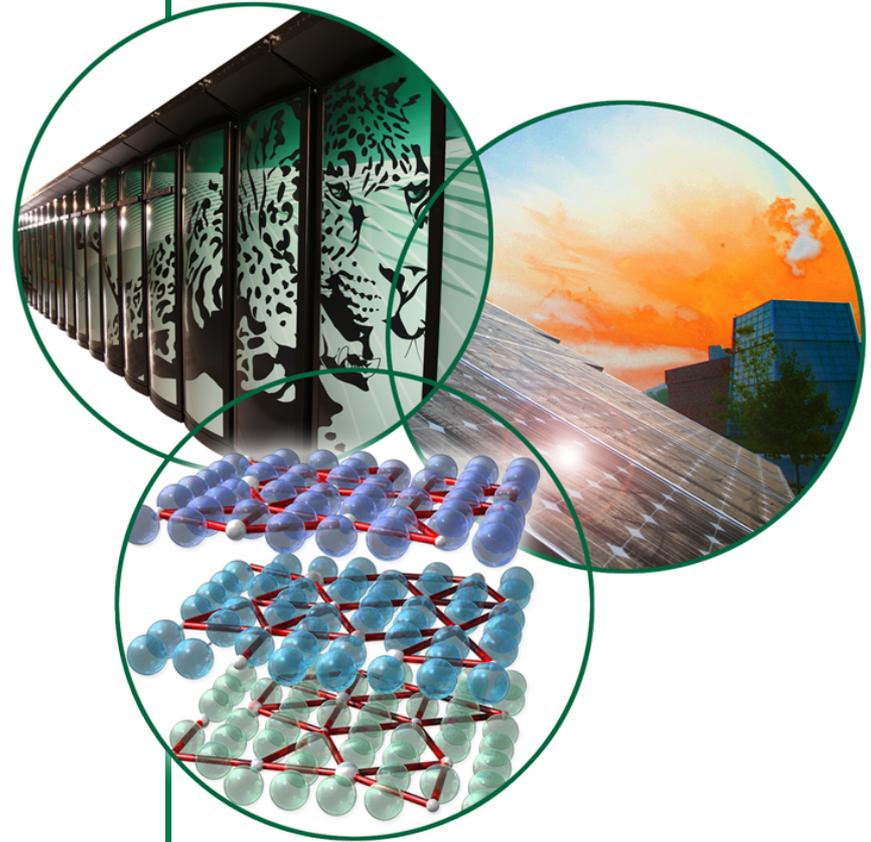


# Uncertainty Quantification Methodologies for Enabling Extreme- Scale Science

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# 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**

**[http://science.doe.gov/grants/pdf/LAB\\_13-895.pdf](http://science.doe.gov/grants/pdf/LAB_13-895.pdf)**