New INL project will improve nuclear reactor simulations

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A new project at Idaho National Laboratory and Brookhaven National Laboratory will improve the way scientists model the inner workings of nuclear reactors.

Researchers from the Idaho and New York labs, led by INL's Giuseppe Palmiotti, won a competitive grant from the Department of Energy's Office of Science. The researchers will use the money to develop more accurate, and more universally applicable, reactor simulations. As a result, engineers should be able to design better, more efficient reactors down the road.

INL and BNL scientists will use data from experiments already performed at nuclear facilities around the world to test and calibrate their models of nuclear reactions at the atomic level. This will enable them to integrate data from the meter scale (humans and their machines) with outcomes at the femtometer scale (the atomic nucleus). The research will cover an unprecedented 15 orders of magnitude, equivalent to the range between a single footstep and a light year.

This approach is novel, because reactor engineers and nuclear physicists occupy separate, rarely intersecting realms, according to Palmiotti.

"This will create a bridge between the nuclear physics community and the reactor community," he said. "The exchange of information between the two will be beneficial to both sides."

INL researchers, including project leader Palmiotti, Massimo Salvatores and Hikaru Hiruta, will take charge at the meter scale. Using INL's supercomputer facility, they will analyze data from experiments investigating the behavior and performance of materials inside reactors. These experiments are broad and varied. Some have measured reaction rates and critical masses for fissionable substances such as uranium and plutonium; others have looked at how neutrons propagate through iron and sodium.

Meanwhile, BNL scientists Michal Herman and Pavel Oblozinsky will use supercomputers to improve models at the nuclear physics level. The two groups will feed off each other, testing the simulations they develop against information from actual experiments.

The new simulations should be more accurate than those currently in use, which have not been tested in this way. And, because the researchers are looking at such a wide range of materials and experiments, their models should also be more broadly applicable.

This project, which received $1.05 million over three years, is one of two INL proposals funded by DOE's Office of Science. The other, which Palmiotti also works on and INL physicist Gilles Youinou leads, could help reveal how to get more use from nuclear fuel. While the two efforts differ substantially in their details, they share common goals.

"Both projects look at improving our knowledge of fast-reactor physics and increasing the accuracy of our simulation efforts," Palmiotti said. Fast reactors employ a nuclear chain reaction powered by especially fast-moving neutrons.

The two grant awards represent a unique accomplishment for INL, which receives the bulk of its research funding for applied engineering work rather than basic research projects such as these. Further,

according to the Office of Science Web site, the two projects together received about $3 million, meaning INL received 10 percent of funds the Office of Science estimates will be available in this round of Recovery Act funding.

"INL is using a science-based approach to obtain better data and to better design future reactors," said Phillip Finck, INL associate laboratory director for Nuclear Science & Technology. "Basically, we're using scientific tools to get better engineering data."

Both projects will start operations Oct. 1.

Source: Idaho National Laboratory