

Design of a Compact K Band Cryogenic Receiver

There is a compact K band radio cryogenic receiver under development in Shanghai Astronomical Observatory. The cryogenic receiver is designed for an advanced research project in pursuing of small size and low power consumption.

To reduce the size and weight of the receiver, aluminum alloy is utilized to fabricate the whole structure of the receiver including the feed network inside the dewar. The K band (20-24GHz) feed network consists of a multimode feed horn antenna and a septum polarizer to provide the ability of observing circular polarized radio signals. A pair of cryogenic LNAs are set at the output ports of the feed network. The multimode feed horn is at 80K stage and the polarizer is at 30K stage as same as the LNAs. There is an isolation gap between the feed horn and the polarizer. The vacuum window of the receiver is made of HDPE material. Arrays of small holes have been bored on the both sides of the vacuum window to obtain a good VSWR and low insertion loss.

In the design of the feed network, we take use of multimode horn to feed the receiver because that multimode horns have compact size and light weight when compared to corrugated horns. A program coded in Matlab has been developed to help with the design of the multimode feed horn. In the program, mode matching method and genetic algorithm are utilized to calculate and optimize the pattern of the feed horn. With the help of the program we can scan a great number of horn antennas with different figure types, and select out the one which meets our requirements in a short time.