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Chemistry Office Hour

Today's Topic: NSF 22-630: Quantum Sensing Challenges for Transformative Advances in Quantum Systems (QuSeC-TAQS)

November 3, 2022

- **Sample Chemistry Relevant Quantum Sensing topics:**

  Identification of molecules in samples, for chemical and biological content analysis using quantum principles; uses of entanglement and many-body quantum states to enable new capabilities such as non-invasive imaging or measurements; novel molecular and materials architectures for quantum sensing; entangled-photon microscopy, spectroscopy, or photonic systems using quantum optics; enhancing measurements of electric fields and GHz or THz radiation possibly using Rydberg atomic states and coherent spectroscopy; improved imaging

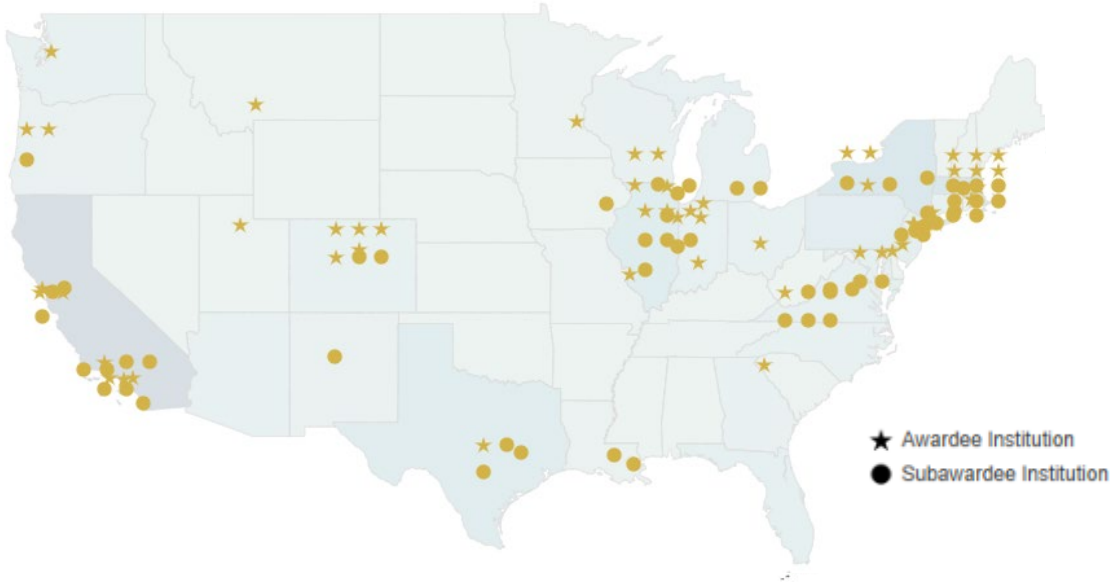
  Atomic clocks; Matter-wave optics; Solid-state and chip-scale methods to detect standards for quantities such as voltage, current, irradiance and temperature; Magnetometers

Previous Examples of TAQS Programs

TAQS = Transformational Advances in Quantum Systems

- **TAQS Pilot** (RAISE-TAQS) NSF 18-035
  - $25 Million for 24 Awards started in 2018
  - Teams with 3 or more investigators
- **Quantum Idea Incubator** (QII-TAQS) NSF 19-532
  - $25 Million for 19 Awards started in 2019
  - Teams of 3 or more investigators
- **Quantum Interconnects** (QuIC-TAQS) NSF 21-553
  - $25 Million for 10 Awards started in 2021
  - Teams of 3 or more Investigators

RAISE = Research Advanced by Interdisciplinary Science and Engineering



- ❑ Innovative, multidisciplinary projects
- ❑ Focusing on quantum functionality
- ❑ Proof-of-principle demonstrations

- For examples see NSF Award Search
  - https://www.nsf.gov/awardsearch/
  - Keyword: TAQS

Sample Chemistry Relevant Funded QII-TAQS Projects

1936353 QII-TAQS: Simulating Entangled Quantum Chemical Abstract Machines, PIs: Srinivasan Iyengar, Jeremy Smith, Philip Richerme, Amr Sabry

1936118 QII-TAQS: Quantum Metrological Platform for Single-Molecule Bio-Sensing, PIs: Peter Maurer, Liang Jiang, Nathalie de Leon

1936219 QII-TAQS: Solid State Integration of Molecular Qubits, PIs: Ezekiel Johnston-Halperin, Michael Flatte, Jay Gupta, Danna Freedman

- For more examples see NSF Award Search
  - https://www.nsf.gov/awardsearch/
  - Keyword: TAQS

- **Solicitation NSF 22-630 has a Quantum Sensing Theme**
  - In alignment with NSTC Strategy *Bringing Quantum Sensors to Fruition* (www.quantum.gov)
  - Innovative proposals on a diverse range of quantum sensing topics are sought.
  - The list of quantum sensor topics in the Solicitation is not intended to be comprehensive or limiting. Scientists and engineers are encouraged to explore possibilities beyond these examples.

- Competitive proposals are expected to present interdisciplinary and collaborative projects that identify a need and describe a sound scientific and engineering approach for developing a novel sensing system with enhanced performance compared to classical technologies.

- Proposed projects should pursue either or both of the following tracks:

  A. Explore new ideas for enhanced sensing functionalities

  B. Translate QIS and engineering discoveries into scalable sensor systems or networks.

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Please review the required elements for preliminary and full proposals in order to ensure compliance with Solicitation NSF 22-630: https://www.nsf.gov/pubs/2022/nsf22630/nsf22630.htm

Programmatic Considerations

Features deemed **important** under this solicitation:

- Quantum Sensing focus
- Interdisciplinarity and Convergence
- Experimental Demonstration

The following are **encouraged** to increase the impact of projects:

- Education and Training
- Partnerships
- International Collaboration, and Student Mobility and Exchange

For questions not addressed in the Solicitation, refer to the PAPPG NSF 22-1: https://www.nsf.gov/pubs/policydocs/pappg22_1/index.jsp

Preliminary Proposals are required, and must be submitted via Research.gov (**See NSF 22-630 instructions**)

Project Summary (1 pg)

- Overview with project title and list of co-Investigators and their institutions
- Intellectual merit of the proposed project.
- Broader impacts of the proposed work

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Project Description (5 pgs)

- Vision and Goals
- Approach and Methodology
- Relevance to Quantum Sensing
- Broader Impacts

References Cited

Senior Personnel Documents

Other Supplementary Documents

- List of Senior Personnel (1 pg) describing what each person brings to the project and how they are integrated to produce positive synergies.

For questions not addressed in the Solicitation, refer to the PAPPG NSF 22-1:
https://www.nsf.gov/pubs/policydocs/pappg22_1/index.jsp

The preliminary proposals will be reviewed by panels of external experts. Based on the reviews, a limited number of preliminary proposal teams will be invited to submit full proposals.

Invited Full Proposals may be submitted via Research.gov or Grants.gov (**See NSF 22-630 instructions**)

Project Summary (1 pg)

Project Description (15 pgs)

- Vision and Goals
- Approach and Methodology
- Proposed Research
- Thrust Area(s)
- Relevance to Quantum Sensing
- Broader Impacts
- Management Plan
- Results from Prior NSF Support

References Cited

Data Management Plan

Senior Personnel Documents

Other Supplementary Documents

- List of Senior Personnel (1 pg)
- Broadening Participation Plan (2 pgs) (optional)

For questions not addressed in the Solicitation, refer to the PAPPG NSF 22-1:
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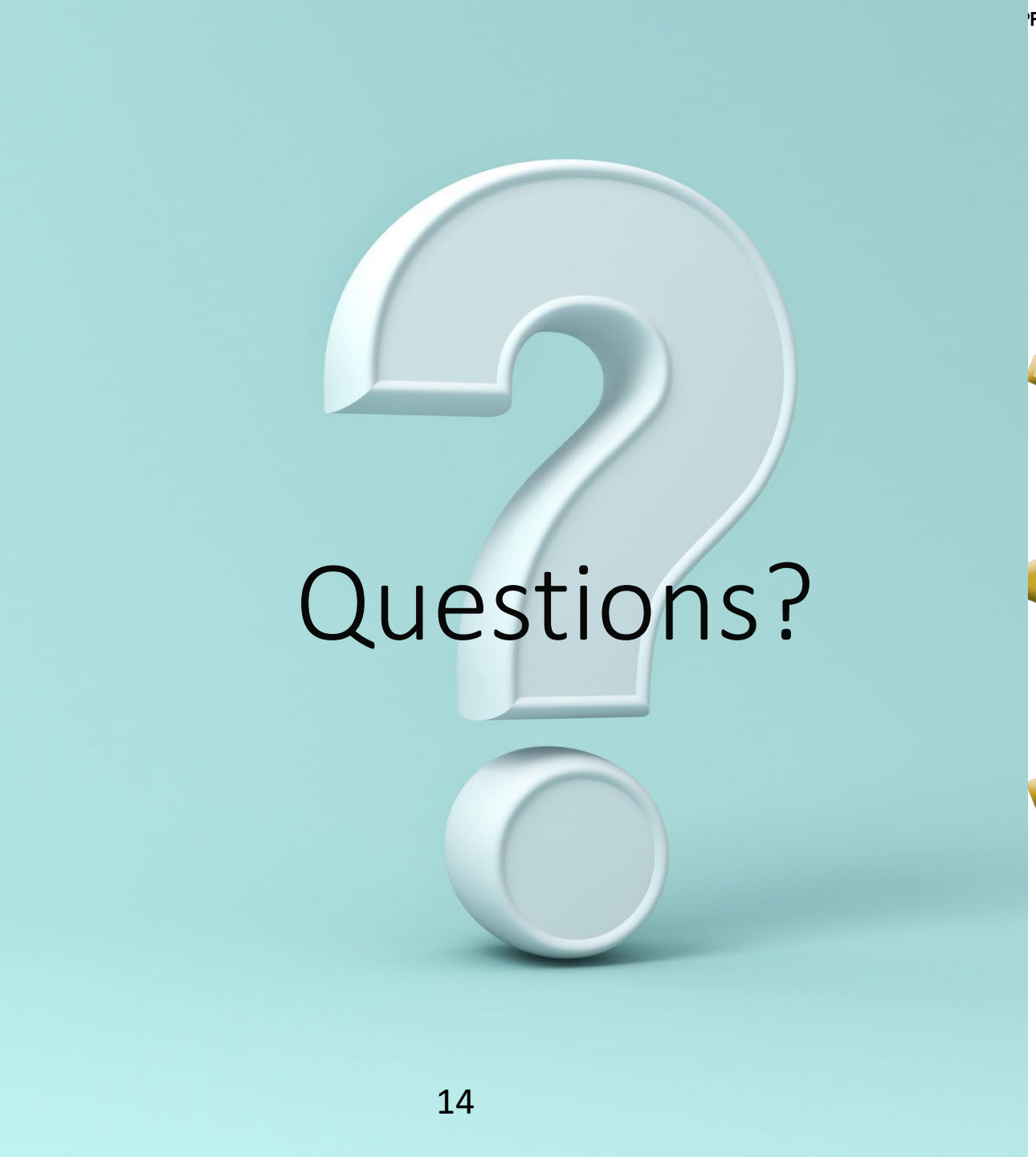
Upcoming Office Hour

- Mathematical and Physical Sciences Ascending Postdoctoral Research Fellowships (MPS-Ascend)
- On December 2, 2022, 4pm Eastern time
- Pre-Registration is required:
- https://nsf.zoomgov.com/meeting/register/vJIsdOCtpzssGs7DTmhgPers_icsz7RGVMM



Questions?

Questions for Solicitation NSF 22-630 on Quantum Sensing Challenges

1. Is there an upper limit on number of Investigators?
2. Do preliminary proposals require a Budget section?
3. When and how will invitations for full proposals be sent?
4. My project does not explicitly utilize entanglement. Is it still eligible?
5. Would NSF support applications for developing non-quantum sensors with comparable sensitivity to quantum sensors?
6. Can a team consist of three PIs all from the same department?
8. How can a QuSeC-TAQS proposal include collaborators from different institutions (e.g., other colleges or universities, non-profit entities, industry, national laboratories, or international partners)?

Further questions can be sent to qusec@nsf.gov
CHE contacts: Tingyu Li, John Papanikolas, Colby Foss