Applied Electromagnetics Laboratory

Department of ECE
University of Houston

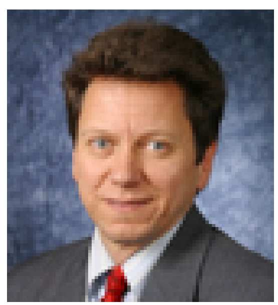
Overview of Present and Recent Research Projects

http://www.egr.uh.edu/ael/

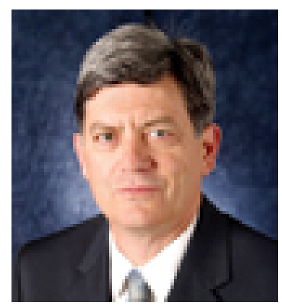
EM Faculty

Ji Chen	Ph.D.	1998	U. Illinois
David Jackson	Ph.D.	1985	UCLA
Stuart Long	Ph.D.	1974	Harvard
Don Wilton	Ph.D.	1970	U. Illinois

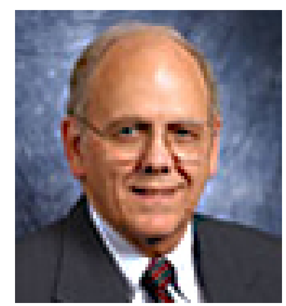
Ji Chen



David Jackson



Stuart Long



Don Wilton

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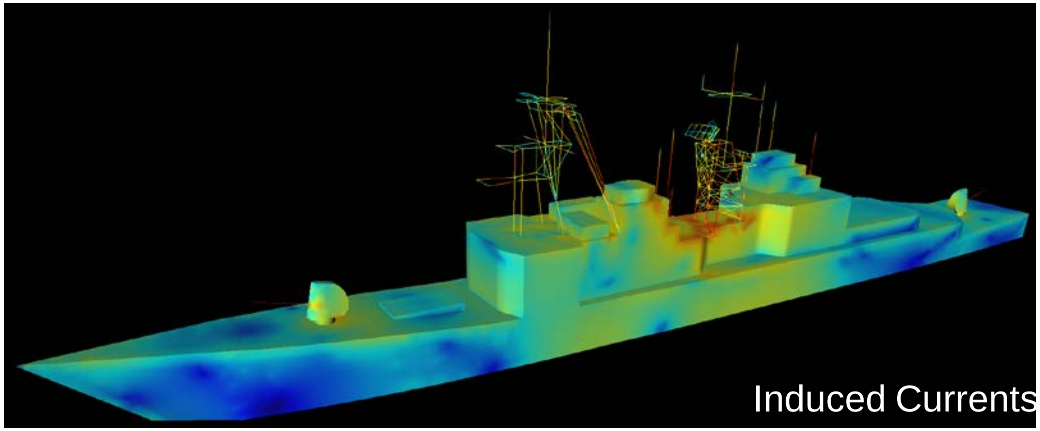
Computational ElectroMagnetics

One of the most significant challenges in computational electromagnetics (CEM) is the development of powerful simulation tools that can model very large and complex structures – such as an entire ship!

Navy Destroyer



Induced Currents

The Applied Electromagnetics group has played a key role in developing a powerful CEM simulation tool called EIGER (Electromagnetic Interactions GEneRalized). The figures above show a Navy Destroyer being modeled with EIGER. The icons below show the participating team members who have developed EIGER (Lawrence Livermore National Laboratory, Sandia National Laboratory, University of Houston, SPAWAR (Navy), NASA, and ANT-S).

SPAWAR
Systems Center
San Diego

ANT-S

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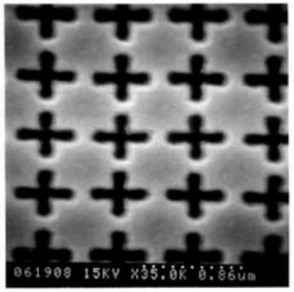
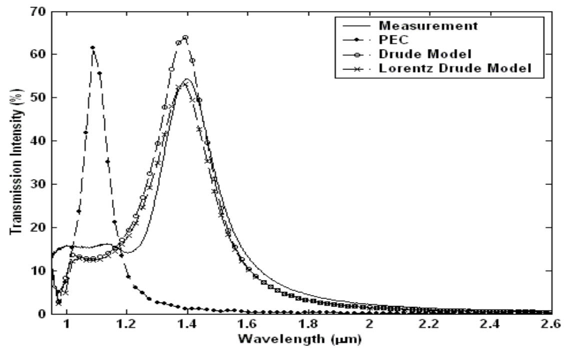
Time-Domain EM Modeling and Applications

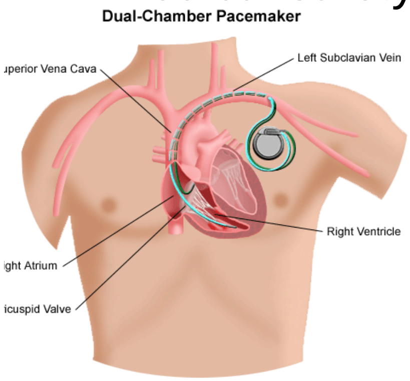
Time-domain EM modeling tools provide capability for transient and harmonic electromagnetic analysis for complex geometries. Application areas include nano-scale EM effects and the design of medical devices.

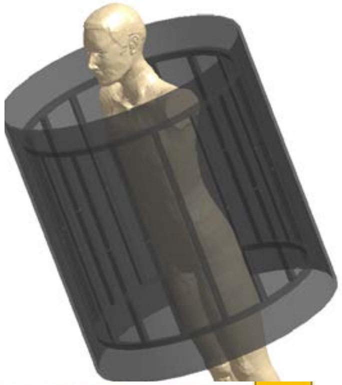
Nano-scale FSS modeling

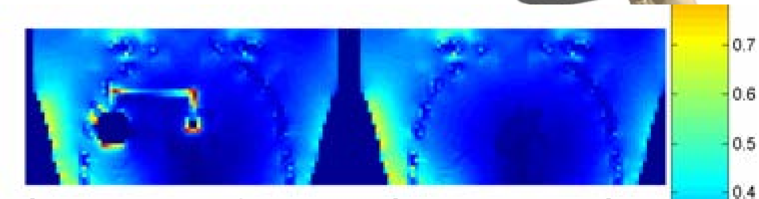




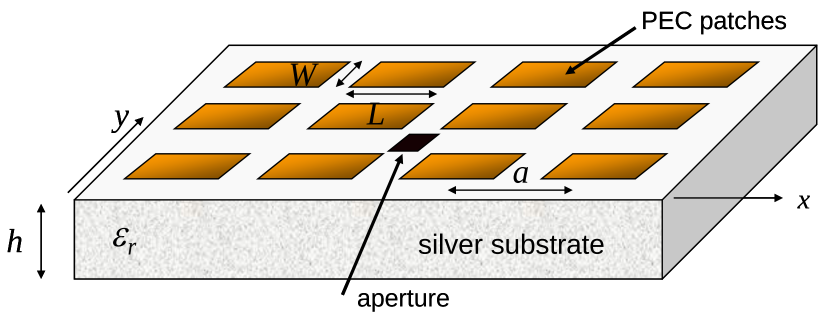
medical safety in MRI



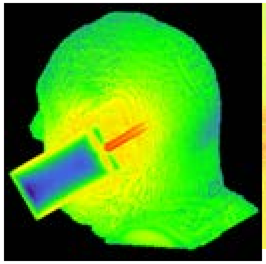


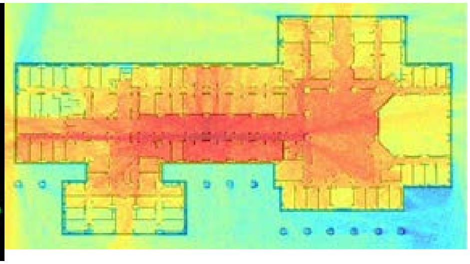


Design of periodic structures



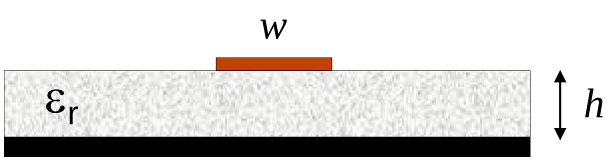
wireless safety and propagation study





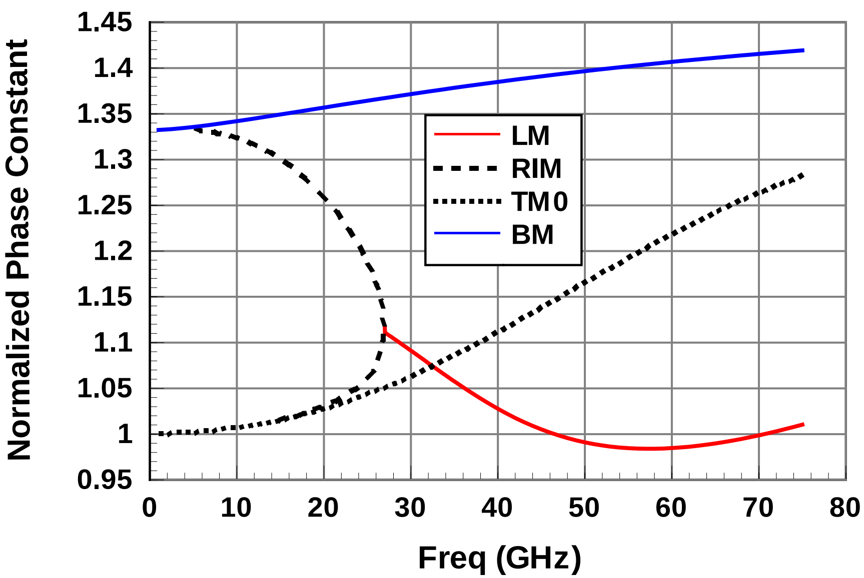
High-Frequency Effects

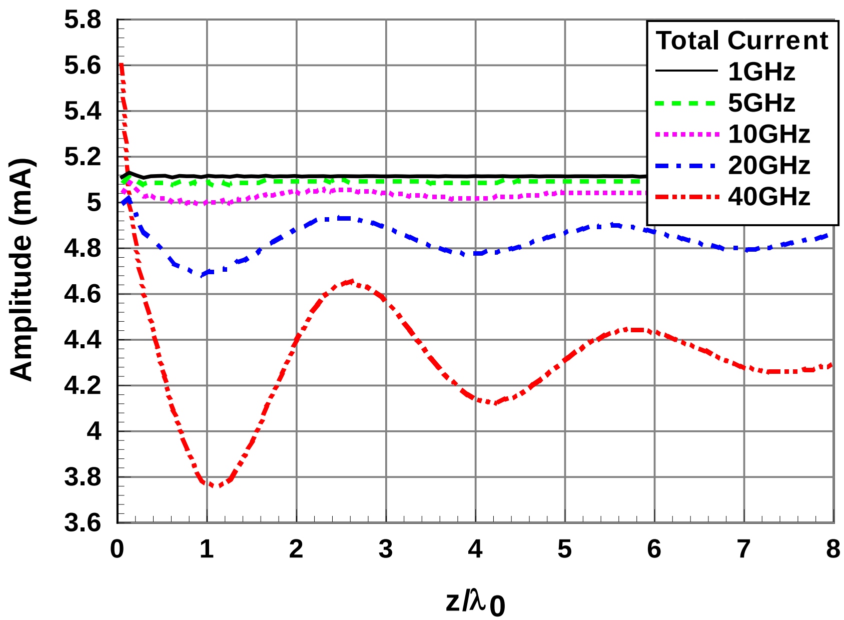
High-frequency effects that occur on microwave integrated circuits are of increasing concern. At high frequency leaky modes (radiating types of modes) may be excited, resulting in significant interference and other effects.



side view

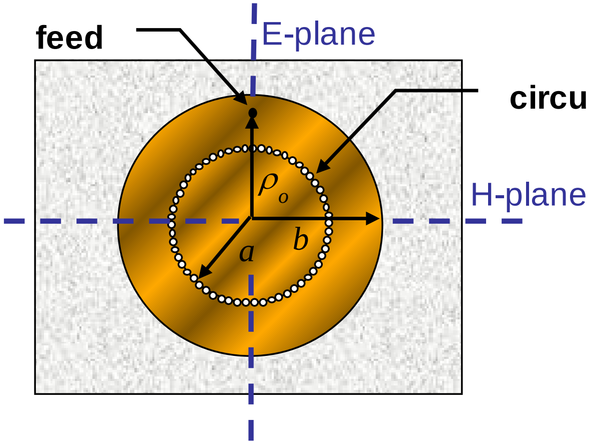
The figure on the left shows a microstrip line, a typical structure for which leaky modes may be excited at high frequency. The figure at the bottom left shows that a leaky mode (red curve) exists above about 27 GHz. Because of the leaky mode, a large amount of interference effects are observed at higher frequencies in a plot of the current on the line versus distance from a gap voltage source, as seen in the figure on the lower right.

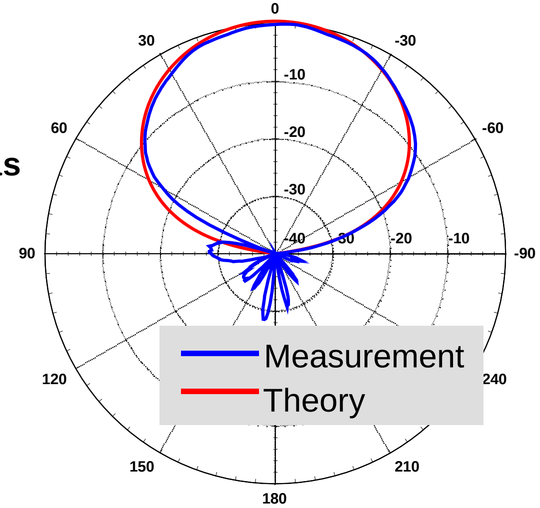


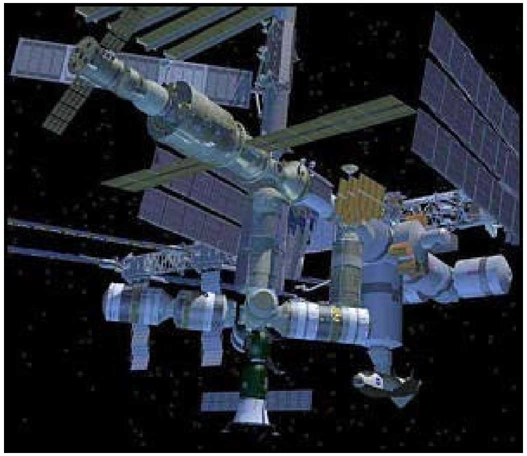


Microstrip Antennas

Microstrip antennas are commonly used at microwave frequencies due to their low-profile nature, simplicity, small size, and low cost. They can be easily manufactured by using photolithographic techniques.





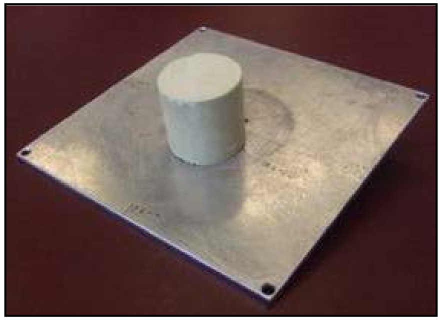


RSW Microstrip Antenna

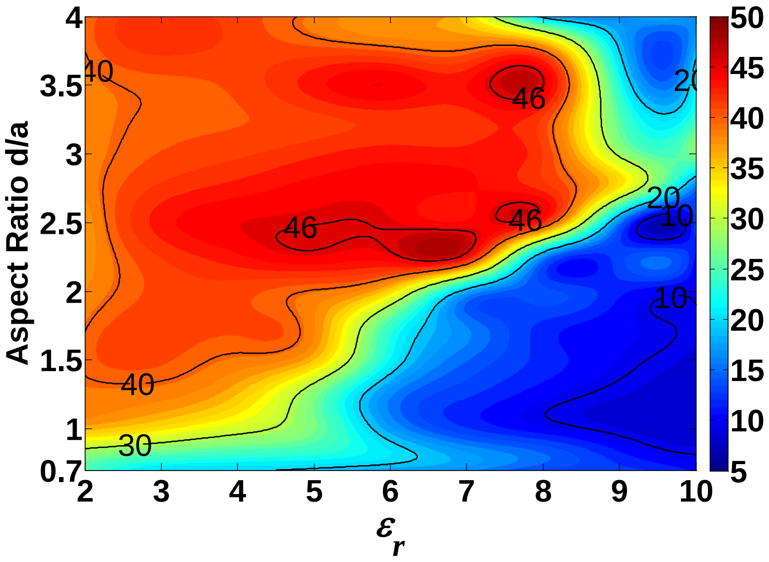
The example shown here is a type of microstrip antenna called the “Reduced Surface Wave” (RSW) antenna. It has low levels of radiation at the horizon, making it well-suited for applications such as GPS, where ground reflections could be a problem.

Dielectric Resonator Antennas

These are efficient high-frequency antennas made from dielectric material, which eliminate the effects of conductor loss.



A significant bandwidth enhancement has been achieved by properly dimensioning a cylindrical DRA.



Impedance bandwidth (SWR ≤ 2.0)

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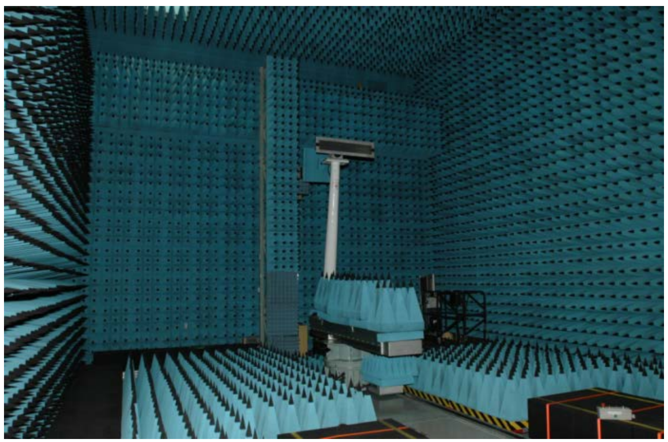
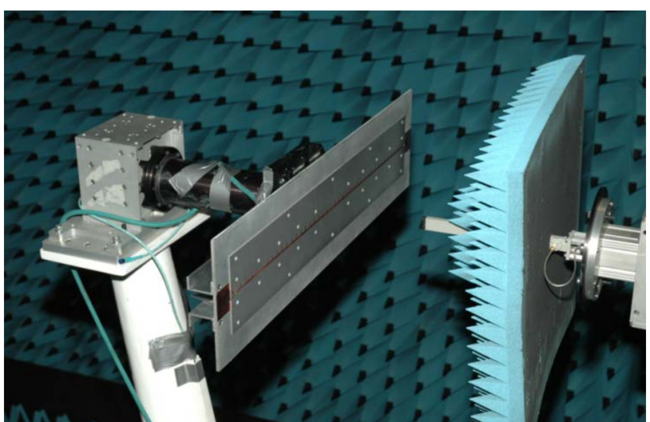
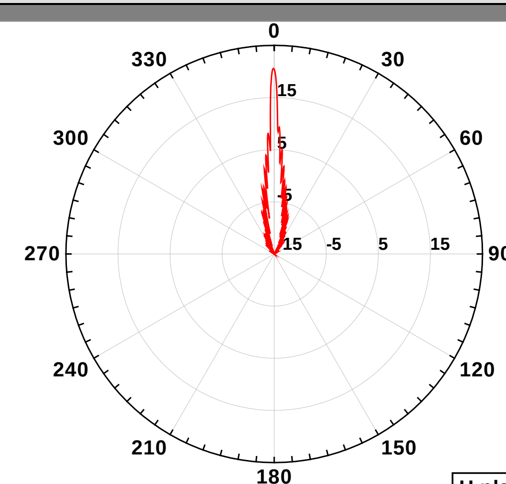
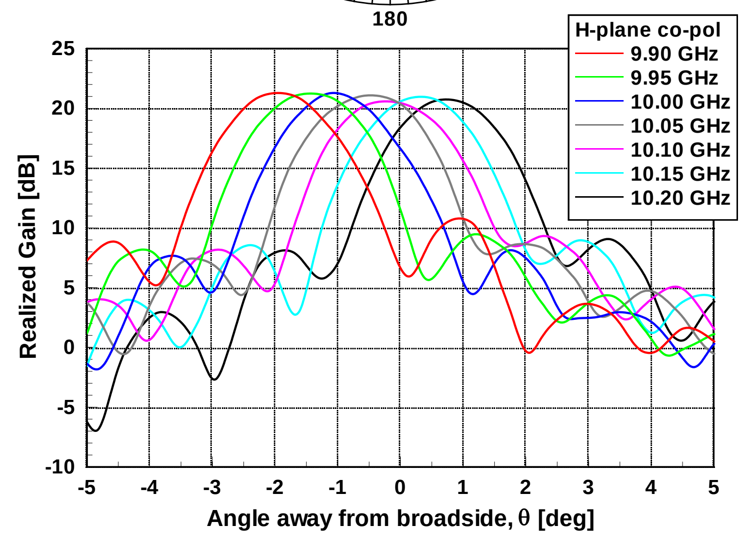
Leaky-Wave Antennas

Novel periodic leaky-wave antennas have been developed, which allow for a continuous beam scan from the backward region to the forward region.









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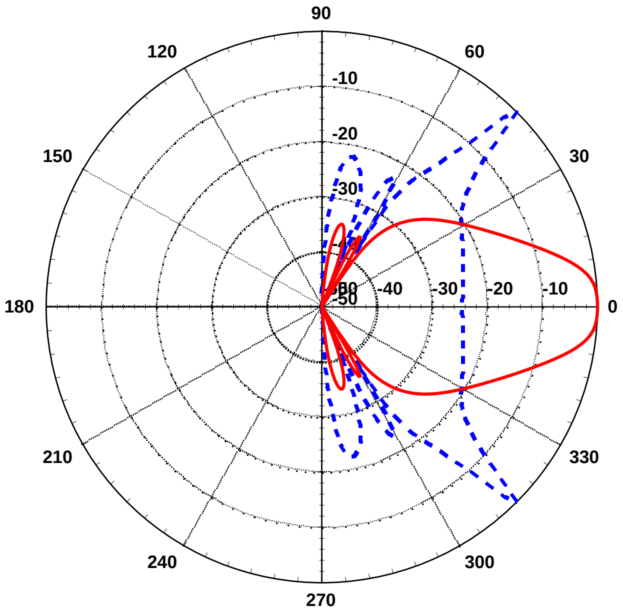
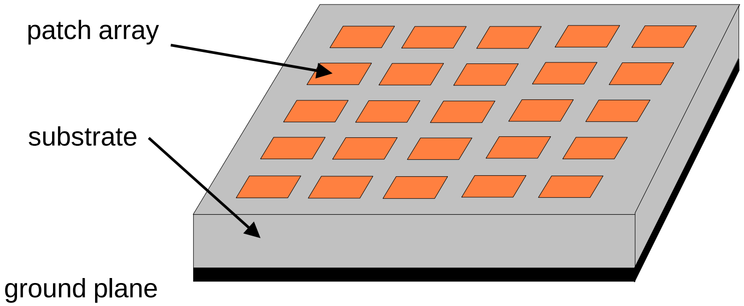
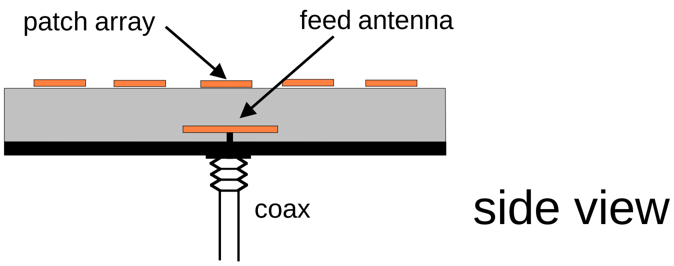
Two-Dimensional Leaky-Wave Antennas

Leaky-wave antennas are simple structures that can provide highly-directive radiation patterns at microwave and millimeter-wave frequencies.







The above figure shows a planar leaky-wave antenna consisting of a periodic array of metal patches that is placed over a ground substrate. The structure is excited by a simple feed antenna.

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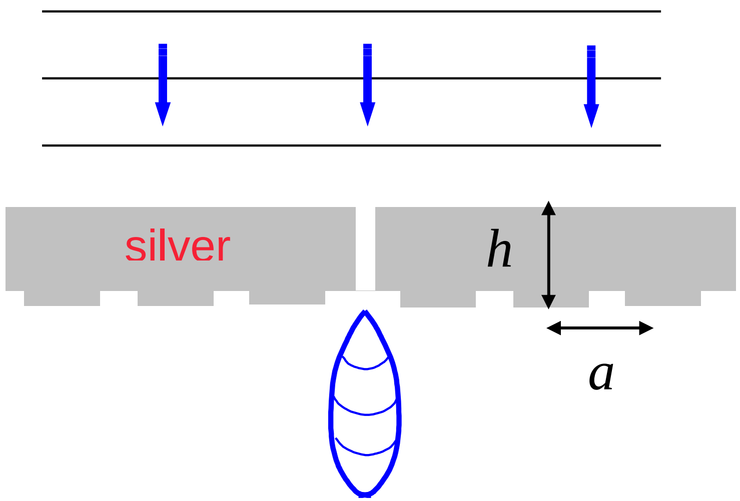
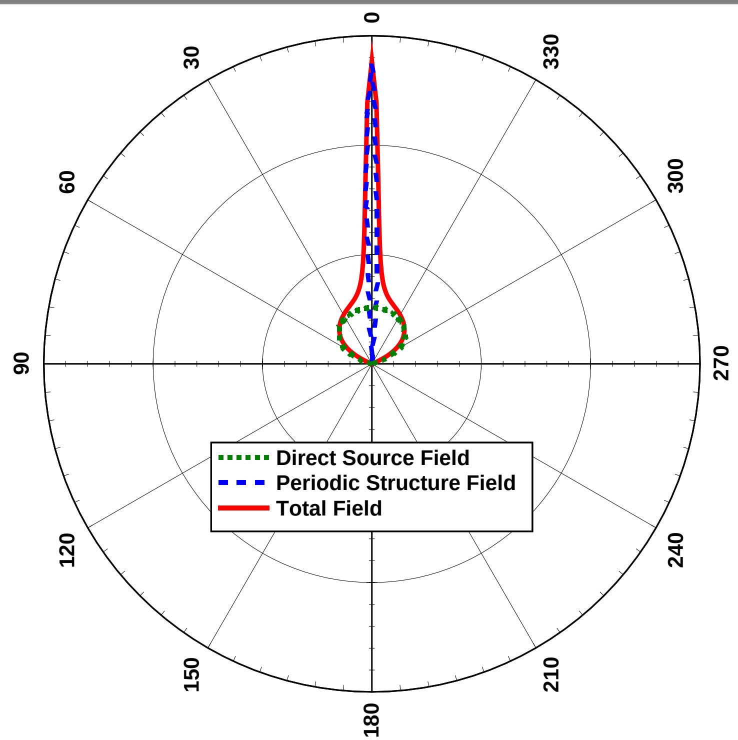
Plasmon Enhanced Optics

Plasmon-enhanced optics can be used to greatly increase the transmission of power through a small sub-wavelength hole in a metal film. It can also be used to create very narrow beams of light from a small hole.

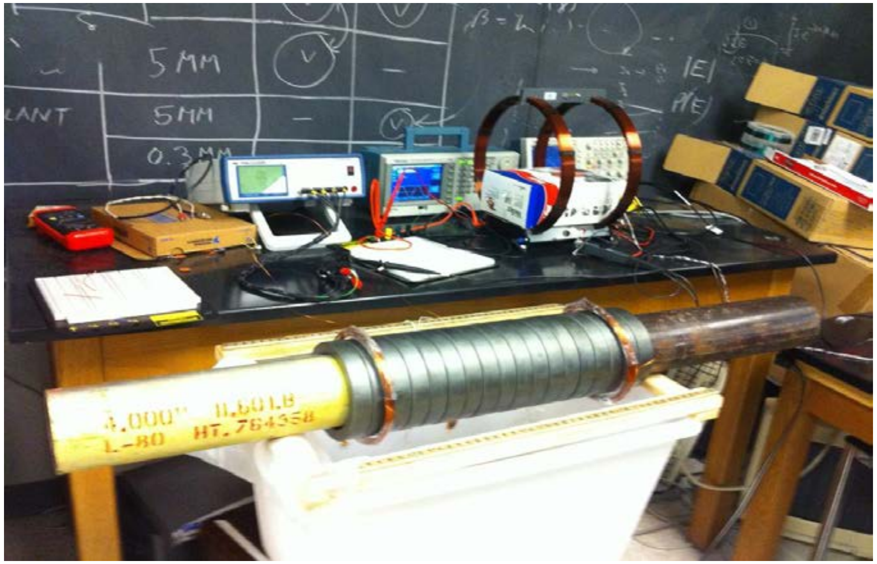


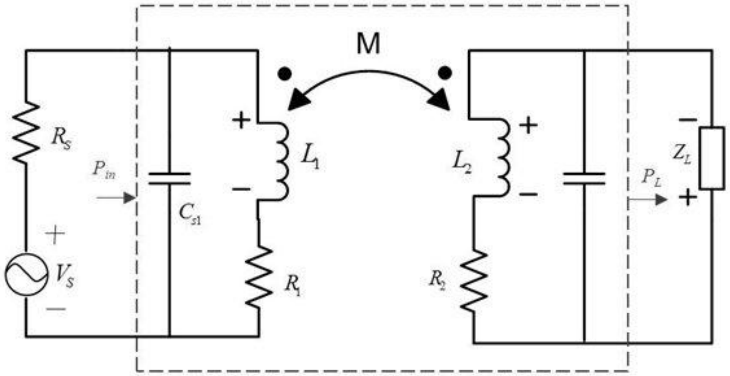


In the structure shown above on the left, a periodic structure is shown on the exit side of a metal (silver) film, surrounding a small hole in the film. The use of such periodic structure can create a sharp beam in the exit region, as shown in the figure on the right.

Wireless Power Transmission

Wireless power transmission is being explored for geophysical applications.





Power is transmitted wirelessly from a transmit coil to a receive coil, in order to power a sensor underground.