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One Year Term Review as a Participating Guest in the Detonator and Detonation Physics Group

A. Lefrancois, F. Roeske, T. Tran, R. S. Lee

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ONE YEAR TERM REVIEW AS A PARTICIPATING GUEST IN THE DETONATOR AND DETONATION PHYSICS GROUP

A.Lefrancois (*), F.Roeske, T.Tran, R.S.Lee

Energetic Materials Center, Lawrence Livermore National Laboratory, Livermore, CA 94550 - USA
(*) Participating guest at LLNL from DGA/Centre d’etudes de Gramat - France

The one year stay was possible after a long administrative process, because of the fact that this was the first participating guest of B division as a foreign national in HEAF (High Explosives Application Facility) with the Detonator/Detonation Physics Group.

1.1 DETONATOR/DETONATION PHYSICS GROUP

The mission on the Detonator/Detonation Physics Group is to:

- Develop new detonator technology, as needed
- Support B-Program HE firing activities
- Support existing stockpile initiation systems
- Improve understanding of the physics of HE initiation
- Maintain and improve diagnostic capability for detonators/boosters
- Maintain and improve modeling capability for detonators/boosters

The scope of the mission includes the following tasks:

- Perform research and advanced development on high-explosive initiation trains.

- Perform experiments to characterize high explosives and other energetic materials.

- Perform experiments to study the interaction of reacting HE or energetic materials with inert materials.

- Design, develop, build and operate high-voltage capacitor discharge systems.

- Design, develop, build and execute experiments and tests involving high explosives assemblies, and capacitor discharge systems, using advanced diagnostic equipment.

- Design, develop, build and operate lasers and optical systems and use them in experiments involving shock waves and high explosives.

- Design, develop, build and operate laser systems and use them in machining and surface treatment of high explosives, inert materials, and assemblies containing high explosives

- Perform maintenance and repair operations on equipment for which the Group and B Program are responsible, as appropriate. This includes bringing in qualified field maintenance personnel from equipment manufacturers for troubleshooting or specialized maintenance.

The work is performed in Building 191 (HEAF). Almost all of these activities involve some degree of hazard, the principal hazards being from energetic materials (including HE), high voltage and intense laser light. The mitigation and control of these hazards will be addressed.

1.2 <u>EXPERIMENTS</u>

Thanks to the approval to work in HEAF with the group, it was possible to attempt some of the experiments they are doing, and discuss the experimental set-up, and metrology :

- Laser femtosecond safely machining of HE parts, and detonators [1][2][3]

- Corner turning test with initiating HE

- Assessment EBW, of the Explosive Bridge wire experiments in water[4]

- Using diode as a shock time arrival metrology [5]

- HDV Heterodyn Doppler Velocimeter [6]

1.3 NUMERICAL SIMULATIONS

Thanks to two courses at LSTC and the LLNL clusters access, it was possible to perform numerical simulations in 2D and 3D using LS-Dyna single processor and multi-processors versions. Different kinds of simulations were performed to help in the design of new set-ups, to compare experiments and simulations and to test the new electromagnetism package as a beta tester. The different subjects are listed below :

- Shock desensitization effect in the stanag 4363 confined explosive component water gap test (ECWGT) for components having a diameter less than 5 mm [7][8][9]

- Diameter effect experiments in initiating explosives [10]

- Floret test, comparison between experiments and simulations of the dent,[11]

- Small scale cylinder test with a groove, comparison between experiments and calculations [12]

- Shock arrival time metrology using photo-diode, numerical simulations[13]

- Corner turning test with initiating HE

- Thermal analysis

- Low impact velocity safety test

- Isentropic compression up to 200 kbars for LX 04, Numerical simulations and Comparison with Z-accelerator experiment shot 1067 [14]

- Isentropic compression for TATB based HE samples, numerical simulations and comparison with Z-accelerator experiment shot 1967 [15]

- Isentropic compression with a rectangular configuration for Tungstene and Tantalum, computations and comparison with Z-accelerator experiments shots 1511 and 1555 [16]

- Copper tube compression in Z-current geometry, numerical simulations and comparison with Cyclope experiments [17]

- Isentropic compression in a strip line, numerical simulations and comparison with GEPI shot 268 [18]

1.4 ATTENDED LECTURES IN OTHER FIELDS

It was also possible to attempt many lectures in other fields [19]:

- Inertial confinement fusion ablator application
- Nuclear Science
- Crystal Defects
- Phase Transition
- Binder
- Biosensing
- Nanotechnology
- Mechanical and thermal properties
- Metrology

1.5 VISITS

Many visits were organized:

- HEAF, High Explosives Application Facility
- DAC, Diamond Anvil Cell
- Femtosecond laser safely HE machinig
- Micro-detonics laboratory
- Visite du NIF National Ignition Facility
- RISI, detonator company, EBW (Exploding Bridge Wire), EFI (Explosive Foil Initiator)
- LIGA foundry, microsystems manufacturing
- Accelerator for Mass Spectroscopy (negative ion source for 14 C analysis)

1.6 FUTURE PLANS, INTERACTIONS, AND POSSIBLE COOPERATIONS

Some future possible interactions are listed below:

- Safely machining the HE with the femto-second laser
- High current machine, experiments and modeling : Z ICE experiments, French machines
- Experiments and simulations of the dent for LLM 105 in the Floret test
- Diameter effects in initiating HE
- Metrology, velocity measurement, shock arrival time metrology with photo-diode
- Gas gun experiments, thermal properties interaction with run to distance detonation

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[19] Attended lectures in other fields