Tailoring Materials and Radiation to Explore Cloaking Phenomena
Why Study Cloaking?

• Radiation/Matter Interactions
  – Fundamental in the study of bio-system light harvesting

• Uncountable applications of being able to make something invisible
Index of Refraction

- The path of light will bend at the interface between two media
- Index of refraction is determined by the electrical properties of the atoms in both materials
- Could light be guided around an object by varying this at every point?

Figure 1.1: Light bending at the interface between two materials
Metamaterials

- Made up of many different “atoms”
- These elements can be fabricated so that each one has a different index of refraction
- Light incident on one of these materials can be guided by the material

Figure 1.2: A Metamaterial
Maxwell’s Equations

- Describe electromagnetic radiation
- The information contained in the solutions to the equations happens to be coordinate invariant
- So, a coordinate transformation could yield a necessary index of refraction profile that causes light to avoid a given region

Figure 1.3: Maxwell’s Equations
Cloaking

- The result is that a cloak can be fabricated with metamaterials that fit the index of refraction profile given by the coordinate transformation.

Figure 1.4: Computer Simulation of a Cloak
Next Steps: Decloaking

• Since cloaking is achieved, what about decloaking?
• Perhaps “smart” electromagnetic pulses can beat a cloak
Acknowledgements

• Professor Herschel Rabitz
• Dr. Alex Pechen
• Princeton Environmental Institute and the Grand Challenges program
• Princeton Plasma Physics Laboratory