Material for Flash-Lamp Modeling contract with
Professor Mark J. Kushner
University of Michigan
Electrical Engineering and Computer Science Department
1301 Beal Ave., Ann Arbor, MI 48109-2122
mjkush@umich.edu, 734-647-8148

Sandia Principle Investigator: Matt Hopkins, 1516, 284-6376

Alternate point of contact: Paul Miller, 1128, 844-8879

Scope of work: Sandia National Laboratories wishes to fund a research effort to develop computational capabilities to describe the physics of operation of pulsed xenon flash lamps. Towards that end, we wish to contract with the University of Michigan to extend their existing code capabilities to describe lamp operation in detail based on first principles. Sandia desires development of a validated code that computes interaction of the lamp with the associated power supply, behavior of plasma inside the lamp, and the temporal behavior of the emission spectrum of the lamp. Pulsed xenon flash lamps have been used for many years for a variety of applications, including stroboscopic illumination and pumping of solid-state lasers. Sandia's initial interests pertain mostly to linear lamps, with lengths from 1 to 2 inches, inside diameters from 2 to 4 millimeters, fill pressures from 300 to 1500 Torr, and lamp energies from 10 to 50 Joules delivered in between 20 to 150 microseconds. Code development will be conducted with close collaboration between the University of Michigan and Sandia, with results of concurrent tests at Sandia being used to check and validate code results. At the end of this effort, Sandia expects to receive the source code and to be trained in compilation and operation of the code.

Budget and period of performance: Two year duration, $150,000 and $160,000 respectively.

First year work:

1. Perform test calculations using the existing two-dimensional code *nonPDPSIM* on Sandia-specified problems and compare with Sandia test data to identify and prioritize needed code improvements.
2. Add Monte-Carlo-based photon transport to existing code.
3. Incorporate Sandia-specified types of electrical circuits in existing code.
4. Add code diagnostics that overlap with Sandia's experimental diagnostics.
5. Update the data base of atomic physics processes as needed to address continuum optical emission.
6. Deliver the improved version of the code to Sandia and train Sandia personnel in its operation.
7. Perform comparisons of results from the improved code with Sandia experimental results.

Major first-year deliverables:

1. Deliver code to Sandia and train Sandia personnel.
2. Conduct code validation with Sandia and assess and prioritize needed further improvements.

Second year work:

1. Investigate parallelization of the code; implement where possible.
2. Evaluate the costs and benefits of extension of code work to three-dimensional computations.
3. Perform detailed modeling of cathode physics.
4. Update and finalize the data base of atomic physics and reaction mechanisms.
5. Assess the sensitivity of code results to physical and numerical assumptions and quantify the parameter range over which the code provides robust and accurate results.
6. Analyze the relation of absolute optical output and spectrum of the flash lamp to operating conditions, drive electronics, and lamp parameters including geometry and fill pressure. Perform this work in conjunction with further experimental validation tests at Sandia.
7. Deliver the final version of *nonPDPSIM* to Sandia and provide any additional needed training.

Major second-year deliverables:

1. Deliver updated validated code to Sandia and provide additional training if required.
2. Provide analysis of achievable lamp performance within the parameter envelop defined by Sandia.