Quantum-Limited Amplifiers for Detector Arrays on NASA's Inflation Probe

Completed Technology Project (2014 - 2018)

Project Introduction

Recently, a NASA satellite mission, the Inflation Probe, has been proposed to search for B-mode polarization in the Cosmic Microwave Background (CMB) the "smoking gun" for the theory of cosmic inflation and a window into physics at much higher energies than that possible in accelerator experiments. The two leading detector technologies for the Inflation Probe are the transition edge sensor (TES) and the microwave kinetic inductance detector (MKID). However, neither technology currently satisfies both the multiplexing and sensitivity requirements needed for the mission. I propose to resolve this issue by performing detector readout with the Dispersion-Engineered Traveling-Wave Kinetic Inductance (DTWKI) amplifier. To achieve this goal, the DTWKI must achieve greater than 20 dB gain over a fractional bandwidth of 30% on each side of the pump, large dynamic range, and near quantum-limited noise performance. However, the DTWKI is yet to realize these benchmarks. I propose a multi-pronged development program, based on experimental characterization of the DTWKI s component nitride thin films, optimization of transmission-line geometries, and new thermal-management techniques. The proposed work will involve extensive collaboration with NASA s Jet Propulsion Laboratory and the University of Pennsylvania. If successful, the DTWKI will have a revolutionary impact on observational astrophysics, enabling unprecedented sensitivity not only in the Inflation Probe, but also in NASA's far-infrared and x-ray astronomy missions.

Anticipated Benefits

If successful, the DTWKI will have a revolutionary impact on observational astrophysics, enabling unprecedented sensitivity not only in the Inflation Probe, but also in NASA's far-infrared and x-ray astronomy missions.

Primary U.S. Work Locations and Key Partners

Organizations Performing Work	Role	Type	Location
Stanford University	Lead Organization	Academia	Stanford, California

Project Website:

https://www.nasa.gov/directorates/spacetech/home/index.html

Quantum-Limited Amplifiers for Detector Arrays on NASA's Inflation Probe

Table of Contents

Project Introduction 1
Anticipated Benefits 1
Primary U.S. Work Locations and Key Partners 1
Project Website: 1
Organizational Responsibility 2
Project Management 2
Technology Maturity (TRL) 3
Technology Areas 3
Target Destination 3

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Stanford University

Responsible Program:

Space Technology Research Grants

Project Management

Program Director:

Claudia M Meyer

Program Manager:

Hung D Nguyen

Principal Investigator:

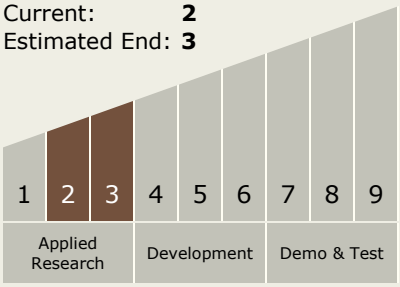
Kent D Irwin

Co-Investigator:

Saptarshi Chaudhuri

Technology Maturity (TRL)

Start: **2**
Current: **2**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  └ TX08.1 Remote Sensing Instruments/Sensors
    └ TX08.1.1 Detectors and Focal Planes

Target Destination

Outside the Solar System