

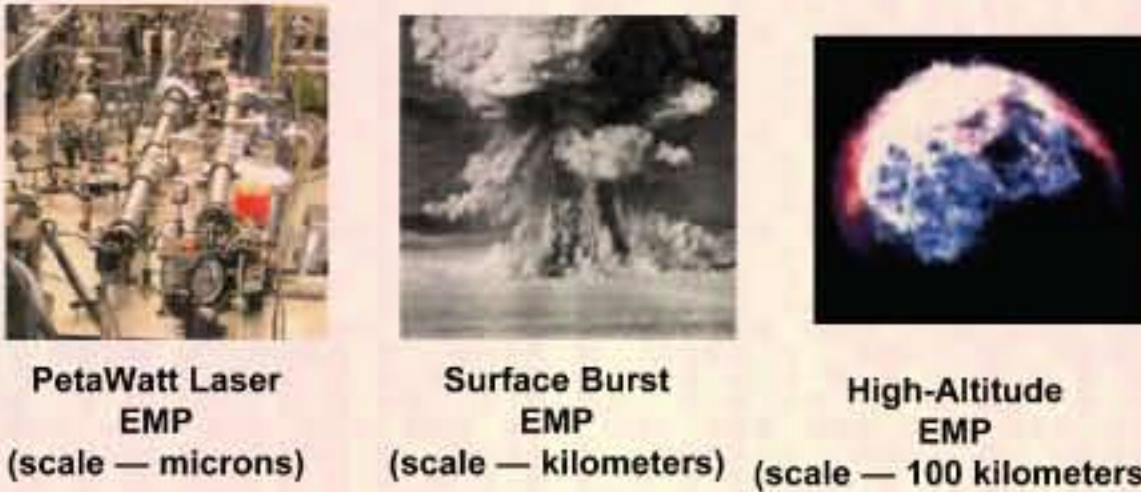
Creation of a First Principles Simulation of Weapons-Generated Electromagnetic Pulse



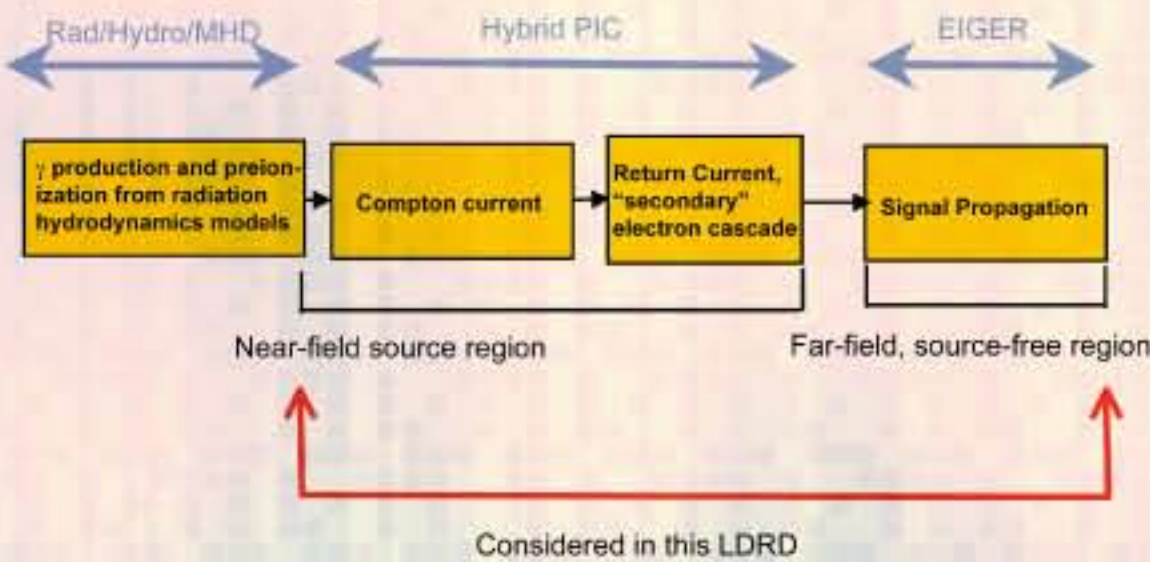
Sandia National Laboratories
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Develop a state of the art WGEMP computational tool for use in solving problems of the Nation

- 3D Electromagnetic Particle in Cell treats PW Laser, Surface Burst, and High Altitude fast EMP emissions in a unified manner. Internal Sandia research in progress.
- Takes advantage of state-of-the-art computational platforms and algorithms. Three disparate spatial scales can be treated in one code —

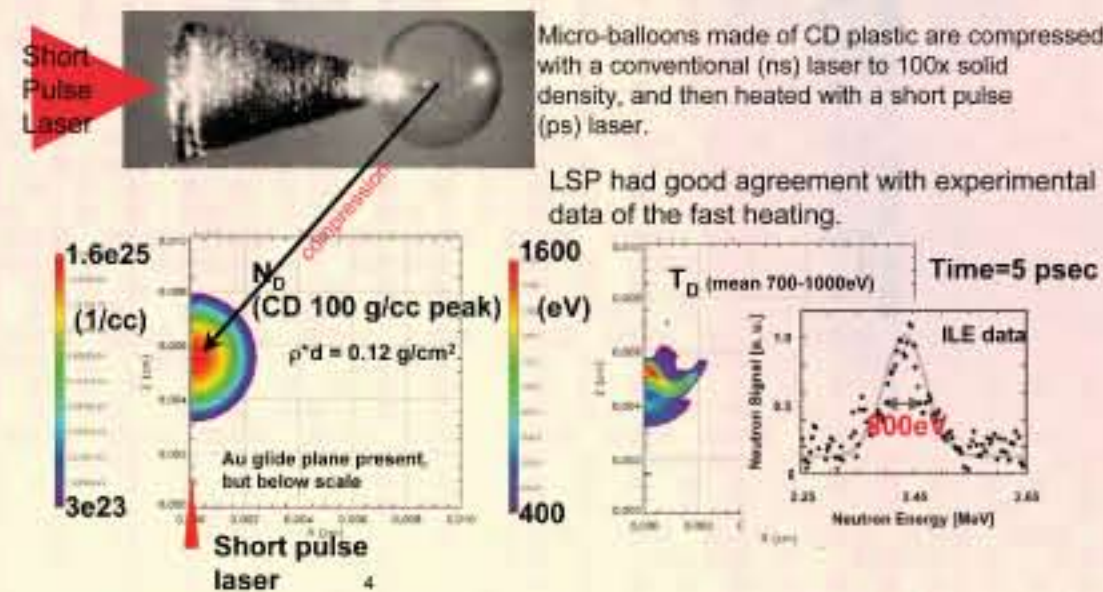


Methodology: Develop physics capability for EMP source, and free space propagation regions.



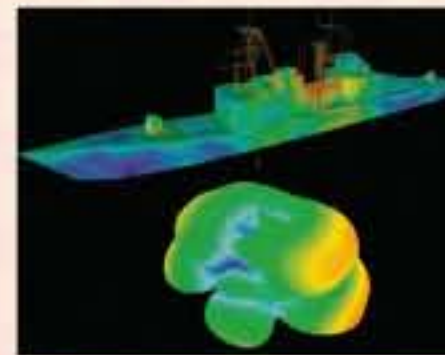
Validation of Plasma Thermalization Model Theory Performed on Osaka's GEKKO/PW System.

Simulations of GEKKO (Osaka U) core fast ignition heating
 Reference: *Physical Review Letters* 94, 055001 (2005)

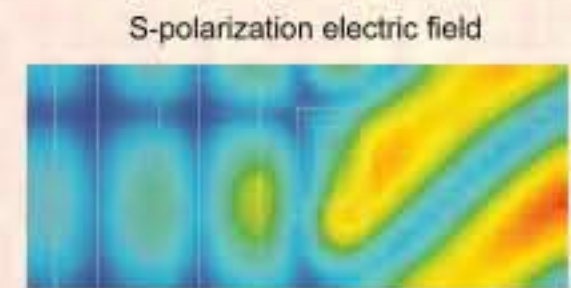


EIGER Applications for EM Double as Validation

EIGER will be used for the source free EMP propagation region in this project



EIGER has been used to predict the installed performance of antennas in complicated environments, such as the destroyer shown above.

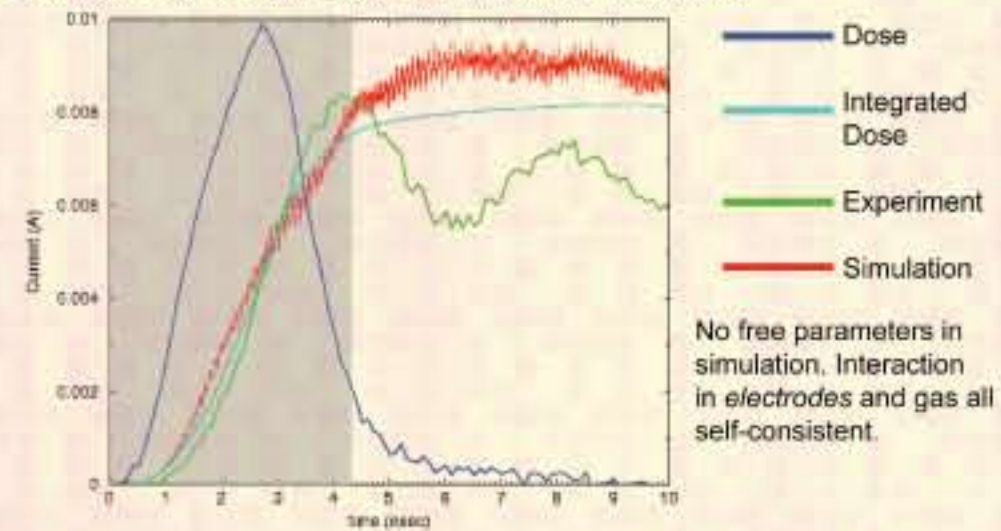


EIGER has been used to study the electromagnetic behavior of periodic structures (PW laser gratings) in the optical frequency range.

Gas Cell Validation Experimental Comparison, P=760 torr, V=300 V, and Al electrodes

Only input to simulation is geometry, circuit, and x-ray pulse

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Shaded area is relevant time range for testing air chemistry

R&D Accomplishments

- Compared present advanced models with legacy code work (CHAP) in the faster source regime, emphasizing the HAEMP application
- Incorporated unique physics for fast non-equilibrium air chemistry.
- Developed innovative solutions in the area of boundary conditions and coupling.
- Initial surface burst simulations in progress, capitalizing on lessons learned from the high-altitude application.
- Performed very encouraging initial validation of models using fast-pulse data from the SPHINX facility.

There has been impact at the National level

Contributed crucial data to the Congressionally mandated EMP Commission....

Key point: There were no great (upside) surprises in EMP peak fields relative to standard theory.

Excerpt from a congratulatory letter from G. Peter Nanos, Jr. Associate Director, Research and Development, Defense Threat Reduction Agency (DTRA):

I would like to express my appreciation to you for your support to the Defense Threat Reduction's (DTRA) 2007 Electromagnetic Pulse (EMP) Peer Review Task Force.

The task force provided a critical part of the MIL-STD-2169B review requested by the Secretary of Defense. By ensuring predicted EMP environments are accurate, DTRA supports the development of military systems designed to withstand the threat without costly, superfluous hardening measures. The EMP Peer Review Task Force you supported thoroughly and skillfully reassessed the original basis for the standard, determined that no changes in predicted environment levels are required, and provided recommendations for maintaining the technical competence and computational tools needed to accurately predict EMP environments in the future.

Your contributions were critical to the task force's success. Thank you again for a job well done!