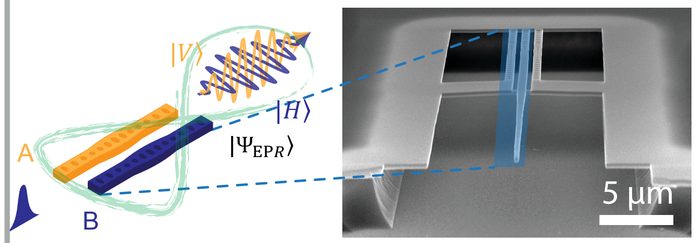
Conclusions & Outlook

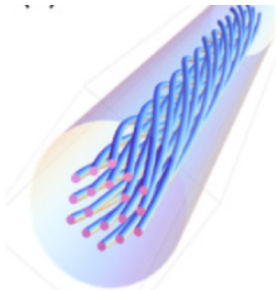
- Fundamental and technological challenges
- Bridge radio and optical frequencies
- Nonlinear optical interactions to write and read information (including quantum)
- Interface with molecular vibration
- OM cavities and waveguides based on active materials

Optomechanical quantum teleportation



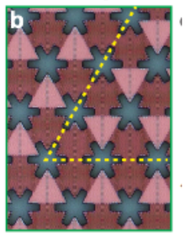
Fiaschi, et al. Nature Photonics 15, 817-821 (2021)

Chiral interaction



Xinglin Zeng, Photon. Res. 10, 711-718 (2022)

Topological transport



Ren et al, arXiv:2009.06174 (2021)

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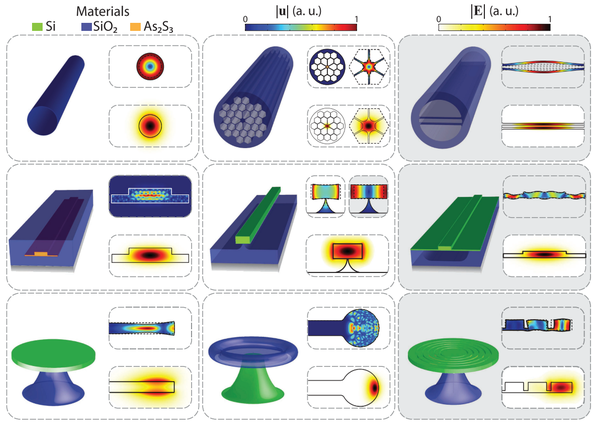

APL Photonics **4**, 071101 (2019)

Volume 4, Issue 7, Jul. 2019

Brillouin optomechanics in nanophotonic structures

APL Photon. **4**, 071101 (2019); doi.org/10.1063/1.5088169

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The man-powered machine learning

Linear Optomechanics

- Displacement detection
- Optical Spring
- Cooling & Amplification
- Two-tone drive: "Optomechanically induced transparency"
- Ground state cooling
- State transfer, pulsed operation
- Wavelength conversion
- Radiation Pressure Shot Noise
- Squeezing of Light
- Squeezing of Mechanics
- Light-Mechanics Entanglement
- Accelerometers
- Single-quadrature detection, Wigner density
- Optomechanics with an active medium
- Measure gravity or other small forces
- Mechanics-Mechanics entanglement
- Pulsed measurement
- Quantum Feedback
- Rotational Optomechanics

Multimode

- Mechanical information processing
- Bandstructure in arrays
- Synchronization/patterns in arrays
- Transport & pulses in arrays

Nonlinear Optomechanics

- Self-induced mechanical oscillations
- Attractor diagram?
- Synchronization of oscillations
- Chaos

○ White: yet unknown challenges/goals

Nonlinear Quantum Optomechanics

- QND Phonon number detection
- Phonon shot noise
- Photon blockade
- Optomechanical "which-way" experiment
- Nonclassical mechanical q. states
- Nonlinear OMIT
- Noncl. via Conditional Detection
- Single-photon sources
- Coupling to other two-level systems
- Optomechanical Matter-Wave Interferometry

Florian Marquardt, 2014