General Terms

Basic research that significantly advance uncertainty quantification (UQ) methodologies as an enabling technology in extreme-scale scientific computing

- UQ broadly refers to the end-to-end study of the accuracy, reliability, development and effective use of computational models in making scientific inferences.

- This Program Announcement calls for basic research in methodologies and tools that will deliver significantly improved or advanced UQ capabilities for DOE-mission science based on anticipating the characteristics and challenges, and fully realizing the potential advantages, of using extreme-scale computing systems.
Extreme-scale Science

• AKA Exascale Challenges
  – O(billion) Parallelism
  – Deep memory hierarchy (data movement is a significant cost)
  – Reduced memory/core
  – Resilience (faults are to be expected)

• Performance portability is a key challenge
UQ methodology basic research topics includes, but is not limited to:

- verification and validation;
- representation of uncertainty and error;
- sensitivity and uncertainty analysis;
- multi-scale modeling and simulation;
- model uncertainty;
- multi-model ensembles;
- UQ for inverse problems and model calibration;
- decision-making and optimization under uncertainty;
- detection and forecasting of rare events;
- dealing with high-dimensional probability spaces;
- statistical modeling and sampling techniques;
- uncertainty reduction; and other related areas.

May also pursue effective strategies for incorporating results from theoretical analysis and/or the use of data from observational or experimental science activities.
Criteria

• Impact for DOE-mission science:
  – What are the scientific challenges that are driving the development of the proposed UQ methodology?
  – How will the advanced UQ capabilities be demonstrated?

• Rigorous UQ methodology:
  – Does the UQ methodology provide a new and/or significant integrated capability for enabling extreme-scale science?
  – What are the potential merits and limitations of the UQ methodology in the context of extreme-scale computing systems?

• Advances in applied mathematics and/or statistics basic research:
  – Does the proposed research develop a strong mathematical or statistical foundation for the UQ methodology?
Funding Available

- Anticipated $5M per year
- Total project budgets of $150,000 to $1,400,000 per year
- Expect 4 to 9 projects funded
  - 5 to 25 Institutions
**Deadlines**

- April 15 by noon: Notify division office of intent to lead a proposal (I only expect to authorize one ORNL led proposal)
- April 19 by 5pm: Notify division office of intent to participate in non-ORNL led proposal
- Pre-proposals are required and due April 24, 2013
  - Must be in the division office by 5pm April 22, 2013
  - Response will be sent back by April 30, 2013
- Full proposals are due May 24, 2013
- Other deadlines will be determined after notifications on April 30, 2013