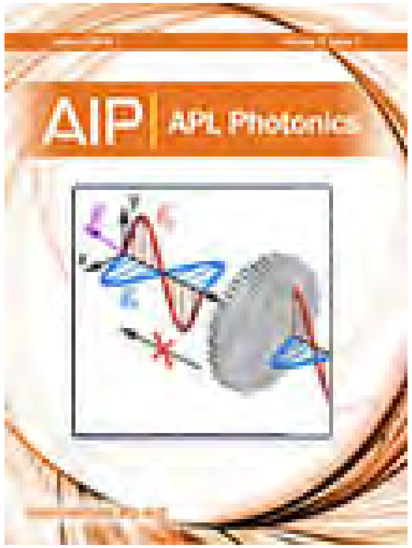


Broadband operation via multipolar response

Broadband highly-efficient dielectric metasurfaces

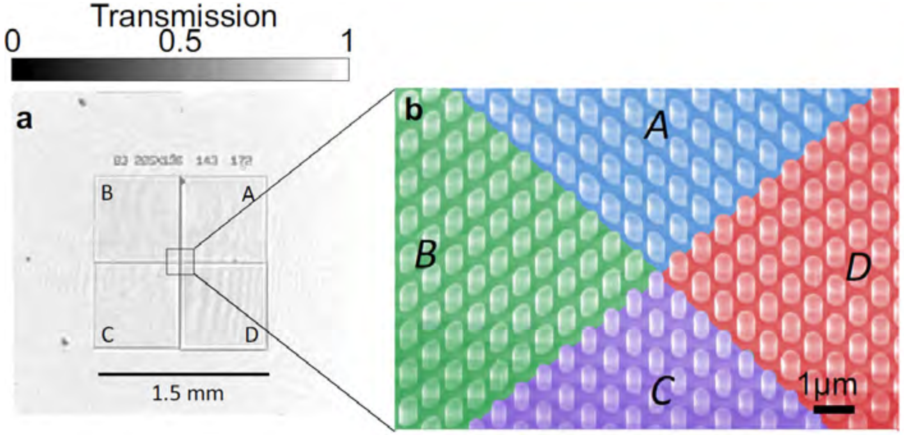


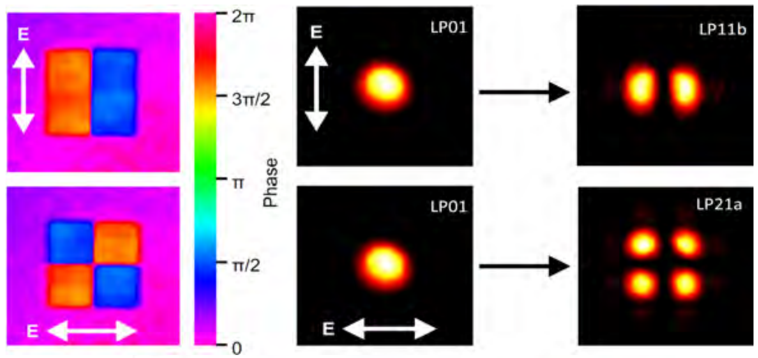




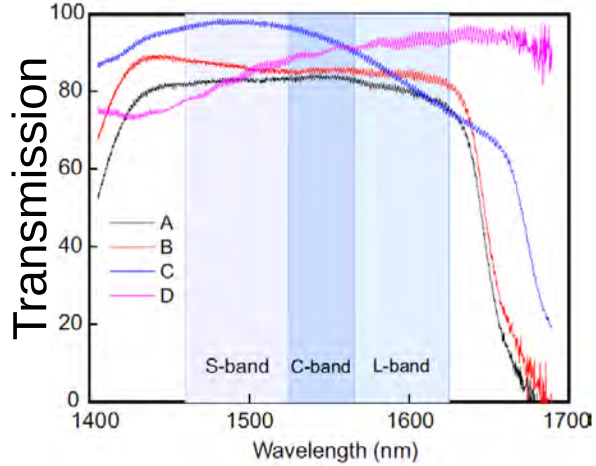
S. Kruk et al, APL Photonics 1, 030801 (2016)

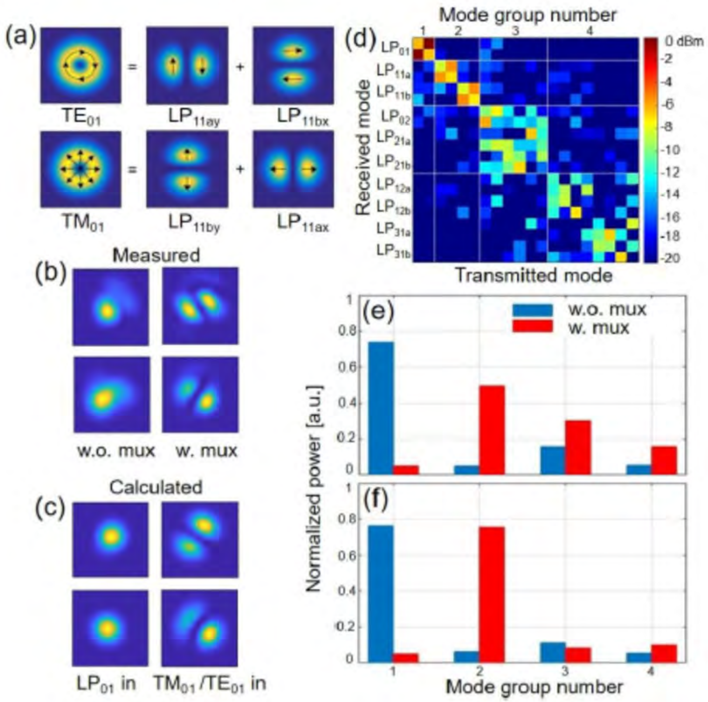
Metasurfaces for optical communications





S. Kruk et al, Laser & Photonics Reviews (2018)





Multimode fiber transmission

FULL PAPER

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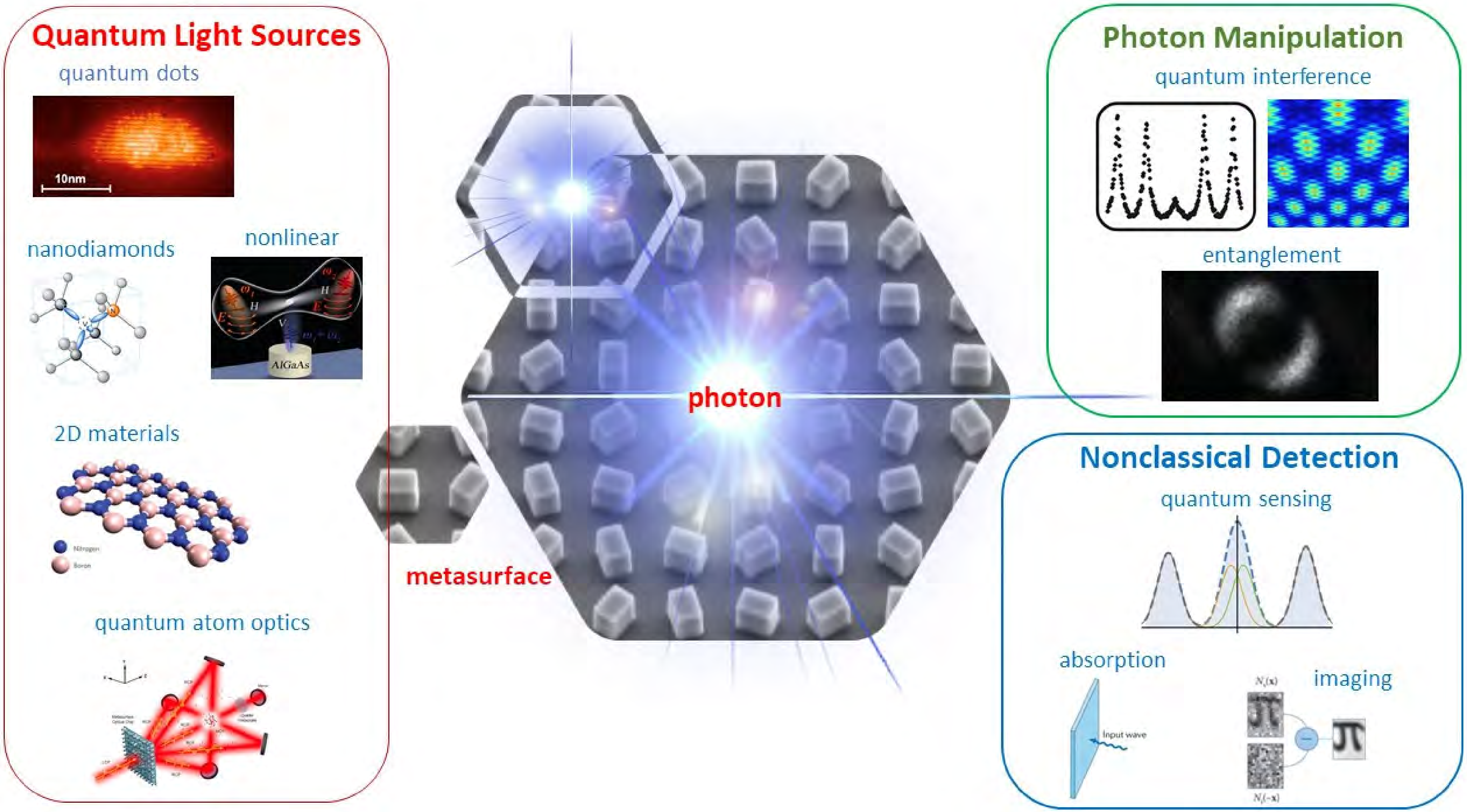
Metasurfaces

www.advopticalmat.de

Dielectric Broadband Metasurfaces for Fiber Mode-Multiplexed Communications

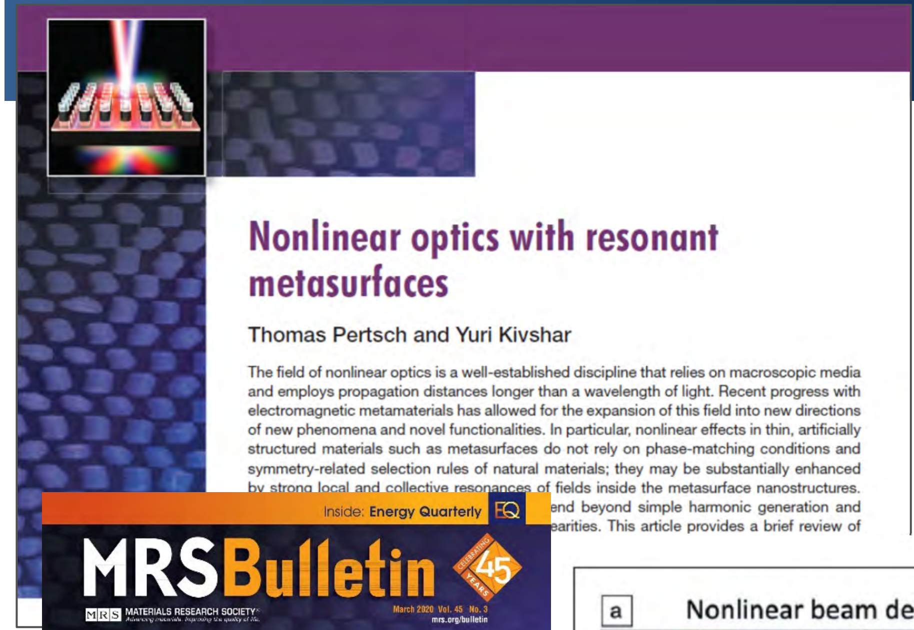
*Elham Nazemosadat, Mikael Mazur, Sergey Kruk, Ivan Kravchenko, Joel Carpenter, Jochen Schröder, Peter A. Andrekson, Magnus Karlsson, and Yuri Kivshar**

Metasurfaces go to quantum photonics



A. Solntsev, G. Agarwal, and Y. Kivshar, Metasurfaces for Quantum Photonics under review in Nature Photonics, preprint arXiv:2007.14722 (2020)

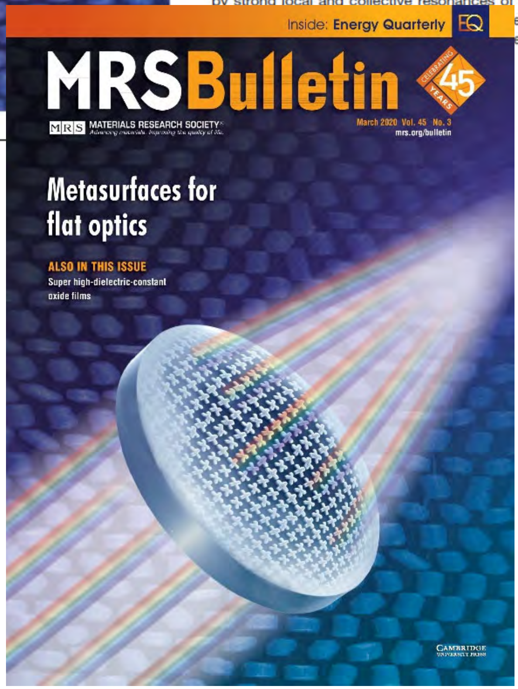
Nonlinear metasurfaces



Nonlinear optics with resonant metasurfaces

Thomas Pertsch and Yuri Kivshar

The field of nonlinear optics is a well-established discipline that relies on macroscopic media and employs propagation distances longer than a wavelength of light. Recent progress with electromagnetic metamaterials has allowed for the expansion of this field into new directions of new phenomena and novel functionalities. In particular, nonlinear effects in thin, artificially structured materials such as metasurfaces do not rely on phase-matching conditions and symmetry-related selection rules of natural materials; they may be substantially enhanced by strong local and collective resonances of fields inside the metasurface nanostructures. ... end beyond simple harmonic generation and ... earities. This article provides a brief review of

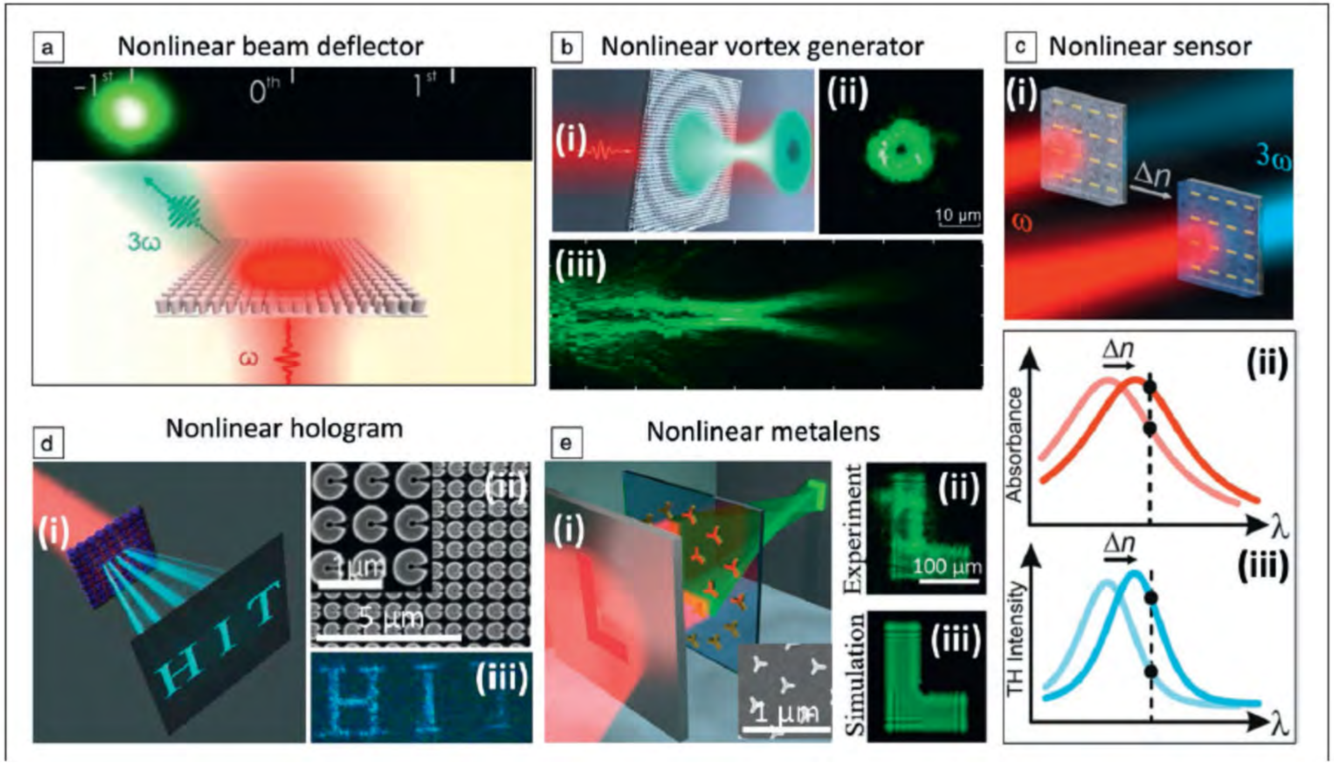


March 2020

Metasurfaces: Subwavelength nanostructure arrays for ultrathin flat optics and photonics

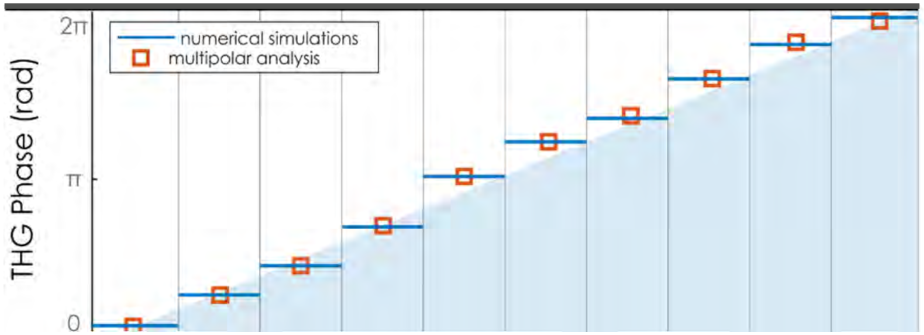
Junsuk Rho, Guest Editor

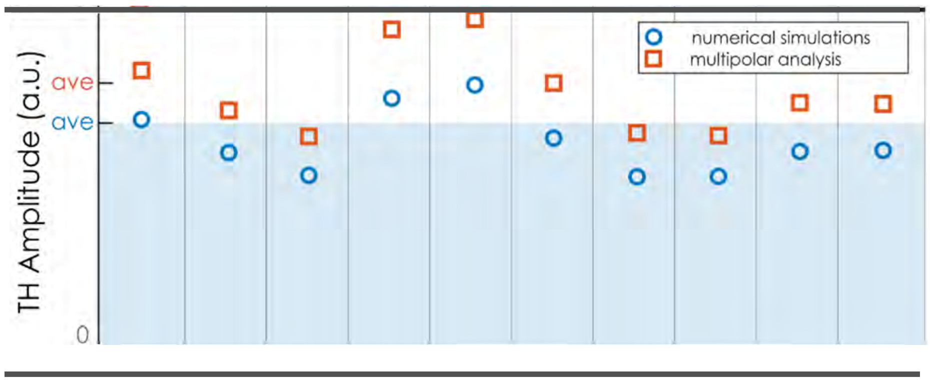
Examples of nonlinear metadevices



Nonlinear dielectric metasurfaces

1650 nm pump → 550 nm TH



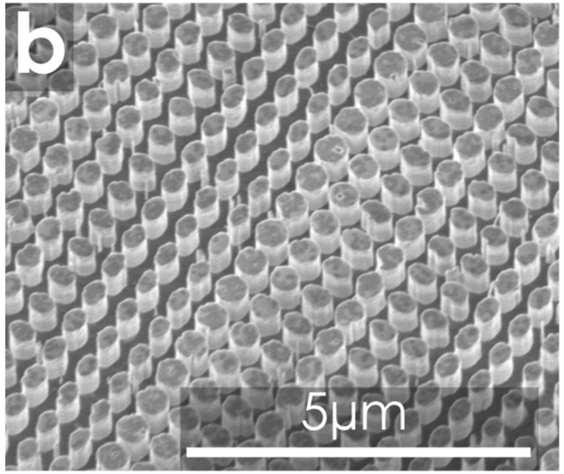


1.4×10^{-4} W^{-2} Conversion Efficiency

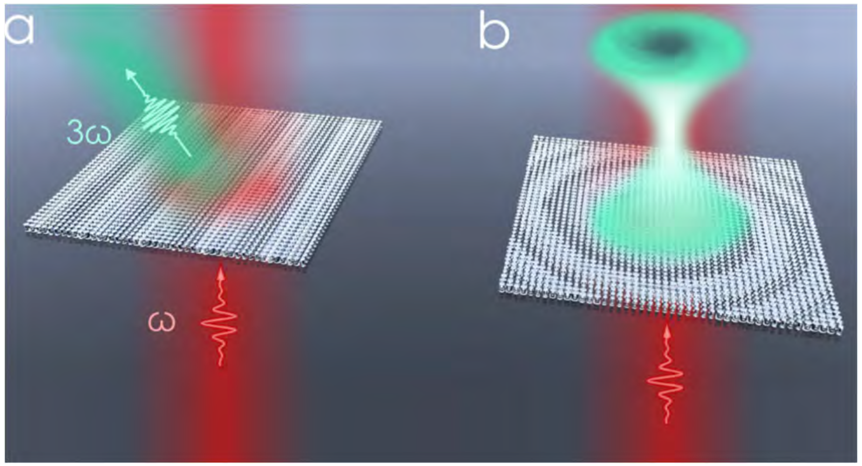
NANO LETTERS Cite This: *Nano Lett.* XXXX, XXX, XXX−XXX pubs.acs.o

Nonlinear Wavefront Control with All-Dielectric Metasurfaces

Lei Wang,[†] Sergey Kruk,[*,†] Kirill Koshelev,[†,§] Ivan Kravchenko,[‖] Barry Luther-Davies,[‡] and Yuri Kivshar[†,§]

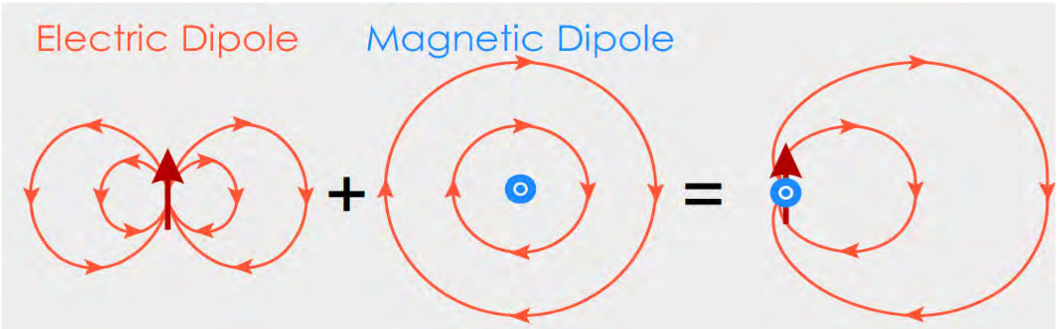


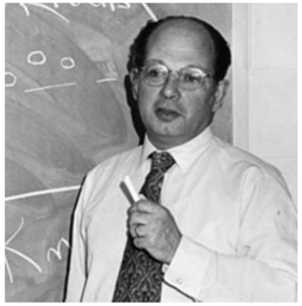
92% Difraction Efficiency



Two strategies for optical metasurface engineering

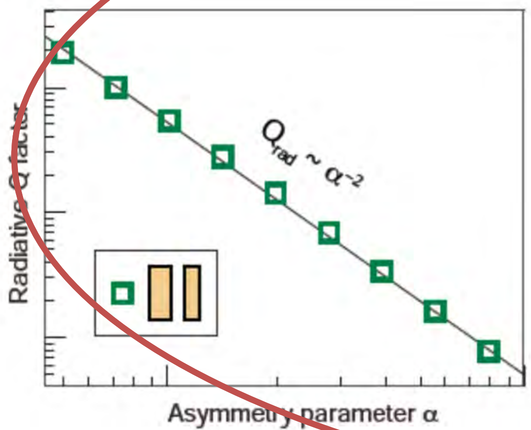
Multipoles for highly efficient transmission

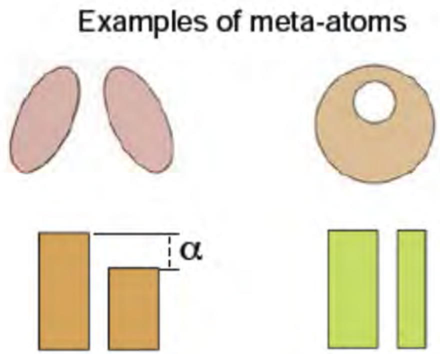




Milton Kerker

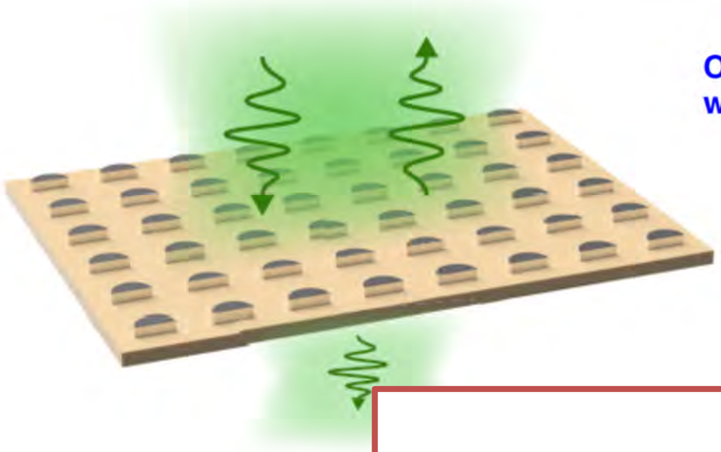
Resonances with bound states in the continuum

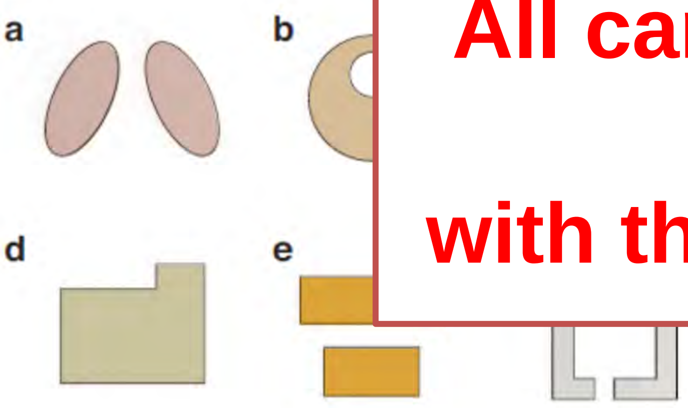




J. von Neumann E. Wigner

Metasurfaces with broken symmetry





APPLIED PHYSICS LETTERS **99**, 201107 (2011)

Observing metamaterial induced transparency in individual Fano resonators with broken symmetry

Ranjan Singh,[1,2,a)] Ibraheem A. I. Al-Naib,[3] Yuping Yang,[2] Dibakar Roy Chowdhury,[1] Wei Cao,[2] Carsten Rockstuhl,[4] Tsuneyuki Ozaki,[3] Roberto Morandotti,[3] and Weili Zhang[2,b)]

Research Article Vol. 26, No. 3 | 5 Feb 2018 | OPTICS EXPRESS 2905

Optics EXPRESS

High-quality trapped modes in all-dielectric

…CHESLAV V. KHARDIKOV,[1,3,4] …ATERYNA L. DOMINA,[4] SU XU,[2] …SUN[2]

…ar barcoding …c metasurfaces

…Yesilkoy[1], Duk-Yong Choi[3], …

All can be explained with the BIC concept!

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Electric and Magnetic Response in Dielectric Dark States for Low Loss Subwavelength Optical Meta Atoms

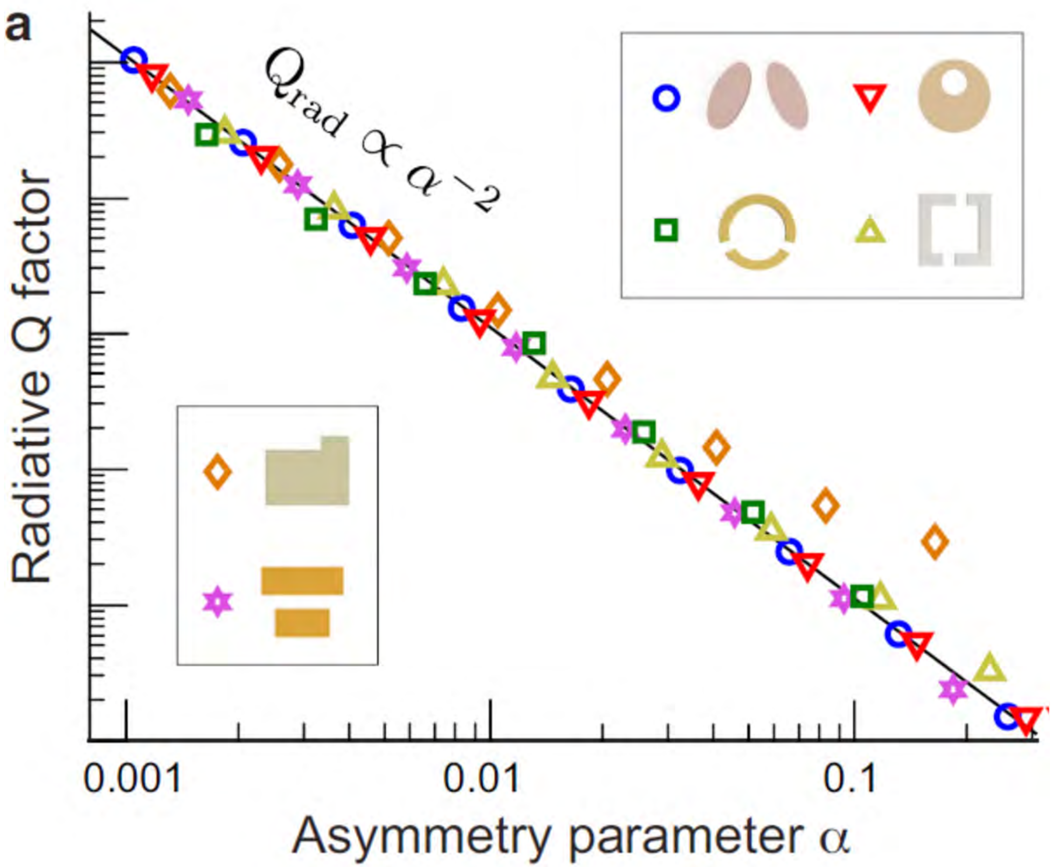
Aditya Jain, Parikshit Moitra, Thomas Koschny, Jason Valentine, and Costas M. Soukoulis*

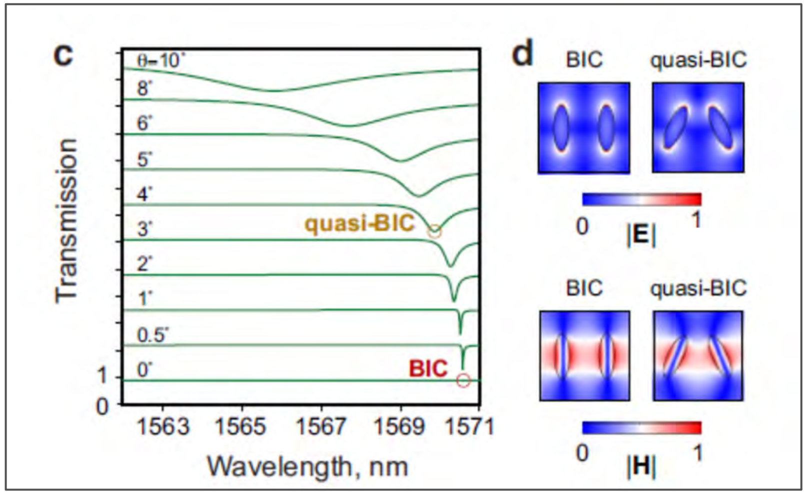
PRL **99**, 147401 (2007) PHYSICAL REVIEW LETTERS week ending 5 OCTOBER 2007

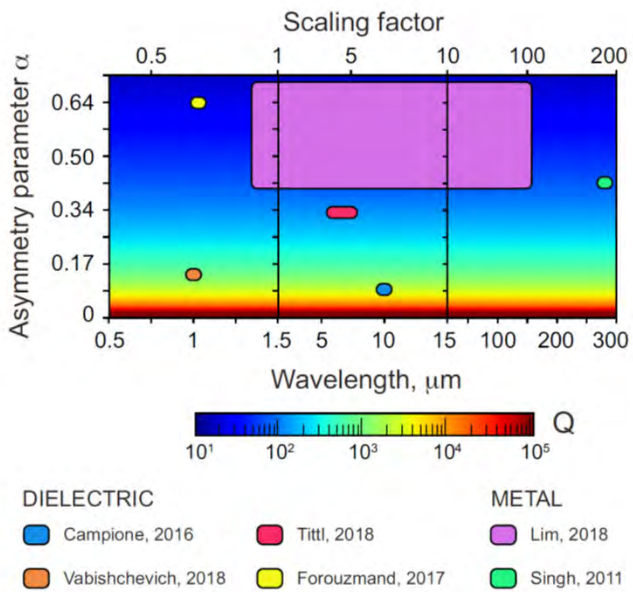
Sharp Trapped-Mode Resonances in Planar Metamaterials with a Broken Structural Symmetry

V. A. Fedotov,[1,*] M. Rose,[1] S. L. Prosvirnin,[2] N. Papasimakis,[1] and N. I. Zheludev[1,†]

High-Q quasi-BIC metasurfaces







PHYSICAL REVIEW LETTERS **121**, 193903 (2018)

Asymmetric Metasurfaces with High-*Q* Resonances Governed by Bound States in the Continuum

Kirill Koshelev,[1,2] Sergey Lepeshov,[2] Mingkai Liu,[1] Andrey Bogdanov,[2] and Yuri Kivshar[1,2]

Metasurfaces and BIC resonances

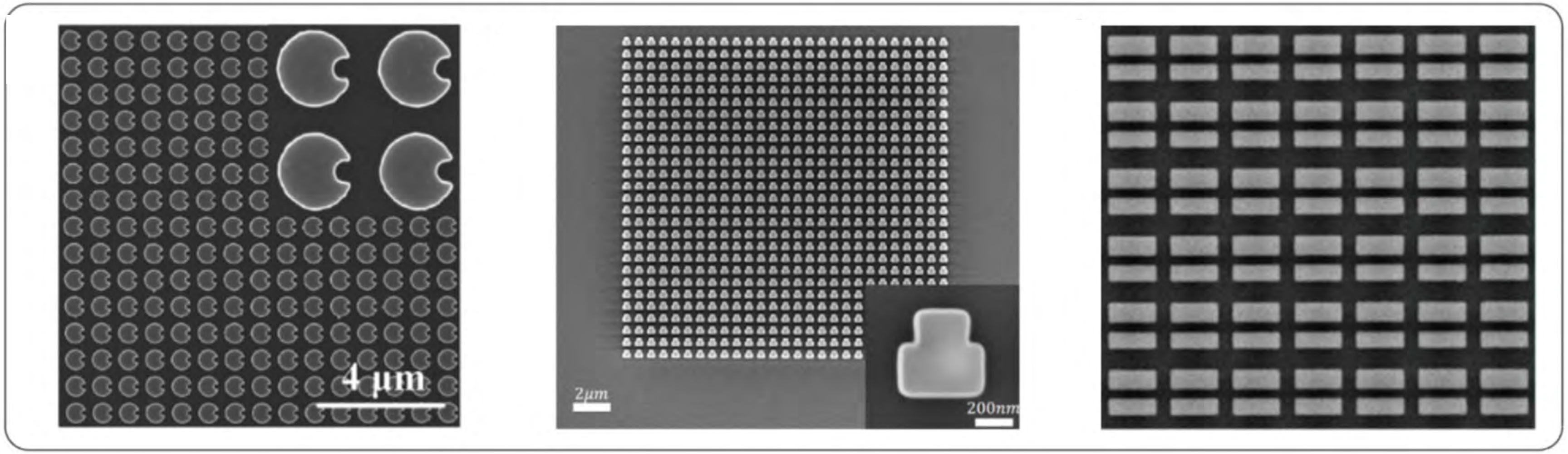
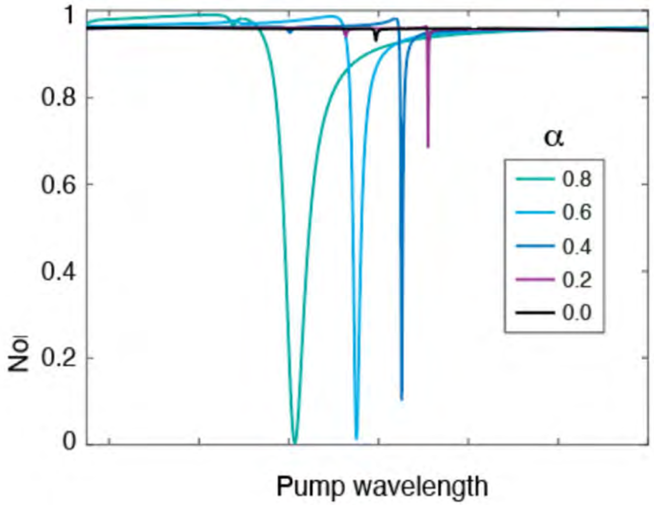


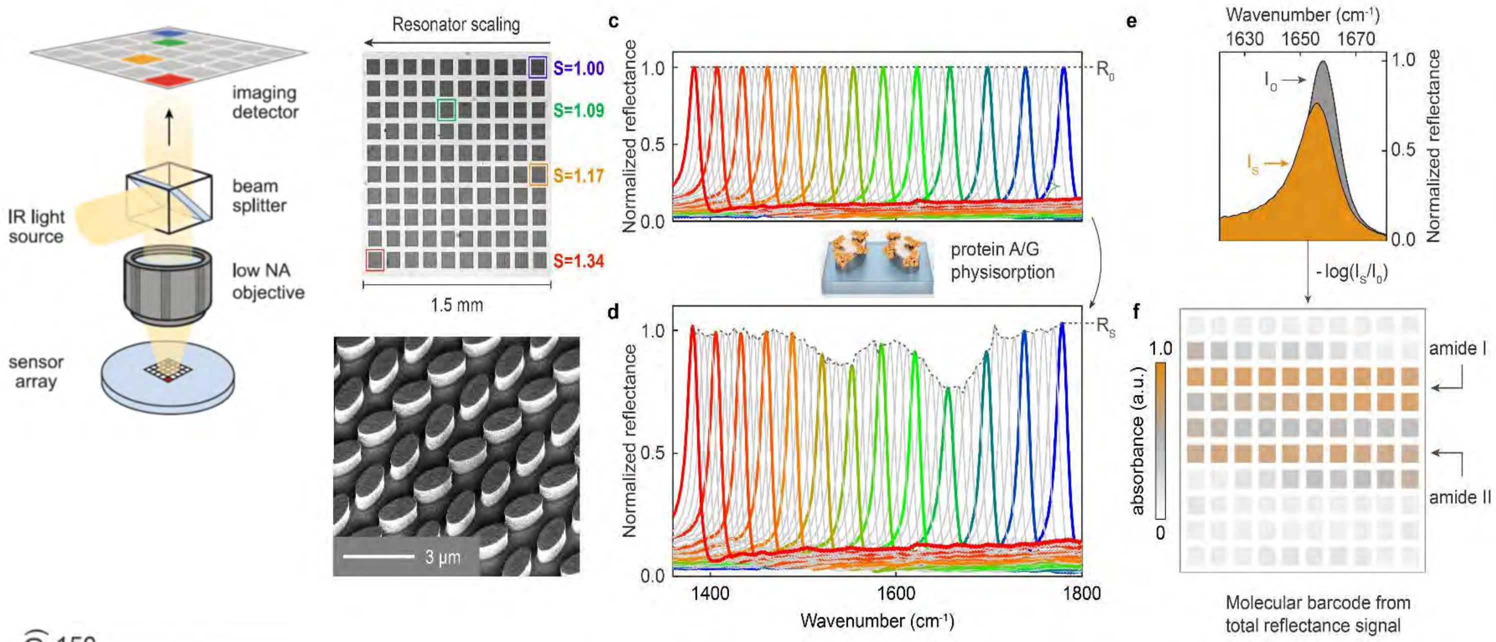
TABLE I. Comparison of Q factors measured under normal excitation conditions for all-dielectric metasurfaces.

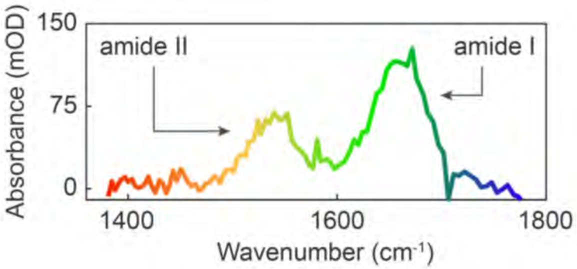
Year	References	Wavelength/nm	Q factor
2014	[37]	1376	483
2016	[38]	1000	350
2017	[39]	1500	300
2017	[29]	1300	1011
2018	[40]	1490	1946
2018	[32]	825	2750
2018	[33]	2320	150
2018	[26]	5700	200
2019	[27]	855	144
2019	This work	1588	18 511

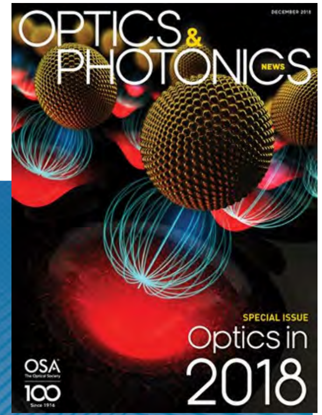


Z. Liu et al, Phys. Rev. Lett.**123**, 253901 (2019)

Pixelated metasurfaces for biosensing







RESEARCHERS

Andreas Tittl, Filiz Yesilkoy and Hatice Altug (hatice.altug@epfl.ch), École Polytechnique Fédérale de Lausanne, Lausanne, Switzerland

Stefan A. Maier, Imperial College London, London, U.K., and Ludwig-Maximilians-Universität München, München, Germany

Yuri S. Kivshar, Australian National University, Canberra, Australia

A. Tittle et al, Science 360, 1105 (2018)

Imaging-based molecular barcoding with pixelated dielectric metasurfaces

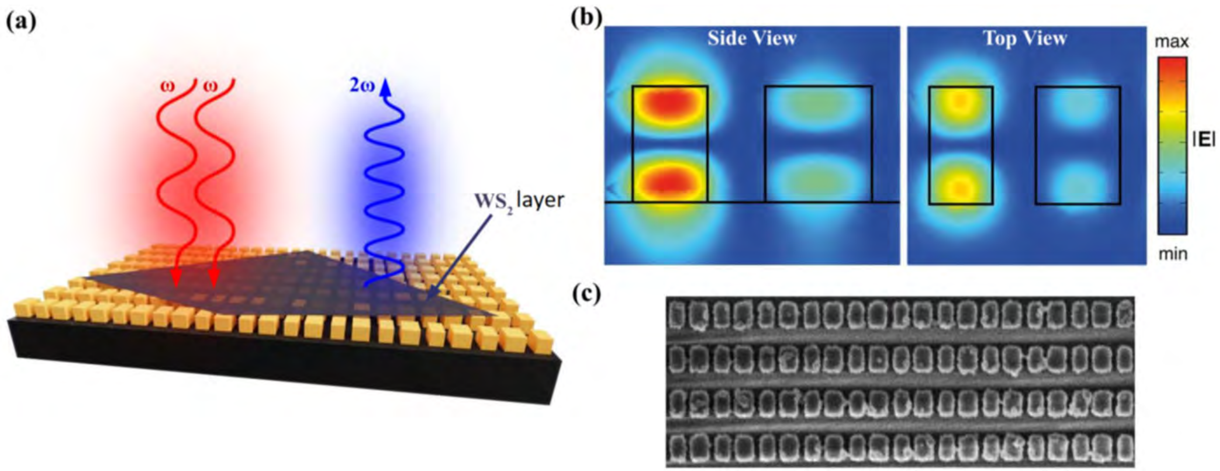
Ultrasensitive hyperspectral biosensing based on high-Q dielectric metasurfaces

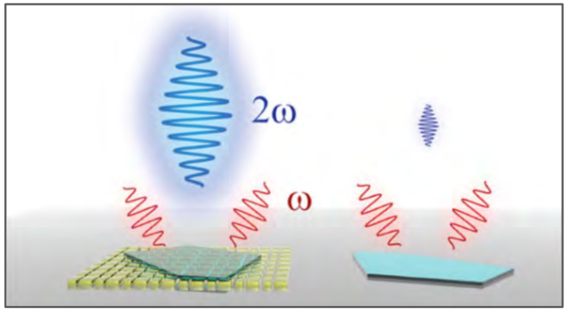
Filiz Yesilkoy[1], Eduardo Romero Arvelo[1,2], Yasaman Jahani[1], Mingkai Liu[3], Andreas Tittl[1], Volkan Cevher[2], Yuri Kivshar[3], and Hatice Altug[1*]

nature photonics

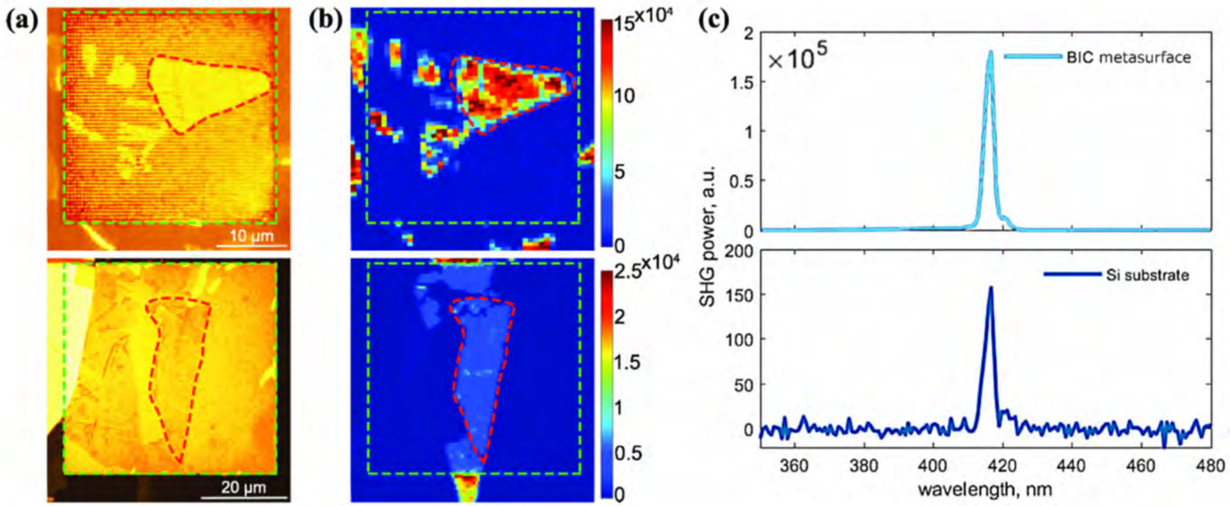
BIC-resonant metasurfaces and 2D materials

Collaboration with Alex Solntsev, UTS



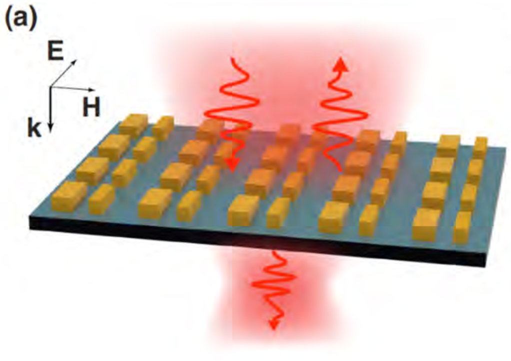


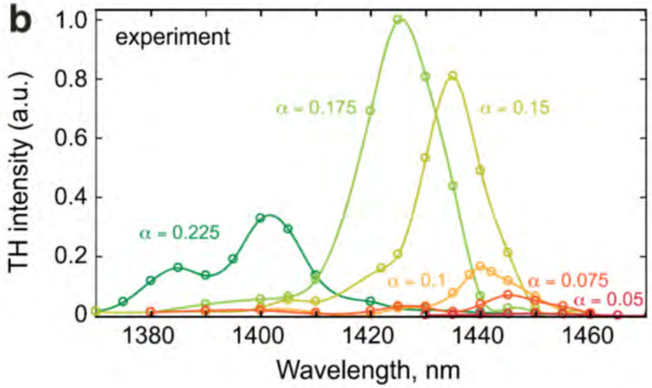
X 10^5 enhancement of SHG

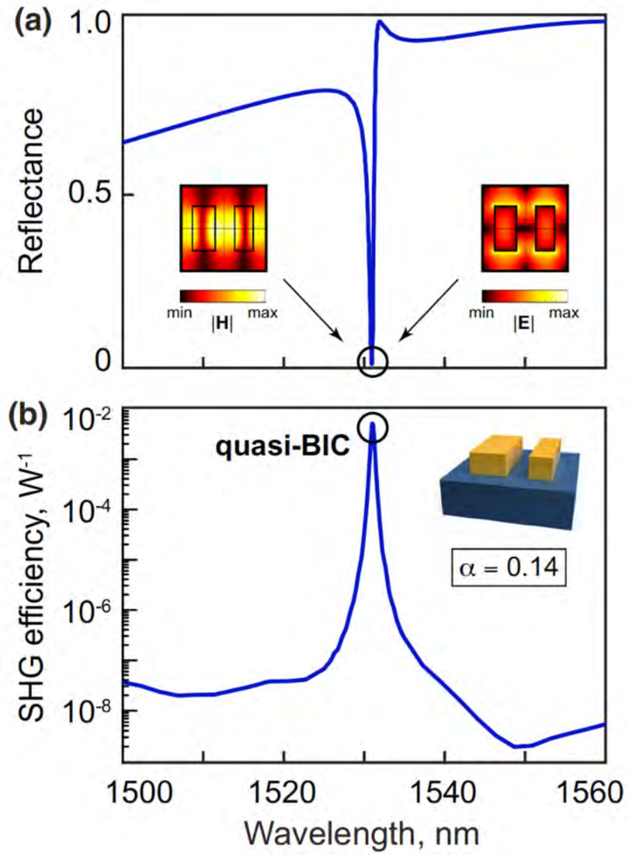


N. Bernhardt et al, Nano Lett. **20**, 5309−5314 (2020)

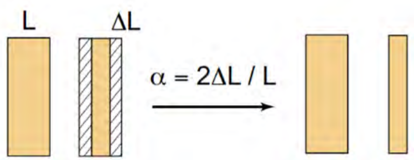
BIC-enhanced nonlinear effects

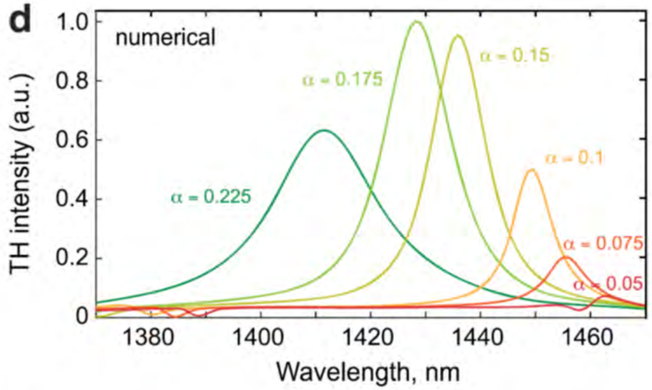


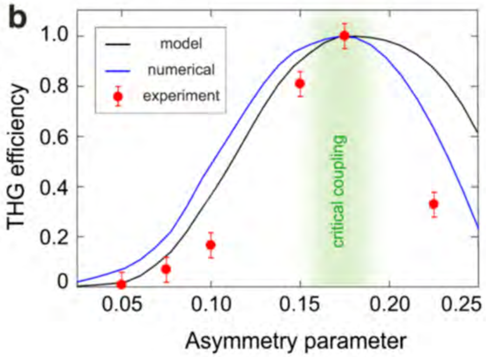




Breaking symmetry





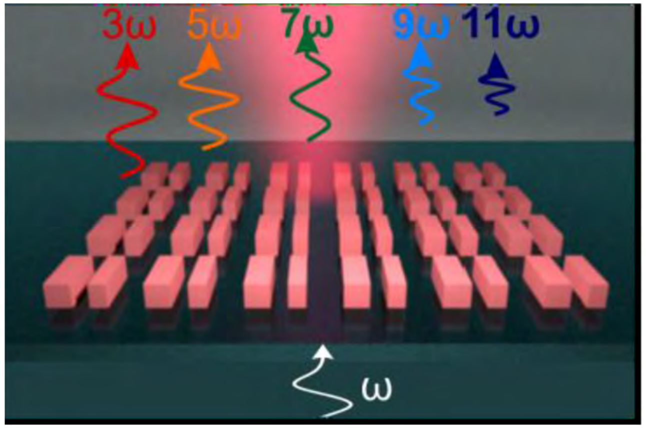


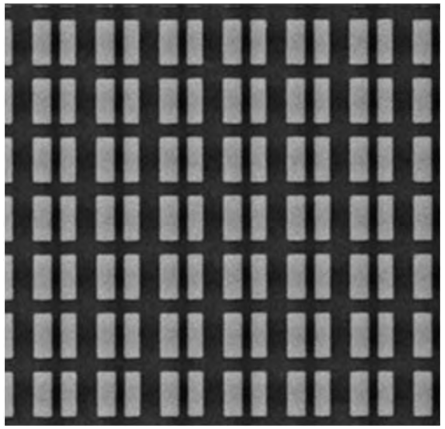
ACS Photonics
Letter
Cite This: ACS Photonics 2019, 6, 1639−1644
pubs.acs.org/journal/apchd5

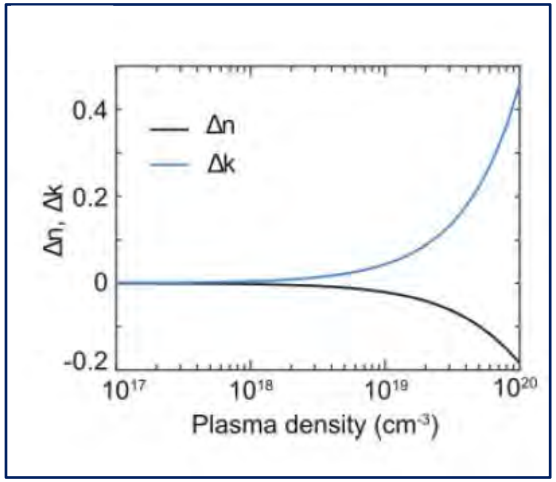
Nonlinear Metasurfaces Governed by Bound States in the Continuum

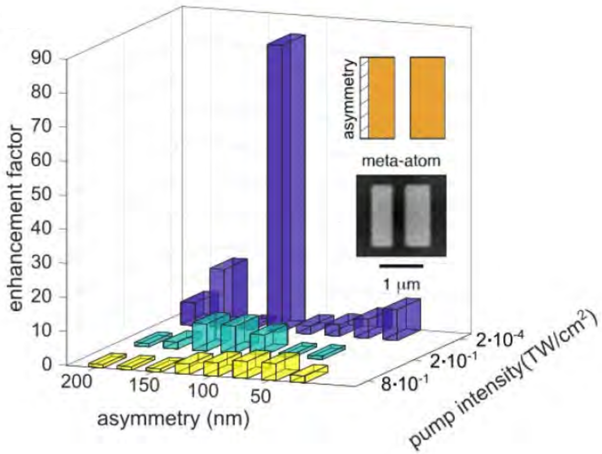
Kirill Koshelev,[*,†,‡] Yutao Tang,[§] Kingfai Li,[§] Duk-Yong Choi,[∥,⊥] Guixin Li,[§] and Yuri Kivshar[†,‡]

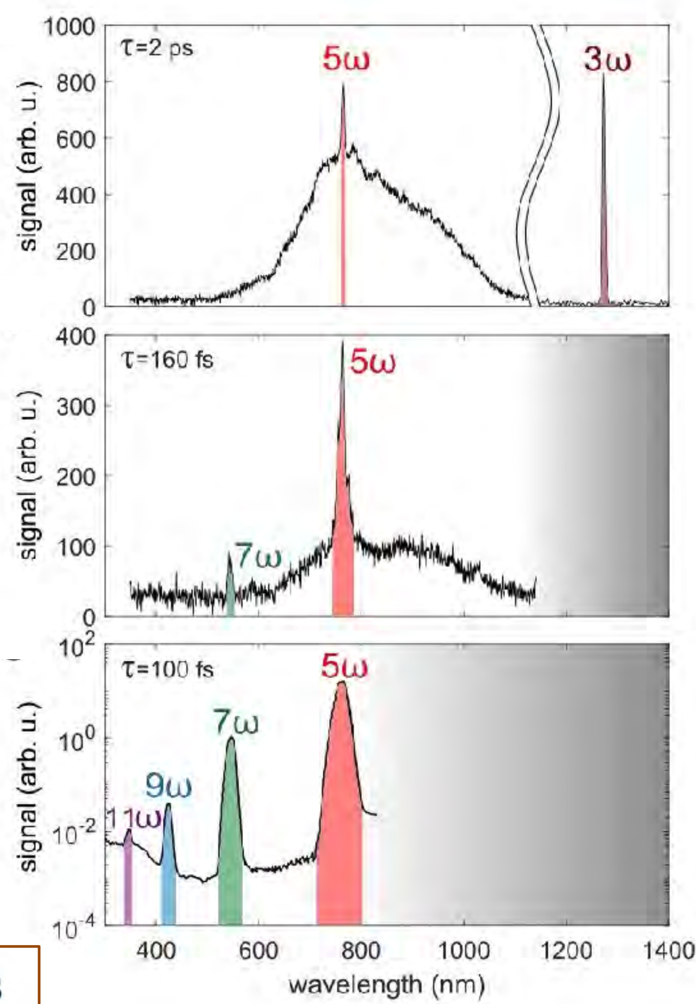
High-harmonic generation with BIC









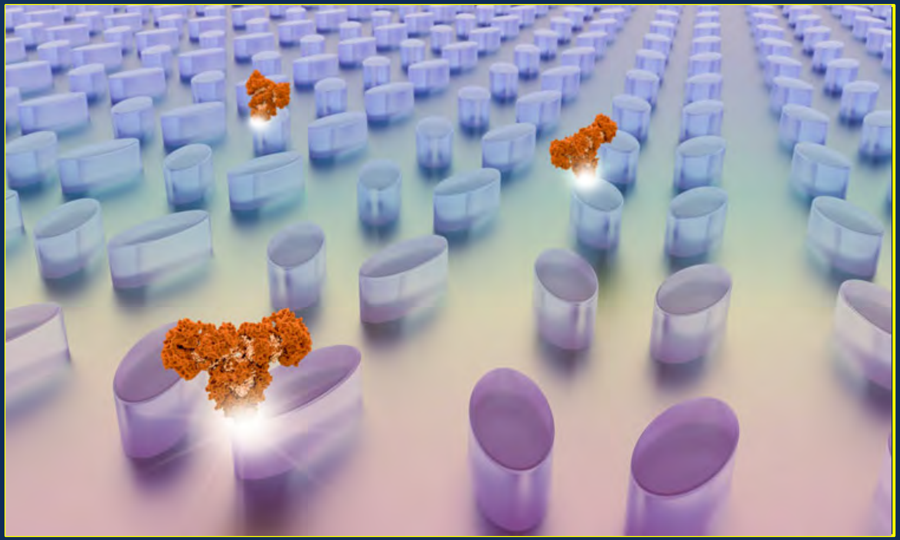


High-Harmonic Generation in Dielectric Metasurfaces Empowered by Bound States in the Continuum

George Zograf[1,2], Anastasia Zalogina[1], Kirill Koshelev[1,2], Duk-Yong Choi[3], Viacheslav Korolev[4], Richard Hollinger[4], Daniil Kartashov[4], Michael Zürch[5], Christian Spielmann[4], Sergey Makarov[2], Barry Luther-Davies[3], Sergey Kruk[1,*] and Yuri Kivshar[1,2]

CLEO May 2020, FTh1C.5
arXiv preprint: 2008.11481

What else you can do with BICs



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Vortices and ultrafast switching with BIC

nature photonics
ARTICLES
https://doi.org/10.1038/s41566-020-0658-1
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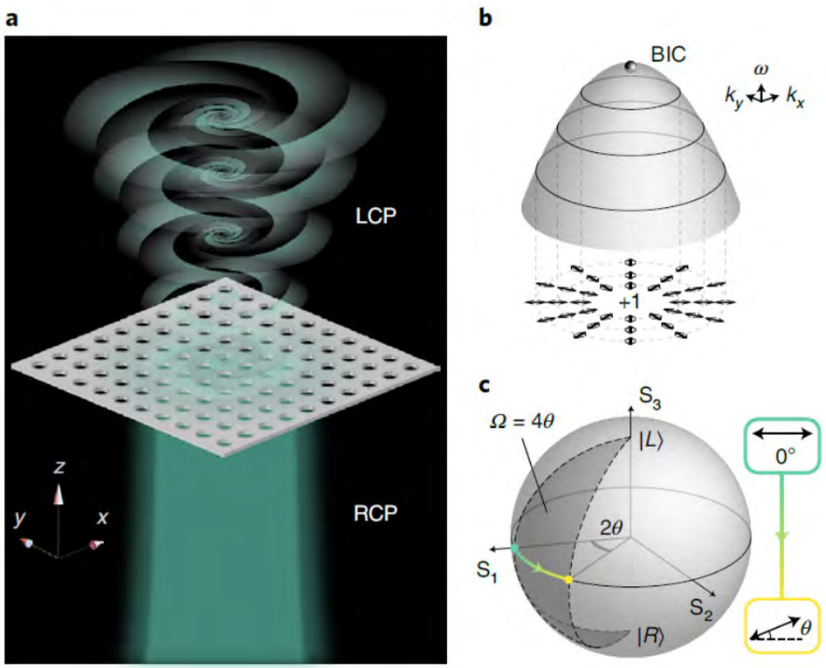
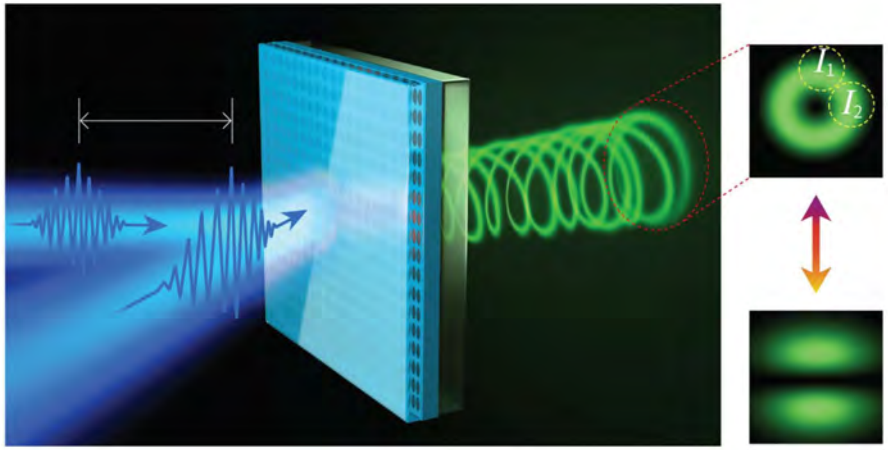
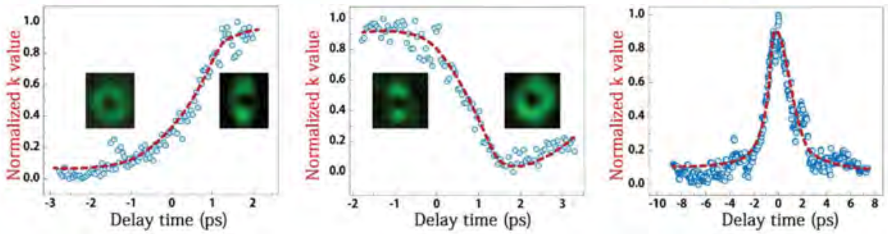
Generating optical vortex beams by momentum-space polarization vortices centred at bound states in the continuum

Bo Wang[1,4], Wenzhe Liu[1,4], Maoxiong Zhao[1,4], Jiajun Wang[1], Yiwen Zhang[1], Ang Chen[1], Fang Guan[1], Xiaohan Liu[1,2], Lei Shi[1,2] and Jian Zi[1,2,3]



Perovskite-based BIC microlasers





Science 367, 1018 (2020)

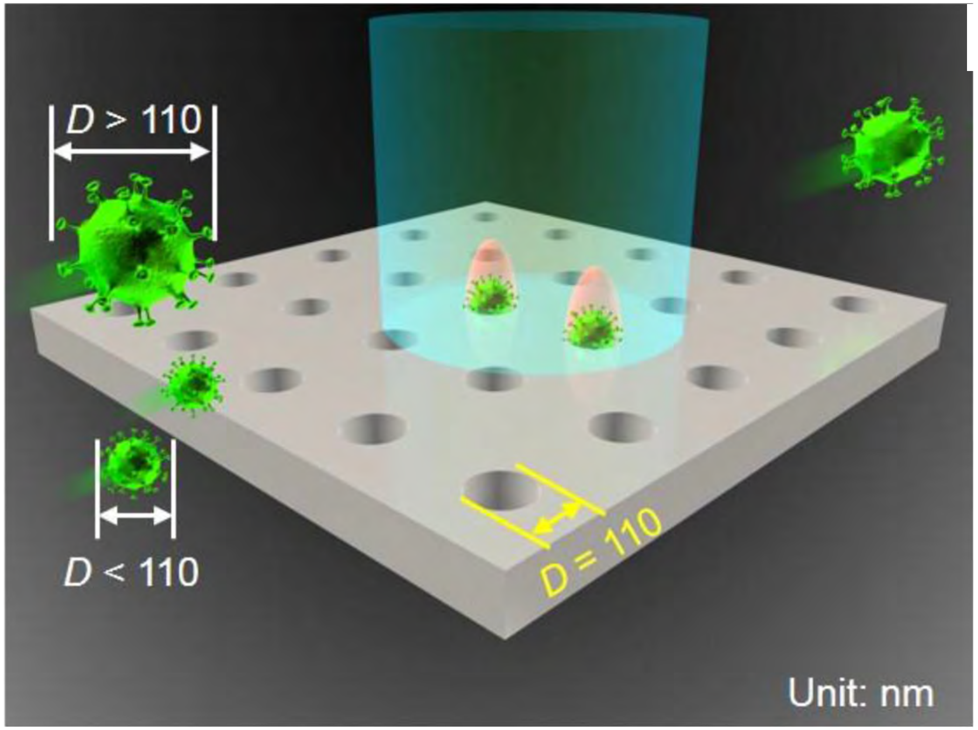
REPORT

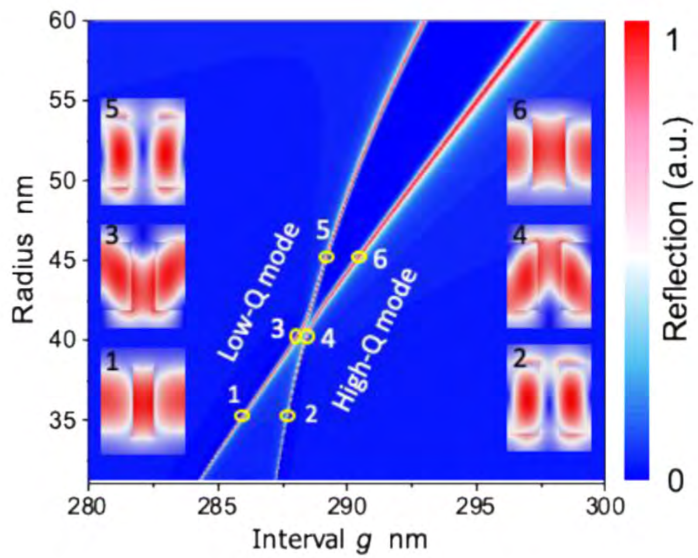
OPTICS

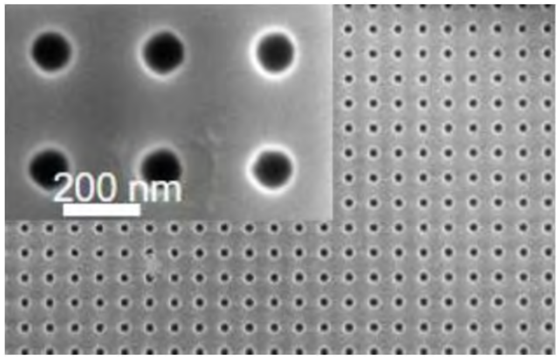
Ultrafast control of vortex microlasers

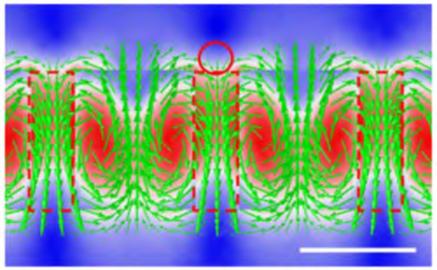
Can Huang[1], Chen Zhang[1], Shumin Xiao[1,2], Yuhan Wang[1], Yubin Fan[1], Yilin Liu[1], Nan Zhang[1], Geyang Qu[1], Hongjun Ji[1], Jiecai Han[2], Li Ge[3,4]*, Yuri Kivshar[5]*, Qinghai Song[1,6]*

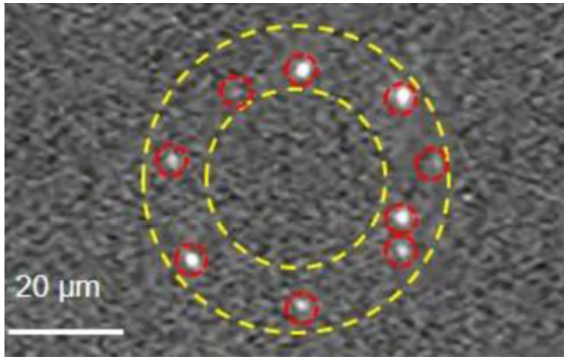
Virus manipulation with BIC cavities







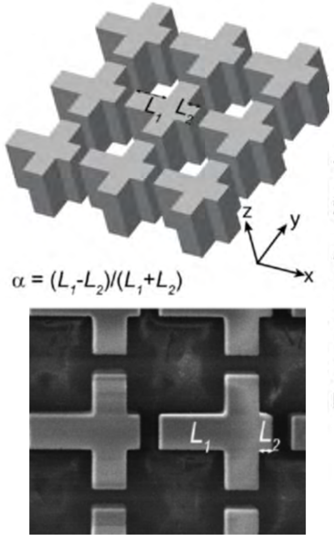


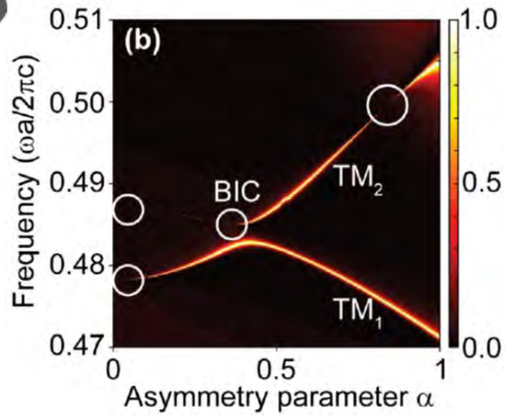


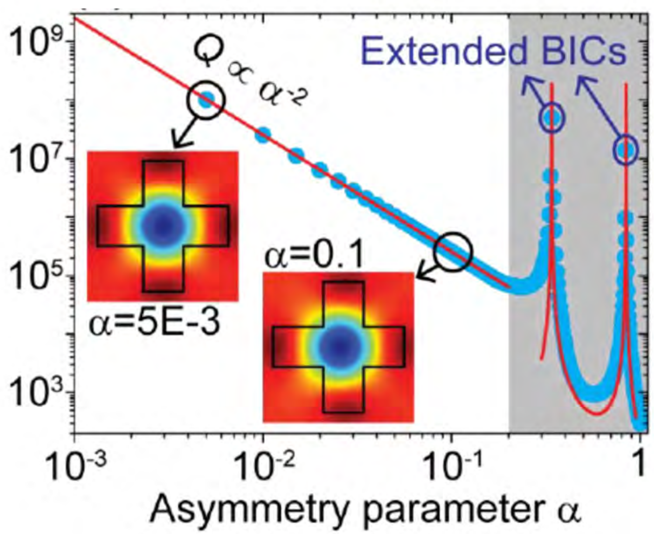
Collaboration with Din Ping Tsai (Hong Kong) and Ai Qun Liu Singapore)

BIC generalizations

Collaboration with Ranjan Singh







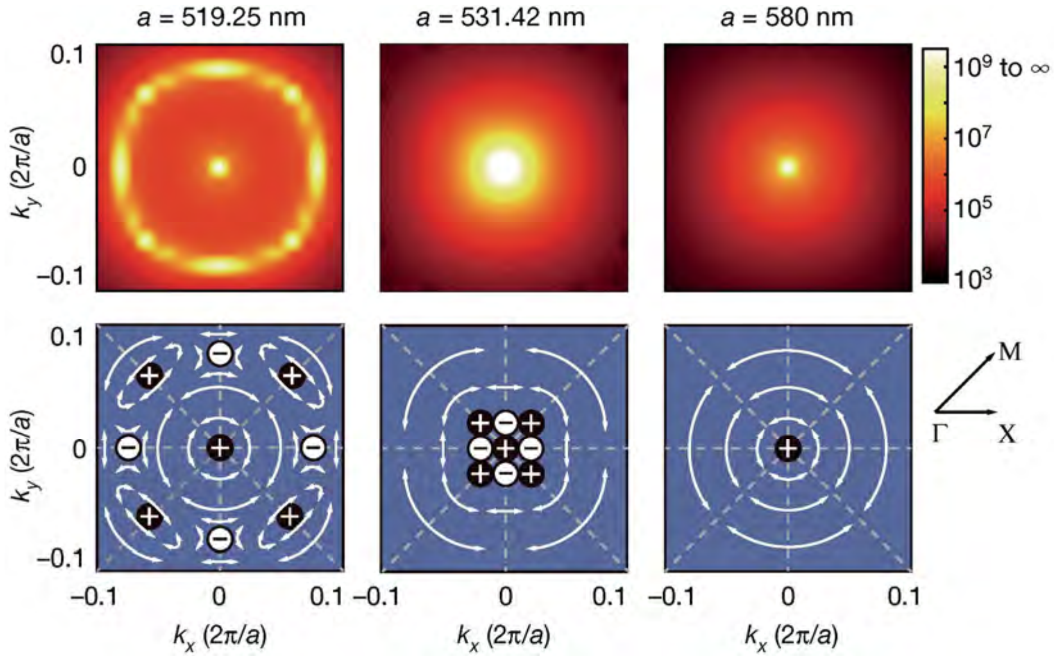
Article

Topologically enabled ultrahigh-*Q* guided resonances robust to out-of-plane scattering

https://doi.org/10.1038/s41586-019-1664-7

Jicheng Jin[1], Xuefan Yin[1], Liangfu Ni[1], Marin Soljačić[2], Bo Zhen[3] & Chao Peng[1,4*]

Measured Q factor = 5 x 10^5



Chiral BIC metasurfaces

PHYSICAL REVIEW LETTERS 125, 093903 (2020)

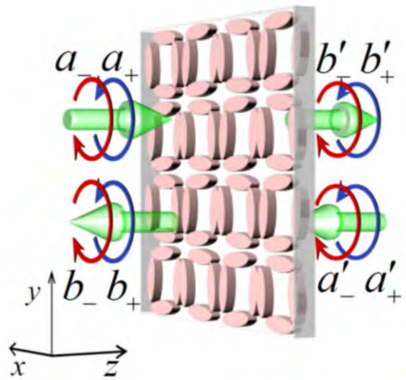
Editors' Suggestion

Metasurfaces with Maximum Chirality Empowered by Bound States in the Continuum

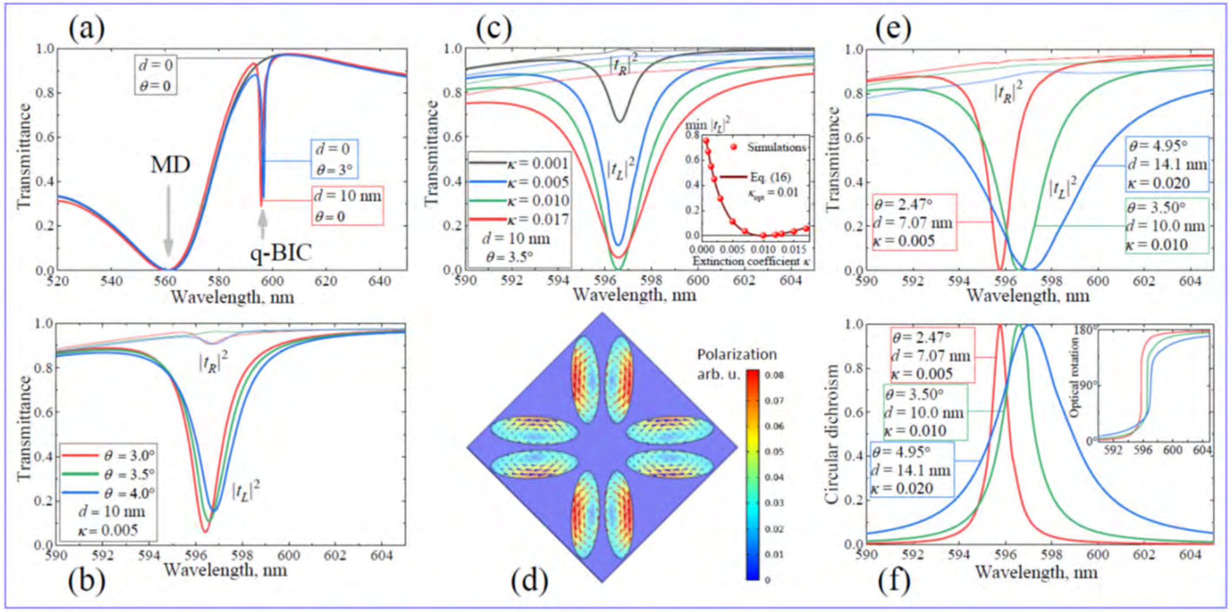
Maxim V. Gorkunov,[1] Alexander A. Antonov,[1] and Yuri S. Kivshar[2]

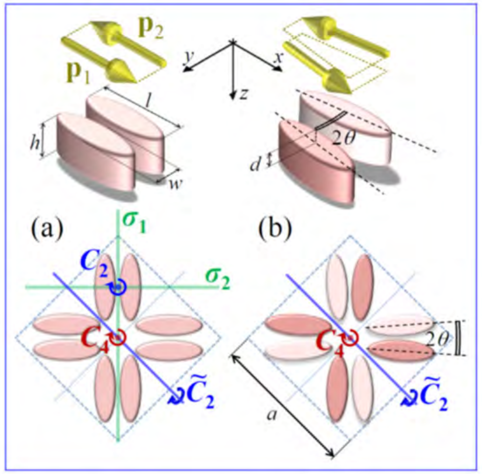
[1]*Shubnikov Institute of Crystallography of the Federal Scientific Research Centre "Crystallography and Photonics," Russian Academy of Science, Moscow 119333, Russia*

[2]*Nonlinear Physics Centre, Research School of Physics, Australian National University, Canberra ACT 2601, Australia*



Being uncoupled from one circular polarization and resonantly coupled to its counterpart, a metasurface hosting the chiral BIC resonance exhibits a narrow peak in the circular dichroism spectrum with the Q factor limited by weak dissipation losses



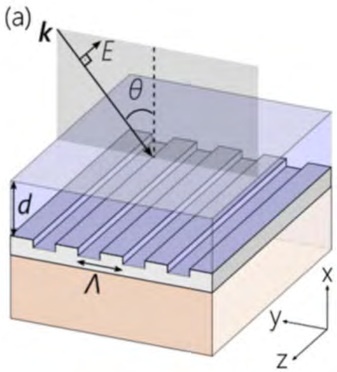


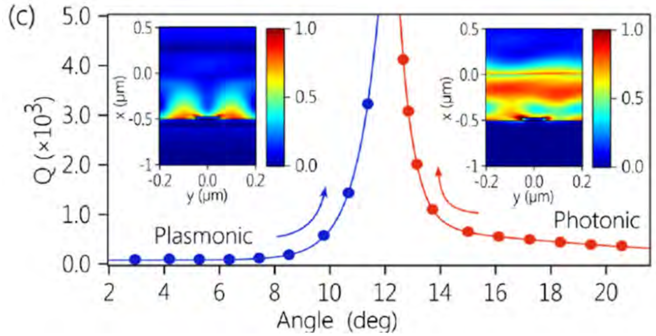
BICs in hybrid and plasmonic metasurfaces

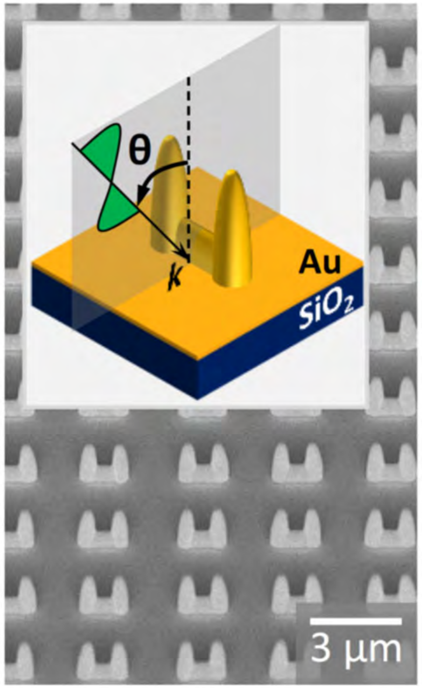
PHYSICAL REVIEW LETTERS **121,** 253901 (2018)

Formation of Bound States in the Continuum in Hybrid Plasmonic-Photonic Systems

Shaimaa I. Azzam,[*] Vladimir M. Shalaev,[†] Alexandra Boltasseva,[‡] and Alexander V. Kildishev[§]
School of Electrical and Computer Engineering and Birck Nanotechnology Center, Purdue University, West Lafayette, Indiana 47907, USA







NANO LETTERS
pubs.acs.org/NanoLett
Letter

1 **Bound States in the Continuum in Anisotropic Plasmonic**
2 **Metasurfaces**

3 Yao Liang,[▽] Kirill Koshelev,[▽] Fengchun Zhang,[▽] Han Lin, Shirong Lin, Jiayang Wu, Baohua Jia,[*]
4 and Yuri Kivshar[*]

Cite This: https://dx.doi.org/10.1021/acs.nanolett.0c01752 Read Online

Conclusion: a new life of optical metamaterials

- Metamaterials is still an active research field (but now often appears under a new brand name of meta-optics or metaphotonics), that promises many applications in photonics and subwavelength optics;

- Dielectric nanoparticles with high refractive index can be implemented for many metaphotonics phenomena governed by Mie resonances;

- Many novel effects originate from multipolar interferences and the magnetic field enhancement, and they drive novel functionalities of all-dielectric resonant metasurfaces and metadevices

- Recent many advances in meta-optics and nanophotonics are associated with the physics of bound states in the continuum which appear due to strong coupling of guided leaky modes combined with Mie resonances

Questions, comments, and collaboration proposals:

Yuri Kivshar <yuri.kivshar@anu.edu.au>