The half-flare angle for the feed is approximately 30°. Analysis and optimization of the overall feed design employed a combination of finite element and mode-matching tools.

The illumination requirements and relative frequency spacing for this application are similar to those required for the Scanning Multichannel Microwave Radiometer (SMMR) on Seasat, the (TOPEX)/Poseidon, and the Jason missions. However, in this particular application the required fractional bandwidth is larger. Thus, while the three-frequency feed horn described here shares many features in common with the feed previously developed for the above missions, enhancements are necessary in order to achieve broad band performance and manufacturability in the millimeter-wave bands.

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The assembled prototype Three-Frequency Feed is shown, with the low-frequency combiner absent, along with a half-dollar coin for scale. The overall size of the feed, including the combiner block, is approximately 1×1.25×1.5 in. (~2.5×3.2×3.8 cm).

Inverted Three-Junction Tandem Thermophotovoltaic Modules

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An InGaAs-based three-junction (3J) tandem thermophotovoltaic (TPV) cell has been investigated to utilize more of the blackbody spectrum (from a 1,100 °C general purpose heat source — GPHS) efficiently. The tandem consists of three vertically stacked subcells, a 0.74-eV InGaAs cell, a 0.6-eV InGaAs cell, and a 0.55-eV InGaAs cell, as well as two interconnecting tunnel junctions.

A >20% TPV system efficiency was achieved by another group with a 1,040 °C blackbody using a single-bandgap 0.6-eV InGaAs cell MIM (monolithic interconnected module) (30 lateral junctions) that delivered about 12 V/30 or 0.4 V/junction. It is expected that a three-bandgap tandem MIM will eventually have about 3× this voltage (1.15 V) and about half the current. A 4 A/cm² would be generated by a single-bandgap 0.6-V InGaAs MIM, as opposed to the 2 A/cm² available from the same spectrum when split among the three series-connected junctions in the tandem stack. This would then be about a 50%