Scientific Promise and Concepts for a Background-Limited Infrared-Submillimeter Spectrograph (BLISS) for SPICA

C.M. Bradford and the BLISS Study Team

JPL, Caltech, Pasadena, CA, USA

The far-IR component of the cosmic background light is due to dust-enshrouded energy release integrated over the history of stars and galaxies. The fact that the energy in this dust component is comparable to that in the optical / near-IR component means that on average in the universe, interstellar dust has absorbed and reradiated half of the total energy ever generated by stars and black-hole accretion. The first high-redshift dusty galaxies discovered appear to have properties similar to those of the local luminous and ultraluminous IR galaxies (LIRGs and ULIRGs): very powerful galaxies so highly obscured that they emit more than 90% of their luminosity in the far-IR. The next generation of continuum surveys will discover tens of thousands of similar galaxies at all redshifts as the bulk of the background is resolved into its constituent sources.

The key to studying these galaxies will be spectroscopy at long-wavelengths. The rest frame mid-to far-IR offers a rich suite of tools immune to dust extinction that probe all phases of the interstellar medium: ionized, neutral atomic, and molecular. Measurement of these gas-phase and solid-state features provides redshifts, gas masses, and physical conditions from which luminosities, stellar populations, and star formation histories are derived. A complete history of dust-obscured energy production requires far-IR spectroscopy through the regime of peak activity in galaxies, to redshift 5. This is only possible with a large, actively-cooled telescope, and a zodiacal-light-limited spectrograph.

Given recent technological advances, we can now anticipate this opportunity for the first time. We are studying concepts for a far-IR spectrograph for the Japanese SPICA mission. The background-limited infrared-submillimeter spectrograph (BLISS) is a suite of broadband, moderate resolution (R~1000) spectrograph modules covering the 40-600 micron range, with excellent sensitivity to take advantage of the cold telescope. The BLISS instrument employs the world's most sensitive far-IR/submillimeter detectors as well as novel sub-K cooler and multiplexer technologies. The combination of BLISS with SPICA will offer broadband coverage and sensitivities at or better than 10^-20 W/m^2 in modest integrations, orders of magnitude faster than currently-planned far-IR facilities. We outline the scientific motivation for BLISS on SPICA, and present our instrument concepts and key technologies.