Request for Information (RFI): Compact Magnetometers

The Intelligence Advanced Research Projects Activity (IARPA) is seeking information on research efforts in the area of sensitive, compact magnetometers. This request for information (RFI) is issued solely for information gathering and planning purposes; this RFI does not constitute a formal solicitation for proposals. The following sections of this announcement contain details of the scope of technical efforts of interest, along with instructions for the submission of responses.

Background & Scope
Compact, sensitive magnetometers can enable or enhance the capabilities of a number of critical needs ranging from nuclear magnetic resonance imaging (NMRI) to precision navigation without GPS. Superconducting Quantum Interferences Devices (SQUIDs) can detect single flux quanta but the cooling requirements for the superconducting materials in the Josephson junctions at the heart of SQUIDs limit their usefulness for many applications. Alternatively, Optically Detected Magnetic Resonance (ODMR) devices do not require cooling and can therefore be extremely compact with sensitivities approaching those of SQUIDs. In addition, some ODMR devices can provide a high-bandwidth and direct measurement of the vector field (as opposed to forming vectors from multiple independent scalar measurements).

IARPA is interested in current state-of-the-art (SOTA) capabilities in compact, highly sensitive magnetometry for a range of applications. Responses to this RFI can describe both existing and planned detector concepts. Existing applications or areas of interest to IARPA include, but are not limited to:

- NMRI
- Nanometer-scale NMRI
- Detection of biological magnetic signals including, for instance, from the brain and heart
- Magnetic field gradiometry for navigation and forensics

This RFI seeks approaches to magnetometry that are:

- Highly sensitive (approaching the single-flux quanta level)
- Highly compact (suitable for manufacturing in arrays)
- Inherently ruggedizable (robust against vibration, temperature shifts, shock, etc.)
- Low power

Responses to this RFI should quantitatively answer any or all of the following questions:

1. What is the scientific principle that enables your magnetometer?
2. What are the current and theoretical sensitivity limits of your detector?
3. What is the dynamic range associated with your quoted sensitivities?
4. Quantitatively address the precision of both field-magnitude-sensing and field-direction sensing. If field-direction sensing is accomplished via multiple field-magnitude measurements along different axes please discuss individual measurement uncertainties and propagation of uncertainties to the final vector measurement determination.
5. What are the current and upper theoretical limits to detector bandwidth for your detector?

6. Over what frequency range does your detector function? Can it simultaneously collect high SNR data over the entire bandwidth? In other words, does your detector average signals over frequency bandwidth of interest, or does it return an entire spectrum? Discuss resolution and SNR.

7. Does the scientific principle underlying your detector inherently provide vector information? If not, how are vectors formed and how does vector formation affect the sensitivity limits described in question 2? In your answer discuss individual sources of error and propagation of uncertainty.

8. What is the spatial resolution associated with your technique? If spatial resolution is variable, how is detector sensitivity related to spatial resolution?

9. What are the current and lower theoretical limits on the size of your detector?

10. Quantify your detector's required standoff distance from a magnetic source.

11. What are the current and lower theoretical limits on power requirements for your detector?

12. Is your detector technology inherently rugged and portable? Please explain. If your technology is not inherently rugged, please describe approaches to ruggedizing your technology for uses outside the laboratory.

13. In your responses, please also include impacts of the external environment on your sensor’s performance (e.g., earth’s magnetic field, ubiquitous noise sources, etc.). Please also discuss how detector size impacts detection (i.e., do magnetic field gradients impact your sensitivity due to detector size?).

14. Finally, how does your sensor design impact its use in arrays? What are the minimum spacing requirements between detectors so that individual element measurements are not compromised?

**Preparation Instructions to Respondents**

IARPA requests that respondents submit ideas related to this topic for use by the Government in formulating a potential program. IARPA requests that submittals briefly and clearly describe the potential approach or concept, outline critical technical issues/obstacles, describe how the approach may address those issues/obstacles and comment on the expected performance and robustness of the proposed approach. If appropriate, respondents may also choose to provide a non-proprietary rough order of magnitude (ROM) estimate regarding what such approaches might require in terms of funding and other resources for one or more years. This announcement contains all of the information required to submit a response. No additional forms, kits, or other materials are needed.

IARPA appreciates responses from all capable and qualified sources from within and outside of the US. Because IARPA is interested in an integrated approach, responses from teams with complementary areas of expertise are encouraged.

Responses have the following formatting requirements:

1. A one page cover sheet that identifies the title, organization(s), respondent's technical and administrative points of contact - including names, addresses, phone and fax numbers, and email addresses of all co-authors, and clearly indicating its association with RFI-17-07;

2. A substantive, focused, one-half page executive summary;
3. A description (limited to 5 pages in minimum 12 point Times New Roman font, appropriate for single-sided, single-spaced 8.5 by 11 inch paper, with 1-inch margins) of the technical challenges and suggested approach(es);
4. A list of citations (any significant claims or reports of success must be accompanied by citations);
5. Optionally, a single overview briefing chart graphically depicting the key ideas.

Submission Instructions to Respondents
Responses to this RFI are due no later than 5 p.m., Eastern Time, on August 25, 2017. All submissions must be electronically submitted to dni iarpa rfi 17 07 iarpa gov as a PDF document. Inquiries to this RFI must be submitted to dni iarpa rfi 17 07 iarpa gov. Do not send questions with proprietary content. No telephone inquiries will be accepted.

Disclaimers and Important Notes
This is an RFI issued solely for information and planning purposes and does not constitute a solicitation. Respondents are advised that IARPA is under no obligation to acknowledge receipt of the information received, or provide feedback to respondents with respect to any information submitted under this RFI.

Responses to this notice are not offers and cannot be accepted by the Government to form a binding contract. Respondents are solely responsible for all expenses associated with responding to this RFI. IARPA will not provide reimbursement for costs incurred in responding to this RFI. It is the respondent's responsibility to ensure that the submitted material has been approved for public release by the information owner.

The Government does not intend to award a contract on the basis of this RFI or to otherwise pay for the information solicited, nor is the Government obligated to issue a solicitation based on responses received. Neither proprietary nor classified concepts or information should be included in the submittal. Input on technical aspects of the responses may be solicited by IARPA from non-Government consultants/experts who are bound by appropriate non-disclosure requirements.

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