

Heterodyne Array Receivers for Space and Ground Based Applications

Heterodyne array receivers have been successfully built for ground-based telescopes. Here we will present the first detailed design for a space application, the Heterodyne Receiver for the Origins Space Telescope (HERO). HERO follows the traditional design, but limited cooling power and the limited electrical power of the satellite pose major challenges. Minor challenges are limited availability of space and weight. For the eight 3x3 pixel arrays of which 4 can operate simultaneously we attributed 20mW at 4.5K, 35mW at 35K and 205 W at the satellite temperature. Therefore we propose to use SiGe cryogenic low noise amplifiers, with a dissipation of about 0.5mW for 6 GHz bandwidth. The power of the backends also needs to be reduced drastically to about 1 W for 6 GHz bandwidth. CMOS ASIC backends are one option, ADC, followed by FFTs and ACCs another. To reduce the volume and mass, we propose to cover the RF bandwidth of 486 GHz to 2700 GHz in only 4 bands, each with about 50% relative width.

The design might not only be a helpful starting point for any heterodyne array on a satellite, but the low heat and power consumption might be also an essential first step for large (100 to 1000 pixels) heterodyne arrays for ground based telescopes or simply a more energy efficient alternative for any ALMA single pixel or array receiver.

Author: WIEDNER, Martina

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