Developing Spatio-spectral Interferometry in the Lab for Far-IR Space Applications

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Abstract: We describe a NASA-sponsored project to develop and learn the practical limitations of wide-field spatio-spectral interferometry, a technique that will enable the acquisition of high-resolution far-IR integral field spectroscopic data with a future space-based interferometer.
OCIS codes: Image processing: 100.3175 Interferometric imaging, Instrumentation, measurement, and metrology: 120.6085 Space instrumentation, Spectroscopy: 300.6300 Spectroscopy, Fourier transforms.

1. Summary

We describe a NASA-sponsored project to develop and learn the practical limitations of wide-field spatio-spectral interferometry, a technique that will enable the acquisition of high-resolution far-IR integral field spectroscopic data with a single instrument in a future space-based interferometer. This technique was central to the Space Infrared Interferometric Telescope (SPIRIT) and Submillimeter Probe of the Evolution of Cosmic Structure (SPECS) space mission design concepts, and it will be used first on the Balloon Experimental Twin Telescope for Infrared Interferometry (BETTII). Our experimental approach (Figure 1) combines data from a laboratory optical interferometer (the Wide-field Imaging Interferometry Testbed, WIIT), computational optical system modeling, and spatio-spectral synthesis algorithm development. We summarize recent experimental results and future plans.

2. Companion Papers

The spatio-spectral synthesis algorithm mentioned above is described in a companion paper, as are the balloon project, BETTII, the space mission concept, SPIRIT, the science enabled by space-based far-IR interferometry, and related technology development and mission modeling efforts in the UK. We respectfully request that all of these papers appear in a single session dedicated to far-IR spatio-spectral interferometry.

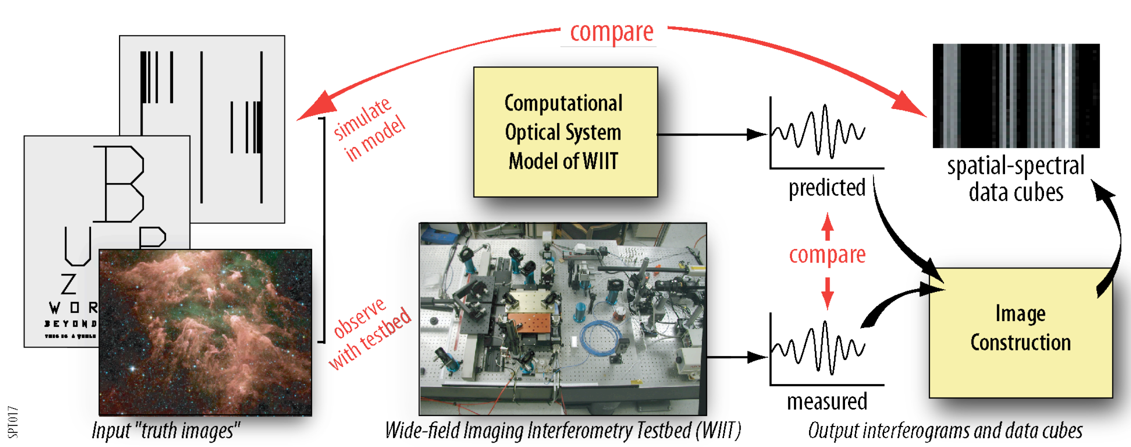

Figure 1. We apply an error-tracking experimental approach in which increasingly complex, more astronomically realistic test scenes are observed, and different observing modes are explored to learn the practical limitations of wide-field spatio-spectral interferometry and to quantitatively understand how each instrument design parameter impacts the quality of the synthesized hyperspectral image cube.