Opportunity Title: Topological Materials & Interfacial Coupling for Topologically Enabled Devices (TED)
Opportunity Reference Code: ARL-R-SEDD-300000

Organization DEVCOM Army Research Laboratory

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Description **About the Research**

The U.S. Army Research Laboratory (ARL) seeks a highly motivated, well informed, cross-disciplinary and skilled research fellow with experience in theoretical/computational modeling and characterization of topological, magnetic materials and heterostructures. This research fellow will study structural, electronics and magnetic properties of topological insulator (TI)/magenetic material heterosturctures with quantum mechanical first principle method. The topologically protected surface states in TI are insensitive to imperfections in the bulk crystal, and do not backscatter off surface defects. The interplay of spin-momentum locking and magnetic materials allows one to efficiently switch the conducting surface channel off and on by applying an electric voltage to a TI/ferromagnet heterostructure. Spin-momentum locking is also why TI surface currents carry a net spin that can be used to flip the orientation of magnets. These phenomena respectively enable new transistor and memory device architectures that smash through the semiconductor power and speed limitations which are ending Moore's law and Dennard's scaling.

This research fellowship is a critical part of on-going DOD-wide research project on topologically enabled devices (TED). ARL is accelerating a strategic initiative to move the physics of topological materials to the engineering of emerging electronic devices that may solve future battlefield challenges with ultra-efficient electronics and RF technology, and equivalently may advance related civilian technology. Recent theoretical predictions for the device concepts based on topological insulator/magentic materials heterstructures far exceed today's state of the art for things such as sensing, sub-threshold switching with markedly reduced energy consumption, energy harvesting and radio frequency or even THz electronics. Many of these opportunities can take advantage of topological surface currents and spin-orbit coupling at room temperature even with today's imperfect materials. This fellowship is a unique opportunity to take full advantage of ARL's strategic intra-extramural reach with a seamless collaboration among ARL laboratories, extended campuses and leading academic scientists.

Keywords: Computational Chemistry, Condensed matter physics, magnetism, interfacial phenomena, topological materials, electronic structure

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About SEDD

The Sensors and Electron Devices Directorate (SEDD) is the Army's principal center for research and development in the exploration and exploitation of the electromagnetic spectrum, which includes radio

frequency, microwave, millimeter-wave, infrared (IR), visible, and audio regions. SEDD is responsible for advances in laser sources, RF sources, IR sensors, signature detection and decoding, target imaging and its interpretation, fusion of data derived from several sensors, and electromagnetic protection.

In addition, SEDD is responsible for improving the technology base for electron devices and materials related to sensors and power devices. Research is conducted in related aspects of physics, electrical engineering, computer science, solid-state physics, chemical engineering, material sciences, and electrochemistry.

About ARL-RAP

The Army Research Laboratory Research Associateship Program (ARL-RAP) is designed to significantly increase the involvement of creative and highly trained scientists and engineers from academia and industry in scientific and technical areas of interest and relevance to the Army. Scientists and Engineers at the CCDC Army Research Laboratory (ARL) help shape and execute the Army's program for meeting the challenge of developing technologies that will support Army forces in meeting future operational needs by pursuing scientific research and technological developments in diverse fields such as: applied mathematics, atmospheric characterization, simulation and human modeling, digital/optical signal processing, nanotechnology, material science and technology, multifunctional technology, combustion processes, propulsion and flight physics, communication and networking, and computational and information sciences.

A complete application includes:

- **Curriculum Vitae or Resume**
- **Three References Forms**
  - An email with a link to the reference form will be available in Zintellect to the applicant upon completion of the on-line application. Please send this email to persons you have selected to complete a reference.
  - References should be from persons familiar with your educational and professional qualifications (include your thesis or dissertation advisor, if applicable)
- **Transcripts**
  - Transcript verifying receipt of degree must be submitted with the application. Student/unofficial copy is acceptable

If selected by an advisor the participant will also be required to write a **research proposal** to submit to the ARL-RAP review panel for :

- Research topic should relate to a specific opportunity at ARL (see Research Areas)
- The objective of the research topic should be clear and have a defined outcome
- Explain the direction you plan to pursue

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- Include expected period for completing the study
- Include a brief background such as preparation and motivation for the research
- References of published efforts may be used to improve the proposal

A link to upload the proposal will be provided to the applicant once the advisor has made their selection.

Questions about this opportunity? Please email ARLFellowship@orau.org

Eligibility Requirements

- **Degree:** Bachelor's Degree, Master's Degree, or Doctoral Degree.
- **Academic Level(s):** Any academic level.
- **Discipline(s):**
  - **Chemistry and Materials Sciences** (1 👁)
  - **Computer, Information, and Data Sciences** (1 👁)
  - **Physics** (16 👁)
- **Age:** Must be 18 years of age