**CHAMP optics**

CHAMP optics also called fore-optics of the CHAI receiver array, is used to set the ratio of the mixer space () to the beam waist () of the receiver. The optics uses a Cassegrain telescope layout which consists of an ellipsoid mirror and one hyperboloid mirror to enlarge the beam waist of each pixel individually from 0.916mm to 3.538mm at 475GHz. The pixel space in the mixer block is 10mm, so the ratio of the mixer space to the beam waist is about 2.83.

If the illumination edge taper of the telescope is about 18dB. The ratio of telescope beam spacing () on the sky to its angular beam size () is about 2.16.

**158GHz 1/3-scale model**

A pair of testing mirrors scaled up by a factor of three was manufactured and measured at 158.33333GHz to check the optical performance. The critical parameters of the optics are listed in the table below.

|  |  |  |
| --- | --- | --- |
| Operating frequency (GHz)  Wavelength (mm) | 158.33333  1.89343 | 475 GHz  0.63114334 |
| Receiver Beam waist () | 2.74925 | 0.9164167 |
| M1 | | |
|  | 70.2857 | 23.4285666667 |
|  | 26.0865 | 8.6955 |
| Reflection Angle | 90° | 90° |
|  | -33.155164 | -11.0517213333 |
|  | 4.2058434 | 1.4019478 |
| M2 | | |
|  | 74.0689 | 24.6896333333 |
|  | 74.501 | 24.8336666667 |
| Reflection Angle | 90° | 90° |
|  | 76.82025 | 25.60675 |
|  | 10.6129034 | 3.53763446667 |