1. **Research Title:** Rydberg Arrays for Enhanced RF Direction Finding
2. **Individual Sponsor:** Charles Cerny, AFRL/RYMP, 2241 Avionics Circle, WPAFB, OH 45433-7333
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3. **Academic Area/Field and Education Level**:

Physics/Electrical Engineering - Complex RF Signal Processing, Computational Electromagnetics, Quantum Mechanics (MS or PhD level)

4. **Objectives**:

Extend existing Rydberg Atom model for the purposes Radio Frequency (RF) direction finding and develop designs for E-field vector sensors.

5. **Description**:

Rydberg atomic cells employ lasers to pump alkali atoms into highly excited electronic states and probe them for perturbations in the absorption characteristics of the atomic vapor caused by external electric and magnetic fields. Rydberg devices are comparable in instantaneous bandwidth to traditional RF antennas, and when configured as antennas have attractive tuning properties while maintaining sensitivity. Improved sensitivity arises from strong dipole interactions within the Rydberg atoms and the reduced coupling to noise sources from conventional RF electronics (Low noise amplifiers, mixers, etc.) and antennas, (all of which would be absent in a Rydberg array). The detection elements of the Rydberg atom cells are phase coherent, allowing the differential output to potentially be used to directly determine the angle of arrival for a signal of interest. The research performed will adapt the Physics-based behavioral model of the Rydberg atom cell to provide angle of arrival estimates via E-field patterns. This complements well with electrically small array designs that go beyond classical computational electromagnetics and identify enhancements to RF sensing through Quantum effects.

6. **Research Classification/Restrictions**: Unclassified
7. **Eligible Research Institutions**: DAGSI-SOCHE members