

Corrugated Horns for ALMA band 11 (1.25-1.57 THz)

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During the ALMA band 10 receiver production at NAOJ, up to 200 corrugated horns were fabricated and tested in the 787-950 GHz band. Of those, around 160 showed good performance in terms of co- and cross-polarization patterns. Many of these horns were fabricated in Japan by direct machining of aluminum. The acceptable yields suggest the possibility of using direct machined corrugated horns at even higher frequencies using the experience acquired from ALMA band 10 corrugated horn production. The main difficulty in the fabrication process was to mill the first corrugations in the horn throat, which are always the deepest. A way to simplify fabrication and presumably increase the yield is to shorten the horn by using a profile different from conical. A simple profile composed of connected conical sections has been used in the design of a horn for a future ALMA band 11 (1.25-1.57 THz). This horn shows good simulated performance but cannot be modeled by conical corrugated horn quasi-optical models. For this, a new modeling method based on numerical near-field Gaussian beam fitting of the simulated fields has been developed. This model has been used to perform quasi-optical designs of relay optics, which show good simulated performance using Physical Optics.

The designed profiled corrugated horn is being fabricated and will be delivered in late January 2016. It will then be characterized at NAOJ, using an already established near-field beam measurement system. For comparison, a traditional long conical corrugated horn based on a re-optimized scaled version of the ALMA band 10 horn is also being manufactured.

This paper will present the proposed design method for THz profiled corrugated horns, together with the newly developed quasi-optical modeling technique. The results of simulations will be compared with measurements to validate the horn design. If available in time, measurements of the long conical corrugated horn will also be included and compared with those of the profiled corrugated horn. In short, this paper will assess the possibility of fabrication of corrugated horns for a future ALMA band 11 by state-of-the-art direct machining.

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