# Sandia National Laboratories
# Overview

## SEERI End of Summer Presentations

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SAND2010-5375 C

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# VIST: A Package for Automated Visualization of Eiger-Generated Data

8/10/10 8:20a

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MIT 2012
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Sandia National Laboratories

# The Team's Question

***Is there a systematic way to make EIGER data visual to help us communicate the results of our work and to help us understand those results?***

↓

**Problem:**

**EIGER electromagnetics solver data is a challenge to interpret—it is extremely useful to post-process the results and make them visual**

# The Answer

***Yes, a simple and systematic approach is feasible.***

↓

**Tasks:**

- **Run the post-processor MOENCH**
- **Convert processed files to formats readable to an open source visualization binary (e.g. GMSH, VTK or Paraview)**
- **Allow the investigator to write and include gmsh options to create images, files, etc.**

# Choices: GMSH or ParaView

## GMSH

Pros:

- Simple functional interfaces: CLI & GUI
- Easy to implement external solvers
- Low cache footprint

Cons:

- Not such an attractive GUI
- Has its own scripting language

## ParaView

Pros:

- Attractive GUI
- Powerful architecture

Cons:

- The complexity of designing a user friendly wrapper package would have been out of the scope of the project

# Three Peaks:  Moench, Eiger, Jungfrau

# EIGER

EIGER is...

a massively parallel, frequency domain, method-of-moments electromagnetics solver, which computes surface currents on simulated structures.

# MOENCH

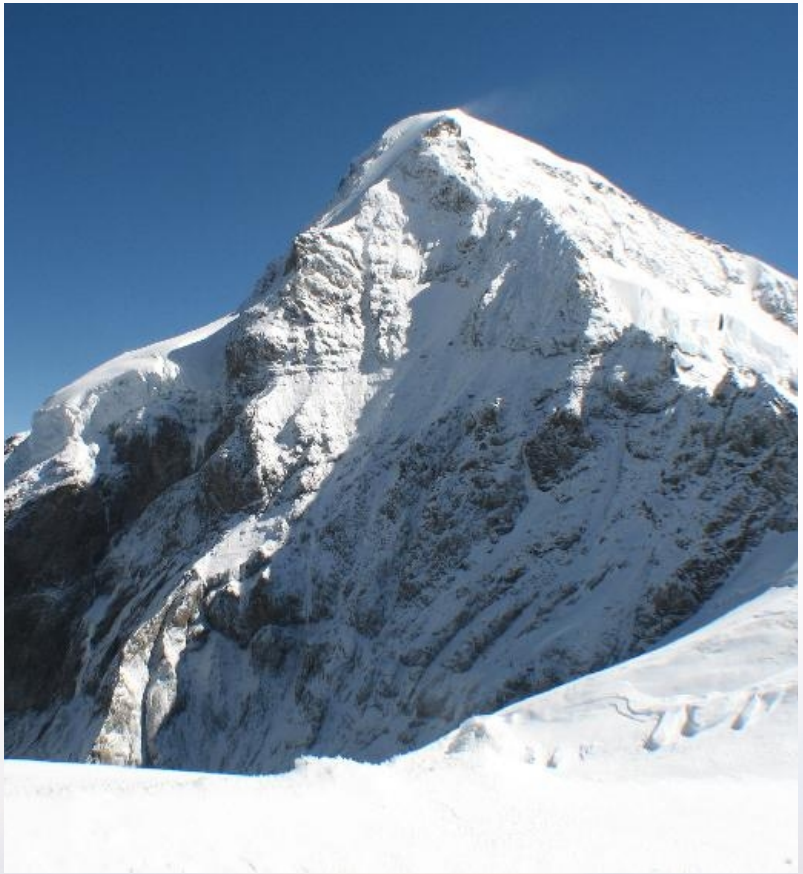
MOENCH is...

EIGER's post-processor that can compute EIGER's surface currents, then write them in alternate formats and do the same with electromagnetic fields, both near and far.

# Jungfrau

Jungfrau is...

the pre-processor to EIGER, where the user sets up the simulation space including boundary conditions, constraints, excitations, and simulation frequencies.



# VIST's Features

- Finds folders containing data and the two executables, MOENCH and GMSH, based on CLI option tags that the user types in to invoke VIST
- Post-processes MOENCH *asynchronously*
- Converts MOENCH's output to GMSH-readable formats
- Creating videos and images is a simple next step

# Structure of the Package

VIST

optionspec
- Reads user defined options file
- Makes commands for MOENCH, GMSH and the CLI (Perl script execution)

execcomm
- Executes MOENCH and GMSH binaries
- Executes Perl scripts
- Determines which file inputs to use within a folder

asyncproc
- Asynchronous subprocessing
- Based on python subprocess module

filer
- Finds files and folders and asks user which ones to use if more than one

EIGER

Jungfrau

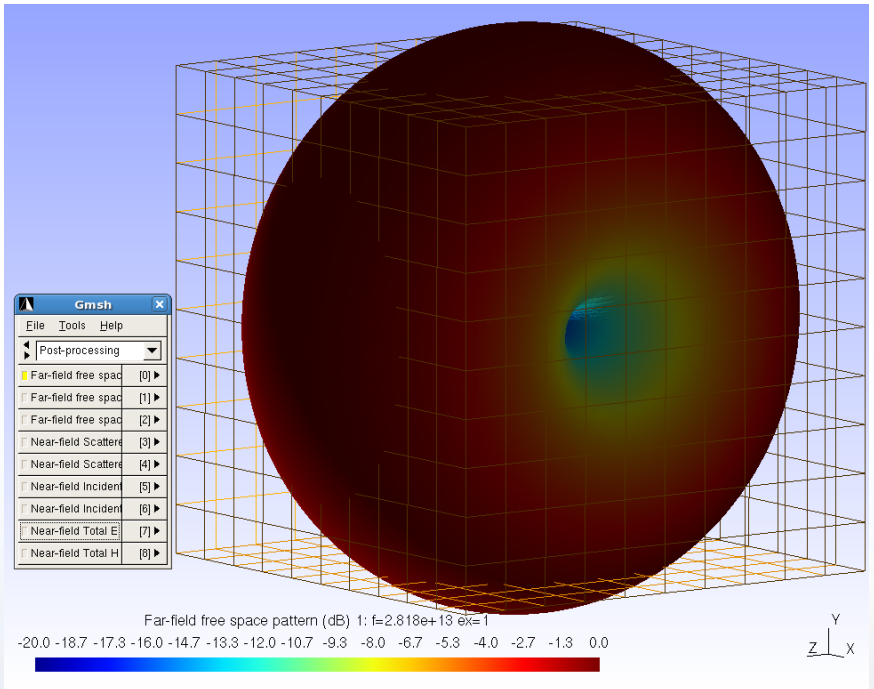
GMSH

Borchart's Perl Scripts

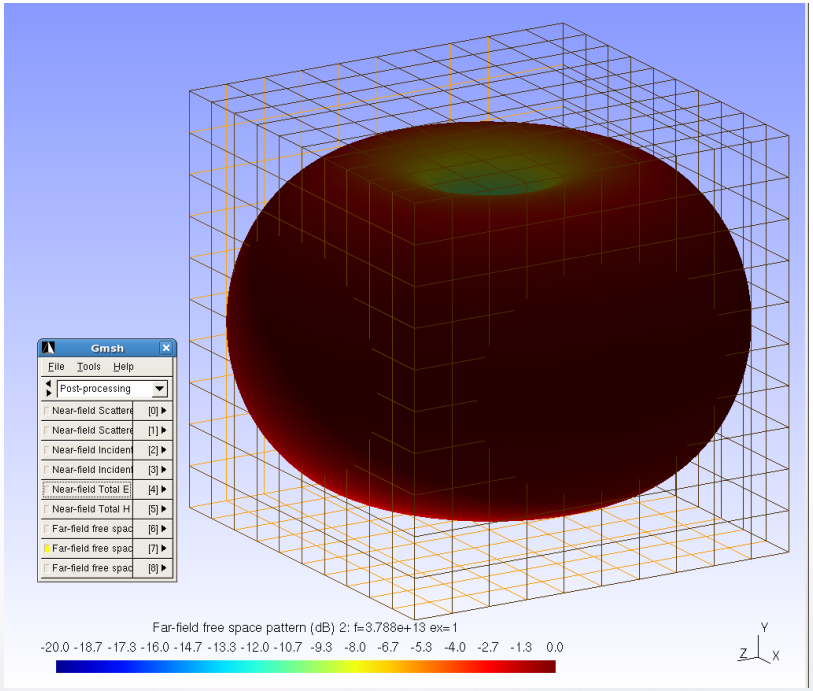
MOENCH

# An Example of Physical Interpretation: Two Cases of the Tellurium Cube

28.2THz Radiation :
E-fields Cancel




37.8THz Radiation :
H-fields Cancel

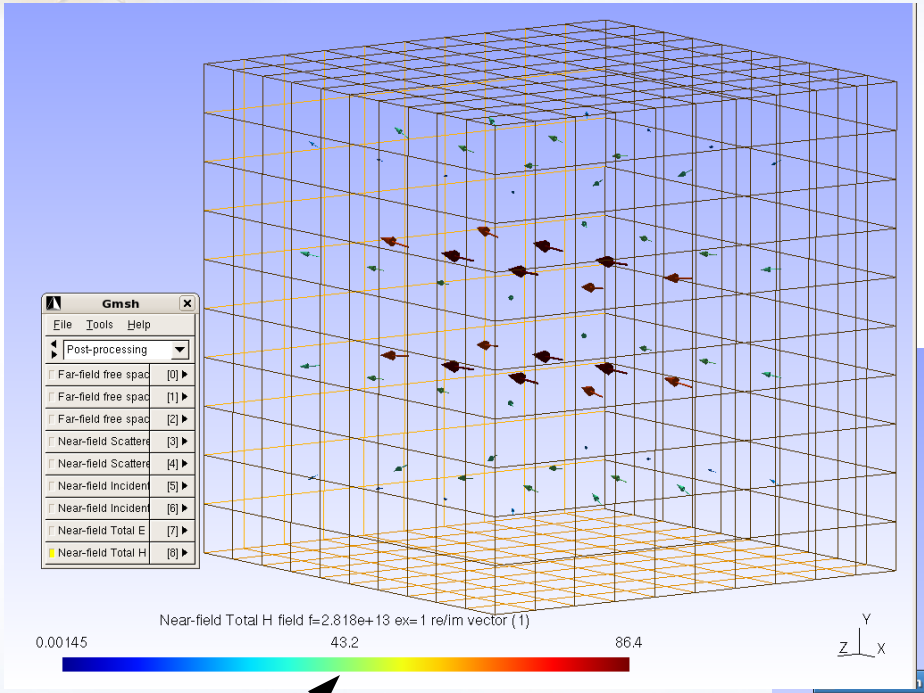


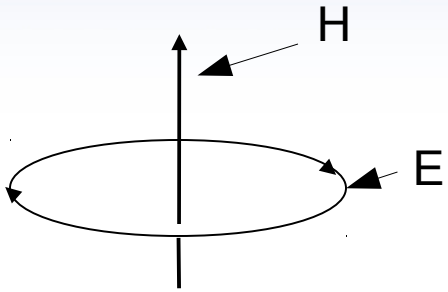

Far Field Radiation: ^ Faraday's Law

^Ampere's Law

Incident Radiation in z-direction

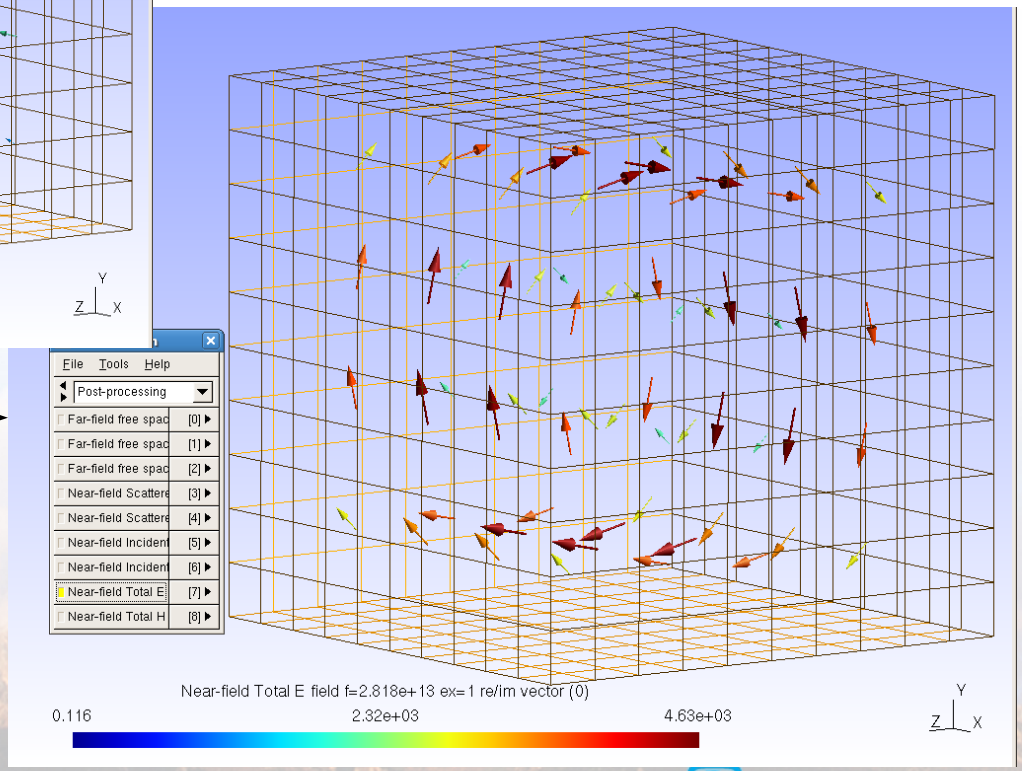
# Faraday: Near-Field Radiation of 28.2THz Case



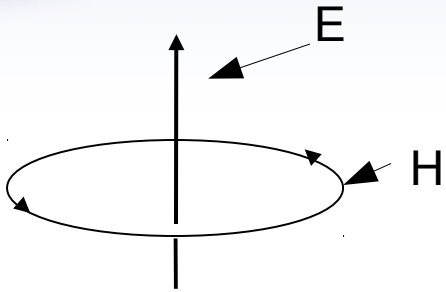

H-field

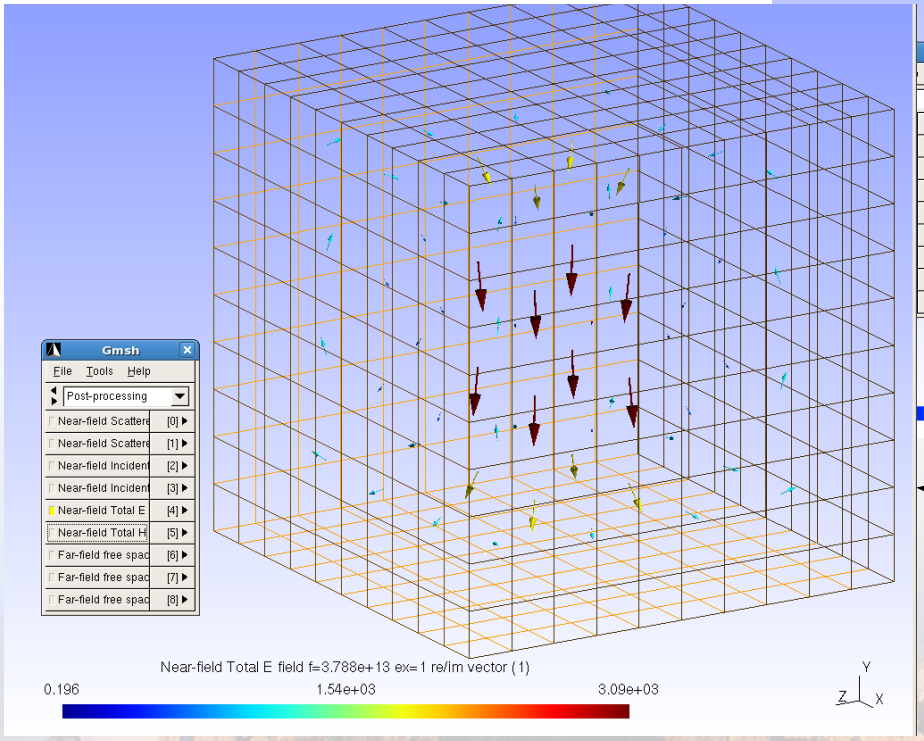
E-field

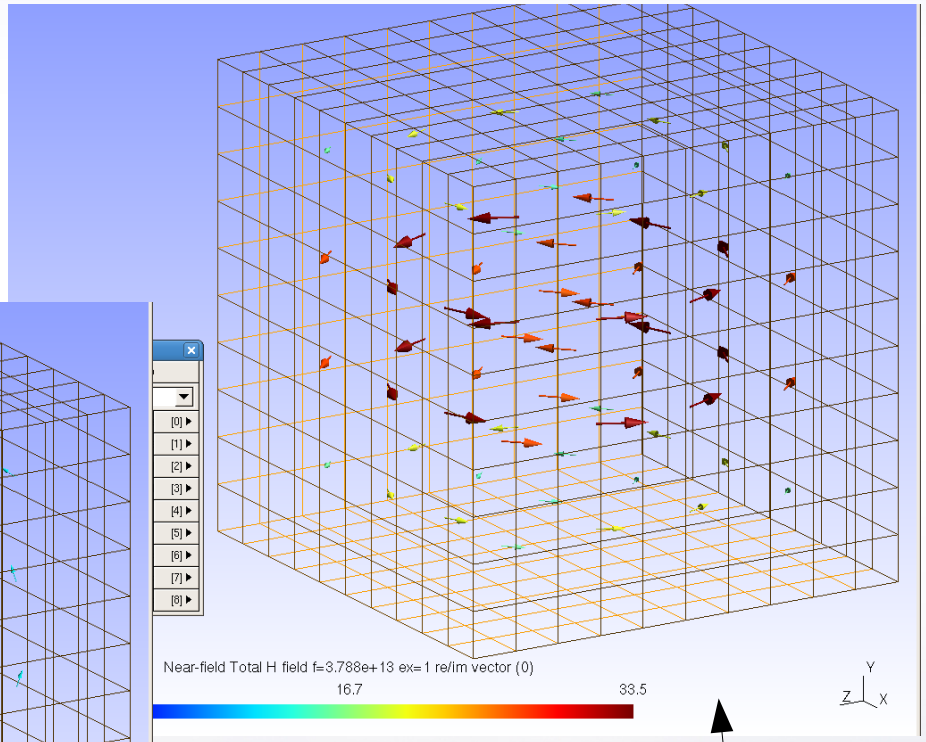



$$\oint_{\partial S} \mathbf{E} \cdot \mathrm{d}\mathbf{l} = -\frac{\partial \Phi_{B,S}}{\partial t}$$

# Ampere: Near-Field Radiation for 37.8THz Case




E-field

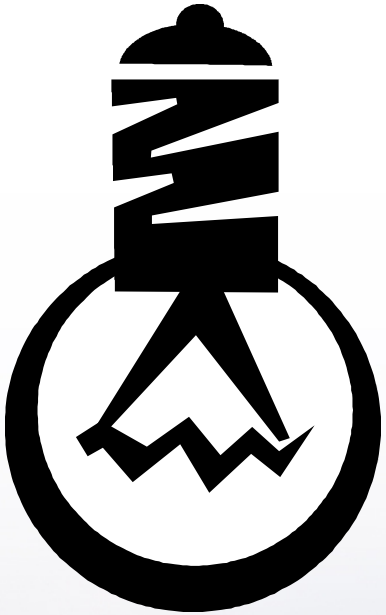
H-field

$$\oint_{\partial S} \mathbf{H} \cdot d\mathbf{l} = I_{f,S} + \frac{\partial \Phi_{D,S}}{\partial t}$$

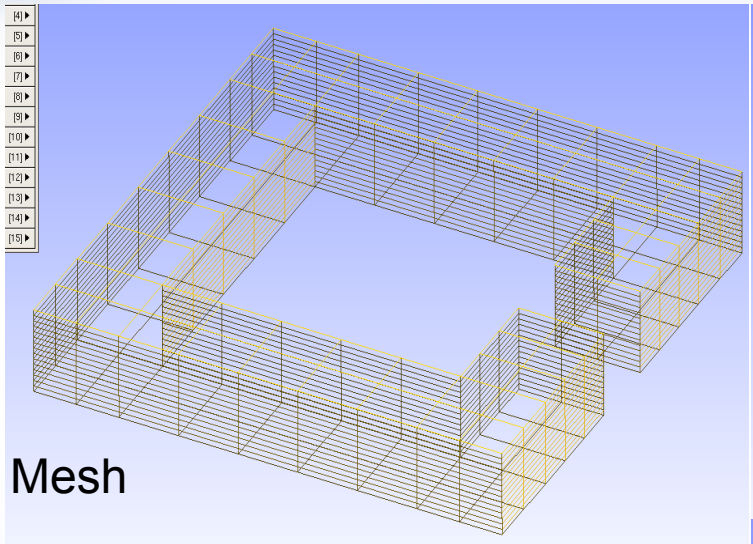
# What could that lead to?

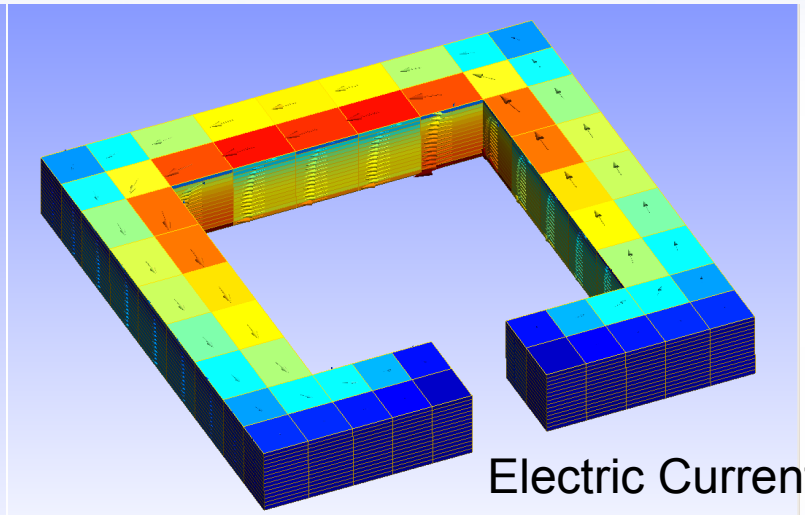
- development of arrays which have effective bulk permeabilities and permitivities that differ from those of their constituent modules

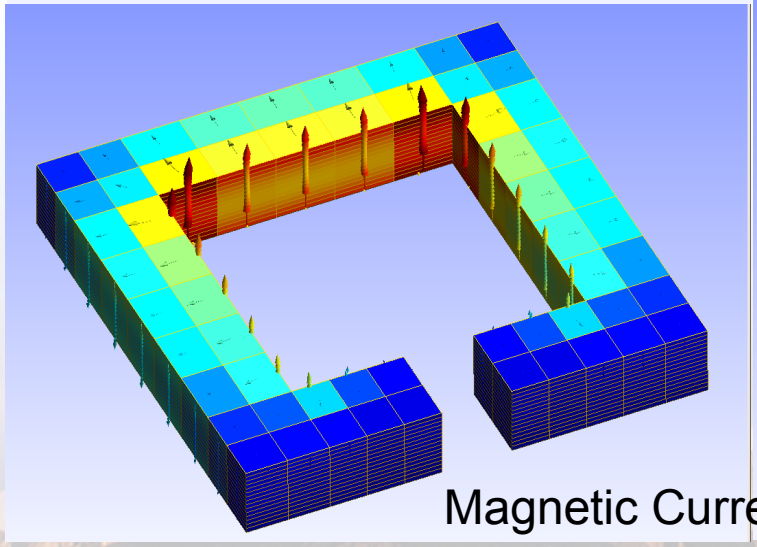
- novel metamaterials with characteristic frequency ranges not found in natural materials

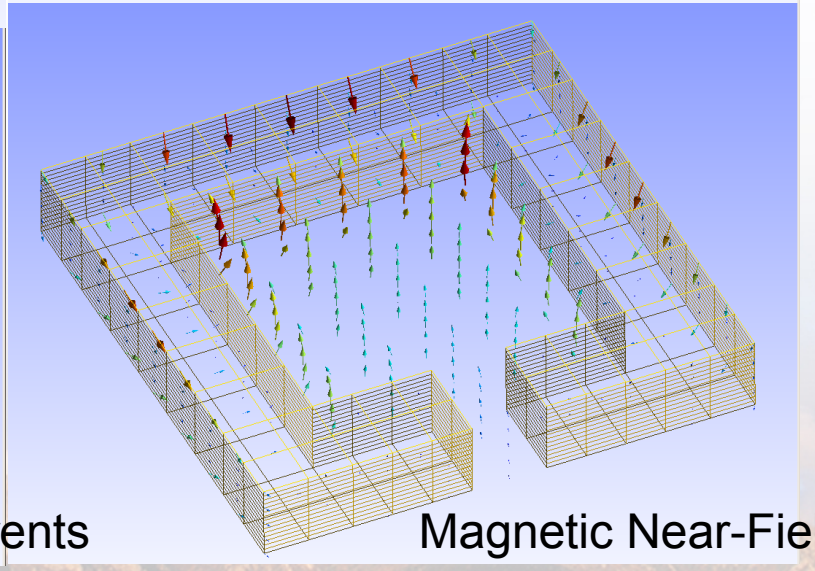


# SRR: The Split Ring Resonator

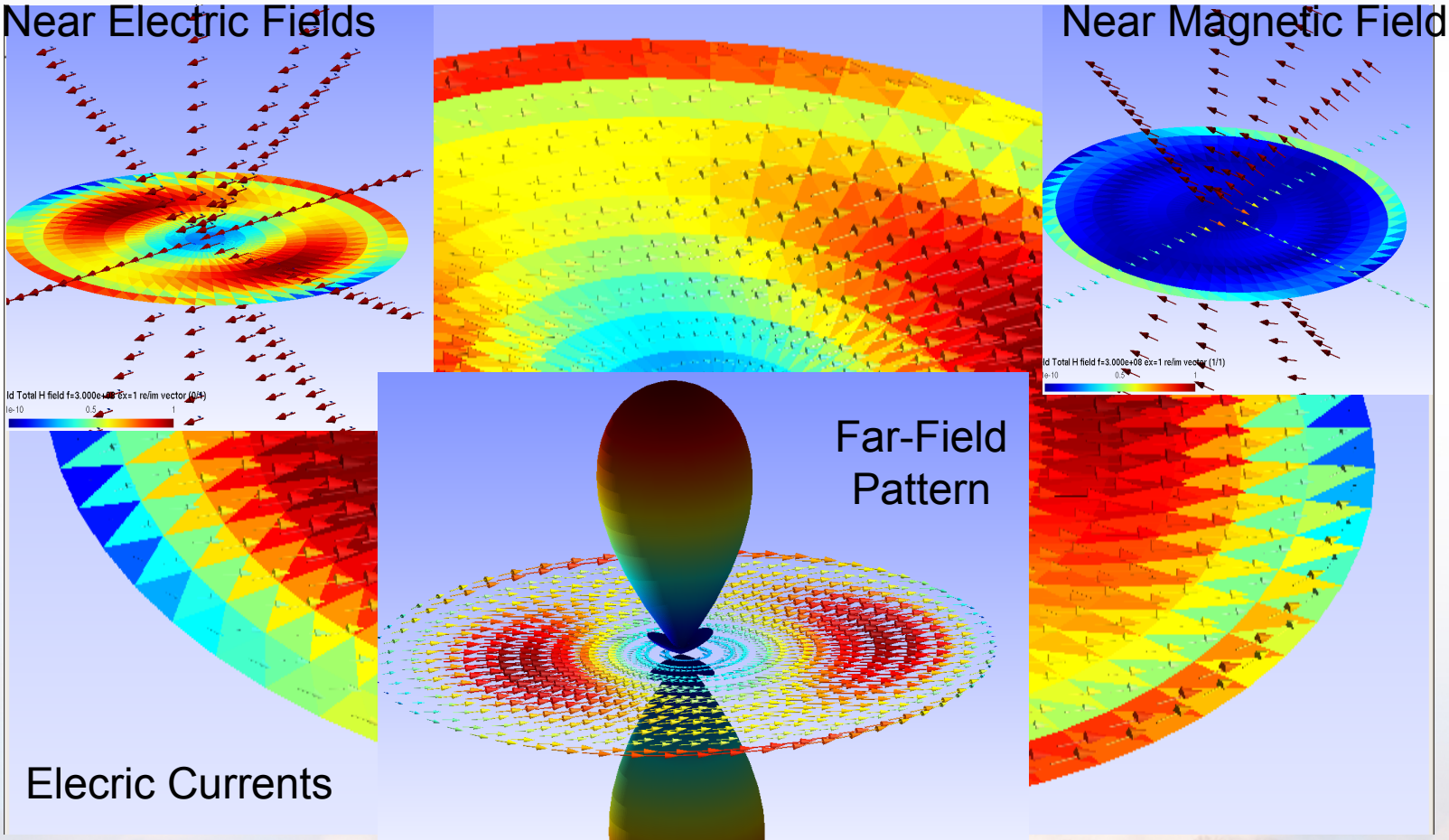


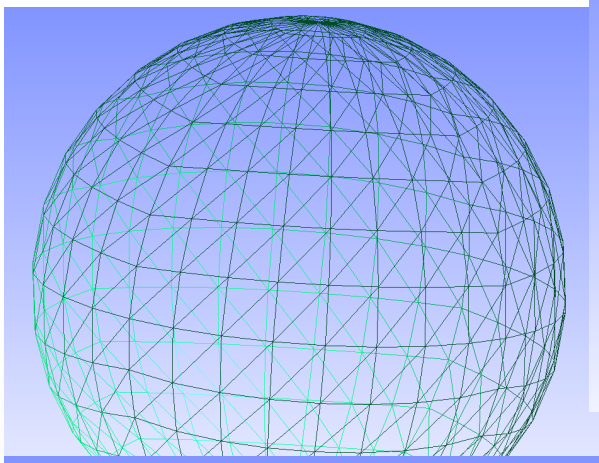
# gaussian_beam: Electric Currents

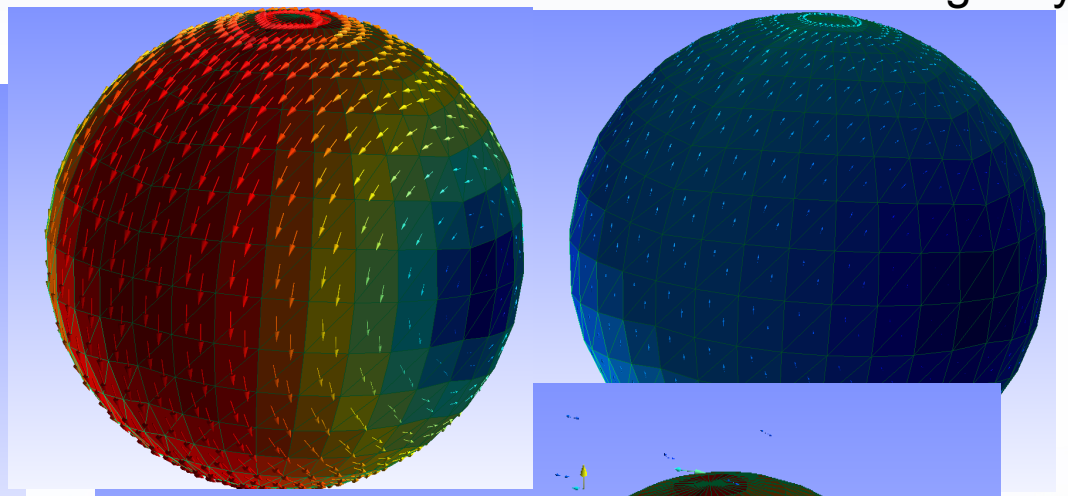


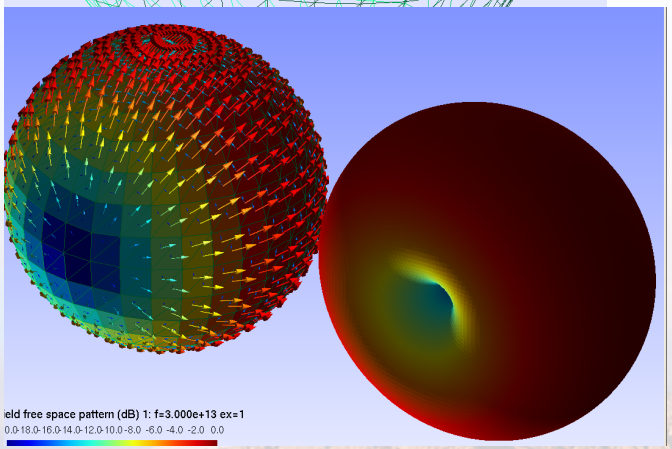
# PbTeSph_SINGLE: The Lead Tellurium Sphere

Electric Currents Real and Imaginary

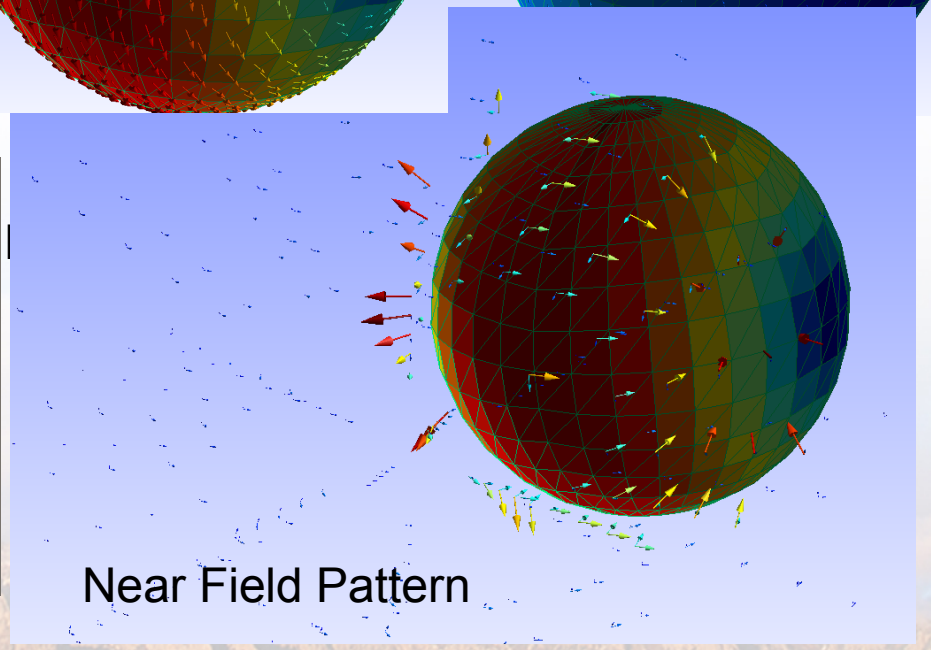
Mesh





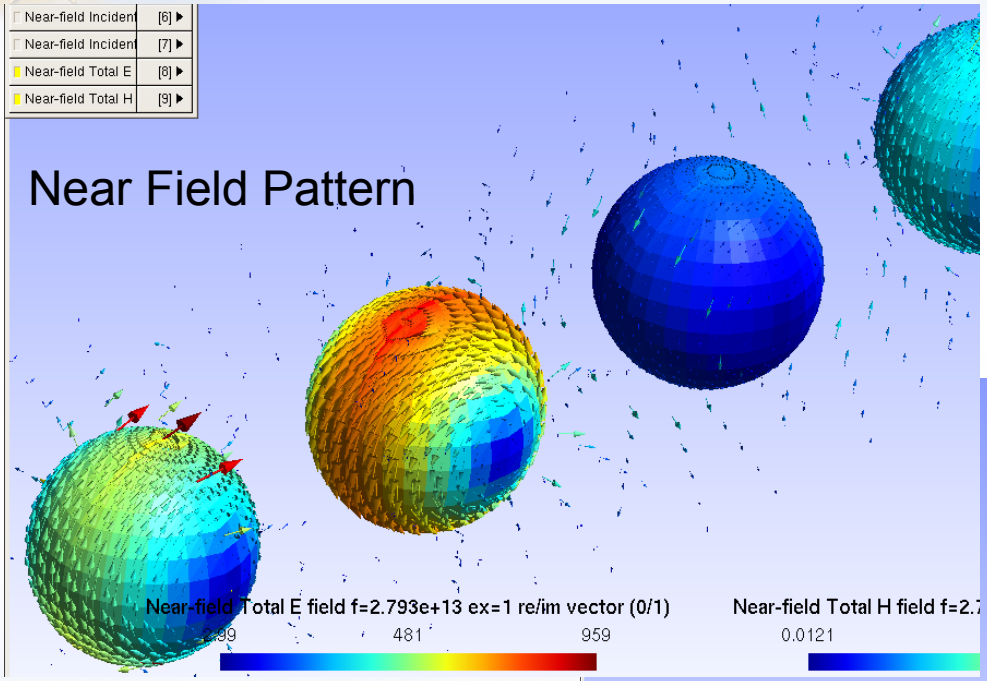


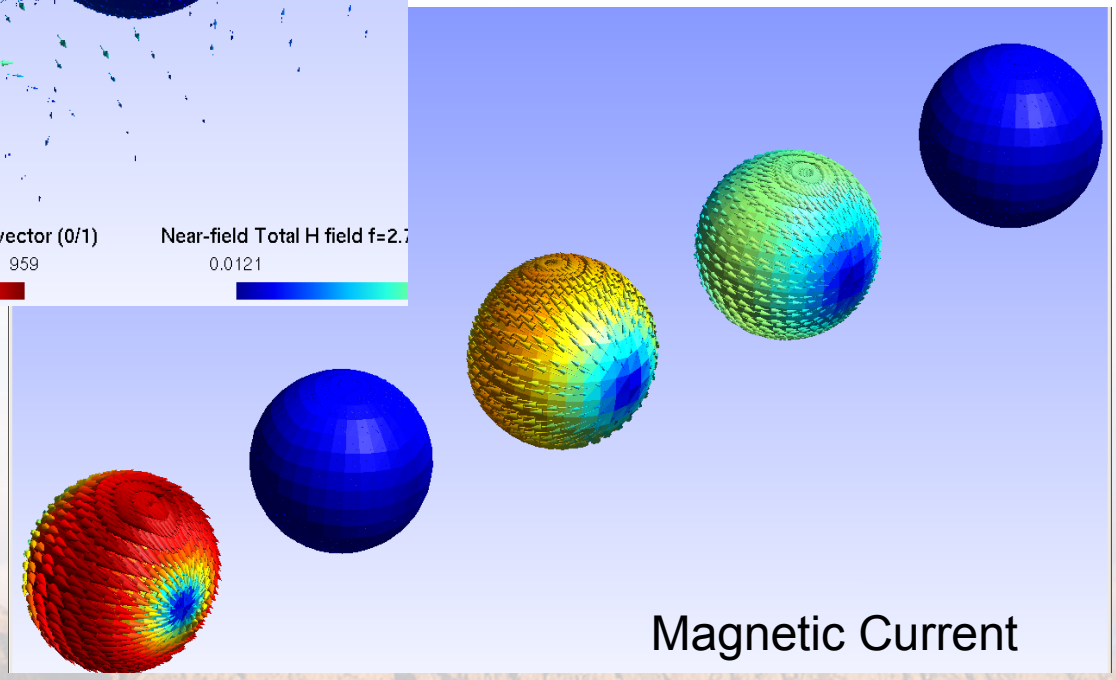

Far-Field Pattern



Near Field Pattern

# Sphere_NIM


Near-field Incident [6]
Near-field Incident [7]
Near-field Total E [8]
Near-field Total H [9]
Near Field Pattern
Near-field Total E field f=2.793e+13 ex=1 re/im vector (0/1)
2.99
481
959
Near-field Total H field f=2.7
0.0121


Magnetic Current

# Summary: Result of the Project

Designed and demonstrated a simple, extensible, and user-friendly package to automate post-processing and visualization of EIGER DATA for any research group using MOENCH, EIGER and JUNGFRAU.

©robhall

# References and Support

- **Core Python**
  - Wesley Chun
- **Python in a Nutshell**
  - Alex Martelli
- **Josiah Carlson**
  - http://code.activestate.com/recipes/440554/
- **Christophe Geuzaine and Jean-François Remacle**
  - geuz.org/gmsh
- **Michele Caldwell 1653**
- **Larry Schneider 1650**
- **Lori Basilio 1653**
- **William Langston 1653**
- **Mike Pasik 1653**
- **John Borchart 5443**
  - Perl scripts to convert to GMSH format and their documentation