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Title: Campaign 3 Quarterly Progress Report, 2QFY11

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Form 836 (7/06)

MTE 3.1 Enhancement of Radiographic Tools

PM/PL/PI: *Steve Balzer, WX-4, balzer@Lanl.gov, 5-5995*

Project Title: **Maintenance and Characterization of Standard DARHT II Camera**

Date: 4/7/11

Project Description:
This work is being performed to characterize and improve the performance of the gamma-ray cameras used at the DARHT facility. The first-axis cameras are in need of refurbishment to continue to deliver high quality data. The second-axis camera is near completion and needs to be fully characterized in order to analyze data from hydrotests. Additional work will be done on studying new radiographic targets that will give a better assessment of system performance. The DARHT accelerators are studying new beam formats for use on hydrotests and the cameras are required to collect data from these studies.

Highlight/Status - update quarterly:

- A set of data was collected with DARHT axis-1 and axis-2 using the French Test Object (FTO). The data will be used to quantify the performance of the accelerators and detectors and will be used by the data analysts primarily to determine the scatter "cross-talk" on the first and second axis detectors.
- The small 1" cathode was installed in the first axis and a tune was developed to transport the beam to the target.
- Working on the Interagency Agreement with the Air Force for the 5th Camera for DARHT 2nd Axis, maintaining communications with Lincoln Labs to facilitate timely delivery of camera once agreement is in place. Also maintaining communication with the Hydro program manager to evaluate potential impacts on schedule. No impacts identified.

Major milestones completed:
4090 - Quantify performance and measurement uncertainty of each frame of the DARHT II 5-camera array. The 5-camera array will be installed on DARHT in early 2011. The array will be utilized on experiments conducted by the C1 and ACC programs. Due Date: September, 2011. STATUS 2QFY11: GREEN

Supplementary information (accumulated list over FY)
Publications:
Jacob Mendez, Stephen Balzer, WX-4 , Scott Watson N-2/ A multi-frame, megahertz, CCD imager/ 29th International Congress on High-Speed Imaging and Photonics Proc. ICHSIP-29, ISBN978-4-905149-01-9, A04-1-6.

Conference presentations:
J. Mendez/ WX-4/ A multi-frame, megahertz, CCD imager/ 29th International Congress on High-Speed imaging and Photonics

PM/PL/PI: *Evelyn Mullen, ADW, emullen@Lanl.gov, 5-7576*

Project Title: **Future NNSS Radiographic Capabilities**

Date: 4/21/11

Project Description:
Develop options for a future radiographic capability at NNSS to support the scaled experiment program. The objective is to commission a radiographic diagnostic at NNSS by November 2017.

Highlight/Status - update quarterly:

- Held a technical meeting with the Campaign 3 Federal Program Manager in January to discuss technical capabilities of pRad and DARHT technologies and associated detectors
- In collaboration with Campaign 1 and LLNL, developed physics requirements for the future radiographic capability at NNSS
- Initiated a project to develop cost proposals for a 20 GeV proton radiography facility and a DARHT axis-2-like facility at NNSS.

Major milestones completed:
n/a

MTE 3.2 Information Analysis Capability and Data Fusion

PM/PL/PI: *Christopher Tomkins, P-21, ctomkins@lanl.gov, 5-6228.*

Project Title: Analysis of Deeply Penetrating Radiography using BIE

Date: 4/6/2011 – Includes Highlights through Q2, FY11

Project Description:

The overall objective of the project is to continue to develop a fundamental understanding of the radiographic measurement at DARHT, and use this understanding to develop cutting-edge tools in advanced radiographic analysis tailored to DARHT radiography. As part of this, we apply tools to test-object experiments in the dual-axis configuration at DARHT to understand the measurement and quantify uncertainties with emphasis on density reconstructions.

Highlight/Status - update quarterly:

- H. Makaruk (P-21) served as chair of two sessions, at *International Workshop on Category Theory: Graphs-Operands-Logic* at the University of Texas, San Antonio TX, March 14-18, 2011.
- H. Makaruk also gave an invited talk at meeting on analytical work on inverse Abel reconstructions of non-axisymmetric objects. (See invited talks below).
- Postdoc James Carroll and C. Tomkins (both P-21) prepared a poster to present recent results on "Scripting Interface Tools for BIE Radiographic Analysis, and their Application to Time Series Analysis for DARHT" (LA-UR 11-02036) for the Predictive Science Panel review poster session. (to be held in April 2011)
- Gary Salazar of WX-4 developed two glyphs for next release of BIE for time-series analysis of evolving edges in image data. Glyphs implement preliminary model of physics, represented by linear interpolation between neighboring curves.
- BIE release: Expected in Q3/FY11, including updated glyphs, bug fixes, improvements in batch image loading, 3D tools.
- UQ: Uncertainty estimated in a key metric for Hydrotest 3618, C. Tomkins.

Major milestones completed:
n/a

Supplementary information (accumulated list over FY)

Programmatic presentations:
Tomkins, C., "A Re-Analysis of the Radiographic Data on Hydrotest 3515 using the BIE (U)", presented at the *Scaling and Surrogacy Project Meeting*, Los Alamos, February 2011. LA-CP-10-01192.

Invited Talks:
Makaruk, H., "3D Perturbation of the inverse Abel Transform," invited presentation at "The Ninth International Workshop Applied Category Theory Graph-Operad-Logic," University of Texas at San Antonio TX, March 14-19, 2011. LA-UR-11-01561.

Tomkins, C., "Analysis of underwater radiographic images using the Bayes Inference Engine (U)," invited to *Extreme Radiography* workshop, October 2010, Los Alamos, NM. LA-CP-10-01345.

Project Staff serving in leadership roles in technical societies/conference:

Workshop Organization: C. Tomkins, P-21, LANL POC for the *US/UK BIE Users Group Workshop*, held under the auspices of JOWOG-32 HDT, Aldermaston, UK, September 27 – September 30, 2010.

Session Chair: H. Makaruk, at *International Workshop on Category Theory: Graphs-Operands-Logic* at the University of Texas, San Antonio TX, March 14-18, 2011.

Software Releases:

BIE version 7.xx planned for 3rd quarter

MTE 3.3 Enhancement of Experimental Diagnostics and Containment Systems

PM/PL/PI: *Frank Merrill, P-25, fmerrill@lanl.gov, 5-6416/Evelyn Mullen, ADW, emullen@lanl.gov, 5-7576*

Project Title: Maintain pRad Capability

Date: 4/21/2011

Project Description:

Maintain the base proton radiography capability to support firing ~30 dynamic experiments for internal and external users from C1, C2, C3 and C4.

Highlight/Status - update quarterly:

- NOTE: 2011 pRad run cycle planned to start in June
- The pRAD Program Advisory Council met in January to review technical proposals for the 2012 run cycle (25 proposals submitted)
- Developed plan, budget, and schedule to support pRad vessel re-certification for 10# HE for next year's run cycle in conjunction with C1 (several proposed experiments for 2012 require this capability)
- Assisted in the development of a RFQ for a new catch tank for the pRad gun in conjunction with C2 (several proposed experiments for 2012 require this capability)
- 1QFY11: 8 pRad shots completed during the first quarter of FY11 supporting or jointly supported by C3
- 1QFY11 (also MTE 3.1): Completed design of advanced CMOS chip. New large 40μm pixel and more advanced 180nm CMOS process (bigger capacitance /μm^2), allow to pack 10 MIM storage caps per pixel. Note: Large IC chip = 42×43 mm^2, will need reticule stitching. Impacts cost and yield. Next step is to fabricate chips for prototype camera.

Major milestones completed:

n/a

Supplementary information (accumulated list over FY)
Publications:
"Ultra-high Speed Burst-mode Imager for Multi-frame Radiography," Kris Kwiatkowski, Paul Nedrow, Fesseha Mariam, Frank Merrill, Christopher Morris, Andy Saunders, Gary Hogan, Vincent Douence, Yibin Bai and Atul Joshi, in *Proceedings of the 29th International Congress on High Speed Imaging and Photonics, 20-24 September, Morioka, Japan; Ed. Eichi Sato, (ISBN978-4-905149-01-9)*, page A08-1

Accepted to the Journal of Applied Physics:
Morris, C. L., et. al. "Flash Radiography 1 with 24 GeV/*c* Protons," LA-UR 11-01047.

PM/PL/PI: *Frank Merrill, P-25, fmerrill@lanl.gov, 5-6416*

Project Title: **pRad Time to Facilitate User Facility Operations**

Date: 4/7/11

Project Description:
Project supports pRad user facility and assists in execution of a user experiment as prioritized by the pRad Program Advisory Council, a technical review committee that meets annually to review pRad proposals for the next run cycle.

Highlight/Status - update quarterly:
- The pRad external user experiment, which is a collaboration with LANL, Imperial College and the Air Force, completed the definition of the experiments to be executed during the 2011 LANSCE run cycle.
- Experiments have been scheduled for 7/25/2011
- A student from Imperial College, who will collect thesis data from these experiments, has been to LANL to begin preparations for these experiments.

Major milestones completed:
n/a

MTE 3.4 Transformational Capabilities

PM/PL/PI: *Evelyn Mullen, ADW, emullen@lanl.gov, 5-7576*

Project Title: Technical Review of Advanced Camera Technologies

Date: 4/21/2011

Project Description:
Activities in this MTE support the development of more revolutionary, higher-risk but high-pay-off technologies that will enable new experimental tools and associated diagnostic options that provide relevant data that could not be obtained with current technologies. Even as the challenge of assessing existing and future stockpile systems places greater demands on interpreting experimental data, the experiments may become less frequent, and more expensive. In many cases, to reduce uncertainties, more accurate data must be obtained. Another goal is to obtain this data at reduced cost.

Highlight/Status - update quarterly:

- 1QFY11 – Held an internal Radiography workshop to discuss current state of the art and potential future directions.