**BLISS: a Far-IR Spectrograph for SPICA**

Matt Bradford (JPL, Caltech) w/ help from many

**Team**
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**Scientific Motivation: Why Focus on Broadband Spectroscopy?**

Cosmic Backgrounds:
- The remnant glow of star and galaxy evolution
- Half is in the far-IR

The Galaxies producing the CIB:
- Discovered with Spitzer MIPS, SCUBA, & AKARI
- Appear to be LIRGS and ULIRGS at z~0.5 to 3

**Future platforms will produce even larger source catalogs from imaging surveys**

Spectroscopic Follow-up is Required for Detailed Astrophysics

A wealth of information is available for early-universe galaxies if we have the sensitivity:
- Suite of lines provides a reliable redshift template, perhaps the only method for very dusty sources.
- Fine structure and molecular lines dominate the gas cooling and measure its properties
- Degree of ISM processing
- Starburst / AGN contributions
- Degree of SED processing

Far-IR lines are subject to very little extinction, they probe the bulk of a galaxy.

**SPICA Spectrograph Sensitivities**

- Far-IR – mm Spectroscopy Platforms
  - SPIRA
  - SAFARI
  - CAT
  - JWST
  - BLISS

**Spectrograph Concepts and Technologies**

The ideal instrument for rapid follow-up of distant (unresolved) galaxies is a broadband grating, operating at or near the background limit.

**BLISS Concept**
- Complete coverage from 38-430 microns
  - 2 beams on the sky, 5 bands in each covering the full range
  - Waveguide spectrometers and cross-dispersed echelles
  - Both compatible with long-leg bolometers

**Z-Spec**
- 1mm prototype, working on Mauna Kea w/ BG-limited performance
  - Bradford, Earle, Apetre, Glenn, Bock, Zmuidzinas, Nagler, Matsuhara, Inami

**BLISS Detectors**
- Requires ~few 10^-8 W Hz^-1/2 for photon BG limit.
  - Use leg-isolated TES
  - M. Kenny, P. Day, JPL

- T_c, G fabricating as designed
- High-aspect-ratio legs: Measured G value of ~10 mV / K at 60 mK using Johnson noise thermometry
- Moly-gold bi-layer TES, works for ~30 - 100 mK
- NEP measured with 220 mK TES

**Noise measurements underway**
- ~4e-19 W Hz^-1/2 NEP measured with 220 mK TES
- Confirms G-dependence, extrapolates to ~6e-20 W Hz^-1/2 for 70 mK
- Time constants OK for BLISS (sub 100 ms w/ feedback)