

**Center for Emergent Superconductivity (CES)**  
**EFRC Director: J.C. Séamus Davis**  
**Lead Institution: Brookhaven National Laboratory**

***Mission Statement:*** *To discover new high-temperature superconductors and improve the performance of known superconductors by understanding the fundamental physics of superconductivity.*

As U.S. electrical energy consumption continues to grow, the nation's electrical power transmission grid faces fundamental structural challenges of capacity, reliability and efficiency if it is to meet the needs of the 21st century. Electricity demand will grow by 50% in the US and by 100% globally by 2030, with nearly all of that growth in cities and suburbs where the overhead power lines and underground cables are already saturated. Power delivery and control solutions based on superconductors could solve these crises by using their demonstrated higher current carrying capacities over conventional cables, self healing fault current limiting capabilities, and substantial increases in efficiency. However, there remain many fundamental materials and physics challenges which must be addressed in order for superconductivity to have broad impact on the electrical grid.

The objective of the BNL/ANL/UIUC ***Center for Emergent Superconductivity*** (CES) is to explore fundamental research issues with the objective to overcome key barriers leading to the viable application of high temperature/high current superconductivity. This will be achieved by enabling the design of superconducting materials with optimal physical and critical properties for deployment of a 21st century superconducting power grid. Thus, the most profound challenge of CES is to understand the fundamental mechanisms of high-temperature and high-current superconductivity sufficiently so as to direct discovery of new or improved families of materials with higher critical temperatures and currents.

The Center brings together a group of PIs with strong records of accomplishment and demonstrated records of collaboration from three world-leading research institutions in correlated electron superconductivity: Brookhaven National Laboratory, Argonne National Laboratory and the University of Illinois at Urbana-Champaign. Through their Center interactions, the PIs bring a diversity of crosscutting experimental and theoretical tools to pursue three key research objectives: finding **new strongly correlated superconducting materials**, understanding the **mechanisms leading to high temperature superconductivity including the cuprate superconductors and the Fe-based materials**, and **controlling vortex matter to raise the current carrying performance** of high temperature superconductors.

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