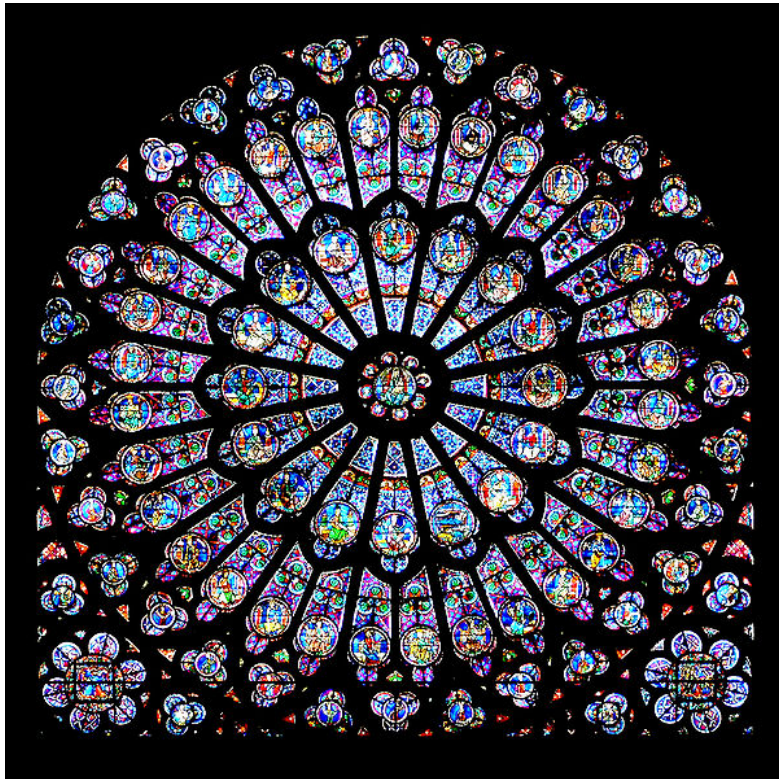


Metamaterials

Properties are more than the sum of their parts...



Glass with metal nanoparticles
Gothic rose window, Notre Dame



Air with wrought iron
Eiffel Tower

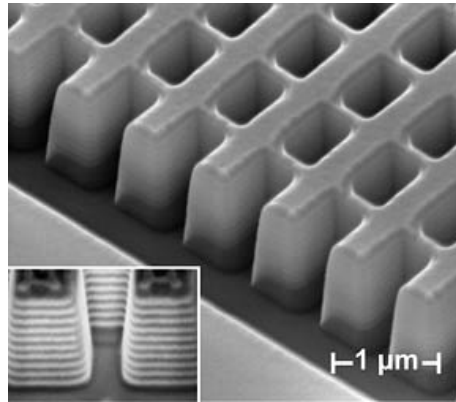
Metamaterials

Enable exotic optical and mechanical properties...

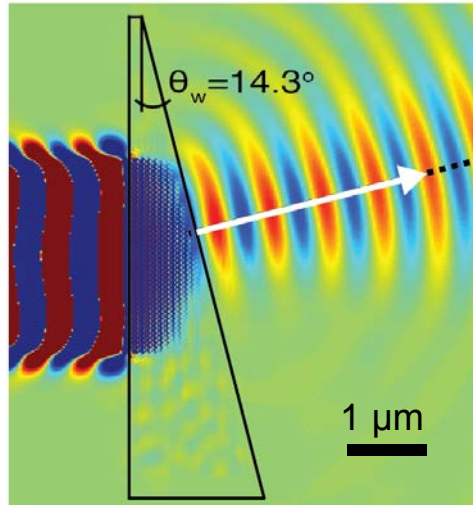
Negative refraction



Dolling, *Optics Express* (2006)

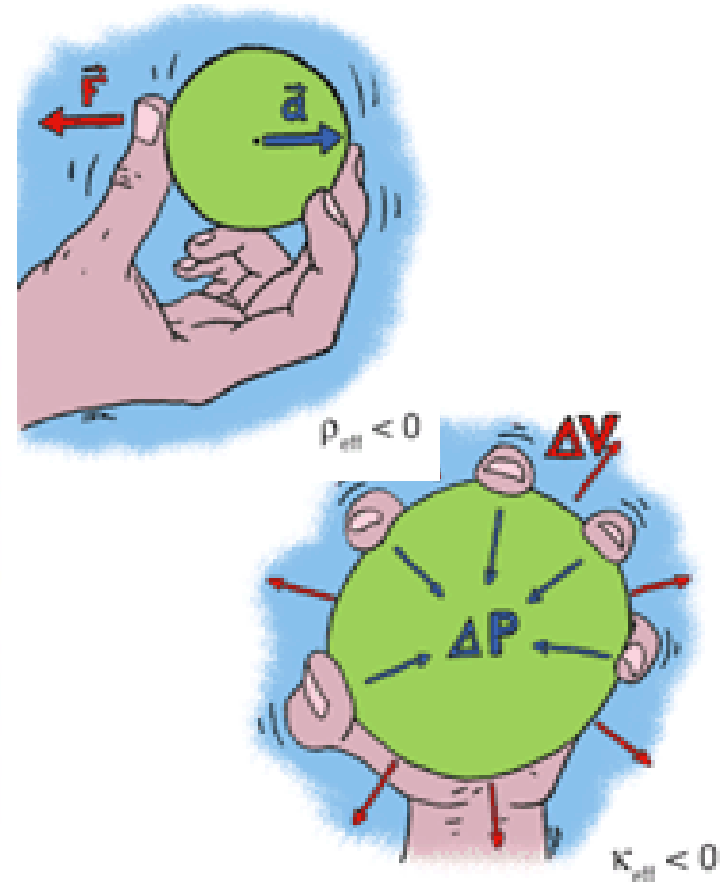


Valentine, *Nature* (2008)



Atre, *Advanced Optical Materials* (2013)

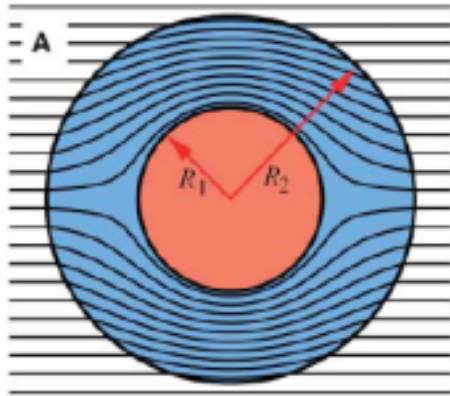
Negative mass density and bulk modulus



Brunet, *Science* (2013)

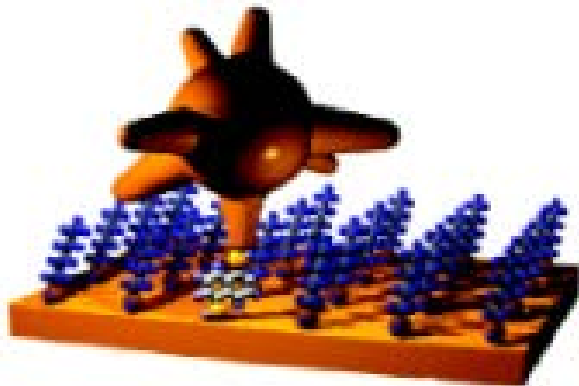
Metamaterials

Designer materials for unique challenges



**Scattering Control;
'Cloaking'**

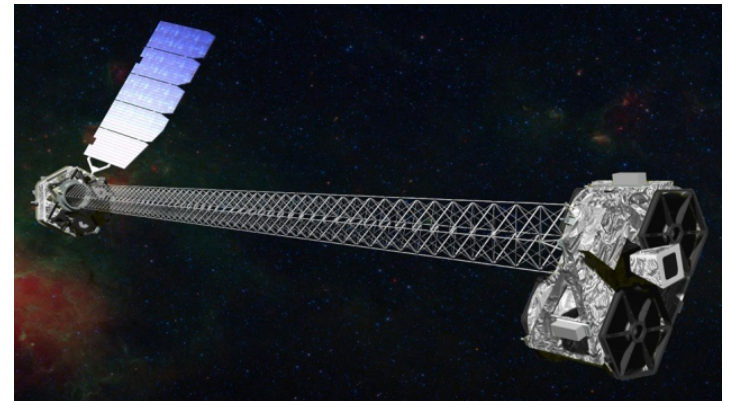
Pendry 2006 Science



**Critical damping of
vibrations**

**Single Molecule
Spectroscopy**

Rodriguez-Lorenzo 2009 J.ACS



NuSTAR deployable mast



Metamaterials

New frontiers in infrared and mechanical materials

Julia Greer, *California Institute of Technology*

Materials by design

Christopher Spadaccini, *Lawrence Livermore National Labs*

Mechanical Metamaterials

Andrea Alu, *University of Texas at Austin*

Metamaterial-based device engineering

Alexandra Boltasseva, *Purdue University*

Catching light rays: refractory plasmonics applications

Jennifer Dionne, *Stanford University*

Luke Sweatlock, *Northrop Grumman Aerospace Systems*