## Topic: N162-125

## HYPRES, Inc.

Read Out of Single Photon Cryogenic Array Detectors Via Energy Efficient Digital Means

This superconducting electronics company offers design, development, fabrication, testing and packaging services for their digital Radio Frequency (RF) product-lines. The goal of the Phase II is to develop a cryogenic digital readout scheme of cryogenic microwave kinetic inductance detector (MKID) arrays, using superconductor analog-to-digital converter (ADC) technology. The application of this technology (ADC's ) to the MKID array has the potential to scale back or eliminate the most power hungry component (the HEMT amplifier) in current read out systems and allow the number of pixels in the array to grow, improving image resolution and field of view. The concurrent ADC improvements will improve the HYPRES Advanced Digital Receivers ability to contribute to spectral dominance in naval multi-function RF applications, including communications, Electronic Warfare (EW), Intelligence, Surveillance (target identification), Reconnaissance (ISR) and Radar.

## Technology Category Alignment:

RF Components for sensing, transmission and communication
Information Collection/Management
Networks and Communications
Broadband/Multispectral Components and Systems
Radio Frequency (RF) (non-EW)

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**SYSCOM:** ONR
**Contract:** N68335-18-C-0120
Corporate Brochure: https://navystp.com/vtm/open_file?type=brochure&id=N68335-18-C-0120

# Department of the Navy SBIR/STTR Transition Program

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Read Out of Single Photon Cryogenic Array Detectors Via Energy Efficient Digital Means
HYPRES. Inc.

## WHO

**SYSCOM:** ONR

**Sponsoring Program:** Naval Information Warfare Systems Command (old SPAWAR)

**Transition Target:** PEO C4I

**TPOC:**
Dr. Deborah VanVechten
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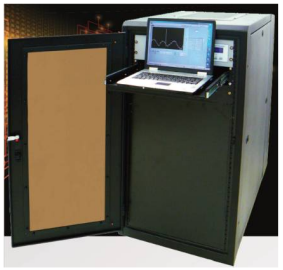
**Other transition opportunities:** Radar, Passive IR, AF TENCAP, Big Safari

**Notes:** Will work with TPOC(s) to identify other Transition opportunities

HYPRES HYDR-02
Modular, Multi-Function Digital RF Receiver





## WHAT

**Operational Need and Improvement:** Naval radio frequency (RF) systems have a requirement to improve spectrum utilization and target identification,. This can be achieved by basing these systems on superconducting broadband analog to digital converters (ADC). Cryogenic Microwave Kinetic Inductance Detector (MKID) array are currently under development for naval imaging/target recognition through obscurants. Their performance can be improved by digitizing the sensor readouts before the information leaves cryogenic temperatures; during this phase II, this performance improvement will be demonstrated.

**Specifications Required:** The goal of the Phase II is to develop a cryogenic digital readout scheme of cryogenic microwave kinetic inductance detector (MKID) arrays, using superconductor analog-to-digital converter (ADC) technology. Extensive analysis of the entire readout chain has been performed and an approach to develop a digital system capable of handling array sizes of 10,000 or more during the Phase II. A scalable approach to integrate MKID arrays to the superconductor ADC will be developed.

**Technology Developed:** Technology developed for this phase II was based on the fielded HYPRES HYDR-02 Modular,Multi-Function Digital-RF Receiver product. The application of this technology (Superconducting ADC's ) to the MKID array has the potential to scale back or eliminate the most power hungry component the HEMT amplifier in current read out systems and allow the number of pixels in the array to grow, improving image resolution and field of view. The concurrent ADC improvements will improve the HYPRES HYDR-02's ability to contribute to spectral dominance in naval multi-function RF applications, including communications, Electronic Warfare (EW), Intelligence, Surveillance (target identification), Reconnaissance (ISR) and Radar.

**Warfighter Value:** The Modular, Multi-Function Digital-RF Receiver systems fielded maximize signal reception for communication, ISR and EW systems, enabling full broadband spectrum monitoring and precise emitter identification and targeting. The version of MKID's sensors proven in this effort will be scalable to multi-band systems with full surround fields of view with significantly better range and resolution than today's room temperature sensors.

## WHEN

**Contract Number:** N68335-18-C-0120 **Ending on:** June 1, 2020

| Milestone | Risk Level | Measure of Success | Ending TRL | Date |
|---|---|---|---|---|
| Demonstrate a 3-bit Flatband | Low | Meets parameters per test plan in Helium Dewar | 3 | 2nd QTR FY19 |
| Develop a chip module for 4-bit FBADC | Low | Meets parameters per test plan in Helium Dewar | 3 | 1st QTR FY20 |
| Develop and Test Wideband MKID array | Med | Passes requirements in Test Plan | 3 | 3rd QTR FY20 |
| Develop Sensitive BP ADC | Med | Meets parameters per test plan in Helium Dewar | 3 | 3rd QTR FY20 |
| Phase II Option- Integrate MKID array with superconductor ADC and Test | High | Passes requirements in Test Plan | 4 | 3rd QTR FY22 |
| Optical Integration and Test | High | Passes requirements in Test Plan | 6 | 3rd QTR FY22 |

## HOW

**Projected Business Model:** The output of this Phase II will result in a product that will be incorporated into the HYPRES digital RF receiver product family which in turn will be inserted into military systems directly and through other DoD prime contractors. HYPRES has worked with L-3 Communications, Boeing/Argon and ViaSat on digital-RF receiver projects in the past.

**Company Objectives:** HYPRES seeks program office support for completion of development, test/evaluation, and transition to relevant programs of record. HYPRES also seeks relationships with prime contractors, DoD program offices and equity investors for transition to major C4ISR, EW, radar acquisition programs and to the commercial market place.

**Potential Commercial Applications:** HYPRES believes there are commercial applications in NOAA weather RADAR systems, remote sensing thru adverse weather conditions such as tornados and hurricanes for early warning of approaching storms.

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