Frequently Asked Questions: DE-FOA-0001250, LAB 15-1250
Exploratory Research for Extreme-Scale Science (EXPRESS)
Posted December 30, 2014

This document will be updated with answers to the frequently asked questions that are received – please visit this page occasionally.

Q-1: Can you please clarify the significance of the $100K/year or $250K/year budget limits? A-1: A **University-led project** must have a total budget of $100K/year so that total would need to be divided up with other collaborating institutions in the project (if any). A **Lab-led project** has a total budget of $250K/year and takes into account the budgets of collaborating institutions (if any). The respective $100K and $250K annual budget is for the entire project and that total depends on the institution of the Lead PI. Note that researchers from industry are considered to be and must submit as "University" collaborators.

Q-1a: Do the $100K/year or $250K/year project budget limits apply to multi-institution collaborations?
A-1a: Yes - the limits apply, and they are triggered by the type of institution that hosts the Lead PI. The limits apply to collaborations, and they also apply if one institution is involved as a sub-awardee of another institution in the overall collaboration.

Q-1b: May a University and a Lab collaborate?
A-1b: Yes - the institution hosting the Lead PI of the collaboration is the lead institution of the collaboration, and that institution's project budget limit applies to the overall collaboration.

Q-2: Regarding Questions 1, in which a Lab-led project ($250K/year) includes a collaboration with a University PI – is it ok for the Lab PI to submit a budget for, say, $75K/year and the University PI to submit a budget for $175K/year? Note that the project is Lab-led and the total project budget is $250K/year.
A-2: Yes – this collaborative budget scenario is permissible since the overall Lab-led project budget is $250K/year.

Q-3: Can you briefly describe the EXPRESS projects that were funded last year in FY14?

1. **Massive Asynchronous Parallelization of Sparse Matrix Factorizations - Edmond Chow (Georgia Institute of Technology).** Asynchronous, extreme-scale sparse algorithms are explored for incomplete matrix factorizations, low-rank matrix completions, approximate inverses, and triangular solves. An unconventional approach is proposed in which matrix factorizations are expressed as a large number of bilinear constraint equations that can exploit the parallelism stemming from massive numbers of cores per node. Asynchronous computations can help address communication and synchronization costs, as well as extreme-scale issues with soft-error resilience.
2. **Modeling the Performance of Extreme Scale Systems - Cory Hauck (Oak Ridge National Laboratory).** The proposed research will explore predictive, multiscale models and algorithms for the flow of data and the overall performance of extreme-scale computing systems. The focus of this proposal is the simulation and analysis of the computer itself. The basic question is - Can we derive tractable mathematical models that can reproduce and

predict statistical information about the dynamical behavior of extreme-scale computers?

3. **Data Structures for Extreme Scale Computing - Simon Kahan (University of Washington).** Many data-intensive science applications are irregular in terms of data structures and unpredictable data accesses. The proposed research explores Aggegrating Data Structures (ADS) and latency-tolerant runtime systems for overcoming the challenges in using conventional data structures at exascale. The implications of ADS hierarchical data structures for energy consumption and resilience are also analyzed.
4. **COOLR: A New System for Dynamic Thermal-Aware Computing - Pete Beckman (Argonne National Laboratory) & Seda Memik (Northwestern University)**. Dynamic thermal management (DTM) schemes are explored for carefully balancing the thermal state of extreme-scale systems for optimal computing performance. System managers are extremely motivated to battle cooling-energy cost: the largest line item in their total operating cost. The overall thermal characterization and modeling methodology - thermal instrumentation techniques, model building, and systematic model reduction - resulting from this project will be applicable to the efficiency of current and future extreme-scale computing systems. A thermal-aware operating and runtime system will be developed.
5. **An Evaluation of the Performance of Functional Programming for Extreme Scale Computing - Philip Roth (Oak Ridge National Laboratory).** Nearly all scientific applications are written in an imperative programming language using a procedural programming paradigm. The proposed research explores whether scientific applications whose core computation is implemented using functional programming (FP) can achieve performance that is comparable to that of the traditional implementation when run on Leadership Class systems. For this hybrid FP paradigm, 3 scientific applications are selected from those used by the Oak Ridge Leadership Computing Facility, Center for Accelerated Application Readiness. This project will inform application developers on the merits of using hybrid FP approaches for scientific application development on future extreme-scale computing systems.