

US proposed instruments

Shuji Matsuura, Hideo Matsuhara
and Takao Nakagawa (ISAS, JAXA)

SPiCA
Space Infrared Telescope for Cosmology and Astrophysics

US proposed instrument(s)

- NASA called for proposal to study a full US-led SPICA instrument (NRA ROSES 2009).

- Selected 3 proposals

BLISS for SPICA: Sensitive Far-IR Spectroscopy Reveals the Cosmic History of Galaxies and Organic Elements

PI: Charles(Matt) Bradford (Caltech/JPL)

μ -Spec: A Revolutionary Far Infrared Spectroscopic Capability for SPICA

PI: Samuel(Harvey) Moseley (NASA/GSFC)

WISPIR: Wide-field Imaging SPectrograph for the InfraRed

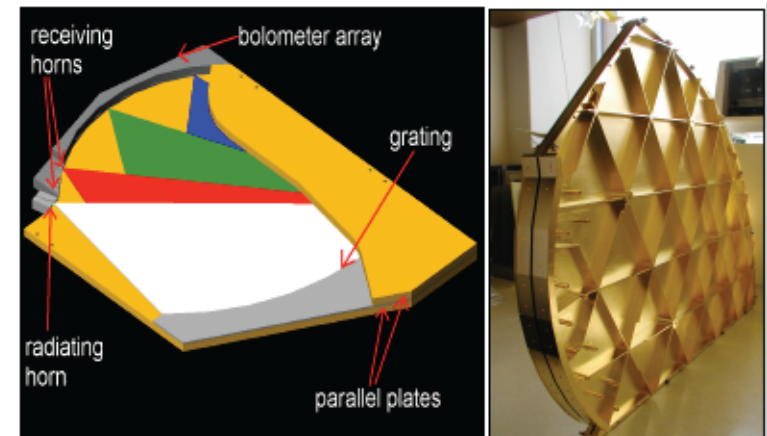
Co-PI: Lee Mundy (University of Maryland) and Dominic Benford (NASA/GSFC)

- Aug 2010: The US Decadal Survey (astro2010) committee strongly recommends US participation to SPICA.
- Sep 2010: Final study reports
 - We are now discussing about implementation of the US instrument.

BLISS overview

BLISS (The Background Limited Infrared Submillimeter Spectrograph)
: Sensitive Far-IR Spectroscopy Reveals the Cosmic History of Galaxies and Organic Elements

- BLISS is a 38-433 μm grating spectrometer ($R=700$)
 - Fills gap between JWST / SPICA-MIR and ALMA with comparable sensitivity.
- The BLISS grating architecture provides maximum sensitivity.
 - BLISS-SPICA is the only way to study a meaningful sample of the tens of thousands of high-redshift galaxies and protoplanetary systems now being discovered with Herschel and other imaging systems.
- BLISS is compact, low mass, and has simple interfaces.
 - Only moving part is a chopping mirror.
 - Cold mass less than 30 kg, size 45x40x40 cm, bolts to 4.5 K instrument bench and rejects heat to SPICA 1.7 K cold finger.
- BLISS uses TES bolometer arrays with a now-standard SQUID multiplexer.
 - Systems issues proven in several scientific instruments.
 - Clear path to achieving the uniquely sensitive bolometers required for BLISS.

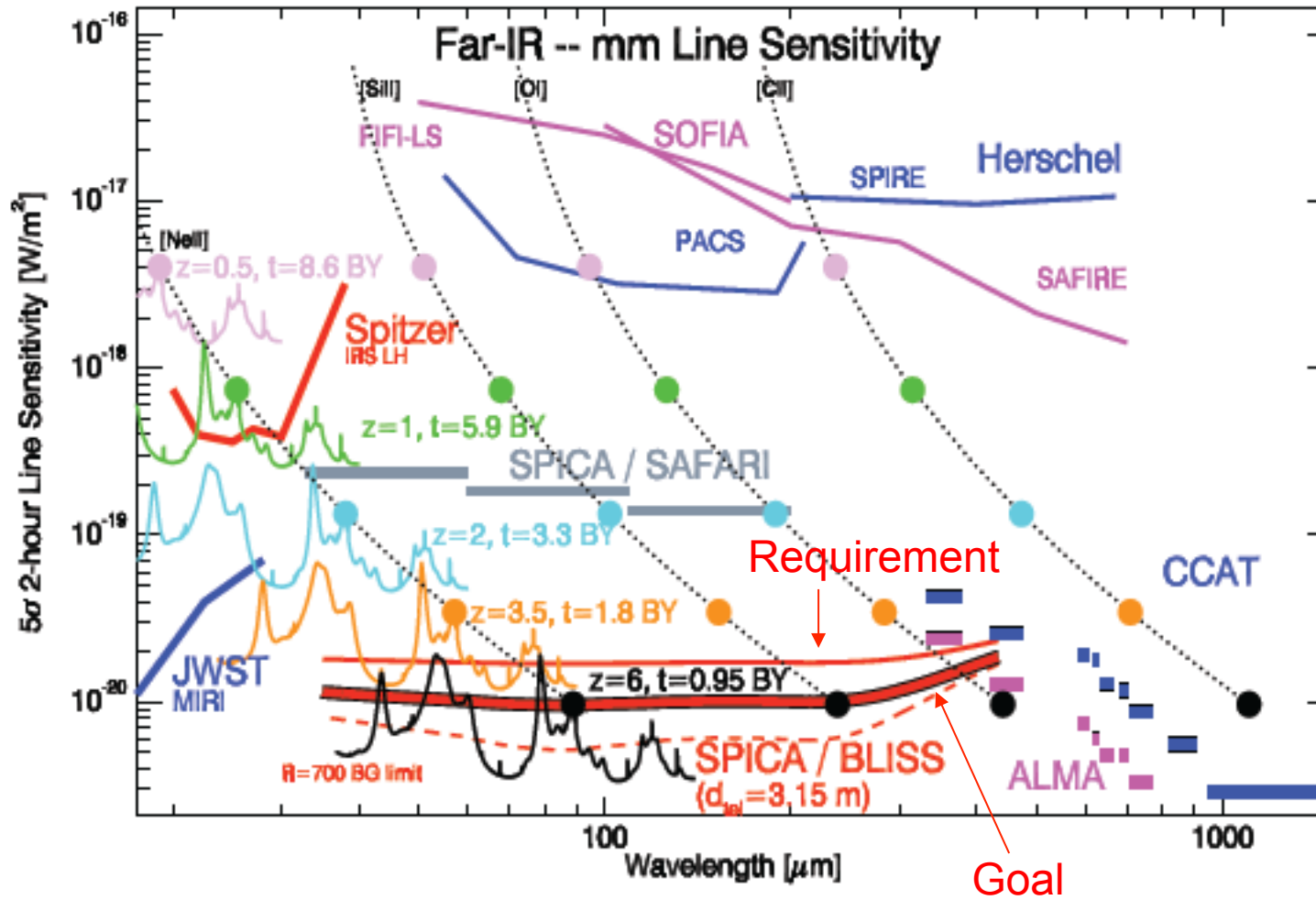


Waveguide grating spectrometer (WaFIRS)
for Z-Spec (as proto-type of BLISS)

BLISS specifications

	BLISS
Line sensitivity (5σ , 1h)	$1 \times 10^{-20} \text{ Wm}^{-2}$
Resolving power ($R = \lambda / \Delta\lambda$)	700
Spectral coverage	38-433 μm
Number of beams	2 (source & ref), Diffraction ltd.
Detector format	4224
Detector sensitivity	$5 \times 10^{-20} \text{ W}/\sqrt{\text{Hz}}$
Detector technology	TES bolometer
Readout	Time-domain SQUID MUX
Spectrometer	WaFIRS waveguide grating
Cooler	50mK ADR + 300mK ^3He sorption

BLISS sensitivity



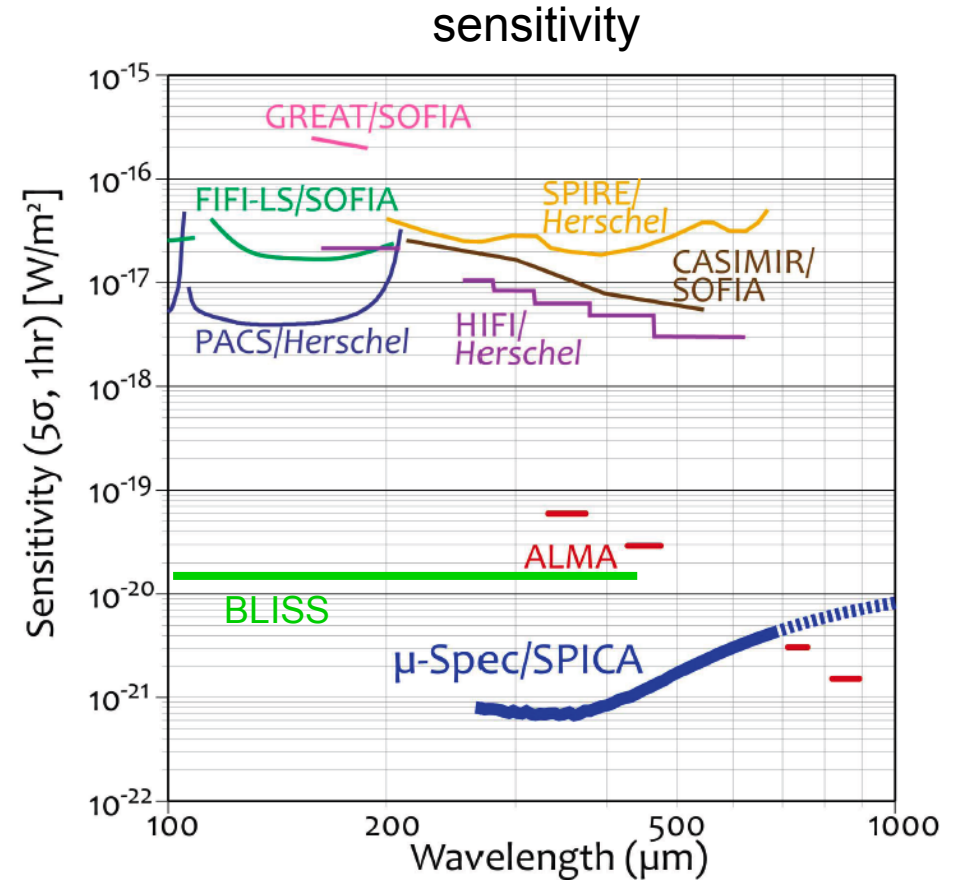
μ -Spec overview

μ -Spec: A revolutionary Far Infrared Spectroscopic Capability for SPICA

- Objectives: similar to BLISS
 - Very high redshift objects (out to $z \sim 10$)
 - H_2O , O_2 molecular lines in ISM
- Ultra-high sensitivity & high resolution with compact system
- Novel technologies
 - $\lambda = 250\text{--}700\mu\text{m}$
 - Micro-strip delay-line spectrometer ($R \sim 1500$)
 - MKID (Microwave Kinetic Inductance), several times higher sensitivity than TES
 - Ultra compact spectrometer module fabricated on a $\sim 100\text{mm}$ (!) Si-wafer
- 50mK ADR / 300mK ^3He tandem cooler system (ASTRO-H)

μ-Spec specifications

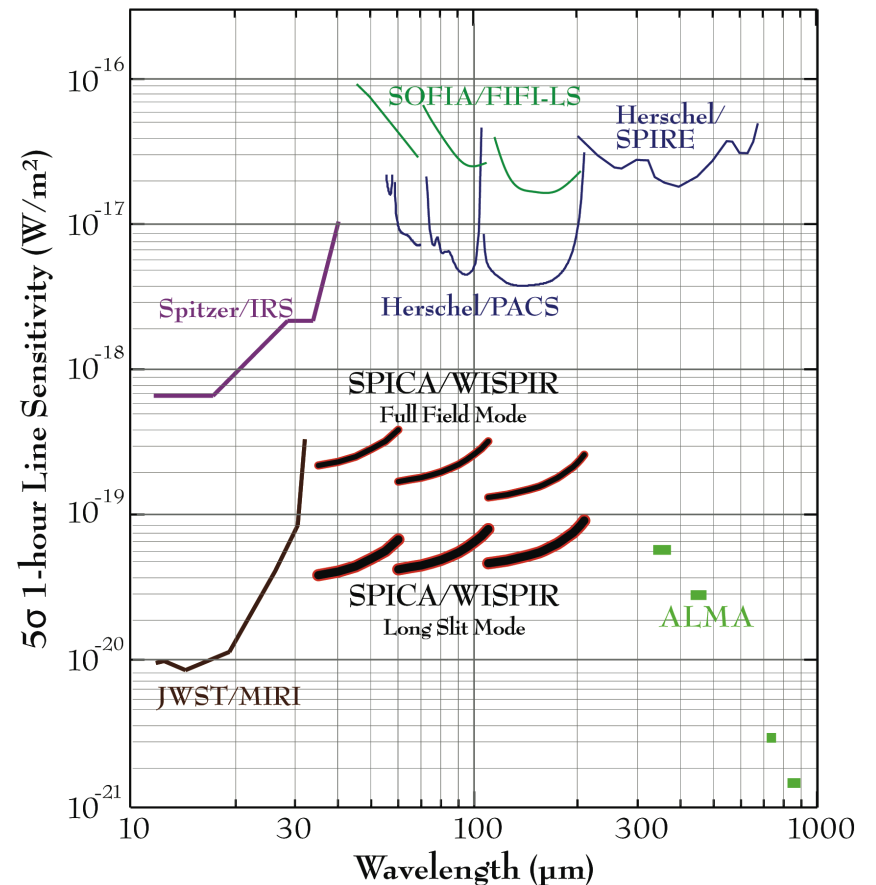
	μ-Spec
Line sensitivity (5σ, 1h)	$1 \times 10^{-21} \text{ Wm}^{-2}$
Resolving power ($R = \lambda / \Delta\lambda$)	1500
Spectral coverage	250-700 μm
Number of beams	1-7 TBD, Diffraction ltd.
Detector format	~4000
Detector sensitivity	$1 \times 10^{-20} \text{ W}/\sqrt{\text{Hz}}$
Detector technology	MKID
Readout	Microwave HEMT
Spectrometer	Delay line spectrometer
Cooler	<300mK TBD



WISPIR overview

WISPIR: Wide-field Imaging Spectrometer for the InfraRed

- Objectives:
 - high-z galaxies & molecular lines in local universe
- Imaging FT spectrometer
- 35-210 μm (3 bands), $R=1000-6000$
- GSFC TES bolometer & SQUID MUX (NEP $\sim 4 \times 10^{-20}$ W/ $\sqrt{\text{Hz}}$)
- 50mK/300mK tandem cooler (ASTRO-H)
- High sensitivity with slit+grism
 - Improvement of SAFARI



Summary

All proposed US instruments:

- FIR/sub-mm spectrometers with dispersion elements
- Super-conducting detectors with ultra-high sensitivity
- Optimized for spectral line detection of point source
 - complementary with SAFARI (imaging FT)