Figures/interferogram.tex00384.57872182.93379 Figures/interferometer.tex00426.53319380.00542

1.1 The physics of star formation

In here, describe

1.2 Clustered environments

2 The Balloon Experimental Twin Telescope for Infrared Interferometry

2.1 Towards higher angular resolution in the far-IR

Observations at mid- to far-infrared wavelengths from the Earth's surface are extremely limited by the large atmospheric opacity in this region of the spectrum. Space-based telescopes like IRAS [**?**, 12-100 ;]]1984ApJ...278L...1N, ISO [**?**, 2.5-240 ;]]1996AA...315L..27K, *Spitzer* [**?**, 3.6-160 ;]]2004ApJS..154....1W, AKARI [**?**, 1.7-180 ;]]2007PASJ...59S.369M, WISE [**?**, 3.4-22 ;]]2010AJ....140.1868W and *Herschel* [**?**, 55-672 ;]]2010AA...518L...1P have demonstrated the scientific value of observations at these wavelengths; but the spatial resolution of space-based observatories is limited by the cost and complexity of building and flying progressively larger aperture telescopes.

In this work, we discuss progress in understanding clustered star formatino through increased angular resolution, by using SOFIA and BETTII, both operating at high altitudes in the atmosphere. High–altitude observatories are a good compromise between ground and space observatories: while less sensitive because of the surrounding thermal emission from the atmosphere, they can still feature larger optics, more experimental setups, and instrumentation that can be changed on a more frequent basis.

SOFIA has a 2.7 primary mirror which is a significant size improvement over *Spitzer* . The instrument we have used, FORCAST, provides unprecedented high angular resolution of 2-3.5 in multiple continuum bands from 5.5 to 37, which allows us to probe a relatively unexplored region of phase space.

BETTII is an experiment that aims at breaking from the single-aperture paradigm by using interferometry between 30 and 90. Interferometry is commonly used on the ground at other wavelengths such as optical and radio, and is a viable path forward to obtain much higher resolution than what single apertures can provide.

In this work we focus on the particular technique called *spatio-spectral interferometry* Mariotti:1988vea, which is a way to achieve high angular and moderate spectral resolutions at far-IR wavelengths from above the atmosphere, without the cost and limitations of large single apertures.

2.2 BETTII description

As a cryogenic payload flying at an altitude of 37, BETTII is the first flying "direct detection" interferometer: it will attempt to coherently combine light from two different telescopes to provide increased angular resolution. Because it is operating from above the atmosphere, it can see the far-infrared universe between 30 and 90 , and provide ;;0.5-;;1 spatial resolution at these wavelengths - a key region of parameter space well-suited to study protostars evolving in dense clustered environments.

To provide this resolution which matches that of JWSTat 25, BETTII needs to be have two collectors separated by ≈8; Because of its operating wavelength, it needs to have a cryogenic instrument; because it is an interferometer, it needs optics with exquisite surface quality; and because it flies on a balloon platform, it needs to be robust to large changes in temperature, large pointing errors, and severe shock resistance for the landing phase.

Throughout this chapter, we will first discuss the basics of double-Fourier interferometers, before presenting the general design of BETTII payload and most of its subsystems.

2.3 Basics of interferometry

Since the end of the 19th century with Michelson [reference], scientists have learned how to use the wave properties of light to learn about new astrophysical

 1 Star formation in clustered environments